LocoMotive

Localisation Motives
for R&D
in Large Companies

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The LOCOMOTIVE project finished on 30 September 2007.

You may download some of the project results in the documents section on the left or by clicking here.

The LocoMotive Project

LocoMotive aims at providing regional policy makers with a better understanding of the current R&D investment policies of large private sector companies in their regions compared with trends in other regions in Europe. The core activities are

- to set up a methodological framework to achieve directly comparable results in LocoMotive;
- to conduct structured interviews with key R&D managers, using the network of the partners (which may extend beyond their specific region);
- to organise regional roundtable discussions on private sector R&D investments with actors from private and public sectors;
- to provide a view of current industrial thinking and then to use these results to encourage a more pro-active dialogue about how regional policies might make R&D investment more attractive.

Linked to these major activities will be leading edge thinking and research on the development of concepts relating to internationally networked "metropolitan hubs" providing transcontinental flows of goods, capital and services and their role as stimulators of regional economic development in Europe. In this way the project will contribute to, and profit from, ongoing research work, while concentrating on improving the understanding of key regional decision makers on current practices.
The chief tangible result will be a study and associated dissemination activities on current R&D investment policies of selected major companies and their relation to regional strategies, together with proposals for how future regional and European Commission activities might better support R&D localisation in Europe. The study itself will be used as a means to bring together R&D managers, regional policy makes and public funded researchers to discuss ways to work together which may well lead to spin-off networks and activities requiring no specific programme support, but which nevertheless act positively towards regional developments in R&D.

LocoMotive

Localisation Motives for R&D in Large Companies

LOCOMOTIVE-Conference finished successfully

08/06/07 15:33

On 6 June 2007 the conference of the LOCOMOTIVE-Project about the reasons for investment decisions of large multinational enterprises in Research and Development was successfully finished in the Hotel Grand Elysée in Hamburg. 60 experts from industry, universities and administrations had discussed the question, how decisions of large companies to locate R&D in a particular region may be influenced.

„The 700 largest companies in the world spend 80% of all industrial research and development money worldwide" stated Rob van Tulder, Professor at the Erasmus University Rotterdam. It should be considered wrong with this background to concentrate on supporting small and medium sized companies only, even if they play an important role in job creation. Equally important is the cooperation with universities, but they should not run into the danger of operating like companies in the marketing of their intellectual property rights as was pointed out by Andrew Dearing, general secretary of the European Industrial Research Management Association. Carlos Orozco, European R&D Director of Dow Chemicals, expressed the opinion „that the current labour laws, immigration rules and the attitude towards industry in universities present obstacles for locating R&D in Europe". He closed his presentation with the words: „Europe is a wonderful location for R&D for Europe, but has to improve to also become a wonderful location for the world!"

The participants agreed that a location of important research and development investors in Europe will only be possible if the regions harmonised their locational and fiscal policies and will be guided less by competing against each other. In addition universities should concentrate more on their research strengths and not to try to offer the full spectrum of possible or fashionable topics in research.

The results of the LOCOMOTIVE-Project will now be summarised in recommendations for the European Commission and regional decision makers, taking into account the results of the conference. These recommendations will be published until 30 September 2007.

The presentations from the conference may be downloaded here.

Read more about the background
Speakers / Programme Committee
Programme

The conference was organised by the LOCOMOTIVE project with support by the Free and Hanseatic City of Hamburg

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Study Visit to Toronto

04/26/06 12:01

From 10-12 April 2007 a group from the LOCOMOTIVE project visited the Greater Toronto Area. The purpose of the visit was benchmarking of the results of the project with a non-European region. The visit was organised with the help of David Wolfe from the Munk Centre of International Studies and included the following institutions:

Tuesday, April 10

Innovation Synergy Centre in Markham

ISCM is a "Not for Profit" business advisory hub that was created to help accelerate the growth and development of firms with the objective of assisting grow their sales and employment base. Supported by the Town of Markham, The National Research Council and the Ontario Ministry of Innovation, ISCM business support is offered at no cost to the SME. These services include linking a company to a very experienced business mentor/advisor, workshops and training courses to inform companies about current business issues. ISCM also has a partnering initiative to link companies to other resources for testing and IP development such as Universities and colleges across Ontario.

Tour of IBM Toronto Software Lab (CAS)

Organized with the assistance of Knowledge Media Design Institute

As one of the largest IBM software development laboratories, the IBM Toronto Lab develops leading products for worldwide distribution in the areas of: application development tooling, application servers, database management software, electronic commerce applications, and systems management solutions. The IBM Toronto Lab is home to more than 2,000 employees from a diverse range of backgrounds and disciplines, with a dynamic mix of early career employees and experienced professionals. Over 70 percent of lab employees hold a degree with a major in computer science, engineering or mathematics, which highlights our technical expertise.

Wednesday, April 11

Toronto Region Research Alliance (TRRA)

TRRA is a results-oriented, non-profit organization dedicated to making the Toronto region a world-leading centre for research and research-intensive industry by: attracting new research-intensive companies to the region and working to expand those already here; building public and private research capacity; and enhancing the commercialization of research. Activities are focused in biotech/life sciences, information and communication technology, and advanced manufacturing and materials science. Its role is to act as a neutral convenor, facilitator, catalyst and advocate on issues and opportunities related to its R&D mission. TRRA provides dynamic, neutral leadership to help forge a regional consensus on strategic priorities.

MaRS Discovery District

MaRS (Medical and Related Sciences) is a convergence innovation centre dedicated to accelerating the commercialization of new ideas and new technologies by fostering the coming together of capital, science and business. Located in Toronto's downtown "Discovery District," MaRS sits at the epicentre of one of North America's most concentrated clusters of biomedical research and expertise – literally steps from world-renowned teaching and research hospitals, the University of Toronto, Canada's financial core and the Ontario legislature. MaRS was created in 2000 to capitalize on the research and innovation strengths of the Province of Ontario, and to position Canada for leadership in the highly competitive global innovation economy. MaRS is focused on helping Canadian innovators turn great ideas into great companies – and supporting those companies as they become global market leaders.

BioDiscovery Toronto

BioDiscovery Toronto is an organization linking nine of Toronto's internationally recognized biomedical research institutions for the commercialization of research. It provides a one-stop shop for companies seeking break-through biomedical and related technologies and expertise.

Thursday, April 12

Ministry of Research and Innovation, Government of Ontario

City of Toronto Economic Development

Round table held in Hamburg

07/12/06 16:49

On 5 December 2006 a round table discussion was held at TuTech Innovation in Hamburg. Following a presentation by Fiona Reid (Director Oxford Science Enterprise Centre) of Oxford University's organisation of technology transfer, liaison with local industries and creation of business awareness within the university, the participants discussed the relationship between research institutions and industry in the Hamburg area. Among the participants were industrial R&D managers and the presidents of the University of Hamburg (Prof. Auweter-Kurtz) and of Hamburg University of Technology (Prof. Kreuzer).

Meeting with EIRMA and local representatives in Toulouse

21/11/06 09:20

On 16 November 2006, the LOCOMOTIVE project presented its findings Toulouse to representatives of local industries, higher education and administration. In addition, Andrew Dearing from the European Industrial Research Managers Association (EIRMA) presented his organisations' views and findings on the motives for allocating R&D to certain regions.

Combined with this meeting was a visit of the project's representatives of the Airbus facilities.

LOCOMOTIVE mid-term project meeting held in Prague 4-5 September

05/10/06 14:20

Following the kick-off meeting in Berlin and a meeting in April in Budapest, the LOCOMOTIVE partners came together again Prague at the beginning of September. A key topic was to review the progress on interviews with leading R&D decision makers and to consider preliminary findings.

Thirty three interviews have now been conducted leading to some interesting insights into what R&D managers are thinking about Europe and the different regions as locations for R&D. Now in the next stage of the project, the partners will bring together individuals from the large multi-nationals within their regions, local policy makers and representatives from the world of research.

A meeting with the General Secretary of the European Industrial Research Managers Association will be held in Toulouse 16 November to compare findings.

A date for the final LOCOMOTIVE conference has been fixed for 5-6 June 2007, to be held in Hamburg.

LOCOMOTIVE Kick-Off Meeting held in Berlin

04/02/09 10:30

The kick-off meeting was held February 6-8 at Hamburg's Landesvertretung in Berlin for the Regions of Knowledge 2 project LOCOMOTIVE which is being coordinated by TuTech. LOCOMOTIVE aims at providing regional policy makers with a better understanding of the current R&D investment policies of large private sector companies in their regions compared with trends in other regions in Europe.

On occasion of the meeting, Monica Schofield, Head EU Office at TuTech, who initiated the project said: "One of the major dilemmas for regional policy makers is to attract the real engagement of the private sector in for example, clustering initiatives. Most of us involved in the technology transfer business have seen examples of wasted efforts where regional initiatives have failed to make any impact with the private sector. There are on the other hand also some success stories. But without understanding the localisation strategies of major private R&D investors better, regional policy makers will not be able to harness or leverage private investment in support of the knowledge based economy. LOCOMOTIVE provides us with the vehicle to get to know our significant regional R&D performers better and to discuss with them, for example, what services TuTech as an interface between academia and business could provide".

Start of the LOCOMOTIVE Project

04/01/06 12:20

The contract for the LOCOMOTIVE project has been signed between the co-ordinator and the Commission. The official start date is 1st January 2006, the project will end on 30/06/2007.

Regions of Knowledge 2

Background to the action

European regions have an important role to play in the creation of the European Research Area (ERA) by enhancing their endogenous research potential and through networking at a trans-national level. European regions represent one of the key stakeholders that can, through a number of direct and indirect measures, contribute to stimulation of European research and to the fulfilment of Barcelona targets of 3 % of GDP for research and development. Furthermore, European regions that invest in RTD and innovation tend to achieve higher economic performance which clearly demonstrates the need for a greater involvement of a wider number of regions and regional actors in the activities aimed at stimulating the creation of knowledge-based economy. Although the regions in Europe represent a very heterogeneous group in terms of R&D characteristics and needs, they all share the need for guidance in their research and technology policies, for the exchange of information and experience, for benchmarking and application of prospective studies in order to make informed policy decisions.

Because of the considerable success of the Pilot Action on "Regions of Knowledge" initiated by the European Parliament in 2003, it has been envisaged to have a similar activity (Regions of Knowledge 2) "embedded" in the Specific Programme 1 Integrating and Strengthening the ERA but focusing on the Barcelona targets. The Regions of Knowledge Pilot Action provided support for application of foresight to policy making, greater involvement of universities in regional development, and for mentoring and exchange of experience in research and innovation. Whereas under this call support will be given to trans-national, trans-regional collaborative projects focusing on the RTD policy-making and investment strategy at regional level. The Regions of Knowledge 2 will address more specific issues regarding RTD investment at regional level aiming also on spreading and further increasing outreach of existing regional RTD initiatives. Moreover, a greater importance will be given to exchange of experience among supported projects and, for this an intensive interaction is foreseen with the IRE network as a basis for mutual learning.

Objectives of the actions

The aim of the projects is to promote increased and better regional investment in research through mutual learning, coordination and collaboration between regional policies and initiatives. Projects should include activities in at least one of the following areas, or a combination of these:

- Analysis of regional RTD performance as well as analysis of bottlenecks and other factors limiting greater R&D investment (e.g. lack of cooperation and trust between research and business communities, low business density and lack of demand for R&D results, absence of political awareness at regional level etc.); analysis of relative success of earlier regional RTD instruments implemented at regional level; integrating R&D investment into local and regional development strategies (e.g. organisation of round tables with the aim of identifying and overcoming the barriers between regional partners, creating regional partnerships for improved RTD performance and greater RTD investment etc.)
- Application of foresight and, more generally, prospective and intelligence methods for identification of R&D policy priorities at regional level, use of benchmarking, networking and other activities providing evaluation of trends and subsequent guidance to policy makers in RTD matters.
- Mentoring in the field of implementing R&T policy, exchange of experience and exchange of personnel with the aim to introduce new (or improve existing) regional level policy instruments for stimulation of R&D investment.

The above list of activities is not exhaustive and additional activities may be proposed. However, the focus should remain on the development of regional dimension of RTD policy and the issue of RTD investment at regional level. In policy terms, the actions pertinent to the following topics and themes are particularly welcome:

- better integration and coordination between private and public RTD investment and complementarities of RTD infrastructures
- governance of RTD policy at regional level, including the issue of competence of regional level in RTD policy and interaction / complementarities with national level
- better and more efficient use of Structural Funds in supporting RTD investment

The actions can focus either on a particular thematic area of RTD (e.g. biotechnology, environmental technology, particular type of industrial technology etc.). However, they should be primarily policy-driven and should address more general aspects of RTD policy in the participating regions rather than dealing too narrowly with a specific technological issue.

Documents

LOCOMOTIVE Overview on Objectives and Results

This document gives an overview on the objectives LOCOMOTIVE set out to receive and a brief description of the major results

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LOCOMOTIVE Policy Recommendations

The report brings together the conclusions and recommendations derived from the core LOCOMOTIVE activities. During the course of the project, the partners have conducted a total of 42 interviews with senior managers, normally CTOs, of MNEs according to a pre-defined questionnaire and methodology developed at the beginning of the project. The interviews were then summarised for comparison and analysis. Subsequently, roundtable discussions were held in each of the regions involving representatives of MNEs, regional decision-makers and researchers. These discussions too have been summarised for comparison and analysis.

In the first part of the report (Section 3), the consensus of the conclusions and recommendations from the project as a whole are presented. These seem to apply to all regions and therefore can perhaps be taken as a general statement about what needs to be done in a regional context at the European level. Section 4 discusses recommendations that address region-specific problems but may be relevant to other regions too. A regional breakdowon of all policy-recommendations will be presented in Section 5.

In presenting these conclusions it should be borne in mind that although the work of the project was guided by academic insight, the results presented are not to be taken as research findings.

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Proceedings of LOCOMOTIVE Final Conference

The aim of the LOCOMOTIVE Conference “Managing the Links: Global Trends and Regional Policies in R&D Location” held in Hamburg 5-6 June, 2007 was to provide an opportunity for a wider discussion of some of the issues. The conference brought together speakers from industrial multi-nationals, academia, regional authorities and those involved in working with these. The objective of the conference was to allow dialogue and exchange of points of view between all actors engaged in the knowledge-based economy and to reflect on the way we work together.

This short report attempts to capture in a summarised form what was presented and discussed at the conference to allow readers at least a taste of the issues raised.

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Report on LOCOMOTIVE Study Visit to Toronto

The LOCOMOTOVE consortium represents nine regions, not particularly being similar but to provide contrasting view points. However, a feature inbuilt into the project was to find a region for comparison outside the European Union. The region around Toronto, Ontario (Canada), was selected since it is both an innovation hot spot, but also considered culturally more similar to Europe than other locations in the USA or Asia. Therefore a study visit to Toronto was conducted in April 2007. The visit was organised with the help of David Wolfe, Professor of Political Science at the University of Toronto at Mississauga and Co-Director of the Program on Globalization and Regional Innovation Systems (PROGRIS) at the Munk Centre for International Studies (MCIS) at the University of Toronto.

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Summary of Regional Roundtables and Inputs to New Policies

This project report provides summaries from a series of regionally organized roundtables on the location motives for R&D investments. The roundtables were set to screen and comment on the main points of the project and review the facts and findings from some 60 interviews with R&D managers in eight European city-regions. The R&D managers interviewed were representing mainly large multinational enterprises (MNEs), able to influence the size and in some regional cases even the direction of R&D investments and related innovation activity in the region. The roundtables, which were conducted in seven selected regions, took place in 2006 and 2007 and were managed by the LocoMotive team in each region. Each organizing team provided inputs to this document in the form of a regional summary account.

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Private Sector R&D: Global View

The Global Outsourcing of R&D has vast influence on the European Union especially as R&D investments have become a central topic on the European Agenda. As this report underlines, investments in R&D support the global economic growth and is as such beneficial to both the investing countries as well as the receiving countries. However, great care should be taken, on both the national and the industrial side, to ensure that the outsourcing of R&D is done with respect for the special circumstances under which the world is becoming increasingly global. This includes also sensitivity to economic as well cultural factors, of which the bestperforming multinational firms bear evidence through their successful outsourcing strategies.

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LOCOMOTIVE FINAL CONFERENCE

Hamburg 5-6 June 2007

Background to project

The goal set by the Lisbon Agenda for European growth is formulated in the Barcelona objective that R&D investment in the EU should rise to 3% of GDP with two thirds coming from the private sector by 2010. This is proving to be a difficult challenge. As Commission Potocnik has had to point out in January 2007, the current figures produced by Eurostat for 2005 show a stagnation at around 1,9%. Ref http://blogs.ec.europa.eu/blog_potocnik/page/potocnik?entry=figures_for_r_d_investment

There are many explanations for this. One of the most influential analyses is given in the Aho report. While there is much to be done at collective EU policy level, equally if Europe is to play a significant role in the knowledge economy, all levels of policy making European, national and regional have a role to play.

The FP6 Regions of Knowledge Project LOCOMOTIVE has been looking at the policies of significant private sector R&D investors (i.e. multi-national enterprises) in the eight regions of the project partners to learn and understand more about current thinking of global R&D decision-makers and how they perceive their locations. Many regional policy makers find a dialogue with the management of international companies problematic. Part of this is due to the fact that the decision-makers for R&D strategy may not be located in the region even though the R&D unit is. But without understanding the localisation strategies of major private R&D investors better, regional policy makers will not be able to harness or leverage private investment in support of regional development. A lack of an effective dialogue could well mean that clustering policies miss their mark, and that much regional investment of time and money could be in vain.

LOCOMOTIVE aims to bridge the gap in this dialogue in a highly pragmatic manner, by offering a framework for discussion. Interviews and roundtable discussions have been conducted with global R&D managers. The culmination of the project is the LOCOMOTIVE Final Conference which under the theme "Managing the links: global trends and regional policies in R&D location" aims to provide a platform for wider access to the findings and a collective discussion about should be done.

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Project Partners

Hamburg - TuTech Innovation (DE)

TuTech was formed in 1992 as the first private technology transfer company founded by a German university. Together with its sister company Hamburg Innovation it serves all Hamburg's universities in technology transfer and industrial liaison matters. Since universities are under the financial and organisational control of the Länder in Germany, TuTech performs many tasks for the Free and Hanseatic City of Hamburg (FHH) as part of a knowledge economy development remit. This includes running the Patent Exploitation Agency for all Hamburg's universities land the Hamburg Start-Up Programme. Through participation on behalf of the FHH in the RoK pilot project Baltic Sea Knowledge Regions, TuTech is playing a pivotal role for FHH in developing international relations relating to clustering. TuTech's model of working and particularly that of the EU Office is recognised nationally. TuTech is often called upon to present research project management and technology transfer best practice in Germany and in other parts of Europe including in the New Member States. TuTech has played an active role in various stakeholder meetings to discuss the objectives and future direction of the RoK Action, and dissemination. TuTech Innovation is also heavily involved in the Interreg Programme with currently a portfolio of eight projects.

Interlace-Invent Aps (DK)

Interlace-invent ApS is a research-based consultancy firm in Copenhagen with regional offices in Barcelona, London, Stockholm, Tallinn and Sophia-Antipolis which serves international clients in Europe, Asia and Africa. Interlace is specialised in the development of business-related networks of innovation, high-tech clusters, science parks and other innovation environments in the urban spatial setting drawing on extensive research experience. The Interlace approach to innovation is implemented by expertise in the realms of Knowledge Management, Innovation Economics, Urbanism and Architecture, Place-Branding, Investment Strategy, and Management of Technology and Innovation.
Coordinated jointly with the Copenhagen Business School, Interlace-invent maintains an extensive research network (called "Hubs&Regions"), which includes 35 leading institutions in Europe and North America and 69 individual researchers, dedicated to the understanding of the "City-Hub" phenomenon in a globalizing economy, where selected cities and their regions are studied as dynamic transaction points in the increasingly knowledge-intensive economy. The network is endorsed by more than 30 stakeholders, including OECD, cities such as Copenhagen and Barcelona, and large business corporations.
As a further resource for this project, Interlace-invent will provide a Cluster Database of over 1050 publications, articles, research papers and so-called "grey" papers (intended for briefing purposes) that serves as a continually growing source of up-to-date, specialized knowledge on R&D, innovation and economic growth at the regional, national and global levels.

CEU Consulting - Central European University Share Company

CEU Consulting is a consultancy organisation with the mission of promoting the specific knowledge, experience and know-how present at the Central European University (CEU). The organisation offers consulting services (comparative analyses and policy) and project management on a wide range of subjects relevant to regional development. CEU Consulting can draw on the exceptionally widespread academic and policy-making network of CEU in Central and Eastern Europe as well as in the US, UK and Germany. Clients include well-known international donor organisations, NGOs, governmental and municipal bodies as well as private entities.
CEU Consulting has been participating in a large number of development projects both at national and international levels. The organisation implemented a number of EC-funded projects including providing technical assistance and training for the Interreg programme and project development preparing potential beneficiaries (with the main focus on local and regional decentralised bodies, e.g. Regional and County Development Agencies). Also, the programme aimed to rebuild and develop cross-border co-operation among strategically important border regions, those constituting the interface between `old` and `new` member states, where the challenges of enlargement will be felt the most.

Technology Centre of the Academy of Sciences of the Czech Republic

Technology Centre AS CR, established as a separate legal entity in 1994, is the National Information Centre for European Research. It works on analytical and strategic studies in RTD and innovation, and trans-national technology transfer. Its main activities comprise: National Information Centre for European Research, including information and advisory services related to the EU Framework Programmes; monitoring Czech participation in international research cooperation programmes; coordination and methodical management of the national information network NINET; Technology Transfer, Strategic Studies and Projects and Regional Development.
Technology Centre works in a close cooperation with the Council for Research and Development and ministries (especially with the Ministry of Education which is in charge of research, also with the Ministry of Industry and Trade and lately also with the Ministry for Regional Development). As for the regional authorities: a closer cooperation has been developed with the municipal council of the Capital Prague (especially on developing the Regional Innovation Strategy for the Prague Region in 2001-2004), with CzechInvest (Investment and Business Development Agency of the Ministry of Industry and Trade) as well as with the Centre for Regional Development of the Czech Republic of the Ministry for Regional Development).
Recent projects include: Strategic Studies for RTD - research plan (2004-2008) - a research project focused on creating qualified information sources for decision-makers which enable them to make informed decisions in shaping national research and innovation policies.; Barriers to the Growth of Competitiveness of the Czech Republic (2004-2005) - the objective of the project was to identify barriers to the growth of competitiveness based on innovation; Bohemian Regional Innovation Strategy - BRIS (2001-2004) to design a regional innovation strategy for the region of Prague and the region of Pilsen, respectively, aimed at supporting cooperation between research and business.

Pôle Universitaire Européen de Toulouse (FR)

The Réseau Universitaire Toulouse Midi-Pyrénées is a wide & regional consortium of research and university entities, socio-economic partners represented by the Chambers of Commerce and Industry, and local and regional authorities involved in higher education and research issues. RUTMiP is an expanding and strong network of 25 regional partners. The core mission is to promote the role of Toulouse universities to the cause of knowledge based economic development and international networking. Recent projects include those involving cross-border co-operation especially with close lying regions such as Catalonia, but also further afield with Alexandria and India. RUTMiP supports academic entrepreneurship and is heavily involved in Framework projects in support of the development of the European Research Area.

Culminatum Ltd Oy Helsinki Region Centre of Expertise

Culminatum Ltd Oy - Helsinki Region Centre of Expertise was established in 1995 to implement the national Centre of Expertise programme in the Uusimaa region and to serve as a joint instrument of regional development for its owners. This Programme promotes utilisation of the highest international standard of knowledge and expertise in business, job creation and regional development. Culminatum Ltd Oy seeks to improve the international competitiveness of the Uusimaa region and to encourage the business utilisation of the region's educational, scientific and research resources. The company is owned by the Uusimaa Regional Council, the city authorities of Helsinki, Espoo and Vantaa and the universities, polytechnics, research institutes and business community of the region.

Oxford Science Enterprise Centre, Saïd Business School (UK)

Oxford Science Enterprise Centre is part of the Said Business School at Oxford, and operates as part of Oxford University's Knowledge Transfer strategy. It offers business training for scientists, plus networks & seminars at the interface between science and business. It draws together the regional science community and researchers in the University, to foster new venture creation in science and technology.
OxSEC works in conjunction with Isis Innovation, which is one of the leading UK technology transfer offices. The University's 41 spinouts have a current market capitalisation of over £2 billion. It works closely with the connections to the clusters, science parks and development agencies in the region, as well as networks of high-tech companies.
The Said Business School is the nodal point in a complex pattern of overlapping networks in and around Oxford. These networks span knowledge-based industries, University and international corporations. Across all areas, the School is showing strong growth and thousands of business people, students and scientists have been involved in our programmes.

Erasmus University Rotterdam (NL)

Rotterdam School of Management (RSM) at Erasmus University Rotterdam is one of Europe's top business schools: Since the 1960s, RSM has acquired a long standing expertise on internationally operating firms. Research on multinationals firms in both their global and local embeddedness has been a feature of RSM during more than two decades. At RSM's Department of Business-Society Management (BSM), the SCOPE International Business Competence Centre maintains a number of up-to-date databases that document the internationalisation of the economy and details on the accompanying business development and strategies of so-called "core companies" (large, technology-intensive multinationals). These databases form a sound basis for comparative research on a number of development issues. Since many years, the BSM Department conducts studies of regional and sector economies across Europe. Science-based or high-tech industrial studies within the global and local contexts have been a long-term specialty of SCOPE, while linking these studies at the intersection of State-Market-Civil Society. SCOPE has access to some of the most R&D resource-full companies based in the Benelux countries, and it has close working relationships with regional authorities across the Netherlands and in various parts of Europe. The LOCOMOTIVE project will benefit from the full access to these databases through the team of experts at the RSM. SCOPE collaborates with international organizations for annual investments reports and other timely topics of broader interest.

LOCOMOTIVE FINAL CONFERENCE

Hamburg 5–6 June 2007

Programme

Day 1 – Industrial perspectives and the changing role of universities

09:00 – Registration
09:30 – Opening and welcome
12:00 – Lunch
13:30 – Can Europe compete as a research location? Some views from industry
14:45 – Coffee
15:15 – Advancing the role of universities as partners for innovation
19:00 – Cocktails and networking dinner at the Museum für Völkerkunde (Museum of Ethnology)

Day 2 – Creating regional policies for global links

09:30 – Creation of regional brands to support research clusters
11:00 – Coffee
13:00 – Networking lunch
14:00 – From policy to action: EU initiatives in support of using research and innovation as part of regional development
15:30 – Close

Programme in Detail with Speakers

Conference Programme (PDF)

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LOCOMOTIVE FINAL CONFERENCE

Hamburg 5-6 June 2007

LOCOMOTIVE SPEAKERS

- Christer Asplund, Interlace-Invent ApS, Copenhagen
  Presentation (755.39KB)
- Cécile Chicoye, Association Cancéropôle, Toulouse
  Presentation (9.73MB)
- Mary Lisbeth D'Amico, Freelance Journalist, Munich
- Andrew Dearing, EIRMA, Paris
  Presentation (716.11KB)
- Hervé Dexpert, Scientific Advisory Board Midi-Pyrénées Regional Council, Toulouse
- Francisco Escarti, Boeing Research and Technology Europe, Madrid
  Presentation (2.92MB)
- Fabienne Fortanier, University of Amsterdam
  Presentation (64.37KB)
- Sergi Guillot, 22@Barcelona
  Presentation (13.18MB)
- Sascha Haselmayer, Interlace-invent Aps, Barcelona
  Presentation (5.92MB)
- Tatu Laurila, Greater Helsinki Promotion Ltd.
  Presentation (4.16MB)
- Helen Lawton Smith, Oxford Economic Observatory
  Presentation (66.51KB)
- Jen Nelles, University of Toronto
  Presentation (4.52MB)
- Risto Niva, Wipro technologies-Wireless Solutions, Rovaniemi
  Presentation (180.08KB)
- Carlos Orozco, DOW Chemicals, Geneva
- Mark Mawhinney, Isis Enterprise, University of Oxford
  Presentation (1.63MB)
- René Samek, Czechinvest, Prag
  Presentation (1.92MB)
- Monica Schofield, TuTech Innovation GmbH, Hamburg
  Presentation (983.87KB)
- John Slater, Open University, Milton Keynes
  Presentation (36.24KB)
- Robert-Jan Smits, Directorate B European Commission DG Research, Brussels
  Presentation (960.65KB)
- Helmut Thamer, TuTech Innovation GmbH and Hamburg Innovation GmbH, Hamburg
  Presentation (27.66MB)
- Rob van Tulder, Erasmus University Business School, Rotterdam
- Xiaming, School of Management and Organisational Psychology, Birkbeck, University of London

PROGRAMME COMMITTEE

- **Jan Annerstedt**, Interlace-Invent ApS, Copenhagen
- **Györgyi Barta**, Hungarian Academy of Sciences, Budapest
- **Elie Brugarolas**, Réseau universitaire Toulouse Midi-Pyrénées
- **Fabienne Fortanier**, University of Amsterdam
- Sascha Haselmayer, Interlace-invent Aps, Barcelona
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LocoMotive

Project no. 030089

LOCOMOTIVE

"Dissemination of knowledge concerning current R&D localisation motives of large regionally important private sector organizations"

Coordination Action

Regions of Knowledge 2

Final Report

Date of preparation: **15 January 2008**

Start date of project: **1 January 2006** Duration: **21 months**

Project coordinator name: **Monica Schofield**
Project coordinator organisation name **TuTech Innovation GmbH**
Revision: Draft 1.0

1. General Project Objectives

LOCOMOTIVE aimed at providing regional policy makers with a better understanding of the current R&D investment policies of large private sector companies in their regions compared with trends in other regions in Europe.

The chief tangible result was a study and associated dissemination activities on current R&D investment policies of selected major companies and their relation to regional strategies, together with proposals for how future regional and European Commission activities might better support R&D localisation in Europe. The study itself was used as a means to bring together R&D managers, regional policy makers, public administrators and public funded researchers to discuss ways to work together.

In this way LOCOMOTIVE addressed a missing link in the current Regions of Knowledge (RoK) and other DG Research policies targeted at regional development in that it tried to build a bridge to large scale private sector R&D investment. Taking a collective approach linking regions through this action and providing plenty of opportunity for cross-regional dialogue, benchmarking, and transferring best practice and research results extracted from other work, ensured the potential for high impact of the study on current thinking. LOCOMOTIVE was not only practical and ‘hands-on’, but also analytical and ‘strategic’ in orientation.

1.1 The context

LOCOMOTIVE considered the interface between large company research and development activities and technology driven SMEs. Rather than take the rather classical view of looking at needs of SMEs, which is well addressed in other parts of the Framework and other programmes, LOCOMOTIVE looked at the way large research organisations engage SMEs in their technology development. It is essential that this relationship is better understood by both entrepreneurs, particularly those not coming from a large company background, and policy makers who seek to encourage start-ups. For many hi-tech SMEs, it is contracts with large companies who can afford the risk in investing in their technologies which holds the key to successful business development.

R&D investment, organisation, and localisation by large companies is in a state of change making it difficult for regional policy makers to understand how these changes may affect their region, or indeed if they need to act to improve the attractiveness of their region. LOCOMOTIVE provided a vehicle to harness personal networks which allow a more trusting discussion of the issues relating to R&D localisation in Europe.

1.2 Research linked to this project

LOCOMOTIVE drew on resources and results established by on-going research work undertaken at Erasmus University and Interlace and in particular to a major research project on “Metropolitan Hubs, Dynamic Regions, Innovation Environments, and Governance in the Knowledge-Based Society”, which explores the spatial or territorial foundations of a more knowledge-intensive European society with an increasingly innovation-rich economy turning globally competitive. LOCOMOTIVE related to this on-going research by using it on the one hand to guide the methodology applied by practitioners in conducting interviews and on the other to compare the perceptions given through personal contacts with what can be determined about global R&D organisation strategies from other sources. LOCOMOTIVE provided in return the opportunity to enhance Erasmus University database of R&D localisation performance indicators.

1.3 Link to policy makers

A key objective was to bridge the evident communication gap between “big” industry and regional policy maker. It was not the goal of LOCOMOTIVE to form policies, but to assist those that do in gaining insights into the current strategic thinking within large companies concerning R&D localisation. It was not foreseen as the role of LOCOMOTIVE to move into highly sensitive political areas of lobbying by the big companies. What the project wanted to find out is how cluster conditions can be improved, or what close ties to a university might mean etc.

The involvement of policy makers is both direct and indirect: Many of the participating organisations are involved in regional development issues on behalf of public authorities or regional Governments. The interest in this project stems from a genuine interest to find out what could be done to improve collaboration between industry, research and regional Government. Secondly, the goal of the project is to pull together the lessons learned and to present these to policy makers. By having a wider spectrum of results to draw from, and the possibility to make inter-regional comparisons some of the tendency to base policy on “anecdotal information” can be avoided.

2. Objectives and Results

LOCOMOTIVE only had one reporting period originally covering 18 months and extended to 21 months through a contract amendment. Therefore this periodic report covers the whole duration of the project, the objectives being the same as described above.

2.1 Methodology

The project set out into analysing the location motives for R&D placement by large companies by developing a methodology which was later used for structured interviews with R&D managers of 42 organisations in 8 regions. Core part of the methodology is a questionnaire which consists of 9 open questions. Questions 1 to 5 ask about the motives for a firm to invest in the region, and what an R&D manager thinks are a region’s weaknesses as R&D location. Questions 6-9 ask about the nature of the R&D activities that the MNE conducts in the region, and how these are linked to the other parts of the MNE organization. The final question then asks about links between the R&D subsidiary and the region. The design of the questionnaire was piloted with one interview per region, and modified according to the experience with this interview. To ensure comparability across regions and therefore also across interviewers, the interview questions are accompanied with instructions to the interviewer.

The methodology also describes the approach to the roundtable discussions. These are to be conducted in a much less formal way and are open to incorporate special regional interests. The methodology also states that stakeholder and roundtable discussions have to occur fairly late in the project to use the results from the interview summaries as input to the discussions. The methodology was described in deliverable D3 “Questionnaire for regional interviews”.

2.2 Interviews

The questionnaire forming part of the methodology was then used to conduct the interviews with the R&D managers. The firms selected for the interviews were chosen on the basis of the criteria that they were considered regionally important i.e. had considerable R&D activities in the region, and preferably also in one of the other partner regions, and that they are in the Fortune Global 500 list, for which Erasmus maintains data relating to R&D performance in its SCOPE Database. This means that the project focuses on some of the largest firms and R&D-players world wide and is able to link interview data with the SCOPE data (part of WP6). It also means that some cross-regional comparisons can be made.

The interviews have been conducted with the most senior directors/managers of MNE’s R&D units. They are semi-structured in nature, with a limited number of open questions, based on the research themes. If necessary, the open questions have been followed-up by more specific questions for clarification, so that as much information as possible can be systematically obtained from subsequent content analysis of the interview transcripts.

The results of the interviews may be found in Deliverable 10 "Report on interviews with R&D managers". The interview questions can be found in *Annex 1* of this report. These questions stem directly from the research themes identified above. Questions 1 to 5 ask about the motives for a firm to invest in the region, and what an R&D manager thinks are a region's weaknesses as R&D location. Questions 6-9 ask about the nature of the R&D activities that the MNE conducts in the region, and how these are linked to the other parts of the MNE organization. The final question then asks about links between the R&D subsidiary and the region.

The partners first conducted one interview to test the questionnaire and the results were compared at a project meeting at the beginning of April 2006. Since then a total of 42 interviews have been carried out. This exceeds the contractual obligation (of two per region making sixteen), but the partners are committed to conducting as many interviews as possible to improve the validity of the general findings.

In most cases the questionnaire was sent to the interviewees in advance. Interviewees were informed about the terms of confidentiality. In preparation for the interview, a "fact sheet" containing public data was prepared which in some cases was expanded on the basis of information received from the interviewees. *Annex 3* contains the fact-sheets for the interviews.

The results of the interviews are presented in the form of interview summaries in the remainder of this document. In addition, in order to further aggregate the results, the interview transcripts were also coded so that (be it relatively crude) quantitative variables could be obtained. A simple database has been built with a graphical user interface that facilitates coding and that also allows for comments, notes and examples for each variable (see *Annex 4* for a screenshot). This dataset will enable the project to systematically compare findings across regions, and to explore relationships among the three themes. Box 1 explains in detail how the variables have been coded; the results are presented *in section V.*

2.3 Roundtable Discussions

Based on the interviews, roundtable discussions were held in the participating regions with regional actors from industry, academia and administrations. The topics and the invitees to these roundtable discussions were left to the local organiser as the roundtables were supposed to follow the needs of the regions in the topics to be discussed. Also, the local partners were given an opportunity to identify the actors they wanted to become part of their network or whom they wanted closer contact with. The roundtable discussions are summarised in deliverable D9 "Summaries of roundtable discussions". An overall view taking into account the background to the regions and both interviews and roundtable discussions may be found in deliverable D11 "Comparative report on R&D decisions of large private sector companies in selected regions".

The results of the LocoMotive Regional Roundtables are summarized according to main points made or themes in the report. Here, it should be noted that each partner in the project has been responsible for delivering a summary of the roundtable deliberations held in their region according to an agreed structure. Each partner was responsible also for managing these regional stakeholder. workshops and for delivering from these workshops a series of observations on top of or integrated with the summary account.

The regional roundtables were all aimed to assess broadly the situation regarding private sector investments in R&D in each selected region, especially with a view to understand the involvement of globally oriented companies as R&D investors. Focus has been on how to attract R&D investments (and related innovative activities) by multinational enterprises (MNEs).

An ambition behind of this part of the workpackage is to put the interviews with the R&D managers into the most relevant regional contexts for, later, to deduce both general and more specific recommendations to industry, to R&D institutions and to regional and other decision-makers in the public sector. It should be underlined that this deliverable (D 9) should

be a bridge between the company-level analysis and the global trends in R&D investments by multinational corporations. The report should help situate these two types of analyses in a context relevant to public policy-makers. However, a focus should remain on the identification of locational factors that could attract regional R&D investment by MNEs, and the way in which MNEs typically structure and organize their international R&D in relation to the European regions under scrutiny.
The presentations below have been organized into issue areas, developed also during the roundtable conversations with the companies and institutions involved. For further details of each regional roundtable or regional set of roundtables, please look at the individual reports from these roundtables, as documented by the regional teams.

2.4 Private Sector R&D: Global View

The pragmatic fact finding tour in the regions involved were supplemented by more global considerations on R&D decisions in large companies as laid out in deliverables D7 “Private Sector R&D: Global View”.

The Global Outsourcing of R&D has vast influence on the European Union especially as R&D investments have become a central topic on the European Agenda. As this report underlines, investments in R&D support the global economic growth and is as such beneficial to both the investing countries as well as the receiving countries. However, great care should be taken, on both the national and the industrial side, to ensure that the outsourcing of R&D is done with respect for the special circumstances under which the world is becoming increasingly global. This includes also sensitivity to economic as well cultural factors, of which the bestperforming multinational firms bear evidence through their successful outsourcing strategies.

The LocoMotive project aimed to provide a better understanding of the factors that influence where these MNEs locate their R&D, and how they organize their innovation efforts across borders, in order to help regional, national and European policy makers to better deal with these firms and maximize the benefits that result from their presence. This document is part of the LocoMotive project and documents in detail the R&D strategies of 8 of the largest technology-intensive firms in Europe: Airbus, Siemens, Philips, Nokia, Volkswagen, Motorola, Shell and GlaxoSmithKline.

The internationalization of R&D of these eight firms - and many other similar ones – goes beyond IT and business process operations, and can also include strategic activities, production, delivery of core products and services and sales and marketing. Although one of the key drivers of this trend is the quest for lower costs (engineers and researchers in regions outside Europe and the US are still much cheaper), access to knowledge and a highly educated workforce are equally important. Access to markets (and future markets) is a strong determinant of the growth of R&D towards India and China. The case studies confirm these impressions and highlight the combination of markets and technology as key locational determinants for R&D investment. The action of competitors is particularly relevant for companies that operate in consumer markets with relatively standardized products.

Yet there are also several impediments. Coordination costs and scale economies favour locating R&D in one single (often headquarter) location, rather than abroad. Insufficient tangible (airport, roads) and intangible infrastructure (legal environment) in host locations often make it impossible to locate R&D elsewhere. Factors related to quality and quality control, as well as IPR concerns, are further impediments. Lack of a common language and cultural differences also make internationalization of R&D difficult. The majority of firms in the case studies has opted to manage their international network organization like networks of interconnected centres of excellence and product development. But when policy influence via e.g. government procurement is large a more ‘multidomestic’ R&D strategy can be observed. Historical path dependencies, such as a strong headquarter or instead relatively autonomous brands within a group, continue to influence the organizational structure of R&D substantially.

2.4 Study visit to Toronto Ontario

A feature inbuilt into the project was to find a region for comparison outside the European Union. The region around Toronto, Ontario (Canada), was selected since it is both an innovation hot spot, but also considered culturally more similar to Europe than other locations in the USA or Asia. Therefore a study visit to Toronto was conducted in April 2007.

The visit was organised with the help of David Wolfe, Professor of Political Science at the University of Toronto at Mississauga and Co-Director of the Program on Globalization and Regional Innovation Systems (PROGRIS) at the **Munk Centre for International Studies (MCIS) at the University of Toronto.**

PROGRIS (http://www.utoronto.ca/progris/web_files/aboutus.htm) serves as the national secretariat for the Innovation Systems Research Network (ISRN), funded by the Social Sciences and Humanities Research Council of Canada. Professor David Wolfe is National Coordinator of the ISRN and from 2001 to 2005 he was the Principal Investigator on its Major Collaborative Research Initiative grant on *Innovation Systems and Economic Development: the Role of Local and Regional Clusters in Canada*, a comparative study of twenty-six industrial clusters across Canada. Along with Meric Gertler, he has recently been awarded a new MCRI grant from SSHRC on the *Social Dynamics of Economic Performance: Innovation and Creativity in City Regions* which runs from 2006 to 2010.

The members of the LOCOMOTIVE party found the visit very inspiring and certainly were able to add fresh thoughts to their regional thinking. Summarising the comments made after the visit, it struck many of them as stunning how similar approaches and problems were to comparable regions in Europe. The main contrast seemed to be the proximity of the Toronto region to the US, which led to a much stronger focus on the innovation situation in the neighbouring country than it would be in Europe. Also many of the problems concerning innovation arise from the relationship to MNEs in the US. The report of the visit may be found in deliverable D8 “Visit Report Toronto”.

2.5 LOCOMOTIVE Conference

All results of the LOCOMOTIVE project were presented and discussed during a public conference held in Hamburg on “Managing the Links - Global trends and regional policies in R&D location” on 5 and 6 June 2007. 60 experts from industry, universities and administrations had discussed the question, how decisions of large companies to locate R&D in a particular region may be influenced. The participants agreed that a location of important research and development investors in Europe will only be possible if the regions harmonised their locational and fiscal policies and will be guided less by competing against each other. In addition universities should concentrate more on their research strengths and not to try to offer the full spectrum of possible or fashionable topics in research. A detailed report of the conference may be found in deliverable D13 “Proceedings of final LOCOMOTIVE conference”.

2.6 Policy Recommendations

Taking the summaries from the roundtable discussions and from the conference, the LOCOMOTIVE project finally condensed its findings into a document giving recommendations on the regional aspects of R&D location. As can be expected in the case of such a cooperative project, the collaboration has brought to light many interesting and relevant dimensions and concerns (regional, European, sectoral, academic vs policy oriented, private vs public, etc.) not all of which can be taken on board in such a summary report. Further, it is understood that LOCOMOTIVE has focused on ‘what to do’, i.e. objectives and priorities. One way to continue the work initiated in LOCOMOTIVE would be to investigate in more details the ‘hows’, i.e. the means and methods best suited to the realisation of these ends.

The report brings together the conclusions and recommendations derived from the core LOCOMOTIVE activities. There was general agreement among LOCOMOTIVE participants on all of the main points to be discussed in the general recommendations. At the same time, it was also found that the discussion needs to be continued on a number of concrete issues. These include the question to what extent support for mobility and immigration inside and outside the European Union creates the threat of brain-drain in less competitive regions. Further, the assessment of priorities has also diverged as to whether R&D is best promoted by providing incentives directly for R&D activities of MNEs or by ‘enabling’ domestic local actors to contribute more effectively to these activities. Similarly, it is unclear at this point whether the knowledge-base profits most from strengthening ‘mass education’ or rather from more focus support for elite educational programs. Finally, there is no doubt that there exist significant structural differences between the economies and regulatory environments of regions in old as opposed to new members states. These differences must be explored further and need to be taken into account in the development and implementation of policies.

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3. Conclusions

Analyses of interviews with R&D managers of MNEs at both regional and sectoral levels proved that technology/supply side factors are the key determinants which strongly influence decision-making at MNEs in locating and keeping R&D in regions. The technology-related factors were important in all selected regions and in all industrial sectors. Particularly, the availability of a skilled labour force and researchers, proximity to a university or research laboratories, and an easy access to research results can be ranked among the most important technology-related determinants, which positively influenced location of R&D activities in the past and keeping R&D in the region at present.

In the more developed regions and in regions with a higher innovation potential the localisation is positively influenced also by the presence of other important/large (high-tech) companies in the region, which provide relevant services to MNEs. Also an acceptable regulatory environment and a favourable taxation system increase the attractiveness of the region for localisation/keeping R&D activities.

Most Interviewed companies had their headquarters and a strong R&D base in the EU-15 countries or in the USA. Localisation (or shift) of R&D activities of these companies to less developed regions (i.e. in the Prague and Budapest regions in the early 1990s) was positively influenced particularly by presence of a quality and cheap labour force and a suitable R&D infrastructure and experience in R&D (for instance in public research institutes or in large state-owned companies) in these regions. A positive influence can be also attributed to the geographical proximity and accessibility of these regions from the EU-15 countries as well as to their cultural proximity to western countries.

The technology-related factors were also mentioned as the most important weaknesses in all regions. Insufficient quality of educational systems, lack of qualified labour force, difficulties for MNEs in cooperating with universities and public R&D laboratories were very often mentioned as weaknesses in all regions covered by this study. The difficulty to attract and integrate non-Europeans, particularly highly qualified workers and researchers, is probably a global European weakness at present. Another problem, which was mentioned in some regions, is the thematic and regional fragmentation of public R&D subsidies (for instance overlapping and too small projects).

An unattractive tax environment (particularly high personal taxation) and high costs of living in more economically developed regions, which usually result in high R&D costs, can decrease the attractiveness for keeping R&D in these regions and can cause the relocalisation of R&D to countries with cheaper labour force and lower R&D costs.

On the other hand, weaknesses~~,~~ which may be caused by the yet unfinished transition to a more advanced educational and research system, which is common for the EU-15 countries, were revealed in the new member states' regions. For instance, insufficient protection of intellectual property, non-stable tax and regulation system, insufficient quality of public administration and a low entrepreneurial spirit of people were mentioned by R&D managers in these regions. Also an absence of a common and complex concept (policy) of R&D, education and business (insufficient harmonisation of the science policy with the education and economic policy system) was stated as a weakness for localisation of private R&D in these countries.

Localisation motives at the sectoral level differ namely in compliance with the continuing process of economic globalisation that implicates decentralisation or even relocation of economic activities. Globalisation influences especially the electric industry. Acquisitions remain an important localisation factor in chemistry and pharmaceutics. Main milestones of individual sectors are these: support programmes and incentives in ICT, R&D expansion to China and India leading to establishing new R&D capacities and deepening specialisation in the electric sector and R&D expansion in accordance with the expansion of chemistry and pharmaceutics.

The results of interviews and revealed key localisation determinants are in compliance with recent studies focused on internationalisation and globalisation of R&D.

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LocoMotive

Project no. 030089

LOCOMOTIVE

"Dissemination of knowledge concerning current R&D localisation motives of large regionally important private sector organizations"

Coordination Action

Regions of Knowledge 2

Final Recommendations

(Deliverable D12)

Date of preparation: **31 October 2007**

Start date of project: **1 January 2006** Duration: **21 months**

Project coordinator name: **Monica Schofield**

Project coordinator organisation name **TuTech Innovation GmbH**

Revision: Draft 1.0

TABLE OF CONTENTS

1. Introduction

The Regions of Knowledge Programme in Framework 6 was introduced by the European Commission DG Research to further the growth of innovation poles and partnerships at regional and local levels. The central idea is to promote investment into regional development and policy-making based on research, mutual learning, coordination and collaboration. It follows on from a pilot programme instigated by the Parliament in 2004.

LOCOMOTIVE set out to contribute to this endeavour by providing regional policy-makers with a better understanding of current research and development (R&D) investment policies of large private sector companies – multi-national enterprises (MNEs) - in a number of European regions from both old and new member countries. LOCOMOTIVE is a coordination action which aims both to provide an analysis of current thinking in MNE with regard to regional influences on their location for R&D as well as the opportunity for relationship building between key private sector R&D decision–makers and the project partners from these regions.

Specifically, LOCOMOTIVE has sought to contribute to the growth of knowledge-based regions by exploring:

(i) how regions can be made more attractive for R&D activities of MNEs;

- LOCOMOTIVE's findings can be helpful to regional policy makers by providing a better understanding of current R&D investment policies of MNEs These findings can also benefit future regional and European Commission activities by suggesting more effective ways of supporting R&D localisation in Europe

(ii) how MNE's could operate their R&D activities more effectively in their respective regions;

- LOCOMOTIVE has aimed to understand the reasons for but also to alleviate the evident communication gap between 'big industry' and regional policy-makers.
- LOCOMOTIVE brings together the viewpoints of R&D strategists and regional developers.

(iii) how R&D activities of MNE's could play a more positive role in the development of their respective regions.

- The recommendations of LOCOMOTIVE can assist R&D stakeholders in enhancing the regional embeddedness of MNE's.
- They can also strengthen regional marketing by helping to formulate more appealing messages for potential investors.

The report brings together the conclusions and recommendations derived from the core LOCOMOTIVE activities. During the course of the project, the partners have conducted a total of 42 interviews with senior managers, normally CTOs, of MNEs according to a pre-defined questionnaire and methodology developed at the beginning of the project. The interviews were then summarised for comparison and analysis. Subsequently, roundtable discussions were held in each of the regions involving representatives of MNEs, regional decision-makers and researchers. These discussions too have been summarised for comparison and analysis. A benchmark region outside Europe – the Toronto Region – was visited and reported on. Finally, in June 2007 a two-day conference was held in Hamburg entitled "*Managing the links: Global trends and regional policies in R&D location*". The presentations can be found on the project website: www.locomotive-project.org.

Beyond the above sources, this reports also draws on the vigorous and stimulating discussions among the partner teams participating in LOCOMOTIVE, especially at the final meeting held in Hamburg in September 2007. It is also worth noting that the summary recommendations contributed by the individual teams on circumstances specific to their regions (see Section 4) were extremely important for establishing regional differences as well as similarities.

There was general agreement among LOCOMOTIVE participants on all of the main points to be discussed in Section 2. At the same time, it was also found that the discussion needs to be continued on a number of concrete issues. These include the question to what extent support for mobility and immigration inside and outside the European Union creates the threat of brain-drain in less competitive regions. Further, the assessment of priorities has also diverged as to whether R&D is best promoted by providing incentives directly for R&D activities of MNEs or by 'enabling' domestic local actors to contribute more effectively to these activities. Similarly, it is unclear at this point whether the knowledge-base profits most from strengthening 'mass education' or rather from more focus support for elite educational programs. Finally, there is no doubt that there exist significant structural differences between the economies and regulatory environments of regions in old as opposed to new members states. These differences must be explored further and need to be taken into account in the development and implementation of policies.

As can be expected in the case of such a cooperative project, the collaboration has brought to light many interesting and relevant dimensions and concerns (regional, European, sectoral, academic vs policy oriented, private vs public, etc.) not all of which can be taken on board in such a summary report. Further, it is understood that LOCOMOTIVE has focused on ‘what to do’, i.e. objectives and priorities. One way to continue the work initiated in LOCOMOTIVE would be to investigate in more details the ‘hows’, i.e. the means and methods best suited to the realisation of these ends.

In the first part of the report (Section 3), the consensus of the conclusions and recommendations from the project as a whole are presented. These seem to apply to all regions and therefore can perhaps be taken as a general statement about what needs to be done in a regional context at the European level. Section 4 discusses recommendations that address region-specific problems but may be relevant to other regions too. A regional breakdowon of all policy-recommendations will be presented in Section 5.

In presenting these conclusions it should be borne in mind that although the work of the project was guided by academic insight, the results presented are not to be taken as research findings. Some publications relating to the work of the project have been made separately.

2. The context of the project

Before presenting the conclusions and recommendations, it worth reflecting briefly on the context and why the project was set up. The proposal was put together and submitted for evaluation in the spring of 2005. It is positioned in the context of the Lisbon Agenda and has run from 1 January 2006-end of September 2007.

The Lisbon Agenda agreed by the Council of Ministers in 2000 was supposed to set Europe on the path to becoming *"the most competitive and dynamic knowledge based economy in the world*" by 2010. In support of this, the so called Barcelona objective was agreed that R&D investment in the EU should rise to 3% of GDP with two thirds coming from the private sector. In 2005 this target was off course. To put things back on course, the need for innovation poles and partnerships at regional and local levels was highlighted at the 2005 Spring European Council. In a press release given for the presentation of the Cohesion Report by EU Regional Policy, Commissioner Danuta Hübner 18 May 2005 stated that, this approach to involve regions more extensively was "In line with the wishes of the EU's Heads of State and Government, who in March 2005 urged regional and local actors, among others, to take greater ownership of the Lisbon strategy, and to actively participate in the achievement of the Lisbon objective of making Europe's economy the most competitive in the world by 2010.".

Another observation noted by the instigators of the LOCOMOTIVE project was that much of the focus of the policy actions at regional and local level was invariably targeted almost exclusively at SMEs – their establishment, growth, or in many cases how to help them survive. While there is no dispute over the importance of SMEs to the economy and employment in particular, the fact is that few SMEs operate in business sectors where they can afford to devote significant resources to carry out research or have the financial backing to cover the risks. The target to increase research spending therefore means that more MNEs have to be persuaded to do more research in the European Union. The key issue if regional and local decision-makers are to become involved is therefore to understand what can be done at a regional to make it more attractive as a location for research activity by MNEs. The difficulty observed which provided the reason for LOCOMOTIVE is that globally operating companies who source their R&D worldwide do not often engage with regional policy makers at a local level. They exist in a region for historical reasons, or because there is something (or someone) which attracts them to locate there. Dialogue with regional actors appears difficult, often because the key decision makers of a MNE may have no regional contacts and there is a tendency for local actors to shy away from approaching the strategic decision-makers of a MNE located elsewhere. There exists cultural barriers to this it seems.

What LOCOMOTIVE sought to provide was not so much a research exercise to find generic factors important to the decision-making, but rather provide a framework to establish a dialogue. Hence although the interviews were designed to extract answers which could be analysed, more importantly they were used to establish contacts for further discussion involving triple helix partners. These took place in roundtables and the results brought to wider attention through the final conference. It is the relationships established which are seen as having lasting value.

A popular summary of LOCOMOTIVE can be described as follows:

- To capture the “mood” of industry
- To compare findings with what is being found in research
- To build tactical relationships
- Networking and mutual support between partners
- Influencing company and regional actors

Since the conception of LOCOMOTIVE the importance of MNEs has become more recognised. Is seems they are less overlooked than in the past and it is now more widely acknowledged that they have also a key role to play in allowing technology and service based SMEs to flourish. Open innovation is now a well established paradigm with MNEs now regarding a combination of SMEs, research organisations and universities as part of an innovation eco-system essential to their business success. In that sense things have moved forward since LOCOMOTIVE commenced, but the recommendations and observations given in this report are seen as perhaps providing a summary of those matters which can and should be addressed by those responsible for regional economic development, as well as the Commission’s support measure in supporting this,

The LOCOMOTIVE partnership represents nine regions. The partners have different profiles and complementary skills, but all are highly respected in their regional context and are well experienced in working with policy makers, private industry and academia. The regions were not sought because of any particular common profile, but for the purpose of contrasting difference situations. They therefore represent a good cross-section of regions in which MNEs are located.. The partners in LOCOMOTIVE are:

- **CEU Consulting** (Budapest) and the **Centre for Regional Studies, Hungarian Academy of Sciences** have been responsible for developing national and regional innovation policies for Hungary.
- **Culminatum Ltd Oy** Helsinki Region Centre of Expertise is a regional development management company acting on behalf of Helsinki and the Uusimaa region, one of the most successful regions according to the Lisbon Agenda.
- **Interlace-invent ApS** is a research-based consultancy firm associated with Copenhagen Business School located in five places in Europe and others further afield, and working with a number of regionally based organisations to create innovation environments.
- **Oxford Science Enterprise Centre** is part of the **Said Business School at Oxford University**, and operates as part of the University's Knowledge Transfer strategy by supporting academic entrepreneurs. Oxford represents one of the most dynamic regions in Europe for research based enterprise.
- **Réseau Universitaire Toulouse Midi-Pyrénées** is supported by a regional consortium of research and university entities, and socio-economic partners acting for a region with dominant clusters in aerospace and bio-medical technology.
- **Rotterdam School of Management, Erasmus University** is one of Europe’s top business schools which has for many year’s been studying MNE R&D investment.
- **Technology Centre Academy of Sciences of the Czech Republic** works on analytical and strategic studies in RTD and innovation, and trans-national technology transfer and has carried out many policy forming studies for the Czech government.
- **TuTech Innovation GmbH** (Project Coordinator) is a technology transfer company belonging to Hamburg University of Technology and the Free and Hanseatic City of Hamburg and has a public mission to act as a facilitator for cooperation between research and private enterprise.

3. General conclusions, observations and recommendations

In this section the general conclusions and recommendations of the project are presented under the following headings:

- *Validity of the project and approach* – observations on whether or not the project methodology was felt by the participants to have been useful
- *The need to improve the dialogue* – reflections on whether or not it is the case that the interaction between regional policy-makers and MNEs needs to be improved
- *The role of universities* – universities are important to research location.
- *The importance of attracting a highly educated work force* – this has emerged as a key issue
- *Addressing innovation in services as well as products* – services are often overlooked, especially in the context of research.
- *Encouraging regional interest in European Knowledge and Innovation Communities* - integration and use of EC policies at the regional level lies at the heart of LOCOMOTIVE.
- *Active involvement in measures to bringing R&D to maturity* - the "valley of death gap" between mature research and emergence of market readiness is important when considering economic gains to be made from research
- *Reduction of fiscal barriers and tax incentives for innovation financing in strategic sectors* – fiscal matters matter.

Validity of the project and approach

LOCOMOTIVE was conceived out of concern that the role of MNEs in the context of regional policies had been underestimated and that in most cases they are not well integrated into discussions of regional policy. The project partners could confirm that largely this is the case. Regional policy makers tend to focus only on SME involvement, and the MNEs themselves have not until now seen the need to engage with regional policy makers to discuss matters relating to the knowledge economy and research.

The partners found the project to be a worthwhile exercise and once the credentials of the project were established, the CTOs of the target companies, with one or two exceptions, were very willing to discuss matters openly. Furthering regional contacts was seen as being of value. Over the project period it can be said that interest from both sides in the role of MNEs has increased.

However the partners agreed that LOCOMOTIVE has only scratched the surface. There is much bridge building to be done, and there is very much a need for continuity in the dialogues established. There is now a challenge to maintain this once the project is completed. Although the dialogue has been established at a regional level, it also took place as part of a larger European activity. Clearly, by providing for cross-fertilisation and easy participation in each others activity, LOCOMOTIVE acted very much as a catalyst. In sum, the methodology and structure of the project seem to have worked well.

Recommendation:
Other regions are encouraged to undertake a similar exercise. It is helpful to the standing of the activity if there is a European or trans-regional dimension to the work.

* * *

The need to improve the dialogue between regional policy-makers and MNEs

Notwithstanding the background to the project, the partners have been surprised at how little effort in many cases is made by regional policy-makers to engage with the MNEs in their region before formulating various policies, for example on clustering. There are an awful lot of “me too” clusters. It appears that many in regional public administration feel uneasy about talking to CTOs. Perhaps it is also true that they are not willing to take a more critical approach to the regional policies adopted. The influence of local/regional politics can play an adverse role too. It was noted that although the LOCOMOTIVE conference provided an excellent opportunity to hear views from MNEs universities and regional case studies, even in Hamburg where the conference was located, public administrators were notable by their absence.

It is concluded that much more needs to be done to engage a more regular interaction between regional administrations and industry and to establish a greater transparency in policy development. More effort needs to be made to solicit views from MNEs.. Since MNEs see regions from a global perspective and do not have the same need for this dialogue, the effort has to be made by regional administrators. Crucial to most of the successful regional initiatives has been individual champions. Personalities are important and for such persons to have credibility and "speak the same language" as MNE CTOs they need to be cosmopolitan and at home switching between the public, private and higher education/research sector.

***Recommendation*:** **To put in place support measures and use appropriately qualified intermediaries to facilitate the dialogue between researchers, public administrators and industry.**

* * *

The importance of strong universities

A clear criteria for the desirability of a region as a location for R&D cited in the interviews and reinforced from studies elsewhere, is its ability to provide a large pool of talented and highly motivated engineers and scientists. Having a strong internationally recognised university is an asset, but it was observed in the interviews this asset is often underused. Universities have increasingly taken on a "third mission" of services for society including wealth creation and knowledge-transfer, but much more needs to be done in this area.

Important to all MNEs is access to well-trained graduates. Concern was expressed about levels of educational attainment. Improvements in higher education were emphatically called for including better skills development, training of teachers and trainers and attracting talented students, especially as regards the absence of relevant business and project management skills. This is something to be taken very seriously also in the context innovation policies. Up to now there has been a tendency to treat education separately from research and innovation, but it needs to be an integral part. Curricula in the relevant disciplines are to meet the changing demands of R&D stakeholders. Cross-disciplinary training programs are to be fostered.

Specifically, strategic partnerships between MNEs and universities can be encouraged in several ways. One crucial issue, repeatedly mentioned in interviews, is the regulation of patents. In addition, R&D units of universities should be given support to cooperate with their relevant counterparts at MNEs. This can help to make sure that university-corporate partnerships do not remain one-off project-based initiatives as it is often the case. It must be emphasized that, given the characteristics of higher education in most European countries, regional and national governments must lead the way in bringing about these changes through governmental funding schemes, research and R&D support programs, fostering three-party cooperation among MNEs, SMEs and universities.

***Recommendation*:**
Policies addressing higher educational matters should not be treated in isolation from innovation and research. Universities should be encouraged to link more strongly to MNEs, for example by having MNE representation on Boards to link global and local perspectives.

* * *

The importance of attracting and retaining a highly educated work force

Common to all MNEs was concern about the numbers of science and engineering graduates in Europe as a whole. The interviews exposed numerous shortcomings in the European R&D+i culture including a) poor entrepreneurial incentives, b) lack of high-status and prestige for innovative research work, c) insufficient funding of research, d) researchers not financial benefitting financially from their research, e) lack of ambition and vision in European R&D+i programs, and f) cumbersome funding processes.

Even if these shortcomings are remedied, however, demand for qualified workforce is likely to outstrip supply. Therefore, most regions will need to import global talent. At the same time, it was observed that there is a disparity between the EU's desire to attract world class talent for R&D and the kinds of barriers imposed on those wishing to enter the EU from other countries as well as on those coming from newly-accessed regions inside the EU. Incentives for increased mobility of highly skilled workforce must be provided within a broader framework based on reciprocity and mutual benefit, especially among member countries (e.g exchange programs, regional diversification).

***Recommendation*:**
To make those working for regional authorities more aware of the impact of their policies on those working for MNEs through for example, exchange and mobility programs for students, faculty, experts and skilled workforce.

* * *

Improving interaction between SMEs and MNEs

Most policies can be safely described as being SME obsessed. At the same time, one of the most under-supported areas is that of helping technology-based SMEs interface with MNEs. This is regrettable since, typically, winning a major R&D contract from an MNEs is the way SMEs grow in value. Therefore, as part of a strategy to maintain or attract MNE interest in a region must be to support active and visible proliferation of SMEs capable of working with and for MNEs. Additional actions in this area could include redesigning existing innovation systems in areas of specialisation, agglomeration, targeted innovation processes and similar activities to foster more embracing environments for SMEs striving to become part of global supply chains. Important is to make it easy for SMEs to access the necessary funding.

Recommendation:
Improve the means by which SMEs can become stakeholders in the R&D sector by for example, establishing funding schemes to provide more opportunities for SMEs to work bi-laterally with MNEs e.g. through subcontracting and outsourcing, and making R&D part of procurement policy.

* * *

The importance of addressing innovation in services and not just in products

The observation was made that regional clustering policies tend to focus on science and technology whereas much of the attractiveness of a region might lie in innovative services. Much more attention needs to be paid to the service sector including R&D services. LOCOMOTIVE has found interesting links among various aspects of R&D+I, on the one hand, and business creation/entrepreneurship, on the other. These include societal innovation, user-driven innovation, innovations in business models, new support structures, and many more. This is particularly important because this is precisely the area where SMEs can most effectively interface with MNEs for mutual benefit.

Recommendation:
Support targeted innovation, especially for SMEs acting in conjunction with MNEs to develop services as well as products.

* * *

Encouraging regional interest in European Knowledge and Innovation Communities (KICs).

An often-repeated statement was that a region is regarded as attractive if it is well linked globally. It seems there is a real need to persuade regional policy-makers that being well-connected to research and innovation clusters in other parts of Europe is the key to the standing of their own clusters and attraction from a global perspective . For this region the European KICs currently under discussion are seen as having a key role. In addition, through their connection to global networks of research and scholarship and their ability to attract world-class scientists and experts universities can act as important facilitators of their region's efforts to 'go global'. Universities provide a gateways for their regions to global networks.

Recommendation:
Regions need to take more interest in the development of trans-regional KICs and to become more aware of R&D+I potential in other regions.

* * *

Active involvement in measures to bringing R&D to maturity

More support is required to make sure that innovative development processes and ground-breaking research are 'followed through' and ultimately yield tangible results and even marketable products and services. Regions can play a crucial role in this by being more focussed in what they support. The public sector through regional authorities and universities could create discretionary funds supporting the testing, implementation and marketing of the results of R&D+i activities. The role of universities in acting as an agent to bringing technology to maturity should be considered.

For example, it has been noted that in the medical technology sector the availability of facilities, people and funding for clinical trials greatly improves the attractiveness of the region as a R&D base. There are other fields where regional as well as EU intervention (funding) to support technology to "transcend the valley of death" would be helpful.

Recommendation:
Greater provision of EU and regional funding and other forms of support for the testing, implementation and marketing of the results of R&D+i activities.

* * *

Reduction of fiscal barriers and tax incentives for innovation financing in strategic sectors

Major challenges for European regions are the fragmentation of innovation and financing. This leaves very few regions in Europe with efficient coverage of the entire funding process from seed funding to IPO for start-ups and spin-out companies. The lack of an efficient pan-European market for venture financing is especially hurting cities in transition from traditional manufacturing to a more service-oriented economy dominated by innovative SMEs (e.g. Barcelona, Budapest). This is a barrier to the further growth of regional R&D activities of MNEs as well which draw heavily on such SMEs for innovative ideas and frequently seek to subcontract creative tasks.

Recommendation:
More work needs to be done to remove barriers to cross-border investments and financial mobility between EU-countries (e.g. double taxation, 'garden gate' taxation, etc.).

4. Cross-regional viewpoints

The conclusions and recommendations given above are considered to be what can be elicited at a general level. The challenges and concerns addressed by these recommendations have figured in all or most regions participating in LOCOMOTIVE.

However, an important finding of the project was the need to focus on regional specifics. In comparing these some observations have been made on where themes appear to correspond or diverge. Note that all regional recommendations are compiled in Section 5. Region specific descriptions of R&D activities of MNEs and the corresponding suggestions will be summarized there. Here we will only highlight the most significant differences among regions in this regard while also including suggestions which, although responding to local challenges, may be usefully applied elsewehere too.

- *Special sources of highly-skilled workforce for MNEs (Copenhagen):*

  ***Harnessing the Innovativeness of New Generations of Innovators and Entrepreneurs**:* Improving conditions for young entrepreneurs, researchers and innovators are paramount to ensuring continued European competitiveness and growth. Specific recommendations: are (i) create micro-incubators in urban settings to attract talented entrepreneurs while maintaining emphasis on quality-of-life and other soft factors; (ii) staff regional industry and science promotion organisations with professional managers from industry instead of civil servants; (iii) create special tax models for innovators and entrepreneurs to cater for fluctuations in income over the years reducing personal financial risks and preserving motivation for commercialisation.

  ***Improving Gender Equality in Entrepreneurship and Research**:* Women are still underrepresented in R&D+i in areas such as entrepreneurship, management positions and natural sciences & technology. There is an untapped potential in a more balanced gender-distribution in these areas which could become a special resource for Europe given its comparatively advanced stage of gender equality. Specific recommendations: (i) create special ice-breaker programs to change corporate and industrial culture; (ii) encourage gender-equality in typically male dominated positions in R&D+i value chains such as venture capital fund managers, executive positions and faculty in hard science; (iii) change reward systems at universities, public institutions and publicly funded programmes to emphasise merits encouraging for female talent in R&D+i; (iv) improve areas traditionally stigmatising women, e.g. maternity.

- *Basic research and applied R&D (Oxford, Budapest):*

  Applied innovation cannot thrive without continued input from basic research. The EU should accelerate its targets for raising the level of spending in the science base in member states to ensure a good supply of graduates as well as top-quality sciences. At the same time, it is often necessary to treat research and development separately both in educational and economic terms. Development is more cost-sensitive and project-specific, while research is usually less costly and allows more creative freedom. Policy-initiatives should not lose sight of this distinction.

- *Science parks, innovation centres, organizations for knowledge-transfer (Hamburg, Budapest, Prague):*

  There is little support forthcoming for innovative R&D activities in science parks, innovation centres and other locations of knowledge-transfer. Attempts to establish science/industrial parks often lead to the creation of office centres rather than that of genuine innovation hubs. Through initiating networking events and training programs, science parks could play a crucial role in fostering the R&D skills and in encouraging an innovation-friendly entrepreneurial culture. Since science parks/innovation centres can act as interfaces for the transfer of knowledge and information, their financing should ensure their sustainable development.

- *Marketing R&D activities (Helsinki, Toulouse):*

  Create local and regional platforms, training programs, 'mobility days', workshops, publications, websites, etc. to exchange and advertise information on ongoing R&D activities, R&D support programs, open calls and tenders, etc. Such platforms can also serve as powerful instruments of regional and city branding and marketing of local advantages for potential investors.

- *Changes in university management (Budapest, Prague):*

  As mentioned, there is a severe lack of research management skills. MNE-university or MNE-SME-university cooperation suffers from the fact that universities show insufficient expertise in the organization and management of R&D projects. Apart from the solutions suggested above (see Section 2), it would also be important to improve university management structures to make universities more flexible in responding to demands of other stakeholders in R&D. This could involve, for instance, the inclusion of strategic corporate partners as consultants or even Board members at universities.

- *Underfunding (Barcelona, Budapest, Oxford, Prague):*

  One of the most critical bottlenecks to increasing R&D is the severe underfunding of universities/research institutes/R&D places. Also, considerable share of corporate funding for R&D remains intra-mural. This is a problem because universities cannot act as partners of MNEs as long as they do not command the necessary resources in terms of financing and skilled management. It is crucially important to increase public expenditure on education and R&D. In particular, incentives must be given to MNEs to cooperate with universities on a long-term, institutional basis (e.g. MNEs should finance not only ‘one-shot’ projects but also R&D places at universities as well as special teaching streams, departments, chairs, training programs, etc.)

5. Regional Summaries

In this section, a summary of the key issues and specific recommendations is provided in a regional breakdown. These are largely based on the conclusions of the roundtable discussions in each of the regions.

Budapest (Central European University and Centre for Regional Stuides, Hungarian Academy of Sciences)

The availability of resources and qualifications on the part of potential Hungarian partners is the principal location factor on which the future growth of MNE-driven R&D depends. Although it is undeniable that some objective factors are beyond their influence (e.g. global economic trends and investment strategies), making domestic stakeholders fit for cooperation with global players is where local and European policy-makers shoulder the greatest responsibility. Encouraging MNEs to integrate their R&D operations based in the region is in the host country's prime interest if it is to avoid the relocation of R&D units and the braindrain of its well-qualified experts. But MNEs too have an interest in avoiding the cost-intensive relocation of their R&D units.

1. Underfunding

Diagnosis:

- One of the most critical bottlenecks to increasing R&D is the severe underfunding of universities/research institutes/R&D places. This is a problem because universities cannot act as partners of MNEs as long as they do not command the necessary resources in terms of financing and skilled management.
- Considerable share of corporate funding of R&D remains intra-mural.
- The government appears to be unsure whether it should continue to finance basic scientific research.

Recommendation:

- Do not reduce public expenditure in education and R&D. In particular, provide incentives to MNEs to cooperate with universities on a long-term, institutional basis (e.g. MNEs should finance not only 'one-shot' projects but also R&D places at universities as well as special teaching streams, departments, chairs, training programs, etc.)

- On the other hand, improve interaction between R&D units of MNEs and R&D organizations by altering regulation, improving education, fostering networks, providing governmental subsidies for actual cooperations (see also relevant points below for more detail).
- Applied innovation cannot thrive without continued input from basic research.

2. Too few science parks, innovation centres

Diagnosis:

- There is little support forthcoming for the incubation of SMEs and innovative R&D activities whether in science parks or elsewhere. Previous attempts to establish science/industrial parks have typically led to the creation of office centres rather than that of genuine innovation hubs.

Recommendation:

- Through initiating networking events and training programs, science parks could play a crucial role in fostering the now sadly missing R&D skills (see poor research management skills below) and in encouraging the rise of an innovation-friendly entrepreneurial culture.
- Since science parks/innovation centres can act as indispensable interfaces for the transfer of knowledge and information, they are to be financed in the long-run in order to ensure their sustainable development.

3. Poor research management skills

Diagnosis:

- Severe lack of research management skills. MNE-university cooperations suffer from the fact that universities have shown inadequate expertise in how to organize and manage R&D projects. This was identified as the principal reason why MNEs are reluctant to outsource the management and coordination of R&D activities to universities and research institutes.
- The current disciplinary and curricular structure of higher education does not meet the expectations of MNEs. Reforms are to be instituted in consultation with experts from the private sector.

Recommendation:

- See education.

4. Weak interaction between R&D places and companies

Diagnosis:

- One strongly supported conclusion was that cooperation between R&D places and companies remains weak.
- More often than not, R&D units of MNEs operate as enclaves with hardly any interaction between them and other stakeholders in R&D.
- Existing links are often based on personal, informal contacts. Frequently, joint ventures are in reality ‘one-shot’ projects, institutionalized cooperations are too rare.

Recommendation:

- It was suggested that the government should undertake a much more pro-active role in alleviating this situation.
- Contrary to current practices, governmental support should be market neutral. At present, the key priority should be not the finding of new partners through direct subsidies given to individual firms, but improving the positions of Hungarian stakeholders, in particular that of the universities, and support for the development of an innovation-friendly infrastructure.

5. Bureaucratic application procedures and delayed financing

Diagnosis:

- The success of existing governmental initiatives to support innovation and R&D cooperations is seriously jeopardized by red tape and the requirement that participants are to pre-finance programs before gaining access to governmental funds.
- The regulatory environment is at best overly complicated and unstable (see point below), at worst positively obstructing R&D/innovation (e.g. by protecting monopolies) and a hotbed for corruption.

Recommendation:

- Reduce bureaucracy.
- Accelerate access to subsidies and funds.
- Stabilize the regulatory environment.

6. Missing stability and predictability

Diagnosis:

- R&D investments suffer particularly heavily from ever changing regulations and shifting development priorities on the part of national/regional/local policy-makers.

Recommendation:

- Investors in R&D could be encouraged by determined political leadership and carefully thought out, long-term governmental blueprints to be adopted by national/regional/local governments outlining national/regional/local RTD and innovation strategies.
- Long-term institutional commitments of other stakeholders would also be helpful.

7. Education

Diagnosis:

- Originally an appealing location factor for R&D-intensive FDI, skilled workforce is becoming harder to find (particularly engineers and natural scientists).
- The introduction of the Bologna-process has brought mixed results as it led to lower overall standards at the undergraduate level.
- Even competent researchers and professionals lack the requisite R&D project management and business skills.
- Scarcity of proficient foreign language speakers.
- Computer illiteracy.

Recommendation:

- Open up the Hungarian labour market.
- Strengthen higher education in the relevant disciplines (returning to traditionally successful areas of the Hungarian school system such as mathematics and natural sciences).
- More attention at the university level to research and project management skills and business expertise even for researchers.
- Support foreign language and IT teaching.
- Introduce some form of talent promotion, possibly through the adoption of a two-track system.
- Need for a general overhaul of the institutional structure, funding and educational priorities of higher education in Hungary.

8. Values and attitudes

Diagnosis:

- The growth of MNE-driven R&D is hindered not only by objective factors but also by the presence or lack of intangibles.
- R&D stakeholders manifest and suffer from the lack of trust, a feeling of security and entrepreneurial courage.
- There is too little openness for cooperative ventures, even though consensus among local players can often prove to be crucial.
- Too little readiness to finance innovation without the hope of immediate return (e.g. risk capital, seed money, incubation, etc.)

Recommendation:

- The key to enhancing intangibles is education (see education above).
- Science parks and innovation centres could also play an important part in transforming entrepreneurial attitudes (see science parks/innovation centres above).

9. Research versus development

Diagnosis:

- For analytical purposes it is often necessary to treat research and development separately. The latter is more cost-sensitive and project-specific, while research is usually less costly and allows more creative freedom.

Recommendation:

The above findings and recommendations may therefore apply differently to these two areas.

Copenhagen/Barcelona (Interlace-invent ApS)

Recommendations from Copenhagen

Retaining Excellent Minds in Europe

The working conditions and funding opportunities for leading scientists and researchers are often being perceived as being below-par as compared to the US and in an increasing degree also to Indian, Chinese and Singaporean elite facilities. Consequently, leading researchers and innovators interviewed in fields such as sound, speech and voice, drug administering technologies and innovative surgical procedures are contemplating leaving or have left the Copenhagen region for more attractive offers elsewhere to continue their R&D, innovation and commercialisation. The challenges stated to retaining excellent European minds in Europe vary from under-funding, red tape, lack of ambition and insufficient commitment from the public sector and industry.

Specific recommendations:

- reduce administrative procedures and red-tape for attracting public funding for R&D
- establish additional tax-breaks and similar incentive schemes for European companies to fund R&D in Europe
- focus on soft factors such as quality of life, living conditions, opportunities for companions and children, as well as taxation, pension, health care and social services in R&D intensive regions.
- improve the ambition level of European R&D within European areas of excellence and strategic industries such as health care, mobile technology, pharmaceuticals, transportation and information technology.
- improve funding schemes for elite scientist to a cost-plus basis to cover also lost revenue and opportunities costs for innovative general practitioners, engineers and innovators in economics and social sciences.
- improve conditions for commercialisation of new technologies (covered in more detail elsewhere).
- implement programs to circulate talent circulation across Europe to overview distortions in availability of talent, graduates and competences. Scandinavians companies for example, are experiencing shortages of skilled engineers, whereas there is unemployment among engineering graduates in Spain and Italy.

Increased Public Risk-Taking in Innovative R&D Programmes

One of the challenges of European R&D is found in the lack of scale, vision and risk-taking in European public funded R&D programmes. Europe is behind in total expenditure of R&D as percentage of GDP, and the lower European GDP growth rates compared to the US and Asia further hurts the public spending of R&D in relative terms. The recent challenges of the Galileo satellite program underlines the necessity for some programmes to have governments carry the full risk for industry to accept participation, even on an opportunity cost basis, similar to the US military R&D spending. Furthermore, with China, Russia, India and Japan launching similar programmes, the European emphasis on satellite technology has been critized for allocating funding to an area where Europe is not necessarily in a position to create a global leading position, and this on the expense of leading positions in industries such as biotechnology and medical technologies.

Specific recommendations:

- increase focus on basic science through massive funding of hard technology such as nanotechnology, bioengineering, genetics, evidence-based medicine, clean tech, quantum computing, micro electronics and new materials.
- establish independent and transparent think-tanks with the responsibility to create bold visions and strategies for national and European strategies similar to US models, and abolishment of the non-transparent practice of ad-hoc expert advisors to the EU Commission.
- transfer of decision-making authority in funding of R&D programmes, as well as specific support programmes and coordination actions away from the EU Commission bureaucracy to industry and science experts.
- flexible R&D contracts allowing for project failures, re-scoping of deliverables to cater for in-project findings and increased risk-taking by researchers.
- broader use of industry professionals and scientific experts in management of regional, national and European funding schemes instead of general-purpose administrators.
- larger degree of industry leadership in public R&D funding programmes, to reflect industry needs and proprietary knowledge.
- better conditions for keeping IPR and maintaining secrecy of competitive knowledge generated by public funding projects with researchers, innovators and firms involved

Harnessing the Innovativeness of New Generations of Innovators and Entrepreneurs

With ageing European electorate, ensuring and improving conditions for young entrepreneurs, researchers and innovators are paramount to ensuring continued European competitiveness and growth. The university structure in Copenhagen has been pioneering in the creation of models to support young entrepreneurs, innovatiors and researchers in developing new commercial ventures with a high degree of R&D. Structures such as the ITUniversity and SCION science park has been both economic and cultural centres for entrepreneurs and start-ups, as well as bridging the gap between universities and business firms with possibilities for co-location of industry R&D at the facilities vis-à-vis student and faculty entrepreneurs.

Specific recommendations

- create micro-incubators in urban settings to attract talented entrepreneurs while maintaining emphasis on quality-of-life and other soft factors valued by the new generations of researchers, innovator and entrepreneurs.
- motivate industry involvement by encourage industry-financed and managed venturefunds within target areas, mentored by senior managers and broad cross-over between universities and firms.
- staff regional industry and science promotion organisations with professional managers from industry instead of civil servants, and allocate the necessary compensation packages and degrees of freedom to attract the right profiles.
- create special tax models for innovators and entrepreneurs to cater for fluctuations in income over the years, reducing personal financial risks and preserving motivation for commercialisation through decreased margin tax on potential future incomes and entrepreneurial rents.

Improving Gender Equality in Entrepreneurship and Research

Copenhagen, as a city in Scandinavia, has widespread gender equality compared to international benchmarks. However, women are still underrepresented in R&D in areas such as entrepreneurship, management positions and natural sciences & technology. The region has had moderate success with encouraging women to become entrepreneurs and innovators in R&D involving both hard science as well social and societal innovations. In addition, the efforts have uncovered a huge yet untapped potential in a more balanced gender-distribution in these areas, which could become a special resource for Europe in general given its comparatively advanced stage of gender equality.

Specific recommendations:

- create special ice-breaker programs to change corporate and industrial culture, identify barriers and opportunities, market possibilities and raise awareness, as well as putting gender-specific issues on the public agenda.
- encourage, or potentially enforce, gender-equality in typically male dominated positions in the R&D value chains such as venture capital fund managers, executive positions and faculty in hard science to change hidden power-structures, underlying perceptions and adverse selection.

- change reward systems at universities, public institutions and publicly funded programmes to emphasise merits which encourage conditions also positive and attractive for female talents in R&D.
- improve areas traditionally stigmatising women such as conditions around maternity and responsibility for the everyday life of the family. Instrument could be regulations regarding recruitment, promotion, paternity leave, pensions, loss-of-income, childcare, schools, tax breaks for cleaning and other domestic services as well as programmes to ensure that female researchers and innovators can stay on top of their field throughout maternity.

Improving Conditions for Commercialisation of R&D

Key concerns for medical devices in the greater Copenhagen region, as well as expressed by for example the medical device industry in Europe, are the barriers to commercialisation of new products of services in Europe. These conditions lead many firms to opt for the US as both future market and future location of R&D. In the health care industry this has lead to Europe becoming a low-tech region with only a small elite having access to private state-ofthe- art health-care. Improving conditions in this industry requires both industry-specific as well as more general structural changes, the latter which could potentially also benefit commercialisation in other industries and thus preserving R&D in Europe.

Specific recommendations:

- enhance possibilities for commercialisation of R&D in Europe by supporting unified market policies including harmonisation of legislation, unified frameworks for patenting, approval, and safety certification.
- promotion of cross-regional collaboration in areas of public procurement and tendering by active collaboration between regional government bodies in e.g. procurement networks and legislative bodies
- increase emphasis on R&D clusters to create centres-of-gravity for economies-ofscale and agglomeration effects in venture capital, procurement, knowledge exchange, partnerships and secondary support industries.
- promote public-private partnerships to drive innovation in new service and product areas, and to pioneer new concepts such as health economics, which private overall efficiency gains and costs reductions for society
- encourage risk-taking by establishing explicit long-term innovative strategies to motivate firms to engage in long-term R&D projects based on public lead markets

- encourage investments in secondary or support technologies such as ICT, which can lower costs and improve efficiency in public services, and in turn finance development of new products and services for the private markets (examples of this are e-learning in Sweden and e-government in Denmark)
- encourage cross-national procurement and supply networks to build critical mass and long-term security for companies in highly innovative sectors.
- minimize unfocused tax differentiation across European regions to avoid taxcompetition between regions

Leveraging Excellence in Strategic Industries

Europe still has a leading position in several industries such as mobile technologies, biotechnology, aviation and automotive. The region of Copenhagen has developed a leading position in fields such as health care services, medical devices and logistics through special models for innovation, which in principle can be copied by other European regions.

Specific recommendations:

- encourage and support systematic R&D in advanced services in e.g. health care through explicit regional and national innovation strategies for public services. Allow for commercialisation and export of results, new service delivery models and knowledge from public-funded pilot projects.
- build regional competences through developing active and integrated innovation systems such as the system build around the medical sector in the greater Copenhagen region. This involves covering several key components in the R&D value chain such as collaboration with universities, involvement of the health care system, industry-led venture capital and entrepreneurship support systems, flexible labour markets and support systems for internationalisation.
- draw upon existing resources and leverage historical industries and traditions through re-innovation of services and new models of delivery such as the logistics clusters build around firms such as Maersk Sealand, involving advanced shipbuilding, advanced logistics services, harbour management, engineering, IT services and spinoffs in many secondary areas of logistics such as mobile solutions and communications.

Recommendations from Barcelona

Harness European Diversity as a Competitive Resource for R&D

Given the diverse cultural and social heritage of Europe, vast innovation resources are hidden in the pluralism and diversity of European cities. However, experiences from Barcelona show initial support actions are often required to open up the possibilities of these resources through e.g. definition of new concepts and understandings, with the purpose of changing existing perceptions in industry as well as public sector organisations. Consequently, R&D can be re-thought in broader terms linking social sciences with technology and natural sciences in new and innovative ways.

Specific recommendations:

- create programs for opening up the labour market for alternative types of innovations linked to high technology, such as new model for usage, delivery, experience, handling and safety. In Barcelona, successful models have been employed to define new positions for young talents with double or mixed degrees combining social and natural sciences.
- use public sector procurement to introduce advanced cross-sector services in public procurement domains such as health care, public utilities, security, public information and education.
- create structures for micro-entrepreneurs including micro-financing, structured start-ups programs, and availability of seed funding through tax-breaks or public cofinancing of business angel networks.
- create subsidised training programmes for could-be entrepreneurs to facilitate the introduction of new businesses from alternative fields and idea domains (on example of such a program is the Entrepreneurship Academy)

Improve Conditions for SMEs in EU Funding Programmes for R&D

The larger number of SMEs in European countries is part of Europe's special industrial makeup. Despite the increasing emphasis on SMEs in EU funding programmes in R&D, SMEs in Barcelona does not find EU funding attractive due to the overall burden associated with EU project outweighs the potential benefits. Unfortunately, the SMEs in Barcelona are not found to be alone with this perception. As the EU is expected to administer an even larger portion of R&D funding in the future, the leaving out of SMEs can become an even greater problem for Europe in promoting excellence in R&D.

Specific recommendations:

- reduce the administrative burden for SMEs by means already employed in industry, and somewhat trivial, such as technology-enabling application procedures, re-use information across projects and departments, simplify reporting, reduce emphasis for cross-national consortiums, simplify monitoring procedures and simplify contracts and conditions for SMEs in EU funding programmes.

- establish better conditions for SMEs to protect intellectual property at risk through collaboration with large enterprises as well as foreign competitors. One radical option in this area, which has been discussed in other contexts, is to transfer responsibility for protecting IPR from the individual European company to the national or European government to avoid especially small companies being brought down by the costs of law suits and enforcement of patents.
- establish a trans-national body supported by European legislation to review and adjust public programs resulting in or in danger of crowding-out private initiatives. With the definition of what constitutes R&D blurring, there is an increased risk that EU funding might de-motivate private spending in R&D especially in areas such as new business model, delivery methods and business processes. The work of this body could extend into examining issues such the impact of EU funding on the general motivation to fund R&D in Europe, plus whether delays in funding in the EU funding programmes are counter-productive to motivating cutting-edge research, and similarly whether transparency and current contract conditions risk exposing trade secret and other critical knowledge.
- more radical proposals are to take measures to break-up the emerging class of professional services companies deriving the largest part of their income from EU funding programmes, and distribute EU funding more widely among European companies. Due to the complexity of applying for EU funding and managing EU funded projects, companies with experience of EU funding programmes are by default increasingly more successful in attracting new EU funding. This problem is exaggerated with the same companies are being used as advisors and expert by the EU Commission for drafting or commenting EU funding programmes, based on their extensive experience with the exact same programmes, thus closing the circle. Some option could include agglomeration of resources in clusters of excellence to create mega-clusters and harvest agglomeration effects and economies-of-scale in R&D.

Emphasise Closer Integration of Universities and Industry in Fields of Industry-close R&D

Despite advanced facilities for education in high technology, Barcelona, like many other European university cities, is not experiencing the desired engagement of industry and universities. Consequently, several synergies are missed out; young talents are experiencing a divide between university and post-university work, industry is not harvesting the full benefit of R&D and innovation resources, and researchers at the universities and associated research institutions are not reaping the full benefit of industry co-funding funding and access to stateof- the-art knowledge and facilities.

Specific recommendations:

- implement incentive schemes by performance instead by merit at public universities and research institutions to motivate young talent to bypass hierarchical structures in relationships with industry to create additional dynamics at the universities.
- enhance competition for R&D funding in strategic industries by choosing alternative vendors in industries such as telecommunications, transportation and construction on condition of close collaboration with university resources to spur regional competition and dynamics.
- create strategies for innovation as an integral part of public funding schemes for areas such as health care, public utilities, public administration, education, transportation and infrastructure.
- create joint research-centres with industry which are co-funded in public-private partnerships and aims at research areas specific by local or international firms.
- establish pre-seed facilities for students, faculty and talents from regional firms to experiment with spin-outs from industry - to spur entrepreneurship and industry-led innovation.

Improve Conditions for Innovation Financing in Strategic Industries

Major challenges for European regions are the fragmentation of innovation financing leaving very few regions in Europe with efficient coverage of the entire funding process from seed funding to IPO for start-ups and spin-out companies. The lack on an efficient pan-European market for venture financing is especially hurting cities like Barcelona currently in a transition phase from traditional manufacturing and state-sanctioned industry to a dynamic ecosystem of innovative SMEs.

Specific recommendations:

- remove barriers to cross-border investments and financial mobility between EU countries such as double-taxation, ‘garden gate’-taxation, and national exemption from common VAT treaties and other withholding taxes.
- abolish public venture funds in exchange for tax-breaks for private financing in startup companies or co-financing of private funds with cross-border reach, to avoid

crowding-out and emphasise more efficient and risk-taking in management of venture capital.

- standardise accounting rules, taxation of subsidiaries and other technical barriers to establishing pan-European companies on the small scale or moving companies across jurisdictions.

Development of Better Conditions for Staff at Universities to Commercialise Innovations and R&D

Researchers at European universities could be more active in commercialising R&D and innovation, and structures supporting these efforts, with a potential economic upside for the researcher in question, would act as additional incentives to do research in Europe - and thus emphasise subsequent commercialisation of innovations through the European markets.

Specific recommendations:

- change framework conditions to cater for the development of new models for commercialisation such as open innovation, advanced service innovation and societal innovation through public investments for improving efficiency, quality and effectiveness in public services. Tools recommended are for example. precommercial procurement, micro-tenders and public-private partnerships.
- shift away from indirect support structures such as public advisors, incubators and entrepreneur support tools to direct funding of start-ups through public co-financing of existing venture capital funds.
- employ public co-financing through existing private venture capital structures of funding gaps such as seed phase and pre-commercialisation on a per-country basis.

support patenting and patent protection with direct financial support as well as with legal services in the vulnerable early phases of innovation.

Hamburg (TuTech Innovation GmbH)

Hamburg is known as a trading port. It also ranks second in Germany for the number of Concern Headquarters (72 behind Munich's 97). These are on the whole associated with trade. Hamburg ranks much lower than Munich when it comes to numbers of researchers and engineers.[1]

Therefore Hamburg does not have a profile as a location for research, although it would appear to have other factors in its favour. The most prominent corporate research lab in Hamburg is Philips Medical Research (just celebrating 50 years in Hamburg). It seems to be one of the few remaining genuine research labs of the classical corporate model.

- To expand Hamburg's base as a research location, perceptions have to change. This means better communication about research strengths generally.
- A prominent scientific "superstar" is needed both as a role model and to pull in further activity.
- Hamburg needs to engage much more at a European level. It is perceived that this is not happening and there is too much focus on national and regional programmes.
- Joint events between industry and universities could be strengthened.
- Activities and institutions do not always fit together and more could be done to combine forces and improve working relations.
- The entrepreneurial culture for technology-driven enterprises needs to be improved in the Hamburg area. This might be better supported by creating a Science Park.
- More needs to be done to set strategic research agenda in those areas of research that are internationally strong to build up long term research programmes. Industry driven research agenda are seen as being rather too short term to build up excellent teams. More could be done around the "triple helix" concept to support this. .

Helsinki (Culminatum Ltd Oy)

- Finland stands out in several international statistics in terms of R&D capabilities (investments/GDP, researchers/population, patents etc) as well as one of the most competitive innovation environments. This international recognition has not enough realized in increased attractiveness of Finland as R&D location and R&D investments. More active promotion is needed to attract investments, researchers and support international networking of Finnish R&D projects/research.

[1] Source Wirtschaftswoche Survey Sept. 2007

- Changing R&D environment with new type of innovation processes, including open innovation and service innovations, will require new capabilities. Recognition of future needs and actions to support such capability building should be promoted.

- Finland has traditionally been strong in R&D but in order to increase innovation productivity there is need to focus on building commercialization processes and know how and strengthen relationships between industry and research.

- Finnish education system should change focus from quantity to quality. The role and image of different type of education should be clear (polytechnics, university) to gain most of each type of education, to attract motivated students, and increase productivity (graduation time, quality, share of graduates).

- Entrepreneurial studies are needed to complement specialized knowledge and to serve as platform for networking different capabilities (technology, economics, design, business). Special focus should be in building entrepreneurial spirit and understanding commercialization (how to turn research to solutions serving customer needs).

Helsinki metropolitan area should focus on developing the area from the global perspective, regardless of (artificial) city limits. In order to strengthen message in international forums and to global “customers” metropolitan area needs to have shared development strategy, image and promotional message.

Oxford (Oxford Science Enterprise Centre)

On the basis of the interviews with MNEs from the Oxfordshire region and the roundtable hosted at the Saïd Business School a number of preliminary policy recommendations can be drawn from the study. As identified above the main factors which influenced R&D activity of MNEs in the Oxfordshire region were primarily related to non-local factors. The policy recommendations fall broadly into three categories:

1. Labour skills

The over-arching problem across Europe is skills shortages in physics and chemistry. The UK study identified this problem as starting with problems at school level because of a lack of good teachers. This is a local issue for Oxfordshire, as well as being a problem for the UK and EU more generally relating to a lack of investment in the science base. Competition from Russia, India and China is an issue of concern to the region and Europe more generally, not only due to new market opportunities but also because of the growing volume of highly qualified labour in those countries.

Increasingly in the healthcare industry the skills needed are not easily defined in terms of the way people used to be trained - a much more of a cross-functional type background is needed. Currently it is not possible to hire any because there are none.

Specific recommendations:

- The EU should accelerate its targets for raising the level of spend in the science base in member states to ensure a good supply of graduates as well as top quality science.
- Regional and local initiatives should target retaining of school teachers. Funds should be made available to support schools by helping them cover the costs of such training.
- universities should put together life sciences interfaces to develop a broadly based background of engineering principles and biology, biological principles and biochemistry and computing skills.

2. The Regulatory environment

The regulatory environment in Europe and particularly the UK for bio-pharma – the drug approval process and standards were important factors in the extent to which Europe is an attractive environment for the R&D activities of MNEs. For example, the European approach to the price of drugs does not help business. All European companies have a target for the price of drugs. The US keeps the price high and Canada has lower prices so they put up barriers to stop under priced drugs coming in to the US. The consequences are that the US market is 60% or more of the global market for pharmaceutical sales. The consequence is that that in order to increase presence in the US, more R&D is moved there from Europe.

Specific recommendations:

- the harmonisation of standards across Europe be improved.
- Member states and the EU as a whole should address weakness in the system of clinical trials, with resources allocated to improving the efficiency and speed by which they are conducted. Grants are needed to enable companies that have medical and life sciences technology that requires clinical trials to fund them to work with the local hospitals.
- EU Drugs pricing policy be reviewed.

3. Universities

Although UK universities have begun to extend their ‘third stream’ activities, these are not as well developed as in the US. Universities could do more to establish more broadly-based approaches to working with industry.

Europe should think about the time between when a scientist makes a primary discovery but before he/she knows the valid target for the discovery and whether a company can be established – when the research is too early to attract venture capital funding and when it is inappropriate for it to be funded by traditional research grants.

Specific recommendations:

- Universities should review how their interfaces with larger companies, particularly those university spin-offs which have gone through the start-up phase. Universities need to learn how to deal with large corporations with respect to licensing.

- Universities and the regions should create a body of discretionary funds for the scientists to do applied proof of concept studies. This would to enable the gap between an academic study and a drug to be funded, so that drug development is faster and more effective.

Prague (Technology Centre, Academy of Sciences of the Czech Republic)

Following results of the Czech interviews and workshops it is possible to divide policy recommendation into 4 groups concerning the main identified weaknesses.

1. Human Resources

- **secondary education** - It is necessary to direct technical secondary education towards practice and focus more on problem solving than on memorizing.
- **tertiary education**

  1) Education in engineering should be recognized as bringing added value because it is a good basis for a variety of jobs and for this reason its position should be enhanced (awareness raising among young people).

  2) Chances should be given to elite students, e.g. through supporting differentiated study programmes.

  3) University education should also provide entrepreneurial skills.

  4) Technical education should be more related to practice, it should reflect the market demand.

  5) Companies need competent and flexible university graduates. It is not necessary to set up study plans according to any company's specific needs.
- **support to immigration of highly qualified persons and researchers -** Lack of university graduates may be also solved by amending law regulations to make it easier for foreigners (researchers) to work and study in the CR. Friendlier, tolerant and less xenophobic environment should be created , stimulating job migration.

2. R&D management

- **Changes in university management are needed** e.g. industry should be represented on Boards, matrix structure for R&D management should be established at universities.
- **Quality criteria for evaluation of study programmes should be established.**

3. Cooperation between (public) research institutes/universities and MNEs in R&D

- **transferring knowledge into practice**

  1) A good practice here may be incubators established at universities, setting up spin-offs from research institutes/ universities.

  2) It is necessary to establish mediators /inter-links between researchers and industry, which would find a common language and mediate mutual understanding.

  3) More workshops for MNEs and universities should be initiated to make contacts etc.

  4) Creation of web sites promoting faculties through catalogues of their technical abilities would be useful.

- **informal linkages between graduates and universities** - Building loyalty feelings in students towards their alma mater may also help their being in contact with the university after leaving it for the business world.

4. Support to R&D activities in large MNEs

- **Support to consulting services and mediation of business contacts between MNEs, universities and local companies**
- **Creation of a business-friendly environment** - General improvement of business environment: simplifying bureaucracy is under way, a clear strategy on the level of state administration is missing.
- **Financial support**

  1) So that incubators /technology parks at universities have something to offer, interest and support from (regional) state administration is crucial, in terms of providing political support and initial funding.

  2) Incentives for MNEs for their setting up new R&D centres in the CR – financing could possibly come from the EU Structural Funds.

Toulouse (Réseau Universitaire Toulouse Midi-Pyrénées)

- **Involvement of public researchers in JTIs (Joint Technological Initiatives)**

Some industrial R&D managers of large companies are involved in European Technology Platforms (ETPs) organized by the European Commission. These platforms aim to match the European priorities and the needs of industry in terms of research. They strongly contribute to the preparation of the research Framework Programme.

The Joint Technological Initiatives are dedicated to a specific area within a large industrial sector and they propose research leads in order to develop key technologies or breaking technologies.

ETPs and JTIs are led by industrials in agreement with the European Commission directories, among them DG RTD, la DG ENTR, la DG INFSO.

Industrial R&D managers of the Midi-Pyrenees region should exchange and bring public researchers in on their upstream activities. Public researchers are involved in upstream research projects, their work sometimes stand at the crossroads of research disciplines (nanosciences, materials, process…). They often work on research themes that may lead to breaking technologies.

- **Creation of quality procedures in order to guarantee privacy and respect the commitments**

This recommendation can bring an answer to the industrial R&D managers' remarks.

Indeed, although industrials have notified a positive evolution as regards the respect of commitments from public researchers, they consider that some more efforts can be done from the academic world as regards privacy, the respect of schedules and the respect of results to be produced.

That's why we propose the set up quality procedures within the laboratories and research teams so that industrials could measure public laboratories' commitment to agreements.

- **Organization of dedicated days :**

Multinational companies still have a lack of knowledge of the Midi-Pyrenees research potential. On the other hand, public researchers don't always identify application sectors in which their findings can bring answers and solutions to industrial problems.

That's why dedicated days for industrial should be organized where several research teams from different laboratories would present their activities in relation with the industrial activity, even if the activity does not exactly correspond to the industrial R&D core activity.

Dedicated days for laboratories or a techno-scientific area should be also organized (nanomaterials, safety in embedded systems) where industrials would be invited.

- **Spread of technologies in different sectors of activity:**

Industrials develop their R&D activity according to the objectives and constraints of their sector (quality of products, quantity to produce, specific packaging…) However, most of them have noticed that technologies they are developing could be transferred in other industrial sectors with some modifications, improvements that could be the result of applied research work.

We propose that the Midi-Pyrenees Regional Council organize a process and/or methods that could increase the value of technologies that have been achieved in a specific area of application and transfer it to other areas of application. Public laboratories and industrials would work together in this process which is likely to generate new activities.

LocoMotive

Project no. 030089

LOCOMOTIVE

"Dissemination of knowledge concerning current R&D localisation motives of large regionally important private sector organizations"

Coordination Action

Regions of Knowledge 2

Proceedings of Final LOCOMOTIVE Conference

(Deliverable D13)

Date of preparation: **31 October 2007**

Start date of project: **1 January 2006** Duration: **21 months**

Project coordinator name: **Monica Schofield**
Project coordinator organisation name **TuTech Innovation GmbH**
Revision: Draft 1.0

Managing the Links

Global Trends and Regional Policies in R&D Location

- Hamburg, 5-6 June 2007 -

With the Lisbon Strategy, the European Union shows its desire to become the most dynamic and competitive knowledge-based economy in the world by 2010. The EU member states have committed themselves to increase substantially their R&D expenditure, especially through private sector investment. To achieve this objective, many actions are required. Improving collaboration between all the innovation stakeholders and knowledge transfer between public research and industry is vital to enhancing Europe's economy. Furthermore, Europe needs to tackle the competition faced from the attractiveness of some developing countries as not only a location to do business and profit from rapidly expanding markets, but as a place to locate research. Europe has to show its capacity to retain and to attract multinational investment in research.

The LOCOMOTIVE project was set up under the Framework 6 Programme "Regions of Knowledge" to address some of these issues by looking at these from a regional perspective. It provided a framework for interviews to be conducted with Chief Technology Officers/R&D Directors of industrial multi-nationals with activities located in the regions of the partners to tease out their perceptions of what regional policy makers could do to improve the attractiveness of a region as a location for research. These were then complemented by regional roundtable sessions bringing together leading representatives of academia, the multi-nationals and regional authorities. The findings of these and the interviews is has been compared with research undertaken by the academic partners in the project.

The aim of the *LOCOMOTIVE Conference "Managing the Links: Global Trends and Regional Policies in R&D Location" held in Hamburg 5-6 June, 2007* was to provide an opportunity for a wider discussion of some of the issues. The conference brought together speakers from industrial multi-nationals, academia, regional authorities and those involved in working with these. The objective of the conference was to allow dialogue and exchange of points of view between all actors engaged in the knowledge-based economy and to reflect on the way we work together.

This short report attempts to capture in a summarised form what was presented and discussed at the conference to allow readers at least a taste of the issues raised. The presentations and further information and findings of the project are available from the web site www.locomotive-project.org. Further information may be obtained from the coordinator of the project **TuTech Innovation** by email locomotive@tutech.de.

As a conclusion it can be said that the project and the conference could only scratch the surface. Much more dialogue is necessary if European universities, regional authorities and other local actors are to become more effective in ensuring Europe remains attractive as a base to do research and thereby attract investment to exploit knowledge. The response to the invitation to the conference which was targeted at regional policy makers, showed that more needs to be done to convey an understanding of the bigger picture and raise the level of interest. There is still a tendency to prioritise resources to regional self-promotion rather than to understanding the true underlying issues. As was pointed out in the introduction to the conference, there are many regions which claim world leading clusters in Information and Communication and bio technologies apparently oblivious to how the regional strengths might appear from a global viewpoint. The fixation of EU and regional policies on the role of small and medium enterprises (SMEs) has perhaps overlooked the importance of engaging with multi-nationals (MNEs) at a regional level. These are hugely important to the economy not only as employers, but as entities which are able to support longer term knowledge creation and above all exploitation on a global scale. In this way they act as vital hubs in the context of both the global and regional economy and provide SMEs with opportunities to grow as suppliers of innovation and services. But they also act as important sources of information about what is going on in other regions from which regional policy makers could profit.

The paradigm of Open Innovation provides new opportunities for all who can engage with people working in different contexts at both a regional and global level. LOCOMOTIVE has highlighted some of the issues to be addressed by policy makers if their policies are to be effective. It has also opened up channels of communication between the partners and companies interviewed and provided a means fro cross communication between regions. Since the conference, these links have continued. It is the engagement and willingness of people to work together that is of lasting value.

The organisers of the conference would like to thank all those who took part for their willingness to enter the dialogue, express well founded and qualified opinions and contribute in other ways to what was a highly rated event.

Programme

Day 1 - Industrial perspectives and the changing role of universities

	Opening and introduction
09:30-09:45	*Opening and welcome* Reinhardt Stuth, Director Senatskanzlei (Mayor's Office), Free and Hanseatic City of Hamburg
09:45-10:15	*The LOCOMOTIVE Project* Monica Schofield, LOCOMOTIVE Project Coordinator
	Research and innovation in Europe: threats and opportunities
10:15-11:00	*Enabling Europe to Innovate* Andrew Dearing, General Secretary European Industrial Managers Association (EIRMA)
11:00-11:45	*The role of multi-nationals in regions* Rob van Tulder, Professor Erasmus University Business School
12:00-13:30	Lunch
	Can Europe compete as a research location? Some views from industry
13:30-13:55	*The Good and The Bad ... A Global Perspective of Europe R&D* Carlos Orzoco, Dow Chemicals Global R&D Director for Performance Plastics and Chemicals
13:55-14:20	Francisco Escarti, Director General, Boeing Research and Technology Europe
14:20-14:45	*Why Indians invest in Europe* Risto Niva CEO Wipro Technologies-Wireless Solutions
14:45-15:15	Coffee
	Advancing the role of universities as partners for innovation
15:15-15:45	*Innovation Systems and Culture in Oxford University* Mark Mawhinney, General Manager ISIS Enterprise, Oxford University
15:45-16:15	*E-learning: an opportunity or a threat for regionally based inter-working between universities and industry* John Slater, Professor Institute of Educational Technology at the UK Open University
16:15-16:45	*Merging the boundaries between science and innovation: The Biocatalysts 2021cluster Initiative* Dr Helmut Thamer, CEO TuTech and Hamburg Innovation
16:45-17:45	*Panel debate: What can regions do to attract researchers and research investment?* Moderation: Mary Lisbeth D'Amico, Journalist
19:00-	Cocktails and networking dinner at the Museum für Völkerkunde (Museum of Ethnology)

Programme

Day 2 - Creating regional policies for global links

	Creation of regional brands to support research clusters:
09:30-10:00	*The Toulouse Cancerpole : an example of public/private diversification strategy based on R&D* Cécile Chicoye, Director of the Association Cancéropôle, Toulouse
10:00-10:30	*Promoting R&D Development in the Czech Republic* Jiri Krechl, Director of R&D Support Department CzechInvest
10:30-11:00	*Establishing a reputation as a region for innovation: practical experiences* Tatu Laurila, CEO Greater Helsinki Promotion Ltd.
11:00-11:30	Coffee
New approaches to inward investment promotion in Europe, North America and Asia.	
11:30-13:00	*Panel discussion : Shaping Innovation Environments by opening innovative markets, partnerships and unique knowledge resources.* Moderation & Introduction: Christer Asplund, Interlace-Invent ApS and former Managing Director Stockholm Economic Development Agency *Shanghai Biomedical Centre and Hongkong Shipping Services Cluster: Two examples of inner city investment environments*. Sascha Haselmayer, Interlace-Invent ApS *22@Barcelona: Shaping an Urban Innovation District,* Sergi Guillot, Director Corporate Development 22@Barcelona S.A. *Supporting Regional Innovation in Toronto* Jen Nelles, Research Assistant Munk Centre for International Studies, University of Toronto
13:00-14:00	Networking lunch
From policy to action: EU initiatives in support of using research and innovation as part of regional development	
14:00-14:30	*European Initiatives in support of regional development* Robert-Jan Smits, European Commission Directorate-General for Research
14:30-15:15	*Summary & Conclusions* Helen Lawton Smith, Oxford Economic Observatory Fabienne Fortanier, University of Amsterdam
15:30	Close

Day 1:

Industrial perspectives and the changing role of universities

Research and innovation in Europe : threats and opportunities

« Closed innovation is obsolete… »

Andrew Dearing reminded us that the concerns and priorities of firms are completely different from those of political decision makers. For a company, R&D investment is made in order to increase profits. Today, companies recognise that they belong to a network and they realise that partnership is essential to innovate. Consequently, it is very important for the European Union to create an environment that promotes open innovation, by creating technology platforms, promoting technological transfers between actors, and creating efficient innovative ecosystems. Open innovation implies lots of challenges in terms of organisation of the business environment.

Rob van Tulder added that this new form of innovation is very complex and poses new challenges not only in terms of business environment, but also in terms of organisation inside the firm. The question is not only at the R&D and innovation department level, but also at the production, marketing and distribution chain levels. Today, the company must be able to manage these links and succeed in recovering the value created from the links established between all these departments.

In this context, multinational firms, which play a very important role in the new economy, have not all chosen open innovation. If closed innovation is obsolete, even impossible today, open innovation is not necessarily the best way.

Questions, remarks: *Some policy makers tend to minimise the role played by multinational firms and to focus their efforts only on SME. Such a position is very risky: aids from policy makers are an important determinant of R&D center location.*

Can Europe Compete as a Research Location? Some Views from Industry

« Yes, Europe can compete as a research location. But efforts still have to be made… »

Europe is a very good place for R&D. Companies appreciate that Europe can rely on various assets. However, to keep on being competitive as a research location in front of emerging countries, **Francisco Escarti** underlined the necessity for Europe to prove its capacity to produce research, pushing its strengths forward and working on its weaknesses.

The three invited companies – Dow Chemicals, Boeing and Wipra – explained which factors determined their R&D location choices. They provided a list of Europe's strengths and weaknesses. According to **Carlos Orzoco,** R&D must be linked to business reality. Indeed, before each localisation decision, they pay attention to three specific points: the quality of infrastructure, the availability of talent and market opportunities. Cost is an issue, but not the main driving force. The European Union has many advantages such as its cultural diversity (in languages, culture, ideas), its geographic situation, its historical research capabilities, its scientific skills and the fact that industry/university collaboration are easier than in the US.

Europe is also a market in which it is important to be present for firms from developing countries. **Risto Niva**, CEO of Wipro, an Indian software company, considers it is very important to be localised close to customers and hire local employees to really know the market. The company has already opened 11 development centres in Europe and employs 4000 people – most of them are native employees.

However, many more efforts still have to be made. Europe should change its labour laws, which are still too protective, and not enough flexible. Its immigration laws do not facilitate immigration of talents from all over the world. Retirement policies are not efficient because they can force some key professors to retire.

Questions, remarks : *Why has Boeing decided to locate its European R&D centre in Spain? In fact, Boing had to make its choice between several possibilities. At first, the company was looking at the United Kingdom. But UK is not really Europe because of its US mentality. Germany was also a possibility but it is the land of Airbus. What about France? Well, France… "Ah, la Frrrrance…"*

Advancing the role of universities as partners for innovation

> *"Promoting collaboration between university and industry… »*

Universities have a very important role to play in the knowledge-based economy. It is very important to specify it in this new ecosystem. Although many companies consider that industry/university collaboration is easier in Europe than in the United States, there is still a need for reforms. Universities must develop new instruments to create links with industry.

Mark Mawhinney presentedl the work that has been made at Oxford University to support exploitation of its research. Oxford University has been good in reinventing itself. Although it has an old culture, it has succeeded in adapting itself to the new economy. Oxford University has not abandonned its two core activities – teaching and research – but it also accepts the importance of technology transfer and relations with industry. It decided to implement instruments to boost this collaboration and hired people to be intermediaries between industry and the academic world. It has developed science parks, composed of innovative companies, spin-offs, founded by external business angels. Oxford University also developed an intellectual property policy and assists researchers who wants to commercialise research. Many instruments have been developed, to boost collaboration and technology transfers between university and companies.

John Slater, from the Open University in the UK, looked at the role of universities as providers of education and training, and the impact of the new generation of students brought up with the internet. He called for a more flexible approach in working in partnership with multinationals and the need to accept education is also a global commodity. On the other hand, multinationals should perhaps take more notice of what is available to them locally.

« Biocatalysis 2001 », presented by **Helmut Thamer**, is a good example of what can be done to boost technological transfers between industry and university. This cluster, which works like a consortium, is composed of 10 universities, 11 large companies and 16 SMEs which work together on a common cross disciplinary projects with funding from industry national and regional governments and demonstrates how a technology platform can be put together to serve the needs and interests of all.

Questions, remarks : *In general, the projects in a cluster receive funding from the State only for a very short term. It is thus difficult to create a sustainable project (for example, in the UK, projects are funded for only 3 years). The European Commission should deal with this problem, and should be funding for a much longer term.*

What can regions do to attract researchers and research investment?

« European Union should focus on some specific niches »

Several determinants have an impact on R&D location choice. Some of them are more important than others. Nowadays, most European Nations want to be R&D attractive as much as possible.

According to **Carlos Orzoco**, low costs and taxes can be an incentive, but it is not essential. One of the main R&D location determinants continues to be the access to talent, high skilled people, with a good English level and the possibility to attract good researchers. Besides scientific criteria, access to market is also essential. As **Francisco Escarti** presented, Boeing chose to settle its European R&D centre in Spain due to several factors. First, Madrid is big enough to attract and retain people. Then, cultural proximity with Europe and Latin America is very attractive for an American Company.

Virtual and physical communication quality is also very important. **Rob van Tulder** added that the sophistication of the market is also essential: the quality of a market is not only determined by the number of potential consumers, but also by its sophistication.

The issue of intellectual property is important. It is a very important determinant of R&D location in some sectors. The problems with the operation of the patent system in China may have acted as a barrier in the past, but this may not be the case in the future.

Regarding all these criteria, Europe is still a very attractive place for R&D investment. Besides scientific offer and market sophistication, collaboration between industry and universities is actually much easier that in the United States, according to some of the panelists. Furthermore, according to **Francisco Escarti**, European framework programs are a very efficient instrument to boost research collaboration. At least, European Union can rely on a specific asset that developing countries do not have: "Europe" is a brand in itself. Indeed, **Xiaming Liu**, professor at London University, stressed that China has attracted many foreign R&D centres thanks to the increasing sophistication of its market and the facilities to support R&D activities. But China is not a brand, and it is very dependent on foreign R&D expenditures.

To reach its objectives, Europe still has to make many more efforts. For instance, labour laws are not flexible enough. Immigration laws and policies often conflict with the need to attract foreign skilled people. Furthermore, according to **Andrew Dearing**, to be efficient (in terms of market, universities, skills, partnerships...) Europe needs to identify some specific niches which it can dominate. It cannot expect to be strong in every sector. According to **Francisco Escarti**, funding clusters in collaboration with industry would be very beneficial for Europe. Regional authorities have a very important role to play in R&D attractivity issues. Somebody in the audience underlined that tax incentives for company investments can be very harmful for the local economy. **Francisco Escarti** answered that regional authorities have to create the environment that will link companies to the region, included through a good IPR policy, creation of clusters, incentives for partnerships with local companies. In this respect, we are facing the question of the best size for a region. According to **Carlos Orzoco**, the creation of a meta-region could be interesting.

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Day 2:

Creating regional policies for global links

Creation of regional brands to support research clusters

« Industry/ university collaborations are essential to create ambitious research projects… »

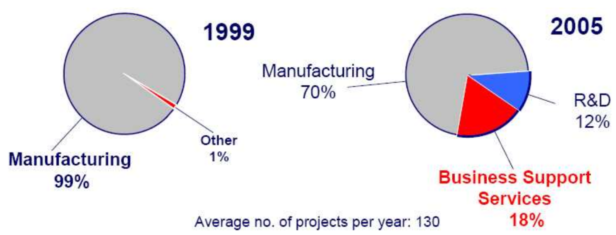
Capabilities and skills are often concentrated in a few cities and metropolises. These can then present themselves as brands: they compete to be visible at the European and world level. They elaborate real development strategies and use very effective communication investments to achieve the their goals of being visible, easily identified and attractive to foreign companies, talent and international capital. In this respect, the contrasting examples of Helsinki, Toulouse and Czech Republic are very interesting to note

Thanks to its differentiation strategy, Helsinki is now one of the most attractive European cities, according to Silicon Valley's ranking.

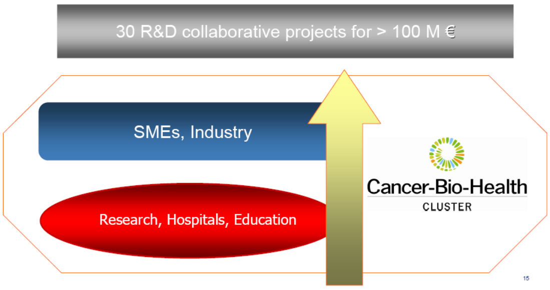
Main criteria for metropolis ranking

Its main strengths are: good availability of a well qualifies workforce, less expensive salaries and good business environment. Helsinki's innovation policies are based on the increase of the internal appeal of researchers and expertise (Helsinki works a lot to attract talents and promote higher education). The city also developed knowledge-based clusters as a way to conceptualise their offer in a complex innovation environment. But, according to **Tatu Laurila**, Helsinki still has to work on issues such as quality of infrastructure and industry/university collaboration. In the future, Helsinki wants to focus its development strategy on three pilars: being effective (ie well-functionning, good networks...), being efficient (ie simplified procedures) and being creative (for convincing foreign companies that Helsinki would provide better solutions to their problems than other cities).

Czech Republic's experience is quite different from Helsinki's. **René Samek** presented a country which used to attract manufacturing activities for its low salaries, but which has decided nowadays to base its development on innovation. Indeed, in 2000, Czech Republic has started to promote itself as a place for R&D and marketing, instead of as a place purely for manufacturing investment. The country had to work on its image of high-tech country. It thus developed some selected science parks and incubators to promote industry/university collaboration, worked on the quality of its infrastructure. The policy seems to be working: recently, foreign companies have being settling their R&D centers without having any previous activity in the country. With this new investment driven phase, Czech Republic enters the innovation phase.



As far as France is concerned, the country has decided to make its scientific offer more visible, by creating clusters on territorial approach. The Toulouse Cancerpole is one the 68 projects selected by the French Cluster policy (2004). It results from the close collaboration between policy makers, industry and the academic world. It is composed of universities, hospitals, start-ups and industries related to prevention, diagnostic and treatment of the Cancer disease. The creation of the cluster was supported by Pierre Fabre company, which considers that collaboration is essential in research. According to **Cécile Chicoye**, these collaborations between all those partners were the pillar of the successful project.



Questions, remarks : *Concerning the Toulouse Cancerpole, what have been the difficulties of clustering? According to* ***Cécile Chicoye****, convincing the public part to collaborate was the most difficult. Collaboration is not in researchers' culture, especially in medical fields. It was also difficult to incite private sector to work with other sectors.*

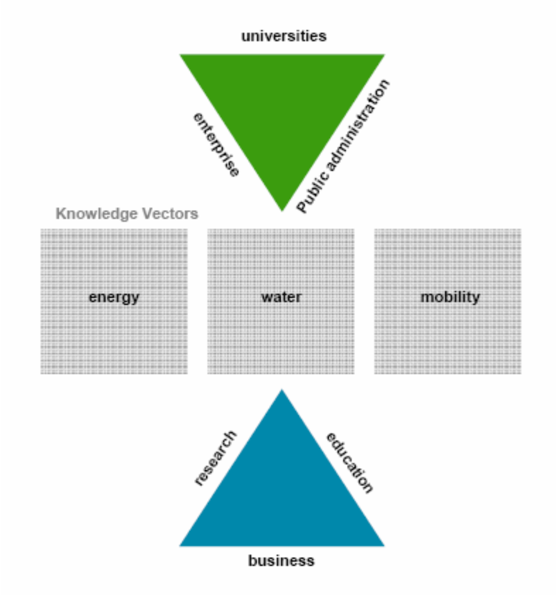
New approaches to inward investment promotion in Europe, North America and Asia

« Reaching a critical size »

Nowdays, there are clusters everywhere. But to be visible and efficient, it is essential to reach a critical mass, included throught the development of connections between clusters. Cities have a crucial role to play in the development of cluster. Nowdays, cities can be compared to transaction points for knowledge. A new urban model is now emerging. A lot of cities around the world have started to develop very important projects based on collaboration between innovation agents.

Sacha Haselmayer presents Shanghai's medical cluster. One of its distinctive caracteristics is that companies were invited to compart the building team of the project. Indeed, companies involved in collaboration with various partners have built a new urban innovative environment.

Barcelona also wanted to create an innovative urban district. The goal of 22@Barcelona project, coordinated by **Sergi Guillot**, was to put several knowledge-based sectors in a single place: media, ICT, energy and biotechnology. The idea was to concentrate all these activites in order to have a critical mass.



Across the Atlantic, Toronto region has created regional innovation networks. The idea was that partnership and knowledge tranfer can help to keep the R&D centers in their region. The region thus tried to encourage these transfer networks.

Questions, remarks : *Do you lack of managerial capacities in Toronto? According to* ***Jen Nelles****, Canada has lots of engineers but the problem is to find good managers.*

Someone in the audience commented that Torontians, and Canadians in general, spend all their time looking at the US. This obsession with the US is really a problem.

Remarking on the Shanghai project, ***Sasha Haselmayer*** *explained that there is no medical care system in China. The idea of the project was to try to make investors participate in the creation of a Chinese medical care system. Furthermore, Shanghaï lacks international quality standards. One issue is to introduce them.*

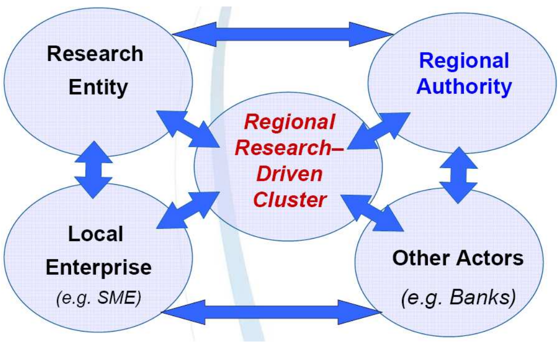
Concerning innovation monitoring, currently, we have very different indicators and surveys to assess the efficiency of innovation in Europe. Do we have a good understanding of which instrument can give a good image of the current health of innovation? We have too many different indicators, which make it difficult to compare and make a benchmarking.

From policy to action : EU initiatives in support of regional development

> *“ Regions are the base of the strategy »*

According to **Robert-Jan Smits**, regional authorities have to find together strategies to attract and retain R&D activities in Europe. Compared to US and Japan, Europe still has lacks in research, education and innovation. But this situation is improving. Thanks to regional activity Europe will reach the objectives fixed by the Lisbon agenda.

As a matter of fact, the 7th Framework Programme tends to boost innovation in Europe, looking more and more at the regional level and promoting collaborative R&D. Structural funds are also focusing increasingly on knowledge-based activities. The goal is to create “regions of knowledge”, which could be compared to “Knowledge Clusters” that associate several agents on a common project.



Questions, remarks: *A member of the audience stressed the fact that European goals and programmes can be unclear due to overlapping instruments, which makes collaboration with Brussels difficult. The dialogue between all parties is often very confusing, contradictory. According to Robert-Jan Smits, lots of things have improved, like interaction between staffs…*

Another person pointed out that during the conference we highlighted how important links between innovation agents are. The problem is that if we do not clearly identify the major actors of research, we cannot develop research and attract R&D sectors. In that way, big companies play a very important role that we cannot minimise.

*Someone else pointed out that from all the presentations that made during the conference, we realize that regions have extremely different strategies. It is very complex to link them. According to **Robert-Jan Smits**, there is a huge problem in transposing research into innovation. In Europe, we do not have only one sector of excellence. It is very important to put all these sectors together in order to have a critical size.*

*Nowadays many indicators are used to analyse convergence between regions, but comparisons between different sets is very difficult making reliable benchmarking almost impossible. According to **Robert-Jan Smits**, statisticians in Europe produced a good database which allowed for a very good benchmarking between regions. The European scoreboard provides a very good measure.*

Speakers Biographies

Christer Asplund

Christer Asplund has been described as one of Europe's leading consultants in the field of building more attractive investment infrastructures at the local place, innovative cluster-building and placemarketing strategies.

Since joining Interlace-Invent as a partner, he holds responsibility for Place Branding activities, with projects being carried out in Shanghai, Barcelona, Scandinavia, the Baltic States among others. As founder of the mCity Stockholm,Asplund is a leading European driver of the Living Labs Europe initiative to advance attractiveness of places through advanced mobile solutions.

Asplund held the office of Managing Director of the City of Stockholm Development Agency and was Managing Director of Business Arena Stockholm. In this office he held responsibility for the branding, marketing and inward investment activities of the City of Stockholm.

He is former senior consultant and co-founder of EuroFutures - a Stockholm-based research and consulting company. During a ten years time he devoted his full capacity to EuroFutures. He has written several books and articles on regional development, industrial policy, innovations, information technology and marketing. His latest book, “Marketing Places Europe”, published by Financial Times, is a joint project with the world leading marketing guru, professor Philip Kotler. Conventional regional policies are abandoned here and instead the concept of attraction policy is introduced. He was formerly managing director of a regional promotion agency involving private and public sectors. The main task was to promote innovative businesses.

Asplund was Chairman of the Swedish Inventors Association and is currently chairman of MentorPool.

Cécile Chicoye

Director of the Toulouse cancerpole association

Cecile Chicoye is presently and since 2004, part time director of the Toulouse Cancerpole association and part time advisor of the « Préfet of the Midi Pyrenees region » for competitiveness issues. As director of the Toulouse cancerpole association, she is in charge of all the aspects relating to the development of this great project which aims to set up Toulouse as an internationally positioned center of excellence in the field of research against cancer and the development of new therapeutics.

Cecile Chicoye is issued from the ENA (Ecole Nationale d’administration) : before leaving for Toulouse , she has worked mainly in the economic development policy field at national and european level in the ministry of industry where she was director of the international and European affairs department and before that in the “DATAR” (government agency in charge of regional policy)where she was in charge of European structural funds policy . She left for Toulouse in 1998 where she was deputy director general of the regional council of Midi Pyrénées until 2003 .

Mary Lisbeth D’Amico

Mary Lisbeth D’Amico is a Munich-based freelance journalist with extensive experience covering business, innovation, technology and finance-related topics. The roster of publications to which she has contributed includes the *Wall Street Journal Europe*, *Business Week*, *Red Herring*, *Science Business*, *Communication Director*, *Real Deals*, and *Total Telecom*. She is also a freelance editor for in-house publications and helps companies structure and write English-language web sites. Between 2000 and 2002 Ms. D’Amico served as senior editor at *Tornado Insider*, an Amsterdam-based magazine that covered technology startups. Prior to that she was Munich-based technology correspondent for the *IDG News Service*, the news arm of IDG, a Boston-based publisher of IT-related magazines. Before moving to Europe, Ms. D’Amico, who originally comes from New Jersey, worked as a reporter for several financial publications in New York, including the *International Financing Review*.

Andrew Dearing

Andrew Dearing is Secretary General of the European Industrial Research Management Association, a networking organisation for companies that engage in research and development to drive their businesses. EIRMA helps to strengthen these firms’ competitiveness through well-managed, well-organised research and development, and has a membership of 150+ companies based throughout Europe and across all sectors of industry.

Dr Dearing has held positions in the private, public and not-for-profit sectors, including 20 years spent with Royal Dutch Shell, beginning as researcher and research manager, then responsible for the planning and coordination of the company’s longer-term R&D portfolio, its external relations in science and technology, and its research and technology strategy planning.

He acts as advisor to the European Commission on aspects of industrial innovation and research policy. He is Chairman of the Technology Committee of the OECD's industry advisory body, BIAC, and a member of the Board of Administration of the Maison de la Chimie, France.

Hervé Dexpert

General Secretary of the Scientific Advisory Board Midi-Pyrénées Regional Council

Dr Hervé Dexpert is Research Director at the French National Centre for Scientific Research. As a scientist involved in several fields of Materials Science, he has been concerned for many years by the understanding of the relationships between the description at the nanometer scale of different classes of materials (rare earth compounds, heterogeneous catalysts, amorphous phases) and their macroscopic physico-chemical properties. He developed structural and electronic investigations by electron microscopy and X rays absorption in several research centres, from Paris (CNRS Rare Earth Laboratory and French Institute of Petroleum), Cambridge (Cavendish Laboratory), Orsay (National Centre for Synchrotron Radiation) to Toulouse (Materials Centre). He has been the supervisor of many PhD thesis and the head of two large laboratories (LURE-Orsay and then CEMES-Toulouse).

Since 2000, he is the General Secretary of the Scientific Advisory Board of the Region Midi-Pyrénées. This Committee of 80 members gathers representatives of academic institutions (Universities, Research Centres) and industrial companies (SMEs and large enterprises). He has in charge the promotion of the activities linking research, innovation, technology transfer and economic development. To fill this objective, he participates to different programmes and tools as regional calls for projects, grants supports for PhD students and post-docs or to the establishment of inter-regional actions at the French and European (ERA NET) level.

Francisco (Paco) Escarti

Paco is currently Managing Director of the Boeing Research & Technology Europe in Madrid. The BR&TE is involved in research topics within the fields of aviation safety, environment friendly aerospace products and processes, and also develops advanced air traffic management systems.

Prior to his assignment to the Boeing Research & Technology Center Paco worked as vice president of Business Development – Boeing ATM in Europe developing and implementing strategies and negotiating business agreements in the region.

In 1985, Escartí became general director of Iberia Airlines, where he was involved in creating three new airline operations for charter, regional and cargo services. He also introduced a yield management system for the Iberia Group, negotiated fleet acquisitions, and helped develop the worldwide reservation system, AMADEUS.

Early in his career, Escartí worked as an engineer in the United States where he gained experience in air traffic control systems and radar data processing. In 1975 he returned to Spain and joined CESELSA (later INDRA), a diversified engineering group. He established a small department for air traffic systems, which has since grown into a respected provider of air traffic control solutions in Europe.

Escartí drew on his extensive industry experience in 1992 when he founded Services Improvement, a consulting company to civil aviation authorities, airports and air Navigation service providers.

His 1998 election to the EUROCONTROL Performance Review Commission, which independently analyzes and evaluates the European air traffic control system, provides a regulatory perspective.

Fabienne Fortanier

Fabienne Fortanier holds an MScBA from the Rotterdam School of Management (RSM), Erasmus University. She currently works on a PhD research project at the University of Amsterdam (UvA) Business School (Faculty of Economics and Econometrics), where she also teaches on International Business and its impact on developing countries, on Sustainable Management and Corporate Social Responsibility, and on Statistical Methods. Ms. Fortanier's research and publications focus on the interaction between multinational enterprises and host governments in developing countries, and on the impact of those business-government interactions on economic growth and sustainable development.

In addition to her research activities, Fabienne Fortanier is also active in various consultancy projects. She is a (founding) member of ECSAD, the Expert Centre on Sustainable business and Development cooperation, which joins researchers from the University of Amsterdam, the RSM, Nyenrode, and the Maastricht School of Management in order to advise governments and non-governmental organizations. She acted as (external) consultant for the Dutch Ministry of Economic Affairs; the Dutch Directorate General for Development Cooperation (DGIS) of the Ministry of Foreign Affairs; ICCO (Dutch Non-Governmental Organization), KPMG, UNCTAD; and the European Commission.

Prior to joining the UvA Business School, Fabienne Fortanier worked at the OECD in Paris as a consultant on corporate social responsibility by developing country firms, and on the relationship between foreign direct investment and sustainable development in host economies. She has worked as research associate for the SCOPE Expert Centre on Multinational Enterprises (at the RSM), and continues to coordinate projects for SCOPE aimed at updating and upgrading the databank that documents the strategies of the world's largest corporations.

Sergi Guillot Pichot

Mr. Sergi Guillot is the Director of Corporate Development of the 22 ARROBA BCN, S.A. in Barcelona since 2004, where he is developing a transformation strategy of an industrial district in Barcelona into a pole of business, scientific, technological and cultural activities.

Mr. Guillot speaks several languages and has a long national and international business career, including Business Unit Director of Amitech Pipe Services S.L., Spain, Director of Strategic Purchases of Vogt Electronic GmbH/Siemens Witten, Germany, and team leader and project manager at the Catalan Institute of Technology at projects in Portugal, France and Spain.

Mr. Guillot holds a Master's Degree in Economics from IESE University of Navarra, an MBA from Columbia Business School, and a Master's Degree in Industrial Engineering from Polytechnic University of Catalonia.

Sascha Haselmayer

Sascha Haselmayer is an expert in the field of knowledge and innovation intensive urbanism in international environments. Trained as an Architect at the Architectural Association in London, Haselmayer has worked on a wide range of design & strategy intensive urban and socio-economic development projects across Europe, Asia, Latin America and Africa for non-governmental, public and private organisations.

Currently, Haselmayer is a co-founding director of Interlace-Invent, an international research-based consultancy headquartered in Copenhagen. Living Labs Europe™ was founded by Interlace-Invent ApS as a network of leading European cities with a commitment to innovation and advancements in mobility.

Furthermore, Interlace-Invent ApS coordinates the Europe Innova mClusters networking and policy advice expert group on mobile technology clustering involving leaders from 9 European mClusters.

He is responsible for several leading-edge strategy projects in for clients in Shanghai; the cities of Barcelona and Sant Cugat, Spain (Living Labs Catalunya and other innovation projects); Nogent Technology Park (France); and with partners Euroland Projektierungen the projects for development of the Competence Centre Konstanz (Germany), Easylease, and the Barcelona Health Innovation Building (with 22@Barcelona). Furthermore, Haselmayer is the responsible coordinator for Interlace-Invent of the global research project 'Hubs&Regions', in collaboration with the Copenhagen Business School. This project encompasses a network of 35 Universities across 5 continents investigating the globalisation of innovation and knowledge intensive economies and their impact on cities, regions, companies and institutions.

Before co-founding interlace-invent, Haselmayer developed innovation driven strategic solution for several well-recognized projects as part of Carillion Professional Services (UK), the UK's leading construction group and practiced as an architect on international projects.

Haselmayer is conducting research on innovation environments and their urban impacts and is a Senior Lecturer at the Copenhagen Business School (Full-Time MBA and MA programmes), Theseus MBA Programme (France), Pompeu Fabra University (Spain) and the Architectural Association Housing & Urbanism Graduate Programme (London). Previously he held positions as Architecture and MA Urban Design Unit Master at Greenwich University.

Tatu Laurila

Tatu Laurila is the CEO of Greater Helsinki Promotion Ltd. Jointly owned by the cities of Espoo, Helsinki, Kauniainen, Vantaa and the Uusimaa Regional Council, Greater Helsinki

Promotion will join forces with the region's leading organizations, both public and private, to build the Helsinki Alliance. The Alliance will develop Helsinki's international offerings in order to attract more international people, companies and investments into the area. Tatu joined GHP just a few months ago and he has gained most of his experience in different kinds of regional innovation and economic development related projects e.g. he was in charge of Helsinki's first regional Innovation Strategy published in 2005. He has also been actively involved in the Baltic Metropolises Innovation Strategy (BaltMet Inno) project, funded by the Commission's Interreg IIIB programme.

Helen Lawton Smith

Dr Helen Lawton Smith is Reader in Management, School of Management and Organisational Psychology, Birkbeck, University of London. She is a Distinguished Research Associate at the Department of Geography, Oxford University, a Research Associate at the Centre for Business Research, Cambridge University and an Academician of the Learned Societies for the Social Sciences. She is the founder, Managing Director and Director of Research of the Oxfordshire Economic Observatory (OEO), Oxford University, http://oeo.geog.ox.ac.uk. She has extensive experience in the field of entrepreneurship, innovation and regional development. She has undertaken a number of studies of entrepreneurship in high-tech economies, inter-firm collaboration for innovation, university and industry linkages. She is the author over 70 journal articles and book chapters and seven books. Her most recent books are Universities, Innovation and the Economy (Routledge 2006) and Economic Geography:Past, Present and Future (Co-edited with Sharmistha Bagchi Sen (Routledge 2006).

Jen Nelles

Jen Nelles is a Ph.D candidate in the Department of Political Science at the University of Toronto and editor of the Ontario Regional Economic Development and Innovation (OREDI) Newsletter. Her dissertation work examines city-region governance and economic development in Canada and Germany.

Risto Niva

Mr. Risto Niva Vice President of Wipro Technologies.

Wipro Technologies Oy Finland is a company specialising in embedded telecommunication systems. The activities of the company concentrate on the planning and testing of real-time telecommunication systems in wireless network environments and in TETRA-networks.

Risto Niva joined the company in its previous form (Saraware Oy) in 1998 and has worked as the CEO and President since. In 2000 he became one of the main owners of the company through a management buy-out.

Before joining Saraware, Rosto Niva worked for 7 years in the travel sector. He was General Manager and entrepreneur in three different hotels in Finnish Lapland creating turn arounds. Risto studied economics at the University of Lapland, majoring in marketing. He also holds a Bachelor´s degree in Business studies from the Commercial College.

Carlos Orozco

Carlos Orozco joined Dow in 1985 as an Epoxy Resins Technical Service & Development Engineer in Bogotá, Colombia. Early in his career he had a variety of technical and managerial assignments in Epoxy Resins, Engineering Plastics and Polystyrene in Latin America and North America. He moved to Plaquemine, Louisiana, as DEXCO (a Dow/EXXON-Mobil Partnership) Research & Development Manager in 1996, and became the Catalytically Modified Polymers (CMP) Dow Corporate Research & Development Platform Leader in 1998.

In 1999, he was named Technical Service & Development Director for the Polyolefins and Elastomers (PO&E) Business in Europe and added responsibilities as the Chairman of the PO&E Global Application Technology Team in 2001.

In 2004 he was named The Dow Chemical Co. Sr. Research & Development Director for Plastics and Synthetic Rubber in Europe, and Global Director of the Plastics Customer Technical Service Centers and in 2006 became The Dow Chemical Co. Global Business Research & Development Director for the Polyurethanes and Polyurethanes System Houses, and Global Director of Research & Development for New Business Development.

Carlos Orozco is a 1985 graduate from Universidad de los Andes in Bogota, Colombia, with a degree in mechanical engineering. Carlos is located in Horgen, Switzerland.

Mark Mawhinney

Mark joined Isis as General Manager Isis Enterprise in November 2004 and manages Isis Enterprise worldwide business activities. Mark has many years experience at operating in the interface between the research world, business and the public sector. His experience in technology transfer comes from a wide range of previous activities, from which he has built a strong understanding of the diverse drivers of innovation.

Isis Enterprise, the consulting division of Isis Innovation, was established in 2004 and provides consulting expertise and advice to clients across the broad range of the public and private sectors, in the UK and internationally. Our current clients include publicly funded organisations such as the Natural Environment Research Council and the Carbon Trust as well as a range of smaller University and business clients.

Most recently Mark was Project Director of Knowledge Starts, an ERDF Programme to support Sheffield's universities in technology transfer and building links with business. Before that he was the first Director of the Sustainable Cities Research Institute at Northumbria University, where he established strong links with public sector agencies and was involved in the formation of a start-up business. Mark has a PhD in Civil Engineering and worked in UK, South-East Asia and South America for Tarmac and Penta Ocean.

René Samek

René Samek is the Director of Investment and Applied Research Support Division of CzechInvest. He graduated with a Master's Degree in Information Science from Charles University in Prague and also studied at the Central European University in Prague and Budapest, where he obtained his Master's degree in the field of International Relations and European Studies before enrolling at the London School of Economics, where he obtained another Master's degree in Political Economy. René has been with CzechInvest since 1997 – he was Marketing Director for four years before moving to London in September 2001 to head the agency's UK & Ireland office, the job he held until 1st September 2005.

Monica Schofield

Monica Schofield is Head of the EU Office at TuTech Innovation GmbH ? a company owned jointly by Hamburg University of Technology and the Free and Hanseatic City of Hamburg whose mission is to promote effective transfer and exploitation of scientific and technical knowledge. Monica joined TuTech in 1999 after 18 years of working as an engineer and R&D manager in the field of robotics in industry, large and small in Sweden, UK and Germany, having commenced her career with ASEA/ABB. Since 1991, Monica Schofield has been involved with the European Research Framework Programmes, and is currently serving as a member of Commissioner Poto?nik's Sounding Board for participation of smaller actors in Framework 7. She is managing several projects dealing with aspects of Regions of Knowledge and to promote Hamburg's strategy to be recognised as a "Wissensmetropole des Nordens".

John Slater

John Slater is a professor at the Institute of Educational Technology at the UK Open University (OU). He has most recently been involved in a number of projects giving information about UK universities to the public and to potential students from overseas to enable them to make more informed decisions about their studies (TQi). He is currently working on the value added to English speaking developed armed services by the availability of elective education opportunities, and on the value of e-Learning in such a setting.

He was trained as a number theorist and lectured in Mathematics at Oxford and London. He then moved into Computer Science and Computer Service provision at Salford and Bath before becoming the Head of the CS department at Kent 1990-6. He then became the Pro Vice-Chancellor (PVC) for Planning and Resources and subsequently for Teaching and Learning before moving to work for UKeU, a start up e-University founded by the UK government with added private investment. He has been on a number of UK national bodies on computing and on teaching and learning (CTI, TLTP, CB, ISC, JISC JCIEL etc.)

Robert-Jan Smits

Robert-Jan Smits is the Director of Directorate B (The European Research Area: Research Programmes and Capacity) at DG Research of the European Commission. Amongst his responsibilities are the formulation and management of EU research activities in the field of: Coordination of National Programmes, Coordination with intergovernmental research organisations (EIROforum, EUREKA, COST) Research Infrastructures, Regions of Knowledge, Research Potential and the relations with the European Investment Bank (EIB). Robert-Jan Smits is the EC representative on: European Strategic Forum on Research Infrastructures (ESFRI), ESF Governing Council and the EUREKA High Level Group (HLG).

Previous assignments of Robert-Jan Smits in DG Research, European Commission included Director "Structuring the European Research Area", Advisor on science policy issues, Head of Unit of “Legal Affairs”, “SME Unit”, “Strengthening research cooperation and Europe’s science base”.

Robert-Jan Smits was born in 1958. He has degrees from Utrecht University in the Netherlands, Institut Universitaire d’Hautes Etudes Internationales in Switzerland and Fletcher School of Law & Diplomacy in the United States of America.

Reinhard Stuth

State Secretary Reinhard Stuth has been the Commissioner for Federal, European and Foreign Affairs of the Free and Hanseatic City of Hamburg since 2001. He is officially representing Hamburg at the Federal Government, at the European Union and for Foreign Affairs. Before joining the Hamburg government he has held posts as a consultant for European Policies at the CDU/CSU parliamentary group in Berlin and Director of the offices of the Konrad-Adenauer-Stiftung in the Czech Republic and Slovakia. Before that Reinhardt Stuth has held various posts in the Land Berlin, the Konrad-Adenauer-Stiftung, the office of the German Federal Chancellor, the European Commission and as a personal consultant to Richard von Weizsäcker, President of the Federal Republic of Germany.

Helmut Thamer

Managing Director TuTech Innovation GmbH and Hamburg Innovation GmbH

After studying physics at universities of Giessen and Kiel and completing his doctoral thesis at the TH Darmstadt on questions of chaotic physical systems, Dr. Thamer was from 1981-85 Assistant to the founding President of the new Technical University of Hamburg-Harburg. In 1985 Dr. Thamer became head of the liaison office of TUHH where he developed and realized the concept of TuTech, which in 1992 was outsourced as the first private transfer company of a German university. Dr. Thamer is heavily involved in regional innovation development both at a strategic and operational level. In 2004 in addition to retaining his position of the re-organised TuTech Innovation, Dr Thamer also became MD of Hamburg Innovation a technology transfer company owned by and serving the majority of Hamburg’s institutions of higher education.

Rob van Tulder

Rob van Tulder is Professor of International Business-Society Management, Erasmus University Rotterdam/Rotterdam School of Management. He holds a PhD degree (cum laude) in social sciences from the University of Amsterdam. Published in particular on the following topics: European Business, Multinationals, high-tech industries, Corporate Social Responsibility, the global car industry, issues of standardisation, network strategies, smaller industrial countries (welfare states) and European Community/Union policies. Acted as consultant for various international organisations, ministries and companies. Research director of the ERIM research project "International Business-Society Management" and the SCOPE databank project. Chair of the Department of Business-Society Management.Van Tulder taught executive courses on International Strategic Management with (executive) managers and academics and has been visiting professor at several international universities.

Xiaming Liu

Xiaming Liu is Professor of International Business at the School of Management and Organisational Psychology, Birkbeck, University of London. He received his BA and MPhil from Anhui and Fudan Universities respectively in China and PhD from Strathclyde University in the UK. Before joining Birkbeck College in January 2006, he had held various academic and management positions in Shanghai and Hangzhou (now Zhejiang) Universities in China, and Abertay Dundee, Aston and Surrey Universities in the UK. Prior to becoming an academic, he had many years' agricultural and industrial experience in China.

Xiaming Liu’s research interests include foreign direct investment, international business strategy, technology transfer and spillover, trade and comparative advantage, and the Chinese economy. His recent research projects include multinational subsidiary typology, and knowledge creation and flows in multinational enterprises. He is the General Secretary of the Chinese Economic Association in the UK, and the Managing Editor of the *Journal of Chinese Economic and Business Studies* published by Routledge/ Taylor & Francis Group.

LocoMotive

Project no. 030089

LOCOMOTIVE

“Dissemination of knowledge concerning current R&D localisation motives of large regionally important private sector organizations”

Coordination Action

Regions of Knowledge 2

Visit Report Toronto

(Deliverable D8)

Date of preparation: **31 October 2007**

Start date of project: **1 January 2006** Duration: **21 months**

Project coordinator name: **Monica Schofield**
Project coordinator organisation name **TuTech Innovation GmbH**
Revision: Draft 1.0

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1. Introduction

LOCOMOTIVE is a project funded by the European Commission Framework 6 Programme "Regions of Knowledge 2". The project aims at providing regional policy makers with a better understanding of the current research & development (R&D) investment policies of large private sector companies in their regions compared with trends in other regions in Europe. This it is hoped will contribute to improving policies towards making European regions more attractive as locations for R&D.

Regions of Knowledge is a relatively new concept introduced by the European Commission DG Research to stimulate innovation poles and partnerships at regional and local levels. The policy idea is to promote increased and better regional investment in research through mutual learning, coordination and collaboration in support of attainment of the Lisbon Agenda.

The Lisbon Agenda agreed by the Council of Ministers in 2000 was supposed to set Europe on the path to becoming "*the most competitive and dynamic knowledge based economy in the world"* by 2010*.* In support of this, the so called Barcelona objective was agreed that R&D investment in the EU should rise to 3% of GDP with two thirds coming from the private sector. Currently this target is not being met and obviously more needs to be done to increase R&D investment in Europe. There is general agreement that regional policy makers have a role to play, but it is not clear what this should be. One of the problems in making innovation policies, and especially regional innovation policies, effective is the difficulty in establishing a dialogue between the significant private sector R&D actors, usually meaning multinational enterprises (MNEs), and those from public sector. They are worlds apart. LOCOMOTIVE aims to bridge this gap in a highly pragmatic manner, by offering a framework for discussion and analysis.

LOCOMOTIVE is a coordination action which aims both to provide an analysis of current thinking in MNE and large companies with regard to regional influences on their location for R&D as well as the opportunity for relationship building between key private sector R&D decision–makers and the project partners from these regions.

The approach taken in the project is for each partner to carry out interviews with senior decision makers of MNEs in their regions according to a commonly agreed structure and questions. These then formed the basis for roundtable discussions involving representatives from the private sector, regional authorities and research. The LOCOMOTOVE consortium represents nine regions, not particularly being similar but to provide contrasting view points.

However, a feature inbuilt into the project was to find a region for comparison outside the European Union. The region around Toronto, Ontario (Canada), was selected since it is both an innovation hot spot, but also considered culturally more similar to Europe than other locations in the USA or Asia. Therefore a study visit to Toronto was conducted in April 2007.

The visit was organised with the help of David Wolfe, Professor of Political Science at the University of Toronto at Mississauga and Co-Director of the Program on Globalization and Regional Innovation Systems (PROGRIS) at the **Munk Centre for International Studies (MCIS) at the University of Toronto.**

PROGRIS (http://www.utoronto.ca/progris/web_files/aboutus.htm) serves as the national secretariat for the Innovation Systems Research Network (ISRN), funded by the Social Sciences and Humanities Research Council of Canada. Professor David Wolfe is National Coordinator of the ISRN and from 2001 to 2005 he was the Principal Investigator on its Major Collaborative Research Initiative grant on *Innovation Systems and Economic Development: the Role of Local and Regional Clusters in Canada*, a comparative study of twenty-six industrial clusters across Canada. Along with Meric Gertler, he has recently been awarded a new MCRI grant from SSHRC on the *Social Dynamics of Economic Performance: Innovation and Creativity in City Regions* which runs from 2006 to 2010.

Sascha Haselmayer (Interlace), Axel Wegner (TuTech Innovation), Irma Patala (Culminatum), Fabienne Fortanier (Erasmus), David Wolfe (Munk Centre Toronto), Monica Schofield (TuTech Innovation), Tim Vorley (OxSEC), Elie Bruguerolas (RUTMP) in front of the IBM Software Centre in Markham.

The LOCOMOTIVE partners would like to express their thanks to Professor David Wolfe for providing an interesting programme which certainly took a lot of effort to set up and coordinate. Professor Wolfe did all this work without having funds available from the project.

Our thanks also go to Jennifer Nelles from the Munk Centre for so nicely chaperoning us during the visit and to the Knowledge Design Media Institute at the University of Toronto for helping with the visit to IBM.

This report in its order of chapters follows the itinerary set up for us and describes the main features and remarks for each of the visiting points.

2. Innovation Synergy Centre in Markham

Innovation Synergy Centre in Markham (ISCM) is a business advisory centre for small and medium sized enterprises. The main focus is to provide access to experienced business professionals to enhance their business growth to next level. ISCM provides guidance, resources and contacts to reach a smart growth rate. The centre aims to reduce the failure rate of small and medium sized businesses.

ISCM has officially been established in May 2003 but started actively soliciting clients in December 2003. Synergy Centre is supported by the Town of Markham, Ontario Government, National Research Council Canada, York University and Seneca College. Its founding partners include RBC Royal Bank and the centre gets additional support from Ministry of Economic Development and Trade. Centre partners also with various organisations, either individually or jointly to present events that focus on business issues like export, education, business issues and training.

The main objective for an advisory centre is not only to improve and develop businesses but also create new opportunities. Centre has an employing effect on the community. Indirect effects of the centre are job retention, new job creation and expansion and maintenance of the tax base. The Centre focuses on existing business opportunities as it is much easier and cost-effective that to create new ones. They offer Mentor Advisory services without costs. Value added issues in ISCM are wide range of access to experienced business leaders, problem solving skills and paradigms, longer term strategic guidance, advice on current business opportunities and general assistance in various fields of business. ISCM offers assistance in marketing, financing, planning, operations and competitive analysis.

ISCM sees their key role as provider of single point of contact to range of services to growth companies including mentor advisory services, business proposals linkage to angel investors, linkages to other organisations and government programs, technology partnership programs as well as educations and networking events. They have consulted some 500 companies with approximately 1,7 sessions per company. In 2006 161 companies were supported in province of Ontario with geographically focus on Markham, Toronto, and other York region.

3. Tour of IBM Toronto Software Lab

The IBM Toronto Software Lab is one of the largest software development laboratories within IBM world-wide and the largest software development facility in Canada concentrating on products for worldwide distribution in the areas of: application development tooling, application servers, database management software, electronic commerce applications, and systems management solutions. Also located at the lab's site in Markham is the IBM Center for Advanced Studies (CAS) Toronto in which university research and interns plays a particular role in identifying and working on strategic mid- to long-term issues that are continually roadmapped, since update cycles have changed from yearly to less than quarterly intervals.

Researchers are identified in the regional universities against their competences and relevance to specific areas.

Intellectual Property issues are important, yet IBM takes a flexible approach. In general terms (although each University has their own policies), IBM allows the researcher to retain the IP with a license to use for IBM. Academic publications, if sensitive, are reviewed by IBM in a rapid process to ensure no trade secrets are published – generally this is considered a tweaking with no implication to the research publication.

Today, IBM has agreements about cooperation frameworks with each regional university reflecting their particular policies. Different measures are taken to evaluate the IBM input in research, i.e. taking into account soft and hard in-kind funding. Central government evaluates the contributions, and IBM tries to involve central government agencies to provide transparency about agreements.

A concern for IBM is less the loss of IP, but the illegal or unreported 'import' of IP through researchers and interns.

Today the site employs 2.500 staff. IBM first moved to Toronto 40 years ago when the main objective was the significant discount to US costs. In fact, this determined many of the later growth and investments, although the currency efficiency has almost disappeared by now.

Original activities included software, and in particular bank machines (then sold to Celestica). The move to Markham (20 years ago) involved also a major investment by central government on a loan on deferred repayment to establish the extended e-commerce software development facility. Markham is seen as a lower-cost alternative to the previous mid-town Toronto location, and further reflects the in-bound commuting pattern of many employees. IBM's move to Markham triggered the development of the ICT cluster in the area, established today.

Increasingly, major public contracts (e.g. military) need to demonstrate national / regional offsets such as R&D investments. IBM has a tradition of decentralised R&D, thereby making it easy to follow best conditions in investments. Further, Toronto offers a unique pooling of excellence – within 2 hrs drive, world-class researchers are available from Markham.

International diversity is very high, and IBM recruits 60% of employees (globally) directly from universities.

IBM works closely with Markham, to improve services (infrastructures, transport, housing, entertainment). The workforce is very young (under 30), and the location in Markham is seen as ideal as a strategic point in the commuting pattern of employees.

Tax incentives and subsidies on buildings are a significant instrument. A TPC grant funded much of the last new building facility (30-35m CDN$) through an interest free loan repayable out of unit-profits.

IBM has several programmes for cooperation with universities and research.

1. Internships: 1 year work experience with about 2-400 interns per year in Canada.
2. Extreme Blue: IBM's elite internship programme attracting top 25 students for 17 week internship to work with highest level internal resources and mentors. Fast track into top jobs and to attract highest quality talent, selections are undertaken in close collaboration with faculty at the different universities.

Recruitment is a core challenge, especially with increasing specialisation of tasks and professional profiles related to the vertical development of software fields, rather than the historic layer based approach.

CAS centres are now being linked globally – i.e. CAS Barcelona will send 3 exchange students to Toronto this year.

Research centres are loosely linked and governed. Short-term research is often done by students / interns, and mid-term research by academics or professional research at universities.

Measuring efficiency is a challenge, one measure is recruitment against research funded. CAS works with an assumption that 1 PhD student works with 3 MA students and achieves a recruitment rate of 1.1 new employees per researcher funded. This double agenda is important – the link between research and recruitment. Further measures include publication citation, and the indirect promotion of IBM theory / technologies through researchers and professors.

Funding efficiency is another factor, i.e. IBM officially funds 22 projects, which in reality fund 47 projects.

IBM Academy is an internal research organisation of 300 top creative people in IBM, meeting regular and directly advising the chair and hold conferences. Increasingly, eMeeting, virtual conferences and other collaborative technologies are used and tested to improve community building. Thousands of internal blogs are structured into thematic communities of interest and expertise through new mechanisms.

IBM work relatively litte with SMEs and focus more on universities as R&D partners. SMEs tend to have problems binding key resources of interest to IBM in management.

4. Toronto Region Research Alliance (TRRA)

TRRA
TORONTO REGION RESEARCH ALLIANCE

The Toronto Region Research Alliance (TRRA) is an innovative network of regional leaders engaged in transforming the Toronto region into a world-leading centre for research and research-intensive industry. TRRA serves the broader Toronto region, embracing Hamilton, Guelph, the Waterloo Region and the Greater Toronto Area. The board of directors is composed of presidents, chief executive officers and senior leaders from the region's business, research and municipal organizations. TRRA is a results-oriented, non-profit organization supported by a wide range of regional stakeholders and the governments of Ontario and Canada.

The greater Toronto region includes 7 million people, or app. 20% of the Canadian population. It is home to 40% of the corporate head offices in Canada, and to 30% of Canadian R&D expenditure making it the economic centre of the country with the exception of oil/resources industry (in Alberta). The greater Toronto region is much larger than the city of Toronto. The city of Toronto accounts for about ⅓ of the population and ½ of the economic activity of the greater Toronto region. Challenges of Toronto City are becoming more similar to those of some US cities: some areas are poor and isolated, there is substantial immigration (which also creates much dynamic); jobs are moving from Toronto city to the surrounding region.

Three key success stories have become icons of innovation in Toronto: insulin, stem cells, and the Blackberry – representing the regional strengths in biomedical research and ICT. One of the strong points of the Toronto region is its highly educated and diverse labour force, which in contrast to most other Canadian regions, is not projected to decline in the big wave of 'baby boom' retirement (due to immigration).

Toronto city is not the only successful city in the region. Other examples include:

- IBM facilities in Markham. There used to be 'nothing' in Markham, but since IBM moved there twenty years ago, a lot of small ICT firms and start-ups have been created in the vicinity. Tax credits were a major incentive for IBM to relocate.
- 'Pill Hill', in Mississauga, with major pharmaceutical investment
- The ATI (now AMD) facility in Austen, with 3000 engineers

Canada is a foreign-investment dominated economy (of which 85% comes from the US), with very few large domestic firms. The key reason for this lack of Canadian large firms is that when local high-tech SMEs obtain a certain size, they get bought by US investors, that are able to offer 2 to 3 times as much compared to Canadian investors (as US investors tend to value the Canadian SMEs higher than Canadian investors). This often results in a reduction of R&D in Canada (which is moved to the US). For example, GE took over Zeon (water utility) and reduced R&D staff. However, this is not always the case: when Sanofi bought in, it expanded the R&D facilities to one of the largest (worldwide?) vaccine R&D and manufacturing facilities.

One of the most important industries for Canada and particularly the Ontario region is the The automotive industry. Many factories are located along the 401-highway, including e.g. GM in Oshawa, Ford in Oakville, and Chrysler in Brampton, as well as several major Asian foreign investors like Toyota and Honda. Magna is a major Canadian automotive parts manufacturer. Government policy was vital in keeping the auto industry in the region, and increasing its size. A fund of 500m CAD was made available for incentives in this industry alone in the past years.

The auto industry became important when US firms invested to access the highly protected Canadian market (tariff-jumping FDI). Now that Canada and the US have a free trade agreement (NAFTA, and its predecessors), US and Canadian car manufacturing are fully integrated, with some parts crossing the border several times (as parts of increasingly larger components).

TRRA is a relatively young organization (1-2 years old), with 10 employees and an annual budget of CAD 3 million (of which app ⅓ from the federal government, ⅓ from the provincial government, and ⅓ from other regional stakeholders, including municipalities, universities and colleges, and private sector firms). The aim of TRRA is to 'accelerate innovation', branding the region as an innovation space that is qualitatively comparable to, yet distinctly different from, regions like Boston or Silicon Valley.

The TRRA strategy is focused on attracting, keeping, and expanding, the investments of large companies. The rationale behind this focus on large firms is that only in really bad economic times, small firms are the major job creators. In a good economic climate, job growth tends to come from large firms (according to recent Statistics Canada study). TRAA does not deal with the automotive industry, as that is dealt with by 'everyone else'. Instead, they focus on ICT, biotech/life science, and advanced manufacturing and aerospace.

TRRA is an initiative that resulted from the concerns among the various stakeholders in the Toronto region approximately four years ago, when the economy was negatively affected by a series of events: 9/11 (that shut the US-Canadian border down), SARS, and a strengthening Canadian currency due to high oil prices. In order to foster economic growth, two key areas for improvement were identified (for which TRRA was set up):

- the lack of linkages between university research and economic development,
- the lack of attention for MNE strategies and investments (much was still SME and cluster oriented, trade missions abroad had no mandate to work with firms already in the region),

One of the activities of TRRA is to help create attractive incentive packages for MNEs. No big company will make an investment without and incentive package (and a firm like e.g. IBM also wants incentives to stay). While not the most important motive for firms to invest in a certain location (e.g., it is only marginally important to select the top20 potential investment locations for a new factory), incentives do become much more important when the number of potential investment locations gets narrowed down (e.g., to choose among the top 3).

5. MaRS Discovery District

The discussion with Tim McTiernan, Executive Director Innovations and Assistant Vice President Research at the University of Toronto (UoT) with colleagues focussed on how the UoT deals with tech transfer and commercialisation and the challenges of implementing a transfer strategy. Many of these were very familiar to all of us working close to universities. Ownership issues to do with IPR are very much determined independently by universities themselves in Canada, with each having an own model.

The UoTs strategy for tech transfer and licensing was formally established in c.1999 although it appeared as a bolt on to the university's ambition as a leading teaching and research institution. Following an external audit 2004/5 the strategy and organisational structure of the tech transfer and commercialisation operations at UofT were overhauled and integrated into the university, besides teaching and research as a core function. This is in part an outcome of the university's strategic plan, but also the appointment of the new vice-president for tech transfer and commercialisation, and how it is linked into the research faculty at vice president level. The university also made revisions with respect to the ownership of intellectual property by faculty, which had formerly been fragmented across the university, to a single consolidated policy.

The strategy and ability to overhaul the tech transfer and commercialisation process was radical in the sense that the function was not revised, restructured or developed - it was effectively replace with a new entity positioned central to the university. While the university is not the sole mechanism and works closely with a range of external intermediaries such as BioNow, although the university remains closely associated with any commercial/tech transfer projects involving UofT. Key to the current strategy is acknowledging its capacity and capabilities so it is able to deliver, and with intermediaries as appropriate.

6. BioDiscovery Toronto

BioDiscovery Toronto is a $10 million publicly funded non-profit organisation linking nine of Toronto's internationally recognised biomedical research institutions for the commercialization of research. In simplest terms the remit of BioDiscovery Toronto is to provide a one-stop shop for academic researchers and companies seeking break-through biomedical and related technologies. Based at the centre of Toronto's bio-life science community in the MaRS centre, the intention of BioDiscovery Toronto is to catalyse and combined the pipeline from basic research to clinical trials.

The member universities and research hospitals are world leaders in genomics, proteomics, drug discovery, immunology, bioinformatics and assistive devices, with annual funding of more than $800 million. The BioDiscovery Toronto effectively acts as a portal, providing a central interface for biotechnology and related research activities among members, industry and the financial community. The focus of BioDiscovery Toronto's activities include a focal point into the network of Toronto's research institutions and hospitals, access to new and emerging technologies available for licensing and company creation and access to state-ofthe-art biomedical core facilities and services available for research and development support.

In short, BioDiscovery Toronto focuses on the earliest stages of innovation, and in collaboration with university technology transfer/business development offices of the member institutions to support and promote early stage commercialisation of academic research. This involves drawing on industrial and business expertise at the earliest stages of invention and technology development, and building partnerships with academics, entrepreneurs, industrialists, investors and the government. In recognising that commercial funding cannot sustain and develop the commercialisation function of universities/research institutes, BioDiscovery Toronto attempts to create and facilitate a public/private commercialisation interface. The unique point about BioDiscovery Toronto is the strength of the network of public and private sector organisations which are then drawn together to nurture and create new partnerships working on behalf of the partner organisations.

7. Ministry of Research and Innovation (MRI), Government of Ontario

Ontario

The Canadian province of Ontario places particular importance on Research and Innovation which is expressed by the unusual fact that the provincial Premier, Dalton McGuinty, also held the post of Minister for Research and Innovation at the time of the LOCOMOTIVE visit.[1]

The visit comprised of several presentations from the ministry and was chaired by Janice Summers from the Innovation Policy and ORIC[2] Secretariat. Presentations were not only on university R&D, which used to be the main issue on MRI's agenda, but which is more and more shifting towards research and innovation in companies.

In the first presentation, John Marshall from the Business Development, Venture Capital, Outreach and Promotion Group presented Ontario's Research and Innovation Agenda. The development of the agenda was based on recommendations from ORIC, formed by the Premier to advise the government on the best way for building "a more creative, innovative and prosperous Ontario". The council is made up of 13 experts from the business, academia, research and innovation communities. The main recommendations from this group advise to Ontario to concentrate on knowledge industries, to attract world-wide best researchers, and to invest in research and innovation in a larger way.

This is also reflected in the strategy of MRI which is a fairly new ministry (only established in 2005 by the current Premier). From a European point of view it is fairly interesting to see the strategic goals and compare them with similar European strategies.

[1] This has changed after the Premier's re-election with the formation of a new cabinet on 30 October 2007 following the elections on 10 October 2007.

[2] Ontario Research and Innovation Council

Ontario's Innovation Goals

High-level goals for the impact of innovation in Ontario by the year 2020:

- Ontario will be the preferred location to grow knowledge-based businesses because of its innovation culture, commerce-friendly environment, highly qualified workforce, support for business and entrepreneurship, access to investment capital and competitive tax policies.

- Ontario will be the preferred location for the best and brightest scientists and innovators from around the world because of its globally recognized R&D excellence and the efficient transition of ideas from the laboratory bench to the marketplace.

- Ontario will attract increased private-sector investment in R&D, becoming a leader in the rapid introduction of innovative products.

- Ontario will generate the highly qualified workforce needed by an innovation-based economy through greater awareness of the key role played by careers in science, engineering, business and entrepreneurship.

- Ontario's government will lead by example, with integrated and coordinated innovation initiatives across all ministries and a culture of innovation in its own operations.

The implementation of this strategy is still under review through an open consultation proves. One of the key points according to John Marshal is keeping up Ontario's research capacity, R&D spending in the province currently amounts to 2.4 % of the GDP. Means to fund and promote research in Ontario is the Ontario Research Fund, a talent programme for next generation researchers, the International Strategic Opportunities Programme for overseas co-operation (funding project management, travel, facilities and similar, not the research itself), and programmes for awards and fellowships.

Subsequently Brad DeFoe, Manager Commercialization Networks and Programmes talked about Ontario's commercialisation network, which was started in 2001-2002 with a focus on the Life Sciences sector, but now is concerned with more general commercialisation. The programme is addressing specific commercialisation gaps and concentrates on pre-seed and seed capital. The funds are made available through agencies like MaRS (see section 5) which is seen as a provincial focus point for commercialistaion.

The presentations ended with an insight into the regional networks, which are seen as an important tool to drive innovation in the province. In Ontario there are the following:

- Ontario Centres of Excellence, which are local and have a sectorial focus (environment, open source software, ICT, nanotechnologies, medical devices). It is foreseen to raise them to provinicial level.
- Knowledge and Technology Transfer Networks
- Regional Innovation Networks (RIN), These are multi-stakeholder, regional development organisations established with provincial funding that support partnerships among business, institutions and local governments to promote innovation. These networks are accepted positively by MNEs as well as others.

All networks are operating separately depending on the driving institutions and persons. Key players often are “pulled in” by the driving people behind a specific network. It was interesting to note that the MRI claimed that RINs are much more successful and effective than traditional clustering methods.

8. City of Toronto Economic Development

The department of economic development at the City of Toronto is fairly large for a city of 2.5 million inhabitants having 75 employees, which allows for a fair degree of specialisation. Our host, Kyle Benham, was concerned with existing cross-sector business initiatives while other units have sector oriented tasks dealing with the ICT, financial services, biomedical, food and beverages, fashion design, and aerospace sectors.

The Toronto region is very technology oriented with the ICT, biomedical and aerospace sectors being the most important ones. As concerns other sectors, the Toronto region is a very important financial centre and has the fourth largest concentration of food and beverages industry in North America.

One of the recent criticisms in research and development in the region was money being put into universities without giving an economic return, this criticism also being voiced by the provincial auditors in investigating the budgets. This criticism created some difficulties for the people from the Toronto Municipality and led to the investigation of issues in industry-university cooperation in the region. The difficulties in university business relations were found to be fairly similar to those well-known in European regions. Universities tend to regard their research as basic research and are reluctant to move into applied research as it is requested by technology-oriented companies. Also, IPR issues between universities and especially companies from the ICT, biomedical and aerospace sectors have proven to be a barrier in cooperation and it had been a concern of the city to push back those barriers in the last two years.

The aerospace sector is seen as particularly important in the Toronto region. Bombardier is producing its Dash 8 series of jetprop planes in the area. This sector also is an example of being effected by world events as the there were serious difficulties after 9/11. Bombardier did its best to bridge the post 9/11 times in cooperation with the city, there was neither any provincial nor national help in overcoming the difficulties. The city of Toronto is supporting this sector in providing means for Human Resources development and for innovation. Innovation in the sector currently is concentrating on technologies for more environment friendly planes (fuel efficiency, cabin quality and noise, emissions).

In general, the city talks to multinational enterprises (MNEs) in the area, but these companies are very cautious about their benefits from these talks. The large companies represented in the area mainly have manufacturing facilities while research and development is done elsewhere, mainly in the U.S.A. The major factor in providing support to these firms is the provision of talented and educated people, major initiatives supported by the city therefore concentrate on enhancing and keeping the labour force.

However, MNEs feature prominently in the city's agenda: it is a strategic goal to attract five new MNEs to the region by 2011. The city's economic development group is particularly successful in attracting plants from the food and beverages industries. In this cost conscious sector it is of advantage for the Toronto region that the cost advantage over the United States amounts to as much as 25 %.

Currently the city of Toronto is concentrating on developing a strategy for the environmental sector.

9. Conclusions

The visit to Toronto was an intensive snap-shot of a region with very pro-active development strategies. Like Europe, Canada seems to be very much preoccupied about competition with US and Asia. The former is prevalent because US investors are seen as more aggressive and through the much stronger capital markets, more able to acquire promising hi-growth companies. This seems to provide an underlying dilemma for regional development: there is perceived to be a high risk that regional simply plants seeds for the US to harvest. A recent well-known example was the acquisition of ATI, a graphics solution company, by AMD, with much of the chip design and development subsequently moved to the US. This is of particular concern as there are strong efforts to create an innovation culture in Ontario through innovation networks and centres and through several tax incentives like tax reductions for R&D spending in companies or tax returns on donations to universities from companies or private persons.

In general one can observe that political strategies for becoming a knowledge-based society and for increase in R&D spending are fairly similar to Europe's. But also some of the drawbacks are similar, like in many regions of Europe there seems to be a problem in fragmentation of initiatives promoting and fostering research and development. These work fairly separately and often lack a coherent overall picture and strategy. This is particularly the case with initiatives funded by the government of Ontario and various communal activities. IN all activities there often were heard complaints about the reluctance on the side of MNEs to be part of the regional networks and to discuss their strategies openly with administrations. A counter-example seems to be the IBM Research Laboratory which is closely co-operating with the community of Markham.

The university system seems to be discussing much the same issues familiar to those involved with it in Europe: IPR and revenue leverage, better knowledge transfer support and involvement of SMEs. There also is a discussion about the contradiction between the universities' wish to perform basic research and industry's demand for universities to go more into applied research.

The members of the LOCOMOTIVE party found the visit very inspiring and certainly were able to add fresh thoughts to their regional thinking. Summarising the comments made after the visit, it struck many of them as stunning how similar approaches and problems were to comparable regions in Europe. The main contrast seemed to be the proximity of the Toronto region to the US, which led to a much stronger focus on the innovation situation in the neighbouring country than it would be in Europe. Also many of the problems concerning innovation arise from the relationship to MNEs in the US.

10. Annex 1: Visit itinerary

Tuesday, April 10

1:00 PM **Innovation Synergy Centre in Markham**
Karen Zavitz, Research Community Liason R&D Partnerships Team who is responsible for the Technology Partnership Program helping industry in building R&D partnerships with local Universities and Collages.
Catarina von Maydell, Investment Programs. The ISCM Investment Network - program introduces "investment-ready" early-stage companies to equity investors. Network has close co-operation with National Business Angel Organisation formed five years ago.
Bob Glandfield, President and CEO
Address: 1380 Rodick Road, Suite 100 Markham, Ontario L3R 4G5

ISCM is a "Not for Profit" business advisory hub that was created to help accelerate the growth and development of firms with the objective of assisting grow their sales and employment base. Supported by the Town of Markham, The National Research Council and the Ontario Ministry of Innovation, ISCM business support is offered at no cost to the SME. These services include linking a company to a very experienced business mentor/advisor, workshops and training courses to inform companies about current business issues. ISCM also has a partnering initiative to link companies to other resources for testing and IP development such as Universities and colleges across Ontario.

3:30 PM **Tour of IBM Toronto Software Lab**
Stephen Perelgut, University Relations Manager, IBM
Address: C1 - 8200 Warden Avenue, Markham, ON L6G 1C7

Organized with the assistance of Knowledge Media Design Institute

KNOWLEDGE MEDIA DESIGN INSTITUTE

As one of the largest IBM software development laboratories, the IBM Toronto Lab develops leading products for worldwide distribution in the areas of: application development tooling, application servers, database management software, electronic commerce applications, and systems management solutions. The IBM Toronto Lab is home to more than 2,000 employees from a diverse range of backgrounds and disciplines, with a dynamic mix of early career employees and experienced professionals. Over 70 percent of lab employees hold a degree with a major in computer science, engineering or mathematics, which highlights our technical expertise.

Web References:
https://www-927.ibm.com/ibm/cas/ (IBM CAS General)
https://www-927.ibm.com/ibm/cas/toronto/index.shtml (IBM Toronto CAS)

Wednesday, April 11

9:30 AM **Toronto Region Research Alliance (TRRA)**

George Tolomiczenko, PhD, MPH, MBA

George is the TRRA Director for Research and Analysis. He has a background in the healthcare sector, and is presently responsible for gathering information relevant for attracting investment and building research capacity. This includes the (annual) release of innovation indicators (favorably) comparing Toronto with other regions.

Mike Williams

Mike is the Senior VP for Investment Attraction at TRRA. He is a regional economic geographer by training and has long been involved in economic development consulting. He is responsible for TRRA's program to attract research-intensive companies and investment to the region.

TRRA is a results-oriented, non-profit organization dedicated to making the Toronto region a world-leading centre for research and research-intensive industry by: attracting new research-intensive companies to the region and working to expand those already here; building public and private research capacity; and enhancing the commercialization of research. Activities are focused in biotech/life sciences, information and communication technology, and advanced manufacturing and materials science. Its role is to act as a neutral convenor, facilitator, catalyst and advocate on issues and opportunities related to its R&D mission. TRRA provides dynamic, neutral leadership to help forge a regional consensus on strategic priorities.

11:30 – 1:30 Lunch Break

1:30 PM **MaRS Discovery District**

Tim McTiernan, Executive Director - Innovations at U of T
and Assistant Vice-President Research, University of Toronto
Address: MaRS Centre, Heritage Building 101 College Street, Suite 320

MaRS (Medical and Related Sciences) is a convergence innovation centre dedicated to accelerating the commercialization of new ideas and new technologies by fostering the coming together of capital, science and business. Located in Toronto's downtown "Discovery District," MaRS sits at the epicentre of one of North America's most concentrated clusters of biomedical research and expertise – literally steps from world-renowned teaching and research hospitals, the University of Toronto, Canada's financial core and the Ontario legislature. MaRS was created in 2000 to capitalize on the research and innovation strengths of the Province of Ontario, and to position Canada for leadership in the highly competitive global innovation economy. MaRS is focused on helping Canadian innovators turn great ideas into great companies – and supporting those companies as they become global market leaders.

3:00 PM **BioDiscovery Toronto**

Dr. David Schindler, Executive Director
Dr. Chris Riddle, Vice President, Operations

BioDiscovery Toronto is an organization linking nine of Toronto's internationally recognized biomedical research institutions for the commercialization of research. It provides a one-stop shop for companies seeking break-through biomedical and related technologies and expertise.

Thursday, April 12

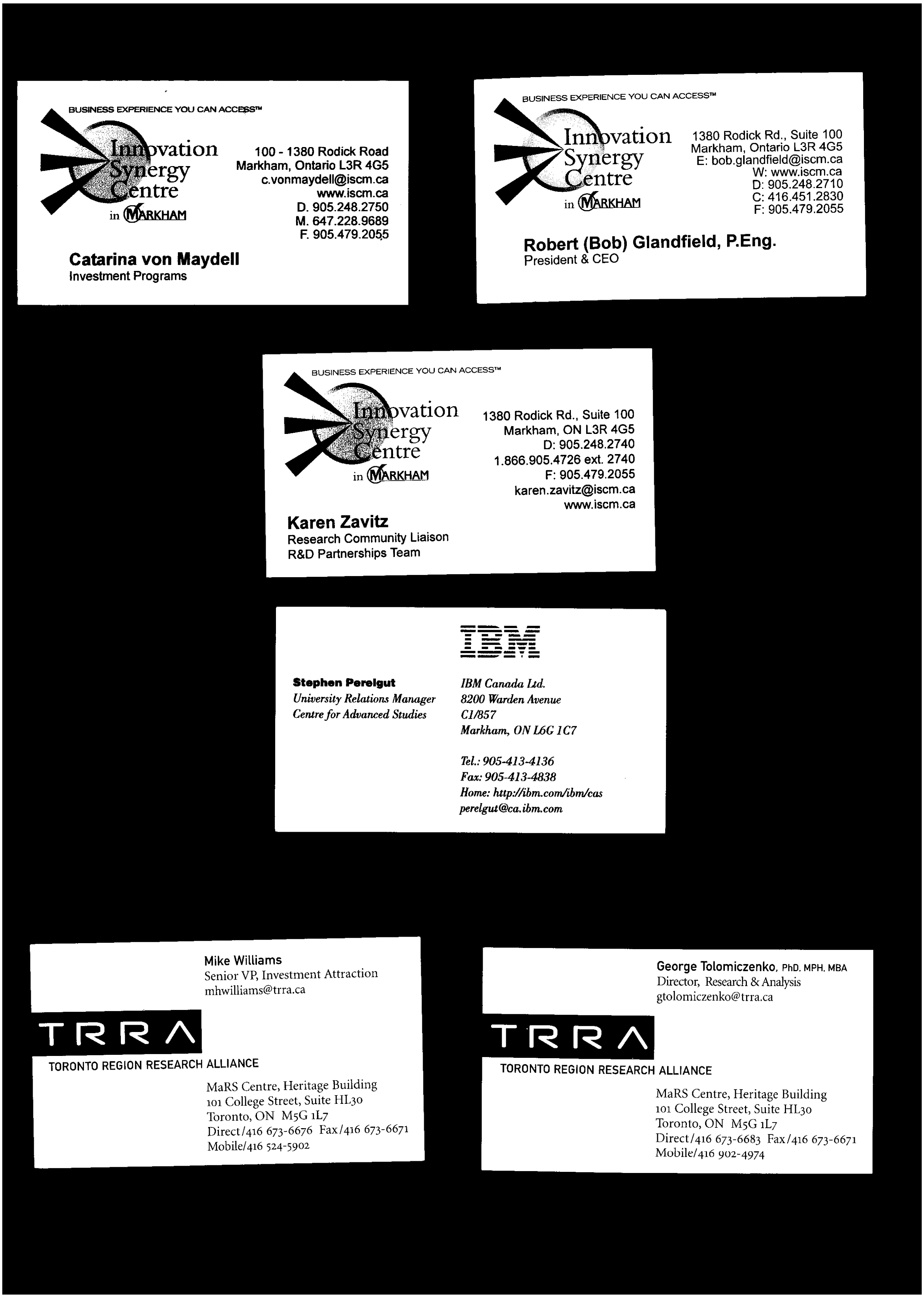
9:30AM **Ministry of Research and Innovation, Government of Ontario**
Brad DeFoe, Manager - Commercialization Network
Alison Paprica, Manager, Performance Measurement & Project Office

11:30 – 2:00 Lunch Break

2:00PM **City of Toronto Economic Development**
Alicia I. Bulwik, Project Director, ICT
Kyle Benham, Director, Business Development and Retention
Address: Metro Hall 8th Floor boardroom

[visit ends at 3:30p]

11. Annex 2: Business cards of contact persons



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13. Annex 3: Members of LOCOMOTIVE visiting party

Elie Brugarolas is responsible for European projects at **The Réseau Universitaire Toulouse Midi-Pyrénées (RUTMiP)**, a wide & regional consortium of research and university entities, socio-economic partners represented by the Chambers of Commerce and Industry, and local and regional authorities involved in higher education and research issues. RUTMiP is an expanding and strong network of 25 regional partners. The core mission is to promote the role of Toulouse universities to the cause of knowledge based economic development and international networking. Recent projects include those involving cross-border co-operation especially with close lying regions such as Catalonia, but also further afield with Alexandria and India. RUTMiP supports academic entrepreneurship and is heavily involved in Framework projects in support of the development of the European Research Area.

Fabienne Fortanier holds an MScBA from the Rotterdam School of Management (RSM), Erasmus University. She currently works on a PhD research project at the University of Amsterdam (UvA) Business School (Faculty of Economics and Econometrics), where she also teaches on International Business and its impact on developing countries, on Sustainable Management and Corporate Social Responsibility, and on Statistical Methods. Ms. Fortanier's research and publications focus on the interaction between multinational enterprises and host governments in developing countries, and on the impact of those business-government interactions on economic growth and sustainable development. Prior to joining the UvA Business School, Fabienne Fortanier worked at the OECD in Paris as a consultant on corporate social responsibility by developing country firms, and on the relationship between foreign direct investment and sustainable development in host economies. She has worked as research associate for the SCOPE Expert Centre on Multinational Enterprises (at the RSM), and continues to coordinate projects for SCOPE aimed at updating and upgrading the databank that documents the strategies of the world's largest corporations.

Irma Patala is a project director at Culminatum Oy in Helsinki and manages the "Knowledge Intensive Business Services Programme (KIBS)" for the Helsinki region. KIBS project activities and business development services are aimed at knowledge intensive business service companies with potential for growth and internationalization. KIBS sector covers technical services including R&D services, legal services, accounting and auditing, advertising and marketing, design, management consulting, and IT services

KIBS project is financed by Uusimaa Regional Council and Employment and Economic Development Centre for Uusimaa.

Sascha Haselmayer, director & co-founder of **Interlace-invent**, is an expert in knowledge and innovation intensive urbanism. Trained as architect at the Architectural Association in London, he is also an expert on design & strategy intensive architecture with experience from urban projects across Europe, Latin America and Africa for non-governmental, public and private organisations. Previous appointment in the Design Innovation Unit of Carillion plc, the leading construction firm in the UK, to develop innovation-driven strategic solutions for several well-recognized projects. Academic appointments include Unit Master for Post-Graduate Architecture & Urban Design Diploma and MA programmes at Greenwich University (until 2003). He has been a visiting senior lecturer in 'Knowledge Intensive Architecture and Urban Design' at the Architectural Association (London) and Copenhagen Business School.

Monica Schofield is Head of the EU Office at **TuTech**. She joined TuTech after 18 years of working as an engineer and R&D manager in industry, large and small, in Sweden, the UK and Germany. Monica is a co-founder and board member of a number of SMEs. She has been engaged as an expert by the Commission on various task contracts since 1993, and is currently serving on Commissioner Potočnik's Sounding Board for Framework 7. Monica lectures widely across Europe on project management for European R&D projects and has since 2003 held a German Federal Ministry of Science backed contract to promote best practice in this field.

Axel Wegner has a diploma in Mathematics and Computer Science. Working in computer and internet related companies as well in a consultancy company for international collaborations, he has since 1984 acquired extensive experience in European collaborative research. He has set-up and managed or supported the management of numerous European industry-led projects, especially in the IST area with budgets of up to 20 M€. In addition he was research co-ordinator in an SME computer systems house. Axel Wegner also has worked as an external expert for the European Commission. Since 2002 he has been a project manager at **TuTech**.

Zdenek Kucera works with the **Technology Centre AS CR** as a project manager in the group of Strategic Studies. Zdenek Kucera obtained the PhD degree in the solid state physics from the Faculty of Mathematics and Physics of the Charles University in Prague. He was engaged in research of solids and optoelectronics in the Institute of Physics of the Charles University in Prague for 14 years. In the Technology Centre he works on projects dealing with analyses and studies focused on research and innovation policies.

PRIVATE SECTOR R&D: GLOBAL VIEW

ERASMUS / Interlace-Invent 2007

Locomotive

EU SIXTH FRAMEWORK [Regions of Knowledge 2]
Dissemination of knowledge concerning current R&D localisation motives of large regionally important private sector organisations
Project acronym: Locomotive
Work-package N° 4 Deliverable 7

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Introduction

The report on the Global View of the outsourcing of R&D is prepared as part of the Locomotive project, a European Commission program, funded by the 6th Framework Programme.

The Global Outsourcing of R&D has vast influence on the European Union especially as R&D investments have become a central topic on the European Agenda. As this report underlines, investments in R&D support the global economic growth and is as such beneficial to both the investing countries as well as the receiving countries. However, great care should be taken, on both the national and the industrial side, to ensure that the outsourcing of R&D is done with respect for the special circumstances under which the world is becoming increasingly global. This includes also sensitivity to economic as well cultural factors, of which the best-performing multinational firms bear evidence through their successful outsourcing strategies.

On behalf of the Locomotive project, ERASMUS University in Rotterdam and Interlace-Invent, we would like to thank all who have participated in the preparation of this report.

August 2007

Dr. Rob van Tulder **Fabienne Fortanier** **Sandra Genee**

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Executive Summary

Multinational enterprises (MNEs) play an important role in regional systems of innovation, in the European Union and elsewhere. They are the key investors in research and development, a slowly but steadily growing portion of which is invested outside their home countries. A key managerial challenge for technology-intensive MNEs is therefore to effectively coordinate their innovation activities across borders, both within their own organization and in cooperation with other players including suppliers, buyers, governments and knowledge institutes in a context of 'open innovation'.

The LocoMotive project aims to provide a better understanding of the factors that influence where these MNEs locate their R&D, and how they organize their innovation efforts across borders, in order to help regional, national and European policy makers to better deal with these firms and maximize the benefits that result from their presence. This document is part of the LocoMotive project and documents in detail the R&D strategies of 8 of the largest technology-intensive firms in Europe: Airbus, Siemens, Philips, Nokia, Volkswagen, Motorola, Shell and GlaxoSmithKline.

The internationalization of R&D of these eight firms - and many other similar ones - goes beyond IT and business process operations, and can also include strategic activities, production, delivery of core products and services and sales and marketing. Although one of the key drivers of this trend is the quest for lower costs (engineers and researchers in regions outside Europe and the US are still much cheaper), access to knowledge and a highly educated workforce are equally important. Access to markets (and future markets) is a strong determinant of the growth of R&D towards India and China. The case studies confirm these impressions and highlight the combination of markets and technology as key locational determinants for R&D investment. The action of competitors is particularly relevant for companies that operate in consumer markets with relatively standardized products.

Yet there are also several impediments. Coordination costs and scale economies favour locating R&D in one single (often headquarter) location, rather than abroad. Insufficient tangible (airport, roads) and intangible infrastructure (legal environment) in host locations often make it impossible to locate R&D elsewhere. Factors related to quality and quality control, as well as IPR concerns, are further impediments. Lack of a common language and cultural differences also make internationalization of R&D difficult. The majority of firms in the case studies has opted to manage their international network organization like networks of interconnected centres of excellence and product development. But when policy influence via e.g. government procurement is large a more 'multidomestic' R&D strategy can be observed. Historical path dependencies, such as a strong headquarter or instead relatively autonomous brands within a group, continue to influence the organizational structure of R&D substantially.

From a European (policy) perspective, concerns with respect to R&D are primarily related to the potential relocation of R&D from Europe to other markets. Although examples of this process have been found – they are often prominently cited in the media – it does not appear to be a general trend. There seem to be few 'trade-offs' in locational decisionmaking, although the relatively small R&D base of many firms in developing countries, and the high market growth rate of these emerging markets will imply that future investments in R&D will grow more rapidly elsewhere than in Europe.

R&D Strategies of Leading Multinationals

Technology firms are today much less vertically integrated, and increasingly use globally dispersed networks of outsourced suppliers and assemblers. This has led to the disintegration of traditional divisions in research, development and innovation. The corporate research lab does no longer exist and much of R&D spending today is in incremental improvements and faster go-to-market of new ideas and innovations.

In a speech at the European Foundation for Quality Management, Gerard Kleisterlee, President and CEO of Royal Philips Electronics made a plea for Europe to increase its competitiveness and to strengthen its knowledge based activities. Even though "Western Europe has frequently been depicted as a somewhat stuffy open-air museum - a region that is in danger of being crushed between the economic power of a flexible, dynamic America on the one hand, and, on the other, Asia with its explosive expansion led by superpowers like China and India" - he believes Europe can improve its competitive position by transforming to a "knowledge economy" specialized in high-end, knowledge-based jobs. (Philips, 2005) "The way in which we organize our economy around knowledge and knowledge-application will be crucial for the future welfare of our society," and will ultimately determine if Europe will be able to meet the challenges set out by the Lisbon agenda. (Philips, 2005)

The ways in which Europe can improve the conditions for (local/regional) R&D spending is the focus of the Locomotive project. Because of the important role multinationals play in regional systems of innovation, the Locomotive project aims to contribute to more effective policy making by providing a better understanding of the factors that influence the way internationally operating firms organize their R&D.

Recent studies on the locational patterns of R&D around the world delineate the following four 'global' trends (see European Commission, 2006; Unctad, 2005; Dearing, 2006; Thursby and Thursby, 2006; OECD (2005); Van Tulder, with Van der Zwart (2006); and the literature contained in Fortanier, Van Tulder, 2006)

Trend #1: Large (core) companies prevail in innovation

The orchestration of Innovation is increasingly in the hands of a limited number of (large) and often multinational companies. Formal R&D investments are at the same time increasingly concentrated in the private sector, which in turn is dominated by a relatively small number of large firms. 700 companies account for about 80% of private R&D and more than half of the total R&D performed within OECD member states (Dearing, 2006). The relative financial contribution of in particular governments has consistently been decreasing since the mid-1980s (OECD, 2005). R&D expenditures remain geographically concentrated in a few countries (and regions) around the world: the ten largest spenders accounted for more than 86% of total R&D in 2002. Two of these countries are emerging economies: China and South-Korea (Unctad, 2005). There is a limited, but noticeable trend that firms in developing countries are a growing source of formal innovation. The share of foreign patent applications from firms located in developing countries jumped from 7% to 17% in the 1991 to 2003 period (ibid).

Trend #2: Degree of internationalisation of core firms rises slowly but steadily

The internationalisation of R&D develops much slower than the internationalisation of sales and assets. But the R&D activities of firms are gradually becoming more international. This process departed from different levels of internationalization and therefore diverges for various home country bases. In the 1994-2002 period, the share of R&D in the affiliates of US MNEs for instance rose from 11% to 13%. For Swedish MNEs (largely as a result of the take-over of core Swedish firms by foreign investors) the figure rose from 22% to 43% (Unctad, 2005). As a result, foreign affiliates are assuming more important roles. Unctad (2005) estimates that between 1993 and 2002 the R&D expenditure of foreign affiliates of MNEs worldwide climbed from around U$ 30 billion, to U$ 67 billion (or from 10% to 16% of global business R&D). The rise was more significant for firms in developing countries, than in developed countries. This illustrates the fact that core firms from developing countries are in a big need to complement their weak national systems of innovation by searching for strategic assets in the developed economies.

Trend #3: Centralised decentralisation as major challenge

Core companies are increasingly seeing innovation as a 'network' approach. They involve other core companies in their own network and aim at 'informal' innovation through innovation through networks with local companies and institutes. New techniques used by core companies are venturing and different types of (outsourcing) partnerships. European firms outsource an average of 18% of their R&D investment (EC, 2006). This figure seems lower than in the case of Japan and/or the United States and some of the developing countries. New products and technologies are developed in close consultation with customers and other stakeholders. This process is better known as 'open innovation' (Dearing, 2006). It requires decentralised management structures of a large number of technology agreements with stakeholders in relevant locations. Yet, most commonly, their prime R&D networks remain at home. A considerable number of firms is therefore still relatively conservative in the internationalisation of R&D (almost 40% of a sample of 200 multinationals did not anticipate any change in their worldwide R&D distribution; EU, 2006). The company's home country in many respects continues to be the most attractive place for locating R&D investments.

Trend #4: No trade-offs in locational decisions

Relocation of R&D (i.e. closing down one site in favour of another site in another country) is not a dominant motive (Thursby, 2006). Although most managers expect their global investment in R&D to grow (EC, 2006), the developed or emerging country sites for R&D locations are considered no substitutes for each other. For developed countries, strategic assets (quality of R&D personnel and related infrastructure, as well as level of IP protection and a predictable legal framework for R&D) are important locational factors, whereas for developing countries market growth potential provides a strong incentive for location. However, the lack of regulation (in particular of IP protection) is considered a major risk of investing in developing countries. Cost (and related tax breaks and/or labour costs) do not appear anywhere as a dominant motive for location.

Understanding the Main Reasons for Globalisation of R&D

The main reasons for the globalisation of R&D can be seen in the firms' attempts to lower rising global costs of R&D and mitigate risks in product development. Also, in certain industries such as high technology, medical devices, textiles and micro electronics shortening product life cycles can be a primary reason for moving R&D abroad. Finally, reasons such as increasing multidisciplinary complexity of technology, requiring large and lateral research teams, as well as the intensifying competition on global markets, have been highlighted as main reasons for the globalisation of R&D.

Figure 1. Global share of R&D 2006

Region	Share of global R&D
US	31.9
Europe	23.2
China	14.8
Japan	12.5
India	4.0
Other	13.6

Source: "Global R&D Report"

The expansion of investments in R&D in countries such as China and India are not isolated events, but should to a large degree be ascribed to changes in government policies and emphasis on the investment and structural conditions for R&D. Also, in order to enhance military strength, direct investments have been a key instrument in the expansion of R&D budgets in e.g. China.

The liberalisation of economies in both China and India has been paramount to attracting private investments and expanding companies in both the domestic and international markets, and policies and regulation encouraging foreign investment and ownership has been a significant driver in the emergence of new businesses. Further, the development of education systems and an emphasis on the availability of a highly-educated workforce in areas such as information technology, engineering and biotechnology, as well as the availability of skilled or semi-skilled workers have been drivers of both the development of India and China.

Finally, foreign multinationals have thus been part in developing the economic systems of India and China by investing in new subsidiaries, joint ventures as well as outsourcing both manufacturing and R&D.

Figure 2. Global R&D spending by private industry 2006

Country	Spending EUR Bn	Average growth over 4yrs
US	167	10.4
Europe	137	5.6
China	1	10.0
Japan	80	5.9
Rest	30	-
Total world	415	

Source: The R&D Scoreboard 2006

Outsourcing goes beyond IT and business process operations, to also include strategic activities, production, delivery of core product and services, and sales and marketing. A recent study by PWC shows that 32% of companies that outsource, actually outsource a varying degree of R&D activities.[1] In the manufacturing industry, the outsourced R&D

processes have until now centred on materials innovations, new innovations, new process innovations, electronic design, component design, software design / development. Some surveys of industry in the US indicate that as much 23% of outsourced R&D also targets basic research, and 47% targets applied research.[2] The results of these surveys further indicate that outsourcing of R&D is not only limited to low-level or trivial research, but also targets high ends of the R&D value chains in major industries. Beyond the outsourcing of research to Asia, South America and other low-cost areas, US and European companies also increasingly outsource R&D across the Atlantic. According to surveys, more than a third of US companies involved with R&D plan to increase the outsourcing of R&D to Europe[3], and Intel has set up R&D centres in countries such as Brazil, China, Egypt and India to research in platform definition and other new generations of high-tech components and infrastructure.[4]

Figure 3. Distribution of sales of top R&D Leaders from each Industry

Company	Industry	Country	R&D EUR M	EU	N. Ame.	Rest
Intel	Technology hardware & equipment	USA	4,995	21	15	59
Volkswagen	Automobile	Germany	4,667	73	14	13
Matsushita	Leisure goods	Japan	4,645	13	14	72
EADS	Aerospace & defence	Netherlands	2,710	40	26	34
Bayer	Chemicals	Germany	2,160	44	27	30
BT	Fixed line communications	UK	1,212	96	3	0
Royal Bank of Scotland	Banks	UK	548	82	17	1
Lagardere	Media	France	433	73	12	15
Cadence	Software	USA	412	18	48	34
Kirin	Beverages	Japan	237	3	3	95
Ajinomoto	Food producers	Japan	233	10	7	83
Alcan	Industrial metal	Canada	220	47	36	17
Tchibo	Food & drugs retailers	Germany	125	85	8	7
Telenor	Mobile communications	Norway	118	84	0	14
Store Enso	Forestry & paper	Finland	100	72	17	12
Suez	Gas, Water & multiultilities	France	97	79	10	11
Anglo	Mining	UK	38	46	9	44

Source: The R&D Scoreboard 2006

Due to the outsourcing of R&D, many Asian companies that have gained knowledge through R&D partnerships with leading multinationals have managed to move up the value chain within the multinationals' ecosystems. Many of these new players have created similar capability-building processes, and succeeded in creating product platforms, on which they can create their own intellectual property Currently an estimated 20 to 30% of global clinical trials are outsourced to developing countries.[5] This has persuaded local governments to improve clinical research facilities. In countries such as China and India, the access to high-quality healthcare, although often limited to certain parts of the population, adds to the benefits of R&D outsourcing.

Studies in the implications of outsourcing have questioned whether effects on performance can be directly measured. No general linkages across industries have been found between outsourcing and company performance, however outsourcing has been found to interact with strategy and environmental factors in other ways; strategies such as cost leadership and innovation differentiation can be further leveraged, and some companies, even when operating in stable environments have been found to achieve performance increases via outsourcing (Gilley, 2000).

Figure 4. Overview of Outsourcing Characteristics of Selected Industries

	Automobile	Electronics	Pharmaceuticals & Biotechnology	Aerospace	Software	Telecom equipment	High Technology	Professional services
Examples of leading firms	Ford, VW	Philips, Samsung, Siemens	Eli Lilly, Pfizer, Novartis, Bristol-Meyers, GSK, J&J	Airbus, Boeing	IBM, Microsoft, Yahoo	Ericsson, Alcatel, Lucent, Cisco, 3Com	Intel, Qualcom	Accenture, Cap Gemini
Drivers of outsourcing	Low-cost manufacturing, access to markets	Access to markets, access to R&D centres.	Outsourcing of non-strategic process, contrac research	Access to business systems, access to engineers	Access to staffing, low-cost of labour, access to talent, purchase of best-in-breed	Market access, purchase of best-in-breed technologies and R&D	Access to talent, access to best-of-bredd companies	Access to staffing, low-cost of labour, language skills
Innovation systems	Complex supply chains, with large parts of R&D outsourced to suppliers supplying the whole industry. Integration with other industries such as nanotechnology, design and IT	R&D partnerships, collaboration with universities on basic reserch, R&D centres or outsourcing for applied research.	Long development times, focus on pipelines and screening. R&D outsourced	Combination of inhouse and outhouse design, strategic R&D projects.	Inhouse software development and client-based R&D in programmes. Application and implementation partnerships.	Inhouse R&D, software / developer networks	Inhouse R&D, purchase of complementary technologies	Inhouse R&D, purchase of branded productd or companies, businessmodel flexibility to develop new services
Global hotspots	Europe, China, South Africa, Brazil	Taiwan, Korea, China, India, japan	India, China, Brazil	US, Europe, Russia, India	India, China, South America (incl. Mexico), Russia, Eastern Europe	China, India	China, India, Europe, US, Brazil	India, China
Focus of outsourcing	Materials innovations, sub-components, process innovaiton	Electronic & component design, process innovations, new materials	Clinical trials, testing, molecule-processing	Special engineering skills, software design, new engines	Development, maintenance & support	Convergence, software development, imposing standards	Basic research, wireless & broadband technologies, convergence	Business process outsourcing, advanced business services, accounting services

Figure 5. Primary Industries for R&D by Country

US	Europe	China	India	South America	Russia
Nanotechnolgy	Medical Devices	Production technologies	Software	Clinical trials	Aerospace
Biotechnology	Automation	Pharmaceuticals	Pharmaceuticals	Automotive	Software
Network technology	Automotive technologies	Consumer electronics	Business processes		
Microelectronics	Software	Telecommunications	Clinical trials		
	Industrial engineering		Electronic components		
	Microelectronics		Industrial automation		
			Engineering		
			Consumer electronics		
			Automotive		

Drivers of Outsourcing

Some of the main reasons for firms to engage in offshore outsourcing is to support R&D in pre-existing manufacturing or marketing facilities, establish facilities tailored to specific R&D activities or contracting with independent sources of R&D such as universities or private laboratories. Hence, establishing R&D operations in target markets is often intended as a method to overcome barriers such as the speed in addressing problems or opportunities in the local markets; or understanding and adapting to local practices and regulations. Local operations may also be influenced by the quality of available resources, infrastructures and materials, or for purposes such as securing local licenses or permits.

The main perceived value derived from outsourcing or off-shoring R&D often involves basic economic rationales such as to improve R&D cost effectiveness and increasing overall competitiveness. However, also less quantifiable, yet strategically important issues such as the creation of a global R&D infrastructure, increasing overall R&D capabilities and building new markets rank high among the reasons for multinational firms to invest heavily into to outsourcing R&D.

Consequently, outsourcing to countries such as China and India maintains its basic attractiveness, as long as there is an abundance in qualified R&D personnel available at competitive prices. The maintenance of R&D centres in these countries also has an additional benefit, as the presence can lower direct costs of research relevant for adapting to local conditions. Thus, building local R&D centres brings with it a strategic investment in advantages of proximity, as the economies of nations such as China and India grow and become important markets. In fact, around the world key public procurement such as defence or healthcare is linked to localising related R&D investments, which has in some cases influenced multinationals localisation of R&D investments.

IBM and Outsourcing

IBM has a long history of outsourcing R&D and doing business abroad. After several waves in which IBM has been expanding and reducing the number of R&D facilities throughout the firm's history, IBM today has limited R&D to eight laboratories worldwide. However, IBM has recently understood that R&D is not necessarily limited to certain research sites, and has consequently found ways of funding high-level R&D by linking it to consultancy projects, and thus charge a premium to its clients. For low-level R&D, IBM employs a more traditional model in the form of a global sourcing strategy, where activities are placed where they are done best and most inexpensively. Consequently, IBM today has more than 50,000 IT employees in India and research in software for health care, insurance as well as software to testing language skills, and is ready for further expansion in India is necessary to maintain a low-cost R&D base.

Multinationals with diverse R&D strategies in terms of geographical presence have been shown to obtain advantages in the ability to develop new technologies, due to a more diverse base of researchers, as well as ease of entry into new markets. This includes also development of new processes that cater for local or regional means and cultures, and products for new and emerging markets.

Figure 6. Drivers of Outsourcing

Drivers of Outsourcing
Low costs
Access to skills
Linkage to key hubs
Access to markets
Scale of R&D facilities
Recruitment potential
Language skills
Willingness to take on new skills
Increasing business-model flexibility
Access to best-of-breed companies
Access to local networks
Adoption standardisation
Avoid regulatory challenges

Low costs – One of the key drivers of global outsourcing of R&D is undoubtedly the aim to maximise cost efficiency, by taking on staff in low-income countries with large pools of skilled labour. Despite massive annual pay rises, engineers and researchers in countries in Asia, South America and Eastern Europe are still between 15-40% of the costs of engineers and researchers in the US and Europe. Lowering costs can either enable more competitive bidding, support low-cost strategies, or can be used to staff up to improve time-to-market, slash research times, or engage in new and more rigorous processing of e.g. molecules in the pharmaceutical industry to improve pipelines and overall competitiveness.

Access to skills / highly educated workforce – With the vast number of engineers trained in the emerging economies, these markets provide an abundant source of engineers to bridge the gap between supply and demand of skilled labour such as engineers and programmers in the western economies. Despite the ongoing debate on quality, companies such as IBM and Accenture are staffing massive R&D centres in India with part of the countries annual 600,000 engineering graduates. The same tendency can be seen in other outsourcing destinations such as Russia, Ukraine and Hungary, where access to the large and advanced base of researchers, Phd's and engineers within strategic industries, enables western companies to tap into the countries historic knowledge and skill bases in areas such as aerospace, computer programming and mathematics. The challenges, however, are that working cultures might be radically different in different parts of the world. Consequently, IT companies experience the return to more hierarchical management methodologies in countries such as India and China, and challenges with retaining experienced employees in non-managerial positions, making horizontal careers and the development of experienced specialists a challenge.

The flow of hiring does not only go from west to the east. Recently, the recognition in some Chinese companies that the quality of the countries graduates and skill base is still suffering has sparked Chinese companies to set up R&D centres to get access to traditional high level of skills of German engineers. Consequently, the pattern on the world markets for access to skills are not unilateral, but increasingly shows behaviour of synergies and a more Pareto-optimal distribution of skills across national borders.

Linkage to key hubs – the geographical placement of R&D centres also relates to the proximity to current or future global hubs, in relation to market access, branding and access to recruitment. Further, the strategic localisation of activities may also be driven byexpectations (or bets) on the likely future hotpots of innovation, or just as importantly, those places with strong linkages to such future hotspots for historical, cultural or economic reasons. Such placements enable R&D centres to build local networks with firms, government and universities in linked low-costs locations, and use the linkages to global hubs to improve market-ties.

Access to markets / presence in future growth markets – Despite the improvements in global trade and global access to markets, proximity in national economies are still important for access to national and local markets. Proximity enables international firms to develop increased sensitivity to local customs, culture and understanding through hiring national experts with insights and knowledge of the market conditions. Proximity also enhances the possibilities to build partnerships and networks which can leverage local insights and knowledge, and thus improve the basis for the integration into the local economy.

In economies such as China and India, local presence can be paramount to securing long-term access to markets not just for political and cultural reasons, but also for the purpose of producing at the local cost-base, thus maintaining competitiveness as well as brand awareness in the emerging markets. The Swiss pharmaceuticals company Norvartis, is current expanding R&D facilities in China for this reason, despite the recent problems of Pfizer in securing protection against copycats of it Viagra drug. Finally, presence in emerging markets means global firms are gathering important knowledge and experience of the local market conditions, business culture and political landscape for future use as the markets grow. Such market knowledge is of vital importance, as brands and key competitors are emerging. This knowledge can also be obtained at a very high cost, as some US companies have experienced by going very early into China, and by learning the hard – and expensive – way how the Chinese markets work in relation to R&D, partnerships and protection of IPR. An important aspect here is the global firms' ability to assess the local markets on the dimensions of market size, potential future revenue stream, quality of recruits and the competition. Some of these lessons have been learned the hard way by western companies, as the national strategies of e.g. China and Russia are still unclear, or changing, as the countries economies evolve.

Scale of R&D facilities - the ability, for the same costs to hire 3 or 4 times as many researchers, or have access to hire from massive pools of candidates such as from the universities of India and China, is in some industries a key driver of the location of outsourced R&D facilities. For IBM this has been a quick way to internationalise R&D, and quickly staff-up on low-cost programmers and engineers. For other industries it has been a strategic move to locate activities in areas with large reserves of knowledge workers to have the ability to quickly grow R&D operations further and to avoid recruitment bottlenecks as seen in Western Europe in certain skill-areas such as engineering and programming resources. For the pharmaceutical industry, it has meant new competitive drivers linked more to quantity, instead of traditional quality, in research. The ability to screen massive numbers of molecules, do 24/7 research, or have access to large populations for clinical trials, means that mundane activities associated with the R&D efforts can be stepped up, with the decisions and core research being lead form facilities in the US or Europe.

In other industries such as engineering, it means that less advanced engineering tasks such as design of circuit boards, application of technologies and testing can be done by cheap engineering resources in R&D centres or through contract-research, focusing US and European engineering capabilities on further development of leading-edge technologies. The ability to create massive R&D facilities, either fully owned, in partnership or through contract research, has also meant the ability the derive economies-of-scale in areas which can be more or less standardised. Scale and speed of R&D based bulk and size, instead of quality of R&D

departments have gained new meaning as a driver of competitive advantage for R&D companies.

Recruitment potential – for companies in software and IT, the access to sheer numbers of engineering graduates is a driver in itself. For IBM, the ability to launch a new R&D centre in India has given the company an opportunity to re-enter a market it left many years ago, and to quickly scale up global capacity to service its clients with low-cost resources for tasks which require massive manpower. These service areas include maintenance, support but also R&D-intensive tasks such as the development of industry-grade software and application integration. For a number of IT companies, the ability to scale up in regions like India is also part of their branding and marketing efforts to show a dedication to stay competitive, have an international focus and offer their customer access to low-costs engineering resources.

However, behind the drive for outsourcing e.g. software development evidence is still lacking about the true costs of such outsourcing of projects. Consequently, IT projects in the shipping industry for companies such as Maersk Sealand have shown that the costs incurred through the need for increased coordination, monitoring, high turnover in Indian companies, quality control, and also quality deficiencies, coupled with annual increasing wage rates of 10% to 20%, can severely influence the total costs of outsourcing.Outsourcing of software services are therefore increasingly seeking other competence centres such as Russia, Ukraine and Hungary, where there are strong software traditions, higher quality, proximity to European countries and in some cases lower wages by comparison with Asia.

Some studies also suggest that the numbers of engineers in India and China are overstated.[6] With the US turning out around 70,000 engineers, India 350,000 and China 600,000, the quality and skills of the engineers are debateable. Despite educational programmes in e.g. India in software development being designed and set up in part by engineers returning from the US, the sheer numbers of graduates and resources allocated to each graduate, questions the attention and level of skills, though without any conclusive evidence. China has been accused of overstating the number of engineers to attract foreign investment, and in some cases upgrade the official position of low-tech workers to skilled workers with industry-specific skills, and inflate educational achievements to boost the number of graduates within hot areas.

Language skills – a major driver of the outsourcing of software to India has been the historical high fluency in English, due to the countries' past as a British colony. The outsourcing of business processes, call centre operations as well as more advanced R&D processes, have been eased by the ability to communicate in English, and thus made the country a choice for US and many European firms. For European firms outsourcing to countries such as Russia, Ukraine and Poland has been hindered by low fluency in the main European languages such as German, English and French, and has lead to some European firms selecting India for outsourcing opportunities, despite the proximity and other advantages of the European neighbours. However, countries such as Romania, which have had traditional strong ties to e.g. France, have successfully created a niche market as the place of choice for outsourcing from French companies in software and other industries.

Willingness to take on new skills / training – the willingness of the workforce to be retrained in asset-specific skills, such as new languages – even certain accents and limited language areas – or call centre functions and local accounting rules, have lead to countries such as India being able to build companies that focus on functions with direct customer contact in other countries. The low costs of labour means that it may also be relatively inexpensive to train and re-train workers to handle skills that are normally depending on local aspects such as language, knowledge of local rules and regulation etc.

Increasing business-model flexibility – the ability to develop parallel organisations with different processes, to quickly expand and contract huge operations, and to conduct inexpensive retraining of staff in completely new fields, provides new opportunities for innovative companies to experiment with alternative business models, or to take risks in new markets, product- or service-lines, with relatively low financial risk. IBM's ability to scale IT engineering through Indian facilities is one example, the significant lowered financial risk of developing new ventures in outsourced locations, such as Skype in Estonia or Google Earth in Bangalore, provide new possibilities for experimentation with new business models, which otherwise would be deemed too costly or too risky.

Access to best-of-breed companies through joint ventures in new and emerging markets and economies – in R&D locations such as eastern-Europe, Russia and China, the presence in local market provides access to best-of-breed companies with specialised competences, presence in key markets, or special strategic positions. Yahoo's purchase, come merger, come joint venture with Tao-Bao in China is an example of how US firms, as late comers to recently deregulated markets, can use their early presence to take a first pick at leading companies, even though it comes at a price. Ebay's purchase of Skype, a leader in voice-over-IP communication was an example of a leading European company, originally with the software base developed at R&D facilities in Estonia, coming under US ownership. In some cases, entire Indian companies have been purchased to accelerate recruitment.

Partnerships with biotechnology companies to boost new product development – small biotech start-ups in Europe and elsewhere are being targeted by international firms to boost their pipeline, effectively creating outsourced R&D operations, though targeted towards specific aims, through direct and frequent corporate buyouts.

Adoption standardisation and of collaborative practices and processes in global supply chains – for some industries, the option of owning or creating joint ventures with foreign subsidiaries or R&D centres is a conscious strategy to enforce standardisation of supply chain processes. This can be logistics, manufacturing or spare parts design and production firms, or it can be R&D facilities in logistics, such as the RFID centre in Denmark being approached by the US military as well as Wal-Mart for the purpose of directly or indirectly influencing the standardisation of RFID.

Avoid regulatory challenges – the prospect of looming trade wars, spiring economic nationalism or tight regulatory regimes on areas such as stem cell research, or environmental concerns, has lead firms to outsource R&D to foreign locations to gain access to areas with less strict regulations on certain issues. Biotechnology R&D facilitie are operated in Singapore, or via subsidiaries in India and China, to avoid barriers or political backlash. The strategy, however, is not only limited to western companies, as Japanese car-manufacturers successfully deployed this strategy in the 1990's, and set up R&D facilities, joint ventures, as well as manufacturing facilities, to avoid the consequences of US punitive taxes on imports from Japan. Consequently, the outsourcing of R&D, as well as manufacturing, is also a pattern of the increasingly interconnected global economy, which makes traditional instruments to control and enforcement of national trade policies more complex to implement and predict.

Barriers to Outsourcing

Despite the many drivers for outsourcing, several factors linked to the integration of economic systems, the emergence of economic hotspots on the global stage, and the new political and economic landscape become barriers for the successful outsourcing of R&D across international economies.

Figure 7. Barriers to Outsourcing

Barriers of Outsourcing
Infrastructures
Quality control
Control of processes
Protection of IPR
Commercial hold-out
Partisan or inefficient judicial systems
Lack of international standards
Language
Work Culture
Economic nationalism
Impact on branding
Safety concerns
Ethical concerns

Infrastructures – significant challenges to outsourcing are the physical as well as intangible infrastructures of the developing economies. In the case of physical infrastructures, these are often transportation and access via airports, hotels, broadband access, phone lines, electricity, advanced facilities such as laboratories and other high tech installations. Intangible infrastructures can be anything from the time to incorporate a company, quality of legal services, quality, availability and reliability of services such as electricians, masons and other craftsmen, or ability to manage cross-border financial or IP flows. The investments required to take many of the emerging economies to western level are massive, and may be beyond the initial economic leap forward, as trade surpluses need to be reinvested in developing tangible and intangible infrastructures instead of being used to fuel the primary production of goods and services for foreign companies.

Quality control / loss of control of processes – major challenges persist in maintaining the quality of outsourced R&D, and control how services are delivered within an organisation and to its external partners. Challenges can relate to skills, culture or communication, and can be found in the inability to scale the firms control and support systems fast enough, as well the inability to conduct proper training, or the lack of sufficiently skilled candidates for the tasks ahead.

Consequently, firms are faced with new challenges to adjust or re-design quality control procedures and business processes to fit the requirements of the foreign subsidiaries. In the case of widespread local supplier networks, contract research or outsourced processes to local second- or third-tier companies, the results of the standard quality control systems can become highly unreliable, and more rigorous testing needs to be implemented. There are cases with Chinese suppliers misunderstanding the European CE mark on consumer products tied to single products, mistaking them for overall approval of the supplier, thus putting these quality marks on products without adhering to safety regulations, or producing low quality batches and still supplying them with the same marks of quality.

Other cases involve counterfeiting or parallel production of drugs of inferior quality, such as malaria medicine, for local markets, which end up on global markets with severe consequences for users as well as the brand owners. Sufficient quality control can also be hindered by lack of implementation of global standards in the local R&D systems, insufficient education, or cultural or other unwillingness to perform according to company procedures. Such conditions require an increased use of monitoring and control or, as many software development companies have done, redesigning work procedures for the foreign R&D centres to tailor them to specific work cultures or specific outsourcing destinations.

Control of proprietary knowledge / protection of IPR - the joining of the WTO has meant that new and more rigorous IPR protection regimes are required to be imposed in countries such as China and India. Originally, countries had a transition period of 10 years to impose new regulatory frameworks, and ensure the proper protection was put in place. The reality however is that new regulations have only been introduced at the end of the grace period, and taking significant time to implement, not just in the legal codes, but also in the practicalities of the judicial systems as well as in the business culture.Although the protection of IPR can be serious barrier to attract foreign R&D to developing countries, implementing proper protection systems require fundamental changes in the make-up of the countries' political, cultural and industrial systems, which in turn delay their implementation.

Another challenge to foreign investment into R&D are the conflicts related to access to the producers in areas such as drugs and cures for major diseases in emerging countries. South-American and African countries have contemplated forced licensing of patents and IPR of drugs owned by foreign companies to treat pandemics such AIDS, in an effort to lower prices of such drugs and increase access to therapy. This has stoked an outrage in the pharmaceutical industry threatening to undermine the industry's willingness to continue investing in research into cures for diseases associated with the developing world, as well as to reduce the amount of foreign investment into R&D in the same countries. Fears stem from the expected reduction in revenues and hence in thereby the justification of research budgetsas well aspotential loss of control of R&D results from operations in the developed world.

For the US and EU there are challenges in industries linked to military R&D such as aerospace, software and microelectronics. Outsourcing of R&D can result in industrial espionage or the transfer of technology for military use to potential future adversaries. Such considerations have been linked to e.g. networking equipment, development of chipsets and other high technology research, and show that there is a political reality beyond the economic rationales for the outsourcing of R&D. The problems of unsanctioned technology transfer have created outrage in areas such as high speed trains, telecommunications equipment and industrial engineering, with military-owned Chinese companies such as Huawei climbing fast up the value chain through a combination of joint ventures, after which telecommunications equipment from Cisco has been effectively copied and resold at discount prices to the world markets.[7] Similar cases can be found with Siemens know-how on magnetic levitation trains possibly being copied to the benefit of Chinese manufacturers; the copying of technologies for developing concrete factories from FLS Schmidt industries; and Indian pharmaceutical firms copying process technologies form Lundbeck.

In 2006, China repealed Pfizer's patent on Viagra, a market which has already been undermined by Chinese producers of the drug, working without repercussions in China. There are many potential leaks across the research pipeline, which makes outsourcing of R&D in strategic areas potentially hazardous to firms' knowledge base. Some US lawmakers have already started warning companies about outsourcing R&D to China, in the case of military tensions with the US

Commercial hold-out, due to improper management of collaborative or third-party relationships – many western companies have experienced that joint ventures in local markets resulted in painful break-ups, and the company's brands, production facility, market access or work force being taken hostage by local partners.

Partisan or inefficient judicial systems – the challenges of emerging economies also relate to the ability to build efficient intangible infrastructures such as banking, government, regulatory authority, as well as efficient and reliable judicial systems. For foreign companies to invest in local markets and be willing to do R&D and develop new products, they must have reasonable assurance that their investments and as well the agreements that govern relationships will be protected by fair and impartial legal systems. Recent cases from Russia and China show that this is not always the case.

The problems of BP in the Sakhalin-2 project have been difficult to challenge, since the allegations are complex and link to legal areas that are ambiguous, arcane and politically biased, such as the Russian tax system or environmental regulations. Similarly, challenges are found in China where manufacturers are known for producing extra copies, outside of contract, for the local markets from the same assembly lines, or sometimes building identical copies of the same factories. Some of these products end up being exported as pirated copies, with the Chinese government doing little to stem the supply. For India, the challenges can be the ability to wait for a court ruling on commercial cases, which can be delayed and take up to ten years even for the first steps in the judicial system.

Lack of international standards – As international players establish R&D centres in emerging economies, it is often overlooked than many of the costs advantages come with clear deficiencies in the intangible infrastructures as well as lack of knowledge of internationalisation best-practices and know-how. There exist vast variations in the application of international standards for research and manufacturing across the developing economies. To address these issues, India has recently amended the schedule Y of the Drugs and Cosmetics Rules of India, to clarify the environment for clinical research. In China, the government has imposed regular monitoring of clinical trials to ensure good clinical practice and compliance with international standards in research centres. The low costs advantages cannot in the long term sustain challenges to the quality of activities and output from China and other Asian developing economies, and consequently, avoiding further scandals in research results and exports are paramount to keeping the overhead of managing security and quality in the R&D centres down, to compete with economies such as India. Furthermore, the requirements of international standards make it difficult for firms in the emerging economies to move up the value chain, and hence can pose limits to the scale and scope of activities, which can be outsourced, from international firms.

Language – insufficient language training, the unwillingness to acquire new language skills and the resistance to introducing new languages in both emerging as well as developed economies, can work as barriers to harvesting the countries' status as preferred locations for outsourcing. For China, the Chinese language poses a challenge to western-style contracts, and the insistence on global standards for communication, often in English, requires the Chinese to invest in training of its workforce, which works as a disadvantage vis-à-vis neighbouring India. For countries such as Poland and Ukraine, the tradition for speaking Russian as preferred second language, has meant that programmers, engineers and other professionals have challenges communicating with R&D teams in their western parent organisations, and have in some instances lead companies to choose the longer journey to India for new R&D centres or outsourcing of other functions. The challenges of language are, however, not limited to emerging economies. The unwillingness of France to adopt English, has lead to challenges regarding the placement of R&D facilities by European and US companies, and in some cases created parallel cultures or isolated research communities in major research hubs near Paris and Nice / Cote d'Azur.

Work culture – inclusion in the world economy also means the adoption of new customs for work culture and the ability to understand and implement the processes of western firms in traditional societies. In India, several western firms have experimented with western-style management, but have had to adjust to more traditional and hierarchical management to accommodate for the local work cultures.

Other clashes of culture in the software development industry have been the willingness of Indian programmers to hand over their code for testing by other programmers, which is normally associated with a strong sense of ownership. In China, local managers are often paid equal to their western counterparts, despite the lower-level of compensation for their, based on the managers' ability to navigate the local business culture, speak the language and behave as is expected in the local context. Finally, factors such as gender specific issues, religion, corruption, and nepotism are also challenges to merging work cultures across international supply chains, and are posing challenges to harvesting expected synergies from the global outsourcing of R&D.

Economic nationalism – despite the increasing integration of global markets and global supply chains, the economies of emerging countries such as China and Russia, still serve as drivers of global political influence as well as tools supported underlying nationalist emotions. The speeches of Chinese leaders concurrently underline the ambition of China to become an economic superpower, and preferably by the emergence of domination by Chinese firms. The original joint ventures imposed on foreign firms entering the Chinese markets enforced majority ownership of Chinese firms in any joint ventures, and many sectors are still protected from majority foreign ownership for reasons of national as well as economic security. Recent moves to hinder Chinese take-overs of US oil firms, Dubai services-firms to run US harbours, Scandinavian firms protection from foreign ownership by placing ownership in special foundations, all underline that economic nationalism, in one form or the other, is not only the act of emerging economies, but just as widespread in the political and economic landscape of developed nations as well.

Impact on branding – brands such as BMW have had problems with brand identity after production of cars, parts, as well as R&D, in developing countries become more and more widespread. The traditional brands based on national identity as marks of quality and exclusivity are under pressure when taking advantage of low costs and access to talent in other countries.

Multinationals such as Apple have successfully created a proactive brand awareness by labelling all their products as 'Designed in California, Assembled in China' to communicate their use of outsourcing almost as an enabling, and value-adding factor (possibly using smart outsourcing in production to enable more investment in design innovation).

Safety concerns – recent problems with counterfeited Procter and Gamble products coming out of China containing dangerous chemicals, have underlined the problems of safety concerns, due to lack of controls in the new global manufacturing chains. Scandals in stem cell research in Korea, also underline the fierce competition and new challenges to traditional control systems of scientific results. Increased pressure is placed on traditional safe guarding mechanisms such as clinical trials (already 20-30% of global clinical trials according to some sources[8]) that are conducted under developing countries legal regimes, or in areas with different traditions for control. Traditional brands can come under pressure if factors outside of their control create scandals in consumer safety, due to outsourcing of activities and subsequent loss of control.

India has recently made amendments to the Drugs and Cosmetics Act, governing clinical trials, and China has improved monitoring of research centres to ensure compliance with the

Good Clinical Practices standards. The problem is also present in other industries, such as automotive. Recently, Toyota, with a global network of produces and suppliers to spark growth has experienced declining quality, with the resulting deterioration of brand value. However, attempts to comply with international standards are undermining some of the competitive advantages the emerging economies enjoy, and the motivation to zealously pursue the control regime can be under pressure from other forces. In addition, the recent scandals over corruption in the high levels of Chinese governmental levels on food safety show that the basic control mechanisms can be seriously flawed.

Ethical concerns – in the rush to lower costs, western companies have run into ethical concerns about the practices of they suppliers in many areas such as child labour, labour laws, workers' rights, use of toxic substances, pollution as well the clash of religious, political or cultural values, which spill over to the economic sphere.

The outsourcing of jobs to emerging economies is still a hot issue in western politics, debated on many levels such as the erosion of the western manufacturing base; the replacement of blue and white colour-workers whilst top management retain their positions (such as IBM top-management was accused of when they publicised their intention of opening R&D facilities in Bangalore, India); and the loss of knowledge advantages through the transfer of intangible capital to foreign R&D subsidiaries and third party firms.

In the pharmaceutical industry, part of the attraction of outsourcing is access to more lax regulatory regimes, clinical trials, and R&D, which exploit the work and skills of the emerging population while passing little IPR value to the country, and often pricing the end-products out of range for the countries' populations. In the recent debates out CO_2 emissions, China, alongside other developing nations, has begun presenting the case that the emerging economies should be exempt from reductions. One core argument is that thedeveloped world has already had its industrialisation, whilst the developing world is only beginning to develop the same living standards. Secondly, it is argued, thatmuch of the emissions are caused by the production for developed countries.

In the areas of wage-cuts, the unions of the western European countries have, often successfully, argued that the employment of cheap eastern-European, Chinese, Indian or Philippine labour is unethical due to the poor working conditions, poor workers' rights for those nationalities, and the unethical aspect of differentiating wages for the same work done, based purely on nationality.

Consequences for Domestic Facilities

For the domestic facilities of the multinationals, there is some evidence that outsourcing or off-shoring of R&D has lead to a reduction of staff , as well as a reduction of funding in existing facilities. However, as the many case studies from leading firms have shown, this cannot be said to be generic, but is instead likely related more to the R&D profile of the multinational in question. There is evidence that the capital-intensive and mature industries of Europe suffer more heavily from the outsourcing of R&D from Europe than the high-technology companies of the US, which to a large degree see expansion into China and India as a driver for growth and new markets, than as an alternative to domestic R&D. In addition, there is evidence that for many US companies, the cost-savings in outsourcing R&D to offshore facilities are re-invested in e.g. basic or strategic research to drive further advantages in R&D.

The current wave of outsourcing from the US and Europe to China and India has been driven by industries such as pharmaceuticals, software and electronics. But beside the emphasis on outsourcing of R&D to China and India, an increasing number of multinationals now also look to smaller Asian as well as South- or Latin-American economies, especially Brazil and Mexico, for placing R&D facilities within the same industries. The question is thus whether China and India have provided special circumstances for attracting these industries, or whether these industries are the easiest industries to outsource in terms of costs as well as practicalities. Further, the concentration of investments in two main economies is also considered by some multinationals to be a risk worth mitigating to avoid over-dependencies. In all, questions could be raised as to the continuing trends in consolidation and motives for R&D investments after the intensive investment period into primarily China and India.

Some of the lessons learned by multinationals in off-shoring R&D relate to dealing with internal operations, as well as external issues such as policies, legislation, red tape and cultural differences. As one of the main reasons to outsource R&D is the access to lower cost-bases, many firms have been surprised by the total costs of the off-shoring operation when taking into account training, establishment costs and recruitment, lost efficiency and quality issues. Recent studies have shown that only about one-third of US multinationals have so far generated a profit from the operations in China. Also, due to special features of the job markets in e.g. China and India, it can be difficult for companies to deal with the high turnover of employees, and related lack of competence building, experience and track record, as well as the high rate of growth in wages for qualified candidates. Hence, many firms have learned to standardise processes and start with scaled-down operations focusing on e.g. product and process research. However, for multinationals that do manage to create efficiently running subsidiaries, the profits can be very attractive, also taking into account the smaller, yet fast growing markets the Asian economies (excluding Japan and South Korea).

For some firms, it has been critical not to see their off-shoring facilities as isolated entities, but to maintain a high degree of interaction between domestic and offshore R&D teams to enable cross-pollination to lower barriers in communication as well as ease cultural differences. Japan serves as a special case since the country's 2002 emergence from the 1992 recession. With the world highest R&D spending of 3.2% of GDP, Japan is currently refocusing its R&D strategies on increased efficiency in R&D spending, flexibility in allocating public R&D funds, to emphasise non-manufacturing R&D, focus on supporting R&D in start-ups, and strengthen international linkages. However, when looking at the global picture, Japan is the least internationally involved country in the developed world, when it comes to outsourcing of R&D, except in the automotive sector.

The big pharmaceuticals are seeing their business models change from being research-driven to being market-driven, in the sense that boardrooms are increasingly populated with economists, lawyers and accountants rather than doctors and engineers.

After a steady decline in the number of drugs researched for tropical disease, the number of drugs in development of the ailments of the third world are now picking up again with a global pipeline of more than 60 drugs in the making. However, with Brazil's recent threats against major drug makers for compulsory licensing of anti-viral drugs against HIV, leading pharmaceuticals might again pull out of research directed at third would and developing countries.

An increasing number of pharmaceutical firms outsource large parts of their R&D budgets to external researchers and firms, opening up the global market for innovative firms and talented scientists to approach the outsourcing budgets for the leading firms in the biotechnology industry, disregarding their location geographically.

The leading multinationals in the pharmaceutical industry, traditionally re-investing a high percentage of sales into R&D, have built networks of research centres that enable them to tap into resource bases across the globe. Many firms that are headquartered in Europe or the

US, can do basic and advanced research in US and Europe, as well as outsource their clinical trials to, for example, Asia benefiting from the low-cost workforce in more standardized R&D processes. This not only reduces R&D costs, but also serves to cut cycle-times for new products to boost productivity and may also reduce regulatory approval in key growth markets.

Building Global Networks

For multinational companies involved in major R&D activities, the ability to build global networks of R&D for the purpose of product development carries many advantages in the possibility to leverage the capabilities of different regions to build efficient R&D supply chains. Consequently, a more open model of R&D is emerging, where companies sees good ideas not only emerging form the inside, but also coming form the outside, through advanced R&D networks, which tap into many markets and many diverse talent pools.

The outsourcing of R&D in some cases leads to decreasing R&D in the companies' home markets. Surveys have shown that over one third of companies in the US outsourcing to Asia plan to decrease R&D in their home countries by over 10%.[9] In the US, the outsourcing of manufacturing has lead to fears that this will at one point have an impact on the R&D capabilities of the nation. It is argued, that an eroding manufacturing base may impact the prospects of US engineers, leading to a decline in the uptake on universities, compared to nations such as India, China and Japan.[10] Despite an average annual rise of 3% in R&D spending in the US[11], R&D in the US manufacturing industry have declined by an estimated 10% since the late 1990's, whilst the expenditure on R&D outsourcing has increased by 15% a year in the same period (with the number of firms outsourcing R&D growing by 7% annually).[12] Behind these numbers, there may also lie an indication that global R&D is increasing, even though the global R&D landscape is changing.There are, however, very diverging results in this area, as many companies end up merely extending their R&D operations with increasing specialisation of R&D functions based on capabilities, improved time to market, 24/7 research, local market access or specialisation along certain technology lines.

Studies in the automotive industry show that the R&D ratio, R&D spending over sales, is closely linked to global sourcing, meaning that vertical integration of new product development across countries tends to increase R&D costs (D'Aveni 1994).

Studies of supplier integration on product innovation in an outsourcing context have shown these effects to be negative (Koufteros 2005), due to the outsourcing of product development to sub-suppliers, leading to less investments in R&D, primarily due to parallel and overarching ambitions to cut costs at the same time, thereby depleting R&D budgets and other overheads.

There are indications, which are also supported by research (e.g. Ettlie 2006), that the ability to successfully manage R&D outsourcing, like other technology partnerships, becomes a competence in itself for firms to harness the advantages of global R&D networks. To take advantage of lowering transaction costs, enhancing flexibility and reducing impact on the environment, firms need to build capabilities to manage these relationships, also in turbulent market conditions. These capabilities include organising process-coordination and integration, learning, reconfiguration of competence profile vis-à-vis environmental issues, and the ability to renew competences.

Despite the current dominance of countries such as India and China, outsourcing has also been popular to other countries such as Japan, Taiwan, Israel and Singapore.IBM has been outsourcing development to Western Europe since the end of World WarII. Texas

Instruments opened R&D facilities in chips and chipsets in Japan in the 1990s to get access to Japanese engineering talent, and to get closer to the market. Singapore has with less strict rules on stem-cell research become a leading area for outsourcing R&D in biotechnology, and consequently developed into an international hub for research in this area.

Europe

Europe's industrial base needs updating, and a large part of the capital-intensive industries have reached the end of their innovation cycle. In addition, as also outlined in the Lisbon agenda, Europe invests too little in R&D. However, with a mature industrial base, increasing spending in R&D can be difficult. Comparing the top 10 R&D spenders worldwide, the European situation, especially vis-à-vis the US becomes clear.

Figure 8. Top R&D spending worldwide

Company	Country	R&D EUR M	Change % Yr	% of sales
Ford Motor	USA	7,767	8.0	4.5
Pfizer	USA	7,223	-3.0	14.5
General Motors	USA	6,503	3.0	3.5
DaimlerChrysler	Germany	6,468	0.0	3.8
Microsoft	USA	6,392	6.0	14.9
Toyota Motor	Japan	6,210	11.0	4.1
Johnson & Johnson	USA	6,127	21.0	12.5
Siemens	Germany	5,903	2.0	6.8
Samsung Electronics	South Korea	5,282	12.0	6.8
GlaxoSmithKline	UK	5,220	10.0	14.5

Source: The R&D Scoreboard 2006

Figure 9. Top R&D spending in Europe

Company	Country	R&D EUR M	Change % Yr	% of Sales
DaimlerChrysler	Germany	6,468	0.0	3.8
Siemens	Germany	5,903	2.0	6.8
GlaxoSmithKline	UK	5,227	10.0	14.5
Novartis	Switzerland	4,705	15.0	15.0
Volkswagen	Germany	4,667	-2.0	4.3
Sanofi-Aventis	France	4,630	2.0	14.8
Nokia	Finland	4,555	4.0	11.6
Roche	Switzerland	4,202	12.0	16.1
BMW	Germany	3,567	11.0	6.7
Robert Bosch	Germany	3,355	1.0	7.0
AstraZeneca	UK	3,280	-11.0	14.1
Ericsson	Sweden	3,127	16.0	16.9
EADS	Netherlands	2,710	2.0	6.9
Philips	Netherlands	2,677	-8.0	7.7
Renault	France	2,593	15.0	5.6
Peugout	France	2,463	2.0	3.8
BAE Systems	UK	2,415	31.0	13.2
Alcatel	France	2,052	15.0	13.6
Finmeccanica	Italy	2,000	20.0	15.6

Source: The R&D Scoreboard 2006

One of the major obstacles to increasing R&D spending in Europe, as opposed to American firms, is the expected return-on-investment shifting from incremental to more radical innovation for European firms. As an example, Lafarge, the French construction group, currently spends only 1% of is annual USD15Bn revenue on R&D in new materials.

European universities are extending their efforts in developing joint R&D projects and corporate venturing projects together with firms. National R&D funding programmes have been set up in many European countries to promote such joint research activities, based on co-funding models, where all partners cover part of the costs.

Corporate responsiveness to such measures varies widely, and no generic assumption can be made about multinationals practices. As an example, whilst IBM globally utilises such in-sourcing and joint venture practices in collaboration with universities extensively, Hewlett-Packard, a key competitor, places more emphasis on collaboration with SMEs as R&D partners – a practice not adopted by IBM. Further, such partnering practices are often linked to historic headquarter or division sites and may not be easily constructed in new locations.

Yet, European (and national) R&D policy and the increase in public co-financing budgets have triggered a review of such joint venturing opportunities between multinationals and public research institutions.

Figure 10. R&D spending of European companies per industry sector

Company	Country	Industry	R&D EUR M	Change % Yr	% of Sales
DaimlerChrysler	Germany	Automobile	6,468	3.0	3.5
Siemens	Germany	Electronics	5,903	2.0	6.8
GlaxoSmithKline	UK	Pharma & Biotechnology	5,227	10.0	14.5
Nokia	Finland	Technology hardware	4,555	4.0	11.6
EADS	Netherlands	Aerospace & defence	2,710	13.5	4.6
Philips	Netherlands	Leisure goods	2,677	-8.0	7.7
Bayer	Germany	Chemicals	2,160	-22.0	6.9
Volvo	Sweden	Industrial engineering	1,288	18.0	4.4
SAP	Germany	Software	1,247	7.0	12.8
BT	UK	Fixes line telecom	1,212	39.0	3.7
Nestle	Switzland	Food producers	1,105	6.0	1.6
TOTAL	France	Oil & gas producers	773	6.0	0.6
L'Oreal	France	Personal goods	568	-2.0	3.4
Royal Bank of Scotland	UK	Banks	548	9.0	1.3
AREVA	France	Electricity	467	1.0	4.0
Lagardere	France	Media	433	18.0	2.9
Henkel	Germany	Household goods	372	19.0	2.7
Saint-Gobain	France	Construction	350	0.0	0.9
Vodafone	UK	Mobile telecom	343	-6.0	0.6
Anglo American	UK	Mining	268	47.0	2.2
Carl Zeiss	Germany	Health care equipment & services	263	10.0	10.4
ThyssenKrupp	Germany	Industrial metals	213	-3.0	0.4
Amadeus	Spain	Travel & leisure	208	19.0	7.6
JM Voith	Germany	General industrial	205	20.0	5.0
Royal & Sun Alliance	UK	Nonlife insurance	203	4.3	1.9
Deutsche Post	Germany	Industrial transportation	200	-40.0	0.4
Tesco	UK	Food & drugs retailers	192	35.0	0.3
RWE	Germany	Gas, Water, Utilities	145	-1.0	0.3
BAT	UK	Tobacco	110	-1.0	0.7
Store Enso	Finland	Forestry & paper	93	7.0	0.7
Deutsche Borse	Germany	Financial	82	-14.0	4.0
Old Mutual	UK	Life insurance	67	300.0	0.3
Co. Generale de Geophysicique	France	Oil equipment	45	17.0	4.5
GUS	UK	Retailers	37	47.0	0.3

Source: The R&D Scoreboard 2006

India

India is still one of the main drivers for outsourcing of the software industry. Microsoft, with 400 researchers in Redmond, and another 300 in offices around the world, is currently investing heavily in India, setting up R&D and technical support facilities for more than EUR 1.3Bn in Bangalore. Intel also has a large R&D lab in India with more than 1,500 engineers, as well as similar sized R&D facilities in Israel, Russia and China. Cisco with its more than 16,000 engineers has been setting up R&D centres in India with an investment value of more than USD 1.1Bn in Bangalore. However, although firms such as Nortel and Cisco have outsourced R&D work to Indian subsidiaries, this is primarily in the upgrading of old products, and not in R&D of new product lines.

Figure 11. Top Private R&D Spenders India

Company	R&D EUR M	Change % Yr	% of Sales
Ranbaxy Laboratories	64	21.0	9.2
Tata Motors	62	29.0	2.0
Dr Reddy's Laboratories	30	26.0	12.5

India is attempting to transcend beyond the notion of cheap labour and outsourced call centres or back office functions. Currently, one of the fears of the US is that major parts of the country's R&D base, and thus its ability to innovate, is being outsourced to Indian engineers. Although companies such as IBM and Texas Instruments have placed research facilities in India, American firms often downplay the role and level of R&D done in Indian firms, or subsidiaries of international firms.

India has the technical skills as well as access to capital, for the country to develop an innovation-driven industry. Yet, it is has been argued that the country lacks adequate business models for how to leverage the potential of Indian R&D to the global scale.

More that 130,000 IT professionals now work in the Indian IT cluster of Bangalore, with the largest Indian IT-services firms such as Wipro, Infosys and Tata forming part of a large cluster for professional services. Infosys has a EUR 120M R&D business, primarily in outsourcing of IT, back-office and call-centres. However, the industry is hoping to increasingly also take on high-value innovation and R&D activities to expand the scope of the outsourcing business.

The outsourcing from Europe to India also goes the other way. Infosys has opened a centre in Brno in the Czech Republic focusing on IT. The Eastern European countries often offer teams that are more controllable and culturally close to the European markets.

Some western companies now hire entire R&D teams in India to manage R&D of projects that the companies do not want to allocate their own in-house engineers to, or as temporary R&D teams. In the Western Telecommunications industry, it is not uncommon to hire teams of over 300 engineers in Indian firms. Recently, SAP has expanded with more than 3,000 engineers in India, and the expansion of SAPs R&D is now entirely focused on off-shoring to especially India, and also to some extend China.

The WTO has improved poor countries access to patented medicines, and countries such as Brazil and India with expertise in producing cheap generic medicine will be able to exploit the new possibilities for combating diseases such as AIDS, malaria and tuberculosis.

Despite the fears by American and European companies that generic drug-makers in e.g. India will start exporting drugs at low prices to the American markets, Indian drug-makers are increasingly looking at expansion into the regulated markets through innovations as well as through generic drugs.

The underlying patterns for the outsourcing of software to India relates to business practices dating back more than 20 years, and are partly ascribed to the massive influx of Indian engineers to the US software and information technology industry. This created strong ties between India and the US and has allowed US-trained Indian engineers to return to India to start companies and change the conditions for education of future generations of Indian software engineers. In addition, this evolution concurred with IBM leaving India due to certain changes in the political context and outlook of the Indian governments, which left a vacuum in the Indian markets for information technology, allowing Indian companies to flourish.

More than 30% of Fortune 500 companies today have R&D activities in India, a number that is expected to increase in the future.[13] Current estimates of the number of foreign companies with R&D functions in India are more than 400, with more than 23,000 workers according to 2006 numbers.[14] Only 0.5% of global chemistry research is carried out in India, and 1% of clinical trials.[15]

The integration with the local R&D systems can however be limited. Over 50% of foreign R&D facilities in India have no local contacts, while under 40% have R&D relationships such as contract research or the likes.[16] Much of the research results achieved in India are commercialised by the foreign companies outside of India, which has the consequences for knowledge and value generated in India only to a limited degree benefit the Indian economy beyond the workplaces created by the R&D industry and the upgrading of the workforce in terms of knowledge, skills and experience. Consequently, there are ideas to place the knowledge generated in Indian R&D facilities into the public domain after a certain period of time, under patent protection or otherwise. Other models also considered include licensing and royalties, which could be reinvested in the higher education systems of India, or an increasing use of public-private partnerships between R&D facilities and the public laboratories for purposes of joint development and joint knowledge creation.

Companies in India are also outsourcing R&D, however currently most outsourcing takes place within India. One such company is Bharat Earth Movers Ltd, which currently has a network of 350 vendors supplying components and hardware, planned to increase by 10% a year.[17] Hindustan Aeronautics is likewise focusing its strategy on outsourcing R&D in production of components and sub-assemblies, but will do so to small local technology centres on a local campus, thus not looking into the global markets for R&D.[18]

The western pharmaceutical industry is sceptical of the pharmaceutical sector in India, despite India being a huge market for medicins and drugs. This is in part due to widely spread copying and production of generic medicines, and the fear that they would further risk losing valuable knowledge to Indian rivals by investing in R&D in India.

AstraZeneca has invested in R&D facilities in Bangalore, specialising in Tubercolosis, and GlaxoSmithKline has initiated joint development projects with companies such as Ranbaxy[19]. However, despite investments in such R&D centres, India does still not figure as a major research hub for AstraZeneca and GlaxoSmithKline.

Biocon have signed R&D partnership agreements with Bristol-Meyers for outsourcing of R&D to India related to services for discovery and early drug development. NPIL have entered into agreement with Eli Lilly to conduct clinical trials globally and to do marketing in certain regions for pre-clinical drugs.[20]

The Indian software industry has been aided by the return of Indian nationals trained at US universities and working in the US pharmaceutical and software industries. India is also developing a position as an R&D hub for electronics hardware. Companies such as Agilent Technology are developing state-of-art-technology for the global test and measurement industry.[21] Wipro employ more than 10,000 engineers for production engineering services in areas such as telecom, computing, storage, consumer electronics and industrial automation, which also features testing and R&D for leading western companies.[22] Consequently, as the Indian companies builds there research based, knowledge and skills, they are increasingly interesting into entering into partnerships in development projects, instead of just doing contract-research and work as outsourcing centres for US, European or Japanese companies.

China

The growth of the Chinese economy in combination with the increase of foreign direct investments into China, has lead to an increase in foreign R&D. Currently, an growing number of large foreign companies are investing in R&D in China. Recent studies have shown that foreign multinationals prefer to invest cautiously and use experience and knowledge from historic operations and networks. Also, multinationals prefer non-equity-based R&D co-operative agreements to equity-based R&D joint ventures.

Chinese R&D has grown to 1.34% of GDP, and China might soon become the second biggest spender on R&D, after only the US, especially in industries such as electronics, telecommunications, biotechnology and aerospace. Similar growth figures are found in the number of researchers, which currently surpasses 1 million, making China number second worldwide only to the US.

Figure 12. Top Private R&D Spenders China

Company	R&D EUR M	Change % Yr	% of Sales
Petro China	231	9.0	0.6
China Petroleum & Chemical	162	48.0	0.3
ZTE	141	-13.0	9.1
Semiconductor manufacturing	46	1.0	6.7
CNOOC	29	50.0	0.6

Currently, Philips is the company with largest number of inventions and patent filings originating from China, yet the total number amounts to less than 1% of Philips overall patent filings. Other large companies taking out patents from Chinese R&D are IBM, Microsoft, Mitsubishi, Siemens and Pfizer.

After the disbanding of the Warsaw pact, R&D spending in China was divided equally by industry and government, with academia only covering around 10% of total R&D spending. However, after 1998 there has an increased percentage of R&D being done by industry. Over the last years, China has seen a tremendous growth in R&D spending of more than 17% on average, compared to the rise in spending in Japan, US and Europe of 4-5% annually. Currently, China's spending equals Japan's spending in 2006, if this is calculated on a PPP basis. However, a large part of this rise in spending is due to the outsourcing of R&D to China, by foreign multinationals.

China is currently the main target for outsourcing of R&D especially in life science, physics, engineering, materials science and theoretical physics, but also challenging India as the number one country for outsourcing in software development. However, Chinese companies have also started making foreign investments in the US and Europe. The recent purchase of IBM's laptop division by Lenovo, and TCL's purchase of Thompson's television division, are examples of Chinese companies acquiring western assets. In addition, the recent shortages of highly-skilled engineers and researchers have spurred Chinese companies to open R&D facilities in Germany, to get access to the highly-qualified engineering and R&D competences of the German industries and educational systems.

In the process of expanding abroad, Chinese companies face challenges to their strategies and traditional modus operandi. Hence, Chinese companies are forced to develop their brands, and their technological and institutional capabilities to compete in the more transparent Western and Japanese markets. Further, Chinese companies in foreign markets cannot rely on their government networks, experience and special access to information that they enjoy in the Chinese markets.

To meet the increased demand for contract research from global pharmaceutical companies in China, joint contract research organisations are now appearing as joint-ventures between leading Chinese joint research companies, and will be able support contract research in areas such as synthesis of new pharmaceuticals, development, tests, lead optimisation, in vitro and in vivo research.[23]

China has until now been the country of choice for manufacturing, where India as been seen as the place to conduct R&D[24]. However, China is evolving together with India to also become the country of choice for the outsourcing of R&D, according to some sources even overtaking India's role as the most attractive global destination for outsourcing[25]. The Nortel R&D Centre in Guangzhou is currently carrying out research in breakthrough wireless technologies such as SIP-based video calls and HSDPA for cross-network roaming.[26]

Microsoft has used its research labs in China to get access to research into special technologies such as speech recognition, as well as getting access to low-cost programming resources.

USA

Spending on R&D in defence is still a major contributor to the American overall investments. However, civilian and commercial technologies are taking over as key drivers to innovations in defence.

US companies are increasingly supporting R&D in their subsidiaries in Western Europe and Asia. In particular, China has grown to become the chosen country for US investments in R&D, topping both India and Western Europe. This is especially due to the ambition of creating a low-cost R&D base in China. Although the number of US deals on outsourcing is increasing, the number of smaller deals with European and Latin American subsidiaries and outsourcing ventures are increasing also. The US is to a large degree building a network of partnering countries, which are expected to be the primary focus for future investments in R&D, and will thus affect R&D investment patterns in the future, not only from the US, but also investments from the partnering countries to the US. Some drivers, which have been highlighted in this process are the increasing availability of talent, the lowering of costs of doing business and the development of the domestic economic conditions of the partner country.

Growing attention is placed by US companies on defending their patents and intellectual property positions, as these are being seen as a valuable asset and source of income of R&D activities. Companies such as Qualcomm and ARM focus on licensing technologies and know-how to the telecommunications industry and with market shares of 80% and 70% in the chipsets and communication protocols for mobile phones, have become virtual R&D companies for many large handset and device manufacturers.

Figure 13. International Patents 2006 based on registered first country of filing

Country	No. Patents
Japan	350,000
US	169,100
Europe	103,000
China	48,000
Russia	21,200
Brazil	4,280
India	900

Besides specific industry sectors, such as electronics where Japanese companies issue very specific patents, US companies are among the most patenting in the world, especially when it comes to software patents. However, enforcing the patents, especially outside US, has become difficult, as the ongoing bilateral negotiations between the US and other key economies, especially China, illustrate.

Conexant

Conexant, a US company specialised in broadband digital communications, was founded 1999 as a spin-off of Rockwell Semiconductor System - part of NASA's lunar program. From originally having a 100% US team of engineers, today 50% of the engineers are located in Asian R&D facilities. The American engineers are the innovators, whereas the Asian engineers take care of implementation. However, the division of labour is expected to have a negative impact on the US teams of engineers in the long run, as the Asian part not only takes on an increasing par of the value chain and also become increasingly innovative, possibly challenging the US status as sole innovators.

Source: The New American April 2006, Vol 22, Issue 8

Looking at the Chinese-American trade, China is already fastest growing export market for the US economy. However, as the devalued Yuan makes labour inexpensive in China, forces in congress are currently contemplating several initiatives to curb Chinese continuous efforts to sustain the huge trade surplus, including declaring the low Yuan an illegal subsidy, thus empowering American firms to seek compensatory tariffs. The question is, whether the weak Yuan reflects a bilateral trade imbalance, or whether the situation reflects changing supply patterns, with more goods passing through China, than former major exporters such as South Korea and Taiwan.

Case Studies

The following chapter presents a selection of case studies of European firms and their global R&D strategies. The firms included in the case studies have been select on the basis of their representation of European strategic industries, their global focus and their importance on the global scene within their respective industries.

Figure 14. Firms included in the case studies

Case	Firm
1	Airbus
2	Siemens
3	Philips
4	Nokia
5	Volkswagen
6	Motorola
7	GlaxoSmithKline
8	Shell

The case studies aim to understand the trends of European firms in relation to the global outsourcing of R&D, and to obtain an understanding of the R&D strategies employed by each company. The extent to which some of these trends are perceived or real is often difficult to establish. Most of the times the proof' for these trends is based on questionnaires and the expected investment patterns as voiced by the managers of these firms (EC, 2006; Thursby, 2006; Dearing, 2006). The actual (implemented) strategies of firms can diverge from these expectations. Another problem is often the lack of unifying framework (often based on relatively superficial questions that are multi-interpretable). The Locomotive framework tries to solve this problem. In this section, the three dimensions of that framework will be applied to score the case studies.

Locational determinants refer to the motives for R&D investment in certain regions. For each case study, quotes that describe the main developments of the way R&D is organised internationally are grouped under one of the six broad groups of determinants or motivating forces (Cf. Fortanier, Van Tulder, 2006):

Factor	Description
1	Market or demand-side factors abroad, which may make it necessary or advantageous to adapt products (and/or processes) to local market characteristics.
2	Technology or supply-side factors that make it necessary to access a wider range of scientific and technological skills and knowledge than is available in the home markets
3	Competitor factors - refers to the need to closely monitor and learn from the technological developments and strategies of competitors.
4	Arguing for decentralising R&D activities are political factors, including 'host country' factors like friendly regulatory legislation.
5	Environmental factors such as surroundings, which can stimulate innovation and attract staff
6	Finally, other factors like path dependencies or mergers and acquisitions also can be an important determinant of R&D locations.

Political factors, even if they are not explicitly mentioned, also play a prominent role in the locational decisions of Airbus (such as the location of R&D facilities next to production sites in China). Companies that operate on even stronger government procurement' markets like Siemens (in particular its infrastructure and public services activities), have strong political motives for local R&D investment as well. Increasingly, large government procurement contracts demand localisation of R&D facilities as part of the contribution to the national economic development.

Volkswagen needs to cooperate with governments to implement new infrastructures for new technologies such as biomass and fuel cells. On the other hand, the action of competitors is particularly relevant for companies that operate primarily in consumer markets with relatively standardised products (Philips, Nokia, Motorola). The location of R&D facilities near consumer markets, not only gives these companies a 'window' on local customer preferences – and thus facilitates adaptation' – but gives them also an opportunity to experience the local market dynamism' that in different countries that could lead to different innovation strategies (for instance in linking R&D activities and product design to marketing).

Methodology

The present document aims to provide more specific information on the R&D activities of a selected group of large multinationals, in order to provide a more global view' to the 'regional portraits' that will be made of R&D activities in eight selected regions as well as to provide background information for interviews with R&D managers and roundtable discussions with stakeholders.

The case firms were selected on the following criteria:

Figure 15. Criterions for the choice of case studies

Criterion	Description
1	Leading firm in the European system of innovation (i.e. with a large number of R&D employees, sizable R&D investment and a large number of patents located in Europe)
2	Present in at least two of the eight regions that are represented in the LocoMotive research project (i.e. with some spread already of their R&D activities across Europe)
3	Substantial sales and production around the world (i.e. with sales and production abroad that is larger than sales and production in the home market)
4	Headquarters spread over a number of countries (i.e. limited overlap in the home base of these companies)

The description of the R&D activities of these firms has been compiled from publicly available information, annual reports, research articles, consultant reports, European as well as global statistics databases. The data collection has been guided by the categories and variables that comprise the three research themes (location motives; organizational structure; regional embeddedness). Quotes were selected if they provided descriptions of the conditions under which particular phenomena were found. In combination, these quotes therefore form a portrait of the company's perception of why R&D facilities are located where they are, how their activities linked to other parts of the firm and in what ways their R&D activities are embedded in local institutions and business environments. But the case studies also confront the perceptions with the realised strategies by looking at the actual spread of facilities over countries. The case studies thus document how firms move from 'global views' to sometimes perhaps remarkably local realisations'.

The case descriptions are not all-inclusive. The picture is only complete to the extent that it has been communicated by the company, so the conditions under which the information is produced must be kept in mind. For example, China is a hot topic, so there are several communications that particularly concern the transition from manufacturing-only to locating R&D in China, and the reasons why. This may over-emphasise the importance of the related locational factors and linkages - just because no quotes were available on the reasons for locating R&D activities in other regions. The resulting bias seems rather limited, since this study has been designed to be part of a larger, multi-method study, evidence presented in this report can be corroborated with data from other sources.

Airbus

Airbus, headquartered in Toulouse, France, develops and produces a range of 14 aircrafts. In 2006 they became a European Aeronautic Defence and Space (EADS) company. "The four national entities which had previously formed the Airbus consortium transferred their Airbus-related assets to the new company and became shareholders in Airbus" , thereby merging Airbus France, Airbus Deutschland and Airbus Espana into one company. Besides the aircraft manufacturer Airbus, the EADS Group also includes helicopter supplier Eurocopter and the joint venture MBDA, the international leader in missile systems.

Figure 16. The global network of Airbus R&D centres

After Boeing begun to outsource an increase part of the work to suppliers in Russia, China and Japan, Airbus are increasingly investigation forming joint ventures with non-European engineering companies. However, until now the global R&D networks of Airbus have been mainly domestic European with two R&D centres outside of Europe in Moscow, Russia and Wichita, USA.

Airbus activities consist of operations, programmes and core functions, and are located across 160 international locations. This includes 16 main development and manufacturing sites in France, Germany, the U.K., and Spain with final assembly taking place in Toulouse and Hamburg. Following a major reorganisation in 2004, these European sites were formed into a range of Centres of Excellence (CoE) in the design and building of the aircrafts. Each Centre has its own responsibilities and chain of decision-making, while maintaining close links with other core functions.

"In operations there are six CoEs based around expertise in key production areas -- wing at Filton and Broughton, UK; forward and aft fuselage at Nordenham, Varel, Bremen and Hamburg in Germany; nose and centre fuselage at Toulouse, Saint Nazaire, Nantes and Méaulte in France; vertical tailplane in Stade, Germany; pylon and nacelle at Saint Eloi, France; horizontal tailplane and A380 sections at Getafe, Illescas and Puerto Real in Spain."[7] Besides the CoEs in operations, the cabin and customisation CoE in programmes is responsible for driving all design and production activities and a CoE Electricity has also been set up to provide electrical products across the company.[7]

In the selected region Midi-Pyrenées, France, Airbus has located its headquarters. Specific R&D activities that take place in Toulouse include those from teams of four centres of excellence involved in the design, manufacture and integration of pylons and nacelles, nose and centre fuselage, cabin and cargo customization and aircraft electrics.[27] The A380 is assembled at a site named Jean-Luc Lagardere, extending "over 50 hectares and comprises a logistics area (receipt of supplies, sections, etc.), the final assembly line (10 hectares), aircraft external testing facilities, a static test building and weighing hall." [28] Besides the A380, Toulouse also hosts the sites of the final assembly of the A300/A310, A330/A340 families, as well as the A320.

Market and demand-side factors

The market or demand-side factors that have induced Airbus to internationalise certain R&D activities include demand for local product and process support and proximity to customer markets and third parties who are affected by its innovations. Airbus should be considered a European firm, with corporate headquarters in France. Investments in product and process adaptation across Europe should not be seen as a factor for internationalising R&D; home country should be interpreted as being Europe rather than just France. R&D mostly takes place at the previously mentioned Centres of Excellence, which means that the firm is strongly embedded in European markets and institutions.

However, Airbus has a global customer base and does have "centres spread across all its customers' main areas of operations"[29]. Subsidiaries like Airbus Middle East have been created for marketing activities and customer services like training and technical support[30]. Other subsidiaries, such as those in Japan and Russia, have been created to gain a better understanding of markets in developing products processes and services. In Japan "the objective is to provide Airbus with a better understanding of and access to the Japanese market"[31], and in Russia "Airbus opened its regional office in Moscow to provide on site support in dealing with the Russian government, aviation authority, industry, airlines and media on development and implementation of the whole range of Airbus cooperation with Russia"[32] Airbus has also assembled teams of experts to support their customers with the entry into service of their A380 aircraft, as well as placing specialist teams at third party locations who are affected by their innovations - i.e. airports.[33]

Technology and supply-side factors

The technology or supply-side factors that have induced Airbus to internationalise certain R&D activities include the presence of sophisticated suppliers, partners and skilled labour. On an industry level Airbus' current R&D strategy is to substantially increase cooperation with the Russian and Chinese aviation industries[34] "In 2005, Airbus decided to extend its ties with the Chinese civil aviation and as such signed several agreements with China for increased cooperation. Two contracts signed with China Aviation Industry Corporation I and II (AVIC I and II) were followed in December by an agreement to study the feasibility of an industrial partnership to set up an A320 Family plant"[35]. In Russia activities have been implemented for the "facilitation and development of future cooperation with Russian aviation industry"[36]

Although cooperation on an industry-level and in certification fields has influenced locational choices, the availability of sophisticated suppliers and partners has played a larger role in the internationalisation of R&D activities. Airbus has implemented "a programme of expansion which is seeing new suppliers emerging in areas where Airbus itself is growing, such as Russia and China: putting Airbus suppliers where the sales are."[37] Airbus' Chinese programme is "committed to increasing procurement and R&D" to reach a value of $ U.S. 120 million dollars by 2010 (in 2007 the target is $ 60 million), and is also offering the Chinese aviation industry participation in up to five percent of the proposed A350 programme[38] In Russia, "Airbus intends to offer Russian companies contracts with a value of US$ 110 million per annum. As such, in August 2005, Airbus and Irkut, the Russian scientific production corporation, signed a preliminary agreement on Russian participation in A350 development and future Airbus aircraft programmes."[39] In the U.S., there have been a series of multi-million-dollar A380 contracts that have been awarded to manufacturers. One example of suppliers influencing the location of development activities in this way is the contract that has recently been signed with Eaton. Over the next 20 years certain Airbus R&D activities will take place at Eaton's California, Michigan and Mississippi aerospace units. "Eaton is a fine example of why Airbus travels the world to find the very best suppliers for every component of its aircraft," says Allan McArtor, Chairman of Airbus North America"[40]

Since a large part of innovation takes place at a supplier level, the previous motives concern capacity to improve linkages with the local innovation environment. However, availability of skilled labour has also been a deciding factor in creating or expanding R&D activities at Airbus subsidiaries outside of Europe. "Airbus enjoyed growing success and increasingly appreciated the advantages of a culturally diverse workforce, looking far beyond its 16 engineering and manufacturing facilities in Europe to capitalise on the potential offered by a more global talent pool."[41] In China, "Airbus plans to establish an engineering centre in China and recruit 200 Chinese engineers by 2008", whereas in Russia. Airbus' regional office has been carrying out numerous research and technology projects from as far back as 1995.[42]

"ECAR, the Airbus and Kaskol Group's joint-venture engineering centre, has operated in Moscow since spring 2003, and currently employs 120 Russian engineers"[43] Another example is Airbus' engineering and design facility in Wichita, Kansas, which was selected because "the talent pool of aerospace and aviation experts here in this city is among the richest in the world [and] by reason of time zones, this office allows nearly 24-hour development work on the A380, in concert with Airbus engineering headquarters in Europe."[44]

Environment

The third type of motivating forces that could be identified are environmental factors such as surroundings, which can stimulate innovation and attract staff. Although the only example actually refers to skilled labour as the locational determinant, this factor is cited as a benefit in connection with establishing the first research facility in the U.S. The specific location of a historical industrial neighbourhood in Wichita was chosen because of its surroundings: "The environment offers the Airbus team an environment more akin to a college campus rather than a typical aircraft factory"[28]

Finally, historical developments and mergers and acquisitions have been a very important determinant of Airbus R&D locations across Europe. The determination of the locations of the company's centres of excellence in France, Germany, Spain and the UK can be traced back as far as 1970: "Airbus (…) started life as a French-German consortium in 1970. Later it was joined by CASA of Spain and British Aerospace"[45]

New R&D facilities in Europe are located in the region where it complements R&D activities already carried out there. For example, the new fuel systems test facility at the Airbus site in Filton, UK has been located there because "design and supply of fuel systems is a key responsibility of Airbus in the UK"[46]

Organizational Structure

Local R&D units are specialized competence centres that have been diversified according to technological expertise in key production areas. "Each site produces a complete section of the aircraft, which is then transported to the Airbus final assembly lines in Toulouse or Hamburg. This unique industrial concept based on Centres of Excellence has proved to be extremely efficient. Airbus' industrial network has been expanded to include a satellite design office in North America, a joint venture engineering centre in Russia and further engineering centre in the People's Republic of China."[47]

Research activities also take place at local partner and supplier sites, for example: "In the early stages of the programme, our priority was developing and proving the many ground-breaking technologies that have gone into Goodrich products on the A380." [48]

Domestic R&D in Toulouse includes teams of four centres of excellence, but they do not have a particular hierarchical function over the series of 16 centres across Europe. "Each CoE is responsible for specific parts of the aircraft and has its own chain of decision-making and command"[49] Only final assembly is centrally coordinated in Toulouse and Hamburg.[50]

Development of the A380 has not been coordinated by home country R&D divisions but by a cross-national team located across different Airbus sites: "These teams have responsibility for delivering aircraft components or systems, meeting quality and performance targets, on schedule and within budget. The Aircraft Component Management Teams are located in Toulouse (France), Getafe (Spain), Hamburg and Bremen (Germany) and Filton (UK), close to the Airbus design offices in these countries. They report to a central programme team headed by Charles Champion."[51]

The Centres of excellence are linked to each other to form a range of competence centres that have their own responsibility for the part of the aircraft they are producing. The Programmes (e.g. the A380 programme) they participate in drive design and production activities across the individual units. There is frequent contact between units participating in the same development programme, for example: "the development programme brought together engineering teams from Airbus' long-range and A380 programmes, pylon specialists from France, wing designers in the UK and Germany and the A380 Iron Bird systems test rig team."[52] Lateral ties with other R&D can therefore be characterised as a network organisation: "The system reinforces trans-national ties - for example, around 160 design engineers in Wichita, USA, may be part of Airbus North America but they are also part of the wing Centre of Excellence working directly with Filton and Broughton in the UK."[53] To facilitate frequent contact and information sharing between R&D units a common working platform has been created - Airbus Concurrent Engineering (ACE). This is being employed in the development of the A380 throughout the entire life-cycle of an aircraft. It can also be used to co-ordinate activities with Airbus suppliers and enables quicker response to late customer modifications[54]

There are strong ties between the centres of excellence and other functional areas: "CoEs maintain close links with core functions such as procurement, human resources, engineering, quality and customer services to develop and manage skills, manage policies and ensure that Airbus employees share knowledge and ideas with colleagues in other CoEs"[55] CoEs also work closely with the assembly line in Toulouse to ensure customer needs are met.

Programmes bring together employees from different R&D and production units and other functional areas; integrating engineering, industrial, financial and marketing activities. "Drawing on the lessons learned from previous aircraft development programmes, Airbus has created a new A380 team structure involving true transnational and cross-functional working, with co-located teams in Hamburg, Filton, Toulouse, Getafe and Bremen."[56] This new way of working has been considered a key element in the successful design of the new aircraft.[57]

The Airbus centres of excellence function as local R&D and production units, which are interconnected to each other through programmes that are coordinated by a trans-national team. This forms a "network of multifunctional teams, which include all the skills such as engineering, manufacturing and procurement that are necessary to deliver complete aircraft section" [42]

"Airbus structured itself around three main elements: Activities in Programmes are based on the overall view of aircraft production: setting the pace of deliveries and taking the lead role in both development and series production. This includes managing the final assembly lines and the centre of excellence for cabin and cargo customisation. Within Operations, seven further centres of excellence are responsible for the on time, on cost and on quality delivery of fully equipped and tested aircraft sections to the final assembly lines: forward and aft fuselage; nose and centre fuselage; wing; pylon and nacelle; horizontal tailplane and A380 section 19/19.1 and belly fairing; vertical tailplane; and electrics. Each has its own responsibilities to maximise production flexibility, with overall co-ordination through a central team, which is responsible for their performance and improvement. All of these teams receive operational support from the Core Functions of engineering, procurement, quality, human resources, customer affairs, customer services, information systems, legal, government relations and communications, and finance and controlling. The Core Functions manage Airbus policies and guidelines as well as developing and managing skills, competencies and best practice in their specific disciplines. Close links between Programmes, Operations and the Core Functions ensure that Airbus employees maintain and develop their technical and professional skills and continue to share knowledge, ideas and experience right across the company."[58]

Linkages between MNE R&D and the region

By describing the type of interactions between Airbus and regional actors, this last section will give an overview of how Airbus investments in R&D contribute to regional innovation and growth.

Airbus engages in much contact with suppliers when developing a new aircraft, including risk-sharing and co-development of new technologies. "The A380 gave Airbus the opportunity to develop a new way of working with its existing and new suppliers and industrial partners by allowing them to be much more closely involved in the development and long-term future of the programme"[59] Approximately 120 suppliers and industrial partners within Europe, the USA, Japan and China have been contracted for developing the A380. Examples of such collaborations include cooperation between Hamburg's A380 fuselage structural assembly team and JAFO Technologie[60]; integrated design teams between Airbus and Rolls-Royce[61], as well as SAAB of Sweden and Finavitec of Finland[62]; and a partnership between the engineering design teams from supplier EADS Military Aircraft and Airbus' plant in Filton.[63] Linkages are facilitated through a software tool that streamlines communication and collaboration, enabling suppliers to manage their performance, exchange information on products and better anticipate opportunities. "The Airbus Supply portal is designed to increase the scope and efficiency of Airbus' collaboration with its suppliers"[64]

Besides suppliers the company also has contacts with customers "to anticipate future demands and creates innovative products"[65] These interactions range from working with a group of representatives from key potential customers in the pre-development phase[66] to customizing final products to consumer needs. A software tool called Airbus customisable cabin/cargo configurator (A3C) has also been implemented to manage communication flows. “Customers are able to work alongside Airbus to define the best possible cabin layout for their aircraft. A3C also enables engineers to address certification issues and assess technical feasibility at the earliest possible stage”[67] Another way to interact with customers is through the Airbus mock-up centres in Toulouse and Hamburg that both show “customers what is possible with the most modern and advanced aircraft in the world”[68]. While the Felix Kracht mock-up centre in Toulouse acts mostly as a sales and marketing showcase to 1800 customers a year, “the A380 design mock-up centre in Hamburg (…) is a proving ground for engineers and developers to test different concepts for the A380, with suppliers transforming designs into mock-ups at the centre”[51]

But it’s not only customers and suppliers that are involved in the development. “Airbus listens to aviation authorities, to pilots, to environmental experts, to the communities around its sites and to suppliers and industrial partners.” [49] The third parties affected by Airbus innovations are closely involved in the development process, to provide information concerning issues like safety, airport and government regulations[69] “Airbus designed the A380 in collaboration with some 60 major airports, ensuring airport compatibility and a smooth entry into service”[70]

There are numerous examples of linkages between Airbus, universities and research institutes. Cooperation with universities include exchange programmes for South African students resulting from the partnership with South Africa's Department of Science & Technology[71]; student placements from universities affiliated with the Partnership of a European Group of Aeronautics and Space UniversitieS (PEGASUS)[72]; and joint projects between Airbus and students, researchers and engineers from the four high-tech engineering schools in Nantes. Together with these schools, Airbus established the TECHNO’CAMPUS. “The location was selected, because of the high scientific level of public research close to two Airbus production plants. TECHNO’CAMPUS is actively supported by the French state, the region of “Pays de la Loire and the city of Nantes”[73]

Airbus also cooperates with the German Aerospace Center (DLR), thereby becoming part of the European Research Area, ONERA. “Airbus is looking to increase its access to groundbreaking technologies and to optimise its use of research resources. The new relationship with DLR and ONERA is important to Airbus as these organisations possess proven scientific and technological capacities.”[74] Other collaborations with research institutes include joint aeronautics research and technology projects with Polish applied research group Technology Partners[75]; a Research and Technology Framework Agreement with the Cooperative Research Centre for Advanced Composite Structures Limited (CRC-ACS) in Melbourne[76]; and a cooperative study with Japan's R&D Institute of Metal and Composites for Future Industries (RIMCOF). “Our joint efforts between Japan and Europe with cutting-edge technologies from both sides would greatly contribute to the advancement of future commercial aircraft technologies.”[77]

Airbus is linked to the region through its employees, encouraging them “to develop their individual talents and experience and to be proud of their roots.”[78] The company stimulates diversity and believes the mix of expertise, experience, and culture is invaluable in the innovation process. Knowledge is transferred to employees through training. For example, a new training centre has been set up to train technical staff from the Hamburg plant. “The A318, A319 and A321 assembly line in Hamburg is in close proximity to the new training centre, which will give trainees a practical insight, and contribute to the overall quality of the courses.”[79] For employees (as well as customers) Airbus also has three major training centres in Toulouse, Miami and Beijing. “A more extensive network of training centres exists through

Airbus' co-operation with training specialist CAE, making Airbus–standard courses available even more widely around the world"[80]

There are several linkages with the EU and cooperative projects that stimulate innovation on a European level. Airbus has instigated the PAMELA (Process for Advanced Management of End of Life of Aircraft) project to research aircraft recycling. "With partners, SITA, EADS CCR, Sogerma Services and the Préfecture des Hautes-Pyrénées, Airbus will now set up a special centre at Tarbes Airport (South West of France) where procedures for decommissioning and recycling aircraft in safe and environmentally responsible conditions will be trialed out". The European Commission has selected this Airbus project to be part of the LIFE programme (l'Instrument Financier de l'Environnement) "which means that Airbus will disseminate the environmental knowledge and practices it has gained to other industrial sectors, allowing them to benefit from its valuable experience in implementing this innovative EMS"[81] In addition, Airbus is collaborating with seven major European aerospace manufacturers (Airbus SAS, Dassault Aviation, Eurocopter SAS, Liebherr-Aerospace Lindenberg GmbH, Rolls-Royce plc, Safran and Thales) in the Clean Sky Joint Technology Initiative (JTI) - "the largest research project ever set up jointly with the European Commission"[82] The initiative will investigate the possibilities of reducing environmental impacts of aircraft components and operations. "This research project will be a flagship for Europe, enabling the industry to network with universities, research centres, SMEs, which work together to minimise environmental impact in the future."[66]

Finally, the technology programme Aircraft WIng with Advanced Technology OpeRation (AWIATOR) involves collaboration between Airbus engineering firms in France, Germany and the United Kingdom, European aeronautical research institutes, and more than twenty industrial partners in Europe and Israel. Airbus is contributing 60 per cent of the 80 million Euro budget and will contribute to programme management in jointly developing and validating the sophisticated technologies under investigation. "Airbus is committed to maintaining its leadership in technology and to do so, we continue to invest in research that is of direct benefit to our core business, said Airbus Chief Operating Officer Gustav Humbert. We rely on an international research network of partners from centres of excellence all over Europe and around the world."[83]

Siemens

With revenues of EUR87Bn, operations in 190 countries, and 80% and 60% of sales from outside of Germany, Siemens is not only a leading European company it is also one of the largest multinationals worldwide. Siemens does R&D in low-costs medical devices in China, and in increasing number of product lines such as transportation will be designed and developed in countries such as China and India in the future.

Figure 17. The global network of Siemens R&D centres

Headquartered in Berlin and Munich, Siemens enjoys a strong technological position as one of the world's largest electrical engineering and electronics companies.[84] "Innovation has always been one of the most important elements in Siemens' business strategy,"[85] and development is geared to establish a new technology, de-facto standard or indispensable feature on the market. Siemens has the goal to become a trendsetter rather than a "first mover" or "fast follower". Aligning this innovation strategy with its business strategy "involves achieving technological leadership, global presence and a comprehensive portfolio of patents that will enable the company to help define the major trends regarding products, systems and services, and to offer its customers important added value."[86]

Siemens spends EUR 5.1 Bn on R&D every year.[87] In 2005, R&D expenditures amounted to EUR 5.2 Bn, or 6.8 percent of the company's turnover[88] - "more than the amount spent annually on research by the European Union."[89] Siemens R&D expenditures ranked 7th in a study of the 1,000 companies with the highest R&D expenditures, carried out by business consultants Booz Allen Hamilton (BAH) in 2005.[6] Within its own industry - global electrical engineering and electronics - Siemens has the highest R&D expenditures.

The percentage of people employed in Research and Development reflects the percentage of expenditures mentioned in the previous paragraph. "Siemens now employs more than 47,000 researchers and developers worldwide. This figure represents more than 10% of all the company's employees."[90] R&D takes place at a 150 sites, located in 38 countries[91].

"Corporate Technology has a leading role to play within Siemens' R&D operations. It acts as an international network of competencies and a worldwide partner for innovations for the Siemens Groups and Regional Companies."[92] Corporate Research takes place at sites in Germany (Munich, Erlangen, Berlin), the USA (Princeton, Berkeley), Great Britain (Hampshire), China (Beijing, Shanghai), India (Bangalore), and Russia (Moscow, St. Petersburg)[93]; and employs a total of 2400 employees.[94] Besides carrying out long term Corporate Technology also has a coordinative role to exploit the synergy potential between R&D activities.[95] This also includes patent management throughout the entire company. To this end it employs "its Corporate Intellectual Property and Functions Division to perform key tasks such as ensuring that the company's R&D successes are safeguarded from competitors."[96] Located in 18 locations worldwide, this division manages Siemens patent portfolio at a strategic level.[12]

To remain competitive, Siemens places a lot of emphasis on patent generation. Following the Patent Initiative launched in 1995 the company initially focused on increasing the number of patent registrations for new inventions, whereas now it focuses on the value of patents - judged by the value placed upon it in cross-licensing agreements, among other things[97] "Siemens currently possesses some 40,000 patents and patent groups - and the portfolio is renewed every five to six years. That translates into approximately 7,000 new inventions registered each year."[14]

The selected location of Munich is the home to Siemens' headquarters. "Nearly half of all Siemens Divisions, many Group headquarters and a large number of R&D activities are located in the city. About 35,000 employees work at over 30 Munich facilities."[98] The other selected location of Siemens Prague focuses on the business areas of Automation and Control, Information and Communications, Power, Medical, and Transportation. "Siemens currently has more than 15,000 employees in the Czech Republic, making it the largest electrical engineering company and one of the most important employers in the country."[99]

Locational Determinants

"The year 2004 saw a further expansion in Corporate Technology's international presence, with new sites being established in India and Russia. Corporate Technology´s objective is to enlarge its existing network of research institutes, get closer to the customer through local R&D know-how, provide better on-site support for the Business Units, expand cooperation with universities and research facilities, and seek out high achievers to join Siemens' ranks"[100]

The market or demand-side factor that motivated Siemens to internationalise certain R&D activities is to be close to its main customer markets. "The reasons for this are simple. A company must have active research and development teams in the biggest growth markets and the countries where innovation is most dynamic, so that it can quickly respond to regional requirements by coming up with new solutions."[101] Specifically the R&D Divisions within Siemens' regional organizations in China, India, Japan, and Russia provide local product development support to the Business Units, and track technology developments within their respective markets[102].

Although these R&D activities are located in growing markets to meet customer requirements, other factors generally play a large role in the location of R&D activities as well: "Siemens focuses on its core expertise and builds up additional capacities in places where we can establish the necessary proximity to customers, find qualified employees and operate at competitive costs."[103]

"China and Eastern Europe are not just important markets. They are also an excellent source of qualified employees. The human factor is and remains critical for companies, and excellent, highly motivated employees are the key to success."[104] Diversity is considered a very valuable asset in this respect: "Siemens President and CEO Dr. Heinrich v. Pierer pointed out the importance of today's team spirit and cultural cooperation when he said, 'Siemens has millions of customers and over 400,000 employees from all over the world. This is why we promote diversity on all levels.'"[105]

Siemens locates R&D activities where there is presence of skilled labour. "A key role in this regard is played by Siemens' close contacts with top universities all over the world, which include the approximately 1,000 cooperative research projects Siemens launches every year with universities and research institutes"[106] This provides Siemens with insights into academic research, but most importantly allows them to establish contact with researchers "who are potential future employees".[26] "Siemens is always on the lookout for highly qualified young people. It currently employs more than 103,000 college graduates with degrees in the natural sciences, IT or engineering - and each year more than 10,000 fresh college graduates are hired." [26] The ability to safeguard and attract a skilled workforce is considered to be a key success factor for Siemens divisions, and thus for its location. For example, the percentage of highly qualified employees at the Siemens plant in Berlin "has reached 80 percent of the plant's 1,000 person workforce; ten years ago, that figure was around 65 percent. This too is helping to safeguard the future of Germany as an innovative business location.[26]

China is however one of the most important locations where Siemens has situated itself to be able to recruit skilled employees: "Compared to Germany, China today already has twice the number of people working in research – some 900,000 – and produces ten times the number of university graduates in core engineering disciplines. Industry forecasts are unanimous in predicting that China, by 2010, will be the foremost manufacturer of electronic components among the world's newly industrialized countries, and will likely have a share of around 14 percent in the world market – greater, even, than Western Europe. This not only explains why many new rivals are emerging in China, it also underscores that any company wishing to compete effectively in the international marketplace has to operate in China"[107]

Locations of certain R&D units are chosen to be able to learn from target competitors or industrial partners. To do so, Siemens primarily uses venture capital to invest in start-up companies "These start-up companies also give rise to valuable cooperative projects in high-tech areas, and these in turn generate innovations in Siemens Groups"[108] Furthermore Siemens recognizes the increasing importance of monitoring competitors in managing its patent portfolio. "We not only have to be active in all markets, but we also have to protect them. Competitors are analyzed and gaps in the patent portfolio are closed."[109] However, no specific mention is made of this being an important factor in choosing its R&D locations.

The final motivating factor that is mentioned are political factors. To be able to stay globally competitive Siemens believes that local presence of R&D can be a prerequisite because "many countries give priority to domestic bidders or companies that will execute the contract in-country."[110] Another related reason is the objective to be perceived as a global citizen: "If you just sell your products in a country, then you are a guest; if you produce them locally, then you are welcomed as a friend. But you are regarded as a citizen only if you carry out your R&D there too."[111]

Organizational Structure

Siemens is comprised of six business areas, namely Information and Communications, Automation and Control, Power, Medical, Transportation, and Lighting "Operating in these areas, we have a number of different Groups, each one an entrepreneurial unit responsible at the global level for its own development, manufacturing and sales activities"[112] Local R&D takes place in the technology divisions of the regional companies, of which there were 64 operating as "entrepreneurs at the national level" in 2002 [32] "These organizations provide local product development support to the Business Units, maintain contacts with universities, and track technology developments within these markets."[113] Strong research activity takes place at these R&D units, considering approximately 95% of Siemens' R&D budget goes to the Siemens Groups and Regions for product, system and production development.[114]

Corporate Research takes place at Siemens' Corporate Technology Department, primarily located in Munich, Erlangen, and Berlin.[115] Within Corporate Technology, R&D activities are organized in five Technology Divisions that are focused on more than forty core technologies. Through these R&D activities, Corporate Technology makes its own contribution to Siemens' innovations.[116] "Experts in each core technology area are gathered in their respective centers of competence, which function as internal technology companies and offer their services to the company's Business Units."[117]

On an international level, Corporate Technology coordinates the R&D activities that take place in Siemens' regional organizations in Germany, USA, Great Britain, China, India, Japan, and Russia; acting as "an international network of competencies and a worldwide partner for innovations for the Siemens Groups and Regional Companies."[38] Corporate Technology in charge of centralized units as well, such as the as Information Research Center and its virtual library, "which ensure that vital knowledge doesn't get lost and that it remains available to the greatest number of people at the same time"[118]; as well as the Corporate Intellectual Property and Functions Division, which performs key tasks like patent protection and support in regulation across the company[119]

There is strong emphasis on creating synergy between the local R&D units that are part of Siemens' Regional Organization to cut development costs and to reduce problems on the customers' end.[120] This means that the local teams of the Groups are pulled together. "Increasingly, we must present ourselves as ONE company instead of each Group acting as an individual competitor."[121] There is therefore frequent contact between local R&D units, as well as between Corporate Technology divisions and the Siemens Groups.

Tools to promote contact between R&D units include "benchmarking and best practice sharing, active patent management throughout the entire company, and the joint development of multiple-impact technologies or platform strategies."[122] Furthermore, Groups also promote idea workshops for experts across the company, and innovation managers from all of the Siemens Groups exchange experiences in the Community of Practice Innovation Management[123]. On a company wide level Siemens has also created the Innovation working group, where Chief Technology Officers, R&D heads from the Groups, and representatives from the regions discuss current innovation issues [44], as well as the top+ Innovation program which focuses on further increasing the efficiency and effectiveness of R&D activities.[124] The latter program is mandatory for all groups, and has been implemented to create synergy and to promote frequent contact, development of cross-product technology platforms, and best-practice sharing between R&D units.[125] Finally, any Group can include all the patents from other Groups in any cross-licensing agreement with external partners, "which once again shows how synergy effects are being exploited at Siemens"[126]

Within the different Groups, local R&D units support regional organizations that are responsible for their own development, manufacturing and sales activities. It is apparent that there must therefore be frequent contact with local functional areas, however contact between R&D and other functional areas is promoted throughout the entire firm: "trendsetters must closely align their R&D activities with their business strategy"[127]

At a corporate level, all corporate technology units are supported by the Strategic Marketing and Strategic Planning Divisions "which systematically investigate and evaluate commercial and technological trends, in order to ensure that Corporate Technology is tuned in to the most important technologies worldwide at the earliest possible stage"[128] Also "part of Corporate Technology are the Corporate Functions Standardization and Regulation; Information Research Center; and Environmental Affairs & Technical Safety"

Linkages between MNE R&D and the region

By describing the type of interactions between Siemens and regional actors, this last section will give an overview of how Siemens investments in R&D contribute to regional innovation and growth. Siemens is dedicated to contributing to society through their technologies and innovation, as well as "delivering benefits through education, training, knowledge transfer, and partnerships with schools and universities in many of the world's countries; and benefits through citizenship activities in the social and cultural spheres."[129] On the other hand, Siemens has a lot to benefit itself from contacts with local firms and other organizations: "when it comes to developing innovations, we can rely on a global knowledge network, hundreds of cooperative projects with universities, our own R&D laboratories all around the world, multicultural innovation teams, and the extensive involvement of various departments, customers and suppliers"[130]

Within R&D, Siemens collaborates with local firms to be able to be able to manage the range and complexity of new technologies, to maintain its global presence[131], and most importantly to gain knowledge to develop new innovations. "We will need to identify best practices in a more targeted way and use the information we gain as a systematic aid. Here, the most important thing is timely inclusion of our local companies in innovation activities."[132]

There is extensive involvement with local companies, ranging from start-ups to customers and suppliers.[133] Besides maintaining contacts through customer service "to develop products that meet constantly changing customer requirement"[134], there are "thousands of account managers" that act as an interface between Siemens' developers and customers. Products are optimized to these needs by engineers, IT specialists, designers, and psychologists in usability labs in Munich, Princeton and Beijing.[57] Siemens also involves customers directly into the development process. "One prominent case in point is our collaboration with the U.S. Postal Service (USPS) on the development of the Postal Automated Redirection System (PARS)"; another example is the collaboration with Daimler Chrysler to develop cordless phones for technical support at their Sindelfingen plant in Germany.[135] In addition to co-development with customers, "Siemens Corporate Technology also participated in over 100 cooperation projects with more than 300 European companies and institutions, primarily in the fields of information and communication technologies, materials, production and manufacturing technologies, and energy and transport technologies."[136]

To be able to respond to regional requirements, Siemens' support of start-up companies should not be underestimated. "To date, Siemens Venture Capital has invested around 700 million euros in more than 100 companies and 30 venture capital funds, primarily in the U.S., Europe and Israel, but also increasingly in China and India. These start-up companies also give rise to valuable cooperative projects in high-tech areas, and these in turn generate innovations in Siemens Groups"[137] Besides providing capital, Siemens also provides complementary technologies, knowledge to bring innovations to market, and builds prototypes of product innovations. It does this through divisions like the Siemens technology accelerator in Germany and the Siemens Technology-To-Business Center in US.[138]

In addition to exchanging technical knowledge, Siemens also wants "to highlight the influence of high technology on culture and its significance as a force for innovation in art." It does this by advancing projects and artists through the Siemens Arts Program, with the aim of building "bridges between culture, industry, and society to encourage the transfer of ideas."[139]

"In 2005, Siemens launched over 1,000 collaborative projects with universities and research establishments worldwide. In general, both parties profit from such relationships. Siemens employs a variety of models, from supporting students, all the way up to strategic alliances to expand its global cooperation network."[140] For example, the Technology Divisions of Corporate Technology in Germany are closely linked to two independent research institutions: Siemens Corporate Research in Princeton, New Jersey, U.S.A., and Roke Manor Research in Hampshire, England.[141] However, "the most common form of cooperation is that of a bilateral relationship between Siemens and individual university scientists."[63] Other forms of collaboration include technology transfer, part-time lectureships, the Siemens Ambassador University Program and the Center for Knowledge Interchange (CKI) model.

"A total of 33 universities and three institutes of technology are part of the Ambassador Program. Each is assigned its very own "ambassador" from senior company management. It is their responsibility to initiate and promote as many strategic forms of cooperation as possible."[142] The closest relationship with a University is created through a Center of Knowledge Interchange: "The CKIs are especially important, since they provide us with direct access to innovation (…) Each CKI has its own administrative office that acts as an interface between the industrial and the academic worlds. It's here that representatives from the Siemens Groups regularly meet with people from universities."[63] "In addition, almost 250 theses and doctorates were conducted at Corporate Technology. These also represent a valuable source of top-class new recruits for positions in engineering and science."[143]

For Siemens these collaborations are beneficial as it provides "insight into all the latest results from the worlds of pure and applied research as well as establishing contacts to the researchers concerned, who are potential future employees. At the same time, it means the company can dovetail its own R&D activities with those of university departments working in areas in which Siemens lacks expertise."[65] For Universities benefits include the "opportunity to explore unconventional avenues of research"; "support for students who are writing dissertations and doctoral theses"; "technical know-how required to advance pure research projects at a university"; and "personal discussions with professors and students, the awarding of research contracts, and the funding of part-time lectureships"[65]. "Such lectureships represent a sensible addition to their teaching profile on the applied side, whereas they give [Siemens] the opportunity to train students as potential employees by providing them with specific practical content." [65] Another example of how Siemens greatly benefits from global networking activities with universities is the best practice database, which stores cases from internal and external sources.[144]

"At present, research cooperation at Siemens has a distinctly German flavor. In view of this, Prof. Klaus Wucherer, a member of the Corporate Executive Committee of Siemens AG, plans to increase the number of international contacts. 'We still need much more cooperation with outstanding universities around the globe,' he said at a university conference in July, 2006. At the same time, he also emphasized that this did not mean that the company would be reducing its commitment in Germany." [65] In expanding its university network, Siemens aims to increase the number of CKIs from 4 to 12, especially focusing on China, India and the U.S. [64].

“Siemens has almost 50,000 people working in R&D in 30 different countries. This is how we bring our technology know-how to other countries and build local competency.”[145] Siemens transfers knowledge and skills to employees through education programs, making “every effort to attract qualified and motivated people to work for us, and to retain and support them”[66] “For employees today, lifelong learning is an everyday part of their professional life. Today’s rapidly changing work environment is a constant call to extend their knowledge and skills. Siemens feels it is responsible for creating the requisite opportunities for employees to build new competencies.”[66]

This sense of responsibility is not just limited to Siemens’ own employees: “Given that the development of knowledge and skills has to begin before people join our company, we maintain close ties with schools, colleges and universities and with their governing bodies.”[66] Ties to universities were already described in the previous section, and provide “an important recruiting ground for new employees. Of the 461,000 people Siemens employs full-time worldwide, 34 percent have an academic qualification (26 percent in engineering, natural sciences or IT)”[146] However, Siemens’ also provides its own vocational training programs, which plays an important role in securing a well-qualified workforce in the regions it operates in. In Germany they are “the number one provider of vocational programs, with 8,600 youngsters currently training at around 60 Siemens locations”[147] “The company has continued to overfulfill its obligations in the vocational training sector in Germany by putting more people through programs than it actually needs for its own workforce” [68] What’s more, Siemens also partners with schools to “encourage a mutual transfer of knowledge and information to promote the development of high educational standards”, shaping curricula to advance education in maths sciences and technology, and supporting a wide range of projects that encourage interest in new technology among youngsters.[68]

Siemens maintains dialogue with interest groups about the influence the company and its innovations have on the development of the economy and on people’s quality of life. “Siemens takes a proactive approach to communication on these and other issues – in part through the Siemens Forums in Berlin, Erlangen, Munich, Vienna and Zurich.[68] Other examples include regular lectures for political leaders, employees of NGOs and university students in the Netherlands, an annual competition for science journalists in South Africa, and membership of the Club de Excelencia en Sostenibilidad, a business organization that seeks to promote excellence in sustainability, to provide a forum for dialogue with stakeholders, and to create a benchmarking platform. [68] “At the European level, the European Commission is extremely active in promoting a climate of open dialogue that brings together companies, management and labor, environmental and consumer organizations, environmental and socially aware investor groups, and other nongovernmental organizations (NGOs). We take part in this dialogue and seek to promote a grounded and realistic discussion by presenting concrete examples drawn from within the company.”[68]

Philips

More than 122,000 employees in 60 countries, and design still primarily done in the Netherlands while low-value manufacturing has been outsourced to Asia. However, 25% of the R&D budgets are spend outside of Europe and an increasing part of R&D also goes to China where Philips now has 15 research centres.

Headquartered in the Netherlands, Philips is a global leader in the interlocking domains of healthcare, lifestyle and technology[148]. Technology is the driving force of Philips' Healthcare and Lifestyle products, and it is "the continuing Philips tradition of innovation" that allows Philips to provide solutions that realize the full potential of fast-evolving digital technologies.[149] In 2005, R&D expenditures amounted to 2,534 million euro[150], but it is Philips' 80,000 registered patents that truly "illustrate the innovative nature of the company"[151] Another source refers to more than 130,000 patent (total R&D) and design rights[152], while yet another refers to more than 115,000 patent rights.[153]

Figure 18. The global network of Philips R&D centres

Philips' activities are organized in five product divisions - Semiconductors; Lighting; Consumer Electronics; Medical Systems; Domestic Appliances and Personal Care; and Other Activities[154] – "each of which is responsible for the management of its businesses worldwide".[155] "At the end of December 2005, the total number of employees of the Philips Group was 159,226", of which 13% was employed in R&D[7] Of this number, approximately 16,000 employees were active in R&D activities in the product divisions; "predominantly engaged in product development and development of production methods."[7]

The remainder of employees is active in Corporate Technologies.[7] Reporting directly to Philips' Board of Management, this is the corporate body that "controls and coordinates" the international research activities of Philips.[156] "With approximately 4800 highly skilled employees at some 20 locations worldwide, Corporate Technologies comprises organizations dedicated to research, intellectual property and standards, system integration services, emerging activities, and technology, competence and innovation management.[157]

With an annual research budget of EUR 30.4 billion in 2005 ("slightly less than 1% of Philips' annual sales"[158]), Philips Research is the organization responsible for creating innovations for the product divisions: "With laboratories in three regions (Europe, East Asia, North America) and staffed by around 1,800 people, Philips Research creates innovations in the areas of Healthcare, Lifestyle and Technology."[159] "Philips Research Europe has its main laboratory on the High Tech Campus in Eindhoven (Netherlands) and in Aachen (Germany). Sectors in Hamburg (Germany), Redhill (UK) and a department in Bangalore (India) are closely aligned with co-located units of Philips Medical Systems, Philips Applied Technologies and the Philips Innovation Campus, respectively."[160] Philips Research East Asia is located in Shanghai[161], and Philips Research North America is located in Briarcliff Manor, NY.[162]

Design activities take place at a separate organization, that has activities spread in 12 locations around the world and employs 450 people.[163] "Originating as a Corporate Design Department within Philips Electronics, we have naturally evolved into a dynamic design studio. As part of Philips we also have a strong link with the Philips Group and its technological knowledge but also offer design services - especially in the strategic area - to other clients."[164]

Locational Determinants

The market or demand-side factors that have induced Philips to internationalise certain R&D activities include the need to support local business units as well as the need to understand the demands of the customers they serve.[165] This is actually the starting point for innovation, as Philips is "convinced that the combination of innovation and market focus is the key to profitable growth."[166]

Philips Research units have been internationalised to support local Philips organizations in selected geographies, such as Asia Pacific, where there are "high growth opportunities." For example "Philips Research East Asia was established in 2000 in Shanghai, serving Philips' rapidly growing business in the East Asia region."[167] Proximity to customers is also an important factor in investing in innovation in this region, because Philips does not just want to serve the Chinese market itself, it also wants to "want to make China a global competence center for economy- to mid-range medical systems, using China as an export base to other developing and emerging markets in Asia and beyond."[168] Furthermore, "Philips Research continuously strives for its mission by leveraging capabilities and international presence to influence regional standards and markets"[169]

On the other hand, Philips Design units act as the "bridge between technology and people"[170] to ensure that innovations are adapted according to customer needs: "We constantly stress the need for relevance, context and genuine appeal, based on expressed user preferences."[171] "Technology alone cannot successfully deliver solutions that take into account all the complexity that the new relationship between people and objects will entail: cultural, personal, ethical diversity and so forth."[20] At a corporate level, Philips Design focuses research on understanding the needs of its main customers groups in the U.S., Europe and China, to "help Philips to create meaningful innovations"[172] Design facilities have therefore been internationalised to gain "insight into emerging local trends and developments, some of which can have significant consequences far beyond their region"[173]

While demand-side factors were portrayed as people-focused in terms of customers, Philips is also people-focused on the supply side; "that's why we employ so many experts in human sciences. That's why we carry out design research projects, often in conjunction with external institutes and partners."[174] This refers to the second type of motivating forces, which are technology or supply-side factors that have induced Philips to internationalise certain R&D activities. They include the presence of skilled labour, universities and sophisticated suppliers, as well as the proximity of centers of innovation. The decision to locate R&D facilities in China has been influenced by all these determinants.

Besides becoming a vital supplier base, "China has an enormous and low-cost labor pool, excellent higher education, rapidly expanding R&D and an impressive inflow of foreign investment."[175] Philips has 15 R&D centers in China, and employs 900 people. "In the spirit of Open Innovation, we cooperate closely with Chinese universities, research centers and companies"[28], because to Philips "China is not just a workshop, or a marketplace – it's also a center of innovation for new products and services with global application." [28]

"Competition forces us to invest where the conditions are the most favorable."[176] However, rather than relocating all R&D activities to China because of skilled labour at low costs, Philips still spends 75% of its R&D budget in Western Europe.[28] Nonetheless, "the lack of progress on business location factors is particularly worrying"[29], which is why Philips is committed to increase the competitiveness of Europe as an R&D location. With this in mind, they initiated the High Tech Campus, where they share their "facilities with scores of other companies, from established names such as IBM, SUN Microelectronics, Atos Origin and ASML to promising start-ups"[28] In doing so, they created a prime example of how "Open Innovation" clustering in Europe can contribute to create the right investment climate in the Netherlands: "Dutch companies will be more inclined to maintain activities here, while foreign firms will be glad to come here too."[29] "There are currently some 4,000 people working at the Campus – but this number is expected to rise to 7,000 or 8,000 by 2008 (…) It is the heart of the Eindhoven region where 40% of all R&D activities in the Netherlands takes place (…) Here, experienced researchers suddenly feel rejuvenated, revitalized by so much innovative energy. This is the very kind of élan that Europe needs."[28]

Proximity to centers of innovation and universities is also a determinant for locating facilities in other regions across Europe: "Cambridge offers a good example of a cluster of excellence with a tremendous capacity to create value. On the European continent, one example among many others of an ever more successful cluster is the cross-border triangle formed by Leuven in Belgium, Eindhoven in The Netherlands and Aachen in Germany."[28] Besides Research facilities in Eindhoven and Aachen, Philips has also located a facility in the IMEC (Inter-University Micro Electronics Center) in Leuven.

Besides proximity to universities, the availability of sophisticated suppliers is another determinant of where R&D facilities are located, because there is "an emerging shift from competing industries to competing networks. Best-in-class companies are those who successfully integrate their suppliers in both innovation and business fulfilment"[177] While in mature markets Philips is consolidating sourcing, their focus on "local for local solutions" in emerging markets means they are focused on developing their supply base in Eastern Europe and countries such as India, China, Brazil and Mexico.[178]

This locational determinant refers to the need to learn from technological developments and strategies of competitors, and the possibility of strategic alliances. "Strategic alliances are an important part of business at Philips. They enable us to bring new products to the market that we would not have been able to develop on our own. Philips combines with a number of leading global companies to build advanced products and services"[179]

For example, Philips approached Rivers Run Red - the leading development agency for Second Life in Europe – because of their "considerable experience and expertise in designing and implementing within this emerging medium"[180]; and they are able to build a strong position in healthcare IT through the partnership with Epic Systems, "which has afforded Philips a prominent position in PACS."[181] In China, the "joint venture with local Chinese company Neusoft (…) is a cornerstone of this strategy."[182] Together, they will develop and produce medical equipment for developing and emerging economies. Other joint ventures and participations include: LG Philips LCD (32.9%); LG Philips Displays (50.0%); Taiwan Semiconductor Manufacturing Co. Ltd. (16.4%); FEI Company (25.0%); InterTrust Technologies Corporation (49.5%); Philips Medical Capital (USA, Europe) (40.0%); TPV Technology Limited (15.0%)[183]

The final motivating factor for the location of certain R&D activities is historical development. Although Philips is a global firm, it remains strongly rooted in the Netherlands and in Europe in general. "Of course there is a special bond between companies with Dutch roots like Philips and Dutch society and the Dutch economy." [184] However, the bond between Philips and the Netherlands is not only being developed by a continuation of the past, "we have and will retain a presence in the Netherlands with advanced industrial activities, such as our lighting factory in Roosendaal (…) that also brings with it high-value employment."[37] Another example of "new economic activity in the Netherlands" is the previously mentioned High Tech Campus in Eindhoven.

Organizational Structure

There are local R&D units in more than 25 countries, which are part of the operating divisions. They are "predominantly engaged in product development and development of production methods"[185]

In addition, Corporate R&D has been fragmented into several organizations, each of which also has dispersed units across the globe. For example, Philips Research has laboratories that are closely aligned with co-located operating divisions. "Roughly two-thirds of the corporate research work is geared to the activities of the Product Divisions of Philips, with contractual agreements about programs and costs. The remainder is research of a more exploratory nature."[186]

"The international research activities of Royal Philips Electronics are controlled and coordinated from a corporate body, which is called Philips Corporate Research. This body, which reports directly to Philips' Board of Management, is responsible for research that is organized in three regions: Europe, East Asia and North America."[187] "Corporate Technologies supports Philips' operating divisions in turning innovations into advanced products. It stimulates the exploitation of technology synergies across the operating divisions through its shared labs and competencies"[41]

Corporate Technology is comprised of organizations dedicated to research, intellectual property and standards, system integration services, emerging activities, and technology, competence and innovation management.[188] Each organization in turn has its own sites and employees across the globe that supports local R&D divisions and business units:

- "Philips Research supports Philips' operating divisions with innovations, inventions and long-range vision, and employs some 2,100 technology experts around the globe."
- "Intellectual property and standards is responsible for managing Philips' intellectual property on a group-wide basis, employing around 400 people."
- "Philips Applied Technologies helps its customers to transform initial ideas into competitive products and costefficient manufacturing solutions by integrating new and existing technologies. Some 1,200 highly skilled professionals work at eight sites across Europe, Asia and the USA. TASS (Technical Application Software Services) develops embedded software on demand with a workforce of some 250 people."
- "In order to speed up the process of transforming R&D projects into new business opportunities for Philips, Corporate Technologies operates the Technology Incubator, in which dedicated investments in promising value propositions are made. Philips Software, which has been transferred to Philips Semiconductors as of January 1, 2006 develops and markets software solutions for mobile multimedia. Together, the Technology Incubator and Philips Software employ around 400 people."
- "The Office of the Chief Technology Officer (CTO) supports technology management, competence management and innovation effectiveness across Philips. It provides assistance for cross-divisional programs such as digital rights and security management and automotive technology management, and strengthens R&D competencies by offering a company-wide R&D core curriculum. The CTO Office also promotes innovation effectiveness by facilitating a joint, market-driven approach by the functions involved, principally R&D, marketing and supply management."[189]

There is a large degree of contact between R&D units from different operating divisions and corporate technology organizations as well as between R&D units that belong to the same group or organization.

Although historically Philips was a very fragmented organization with little cooperation between different units, "making "One Philips" the foundation of the way we work enables us to share solutions more effectively throughout the company, to reduce the number of suppliers, and to deploy shared service centers for support functions."[190] These shared service centers include the corporate technology organizations mentioned in the previous section as well as Philips Design, among others. Examples of ties between different R&D units that are referred to are that "Semiconductors is working with Research on the bio-chip, and Lighting is providing clean air and drinking water with ultraviolet technology", and "Medical Systems, Design and Lighting have worked together on the development of the Ambient Experience concept"[191]

As has been mentioned in the previous paragraphs, there are strong ties between R&D activities and the other functional areas at the Philips product divisions, as they have either been integrated or have been established with the goal of supporting other business functions. For example, Philips research generates innovative concepts in close cooperation with the Philips Product Divisions, "based on multi-disciplinary strength"[192]

Type of Organisational Structure

At local R&D units there is strong research activity, and ties between R&D units and other functional areas are also strong. Although Corporate Technology does coordinate R&D activities, it has a supportive function rather than a hierarchical position over the R&D activities in the product divisions. Besides supporting the operating divisions, corporate technology is also responsible for generating innovations and inventions, supporting Philips' businesses with long-range vision and feeding their innovation pipeline.[193]

Linkages between MNE R&D and the region

In recent years, Philips has strengthened their knowledge-based activities with a strategy of open innovation, clusters of excellence and public-private partnerships in R&D.[194] "Open innovation means getting rid of the 'Not Invented Here' syndrome, embracing co-operation in research with other companies as well as universities."[47] "Our philosophy of 'open innovation' also implies a commitment to alliances as a means of leveraging our innovative capabilities"[195]

However, Philips has always been closely linked to the regions they operate in. "At the height of its industrial production, Philips was Europe's largest 'native' consumer electronics business. Factories and offices were completely integrated in many local communities, part of the fabric of society."[196]

Contracts and informal ties with local firms

On the one hand Philips acquires knowledge from "local organizations to identify the needs of our target market. On the other hand, Philips also transfers knowledge to their partners, as well as educating the local "market on the ways our solutions can help"[197] For example in China, they "cooperate closely with Chinese universities, research centers and companies, transferring knowledge to them."[198] "What really sets us apart is our willingness and capacity to adapt, our eagerness to learn from our local partners and our emphasis on mutual respect as the basis for a long-term, win-win partnership."[51]

For Philips the nature of knowledge acquisition ranges from one-time collaborations to joint ventures, strategic alliances and acquisitions. In the case of most of these collaborations, Philips is able to gain knowledge with regards to local markets or draw on unique expertise in a specific technological field, enabling them to bring new products to the market they would not have been able to develop on our own."[199] In addition to linkages with strategic partners, Philips also builds "partnerships with key customers and suppliers, both in the business-to-business and business-to consumer areas"[200]

Suppliers are involved early on in the innovation process, with the goal of building long-term business relationships, where they "share both the risks and rewards" [201] "We work with a limited and clearly classified set of suppliers in both business-to-business and business-to-consumer markets. Our formalized relationship management enables us to embed sustainable joint value creation through strong relationships with strategic suppliers."[202] Specifically, this enables "'designing in' standard solutions" that meet customer expectations and reduce the overall total lifetime costs of products, thus maximising value.[203] The company also has directly contacts customers to ensure that products meet their expectations. "Consumer feedback is an intrinsic part of our product creation process and is a crucial part of building relevant value propositions for both our consumers and business-to-business customers."[204] Consumer insights are gained through 'Meet and greet' sessions, in-home visits, and consumer test centers. "Domestic Appliances and Personal Care (DAP) has five consumer test centers around the world, in Drachten and Hoogeveen, the Netherlands; Klagenfurt, Austria; Snoqualmie, USA; and Singapore. Consumer Electronics (CE) conducts Consumer Experience Testing during the development phase in Experience Centers in Singapore, Hong Kong and Brugge, Belgium. Product validation testing OEM (Original Equipment Manufacturer) customers are strongly involved in the specification design for innovations in Lighting and Semiconductors."[57] Philips also transfers knowledge to customers through education: “Medical Systems division’s educational offerings include an Online Learning Center; customized clinical user training focused on diagnostic and treatment; and specialized service training for biomedical engineers and other specialists”; ”Lighting Application Centers around the world provide hands-on opportunities for industry professionals to explore the fundamentals of lighting, real world lighting applications and the use of new lighting technologies; and “Consumer Electronics has created the Philips Online Academy, an e-learning environment using online interactive multimedia courses, for its retailers.”[57]

Philips Design also collaborates with several companies to be able meet customer needs, and to create “dynamic and refreshing products that cross traditional boundaries.”[205] “Sustainable meaningful solutions cannot be created by one industry in isolation but only through sharing competence and creativity, and by involving people from the early stages of research onwards.”[58] Examples include collaboration with Alessi for the design of kitchen appliances, collaboration with Italian furniture designers Cappellini to integrate Philips technologies in traditional furniture, and a collaboration with Olivetti to find ways in which technology could enhance the communication flow between colleagues, clients and headquarters.[58] In 1999 Philips Design also collaborated with Nike to develop wearable electronics, because “a technology company alone is not sufficient to deal with the complexity of new products types of this nature and, also for branding issues, needs to join forces with companies leading in the markets in which Wearable Electronics can be applied.”[206]

Contracts and informal ties with research institutes

As has been previously mentioned, Philips Open Innovation strategy involves actively pursuing cooperation with universities in the innovation process.[207] Among the Philips organizations, Philips Research is perhaps the most closely linked with universities. “Philips Research has embarked on its Open Innovation strategy of cooperation with universities, research institutes and other companies.”[208] For example, Philips Research Europe “is cooperating with business partners, universities and other knowledge institutions in Europe like the Embedded Systems Institute, the Holst Center, the Center for Molecular Medicine, Fraunhofer institutes and a variety of renowned universities in an Open Innovation setting.”[209] Philips Research East Asia partners with “the academic and R&D communities in East Asia"[210] “for standards, competencies, talents, and start-ups.”[211]

At Philips Research East Asia - as well as at the 15 R&D centers in China - Philips’ “efforts help to increase China’s knowledge-economy.”[212] “In the spirit of Open Innovation, we cooperate closely with Chinese universities, research centers and companies, transferring knowledge to them.”[65] Ties between Philips and Chinese universities are strong. For example in 2005, "Zhejiang University (China), the Technical University of Eindhoven (the Netherlands) and Philips Research (with laboratories all over the world) have joined forces in three disciplines: Physics, Electrical Engineering and Biomedical Engineering."[213] “This agreement is intended to foster a new culture of technical excellence through the creation of a ‘brain bridge’ between eastern and western universities, and to support China’s efforts to produce the top-flight homegrown scientists and engineers needed to sustain its growing economy.”[214] In addition, Philips is exchanging knowledge with China on the issue of intellectual property, through courses given by Philips IP professionals from the US and Europe at the universities of Renmin, Tsinghua and Fudan, through exchange of IP experts, by inviting a number of Chinese professors to visit various IP institutes in Europe,[67] and through the IP-academies that have set up at three Chinese universities[215]

Philips also actively participates in joint research programs such as the Eurekaprograms like Medea in micro-electronics and ITEA in software-intensive systems.[67] Especially Healthcare

Systems Architecture - a research group of Philips Research - contributes to externally funded projects, such as the Virtual Laboratory for E-Science (2004-2005), Freeband B@Home (2004-2008), Smart Surroundings (2004-2009), IST MyHeart (2004-2006), and TRUST4All (2003-2005), among many others.[216]

Philips transfers knowledge to its employees because "develop people" is one of the company values.[217] Accordingly, they are "further developing our people competencies, e.g. through career development programs that reflect our commitment to diversity and inclusion, and accelerating the development of our top talent."[218]

Other contractual and informal ties with the local region

There are several other types of linkages between Philips and local organizations in emerging markets. Philips South Africa has set up a program called Project SOAR –Supply Opportunities and Achieve Results, which provides goods and services and works "directly on educating the children through a variety of activities, including educational trips and events."[219] In India, cooperation between local organizations has created the innovative service provided by project DISHA. Philips cooperates with the hospital, public authorities and some NGOs, to provide a mobile teleclinic with multi-diagnostic capabilities and a satellite link to a hospital, which tours poor remote areas of India.[71]

Philips also cooperates with Chinese authorities in their efforts "to define, implement and promote a solid system of Intellectual Property Rights in China."[220] With regards to China, Philips also provided knowledge to the Dutch government and Dutch society, considering their perspective as a global multinational which is larger in the USA, and is becoming larger in China, than it is and is able to be in the Netherlands where it is headquartered.[74] They did this "together with a number of other large companies, via what was known as the "business location matrix": a series of recommendations to government on how to increase the competitiveness of the Netherlands as a business location."[221] "As Philips, we agreed and still agree with most of the Lisbon proposals: less red tape, more flexible markets, bigger efforts in R&D, more cooperation between business and universities, take away barriers within the internal market"[222]

Nokia

Headquartered in Finland, Nokia is a leader in the mobile communications industry. The company is comprised of four business groups - Mobile Phones, Multimedia, Enterprise Solutions, and Networks - that are supported by divisions like customer and market operations and technology platforms.[223] "As of December 31, 2005, we had R&D centres in 11 countries and employed 20,882 people in research and development, representing approximately 36% of Nokia's total workforce. R&D expenses totalled EUR 3 825 million in 2005, representing 11.2% of Nokia's net sales in 2005, compared to 12.9% of net sales in 2004."[224]

Figure 19. The global network of Nokia R&D centres

Corporate Research takes place at the Nokia Research Center, responsible for carrying out Nokia's longer-term research and acting as "a link between basic industry research and product development - as well as responding to the product development needs of Nokia's business groups"[225] Nokia's corporate research unit operates from laboratories in six countries and "employs nearly 1,100 staff, with one in five employees holding a PhD (…) Our success is shown by the fact that Nokia Research Center generates half of the essential patents of the company."[3] In 2005 311 were patents granted in 2005 in 268 patent families.[226]

The selected location of Nokia Research Center (NRC) Budapest was established in 1998. As well as a new corporate R&D unit, Nokia Telecommunications also established a R&D unit that would concentrate on the development of Nokia's Mobile Switching software and applications. A significant expansion followed to meet the target of "employing approximately 300 software systems and telecommunications specialists by 1999."[227] The locational motivation for selecting Budapest for this site is because "Hungary is a country that provides high-quality education in computer science and technology."[4].

Locational Determinants

Since Nokia's business strategy is customer focus and consumer understanding in all areas of day-to-day business[228], it is not surprising that Nokia has located R&D subsidiaries close to all major customer markets in the world. Lifestyle and sociological trends are monitored by specialist consumer and market research teams to shape the design, engineering and manufacture of future products according to customer needs across the globe[229] In addition, "to increase its depth of consumer understanding, earlier this year Nokia brought together all of its 250 designers, psychologists, researchers, anthropologists and technology specialists into a single team. The newly named Nokia Design organization is now responsible for the entire design process – from strategy and conceptualization to product development – for the company's complete portfolio of devices. The team takes its inspiration from many different cultures, with its members based around the globe in cities such as Helsinki, Copenhagen, Los Angeles, Tokyo, Beijing and at Nokia's UK headquarters near London."[230]

"China and India increasingly driving demand and design preferences"[231] Nokia has been committed to strengthen its market position in these regions, and continues to invest in expanding R&D activities. In India, Nokia has located three Research and Development facilities to support local manufacturing and to local customer demands. "The end-to-end operations strengthen Nokia's complete solution offering and uniquely position it to work with Indian operators to reduce time to market for both network equipment and terminals and achieve the Government's target of 200 million mobile subscribers by 2008."[232] Engaging skilled labour for local product support was a locational motive when Nokia opened a R&D facility in Mumbai: "Primarily focused on providing software support and technical expertise in CDMA technology, the new R&D facility will leverage Nokia's existing global CDMA competences to build a team of local talent specialising on the CDMA protocol."[233]

In China, Nokia has made a "long-term commitment to be the preferred partner"[234], which also involved a significant expansion of its R&D facilities. This included the launch of a Nokia Postdoctoral Program, the creation of a unit to promote open standards and technology localization, the establishment of a CDMA R&D facility in Beijing,[235] and a major research and development center in Hangzhou.[236] Meeting customer needs has been a motive for locating R&D in China for a long time. Nokia started investing in making China an integral part of the manufacturing product development chain in the 1990s[14]. In 2001, "Nokia's investment in China had surpassed USD 1.7 billion. Nokia has established over twenty offices, eight joint ventures and one R&D center, with over 5,500 employees in China"[237] By 2004, Nokia had five R&D units in China employing more than 600 people, and sustained many collaborative relationships with China's research community. Product adaptation remains a reason to stay: "This cooperation will boost technology innovation and localization, enabling us to strengthen our R&D in key areas and respond to Chinese customer needs."[238]

To gain a better understanding of customer needs, Nokia also partners with local companies such as Shanghai Alliance. "Shanghai Alliance has rich experience in the IT industry and a deep understanding of the China market and customer needs. We strongly believe that the cooperation between Nokia and Shanghai Alliance will secure the future success of the company."[239]

The technology or supply-side factors that have induced Nokia to internationalise certain R&D activities include the presence of skilled labour and universities and the proximity of centers of innovation.

In 1998, Nokia's first phase of internationalising R&D for mobiles phones saw the opening of a research and development centre in the U.K. at a site where the skilled workforce was a major asset to the company. The Southwood Product Creation Centre includes "a global state-of-the-art mobile phone testing facility, a global Product Design Centre, university liaison, global environmental work and regional security operations"[240]. At that point Nokia already had R&D operations in four locations and a base station production plant in the U.K. Today access to skilled labour and proximity to universities remained an important locational determinant since "Nokia's R&D centers are located adjacent to leading technical universities in 12 countries."[241] Even in China Nokia choose to locate itself in Hangzhou to be able recruit well-educated personnel. "The presence of Zhejiang University, a focus on software capabilities and high-level education, as well as good transportation and communications infrastructure were pivotal in Nokia's choice of Hangzhou"[242]

In the U.S., the proximity of Massachusetts Institute of Technology's Computer Science and Artificial Intelligence Laboratory (CSAIL) motivated the opening of a joint research facility in Cambridge, MA, USA[243]. Besides cooperation with Stanford University, the local innovation environment provided by Silicon Valley was also motivated the establishment of a Nokia Research Center in Palo Alto: "In our search for future disruptive technologies, Silicon Valley provides a unique blend of Internet companies, entrepreneurs and academic institutions offering a distinct environment to foster open innovation and collaboration."

The following locations of R&D units were chosen to learn from target competitors or industrial partners. For Nokia, the nature of knowledge acquisition ranges from one-time collaborations to joint ventures and acquisitions.

The Hangzhou R&D center is an example of collaboration with local partners influencing Nokia's locational decision. The center was established to carry out R&D activities together with a local Chinese partner, and "builds on Nokia´s long experience of cooperation in technology development with Chinese partners and universities"[244] Investment in strategic R&D collaborations is a motive for Nokia to invest in certain locations. For example, Avaya and Nokia are collaborating to invest in R&D resources "to realise the enterprise fixed mobile convergence market".[245]

Other examples of R&D activities being established by joint ventures includes a new company formed by a joint venture between ICL and Nokia. The company supports Nokia Information Management's e-business development in Finland. "Nokia chose ICL as its partner because of the company's impressive track record in the e-business area. The arrangement also ensures that in addition to our own growing resources, we have the best expertise in the field at our service."[246] Another example is the company Meridea Financial Software, which has been established by Accenture, Nokia, and Sampo. "The new company, which combines the expertise of the founders in the fields of mobility, banking and finance, produces and markets software for mobile and online financial services."[247] To gain a competitive edge Nokia also gains knowledge by acquiring competitors. For example the acquisition of Intellisync Corporation will "position Nokia to deliver the industry's most complete offering for the development, deployment and management of mobility in the enterprise. The transaction is also planned to enhance Nokia's ability to respond to customer needs in this fast growing market"[248]

Organizational Structure

The following section will describe the intra-firm functional, hierarchical, and lateral linkages that characterise the way Nokia has organized their international R&D activities.

Local R&D primarily involves the development of products within the internationally dispersed business groups Mobile phones, Networks, Multimedia, and Enterprise solutions. “The majority of Nokia’s R&D work is product development conducted within the business groups.”[249]

“New Business development teams across Nokia collect and evaluate submitted new business ideas”[250] which are incubated in the business unit that best fits the scope of the idea. Ideas are not just collected from within Nokia; they are also collected from external sources. Corporate venturing then involves providing the resources to develop the idea to a profitable business.[251]

Besides the product focused R&D that is conducted at the business groups, research also takes place within the Technology Platforms group and the Nokia Research Center.[252] Both entities centrally coordinate R&D activities, and operate from sites in several countries.

Technology Platforms is a horizontal R&D division that focuses on multiradio technologies, including software platforms, chipset platforms, and intellectual property rights among others. “Technology Platforms also works with leading external developers, suppliers and partners.”[30] Research from technology platforms is integrated with the business product groups. The management and compatibility of technologies is centrally coordinated by Technology Platforms. “We support Nokia’s overall technology management and development by delivering leading technologies and well-defined platforms to Nokia’s business groups as well as to external customers.”[253]

On the other hand, the Nokia Research Center is the corporate research division that coordinates research cooperation and standardization. It focuses on strategic and long-term research[254], looking beyond current products, platforms and standards[255] to strengthen Nokia’s core competencies.[256] It is not attached to a specific product development business unit,[257] but rather “acts as a link between basic industry research and product development” by carrying out longer term research and responding to the product development needs of the business groups.[258] It does this from 10 sites in Finland, Germany, Hungary, China, Japan, and USA[259].

It is apparent from the previous sections that lateral ties within Technology Platforms and Nokia Research center are strong. Because Nokia does not directly refer to linkages between the R&D units within the business groups, it is not clear if these units also have a lot of contact. It rather seems that they are only linked to corporate research and supported by Technology Platforms. “Nokia researchers support the product development units to master key technologies and their evolution”[260]

The product development business units are part of the business groups and therefore strongly tied to other functional areas. Nokia Research center and Technology platforms both deliver technologies to Nokia’s business groups; however it is the local product development units that integrate new technologies into the business group, taking into account the specific needs of their customers[261] The Nokia Research Center and Technology platforms therefore perform more of a supportive role to Nokia product development units, and are not directly linked to manufacturing or marketing. “New business cases are created around technologies under development in Nokia Research Center. In most cases, this is done by Nokia's business units, which fund the majority of research projects at Nokia Research Center.” Projects without a clear business case are already incubated in the research center's incubation unit and eventually transferred to the Nokia Ventures Organization.[262]

Local R&D is primarily involved with market driven R&D. At these R&D units product development according to the (local) market needs take place, and they have been integrated with other functional areas. Corporate research acts as a strong centre that directs coordinates dispersed research units, and explores disruptive technologies and long term research objectives. In its coordination role it is supported by Technology Platforms, responsible for coordinating cooperation between units as one of the three horizontal groups that were introduced to make the company more efficient.

Linkages between MNE R&D and the region

Nokia's research vision for the coming years is to "extend the innovation pool"[263] to a wider community. "Collaboration is a key ingredient in Nokia's growth strategy. We work with other companies, research institutions, authorities, and industry organizations to further the competitiveness of our company and the strength of our industry as a whole."[264]

Nokia collaborates with several firms to maintain global contacts and to monitor and influence technological developments.[42] "We are also working with leading companies in other industries to bring to the market advanced specialized technology and applications,"[265] such as fixed IP network security, mobile corporate e-mail and extended corporate telephone systems to mobile devices. [266] Another example includes the collaboration between Nokia and Carl Zeiss optics that resulted in the integration of Carl Zeiss optics into camera phones.[267]

To acquire knowledge about specific markets, Nokia has entered into several joint ventures over time, including in China. "Regional joint ventures have proven to be an effective way to combine Nokia's global technology leadership with strong local partners to accomplish faster and higher market penetration in new and emerging markets."[268] Knowledge about the market is also acquired directly from the consumer, for example at the Nokia Experience Centers. Apart from showcasing their products, these centers allow Nokia "to learn more about consumer needs and wants, which will help Nokia with the creation of future consumer-focused products."[269]

"Nokia recognizes that innovation does not only happen within Nokia"[270] and therefore seeks contact with external sources that have ideas that fit into the Nokia vision.[271] This is primarily done by the Nokia Ventures Organization and other venturing teams. One of these teams is "involved in capturing market innovations through various means, including the joint development of new ventures or partnerships." To facilitate start-up, Nokia provides knowledge and expertise to entrepreneurs, thereby benefiting from getting early exposure to innovative ideas. Another team is responsible for developing and operationalizing strategic new business ideas from inside and outside the company. Besides knowledge, capital is also provided by teams like Nokia Venture Partners and Nokia Growth Partners. The former is a venture capital firm that invests exclusively in mobile and IP-related start-up businesses and technologies on a global level, while the latter is a global mid- to late-stage venture capital fund that invests in mobile technology companies that are already experiencing industry adoption by large companies.[272] Venturing at Nokia extends Nokia's innovation network and creates linkages for developing new businesses.

Besides venturing, Nokia remains up to date on the latest technological developments by keeping its "soft signal antenna" up through participation in standardization bodies as well as "continual external networking with business communities, customers, product users, and a range of other stakeholders"[273] Nokia is represented in many standardization bodies and large international cooperation projects in which Nokia sees specific interest and opportunity.[274] Examples of standardization bodies Nokia is involved in include the Multiband OFDM alliance to support Multiband OFDM UWB technology[275], and the Open Mobile Alliance (OMA) Interoperability Programme to provide the market with interoperable products. In these bodies Nokia is involved in activities such as driving standards and innovation, providing services like testing, and creating specifications[276] Besides standard bodies, Nokia also participates in international research projects and industry forums. A Nokia Research Center representative currently chairs the Wireless World Research Forum[277] and Nokia has also joined forces with Marconi through their Italian consortium Securcomm, to provide the Italian police with secure and reliable communications services.[278] Research projects at an EU level are discussed in the section "Other contractual and informal ties with the local region."

Collaboration on new business ideas is also achieved through a network of research centers and academics.[279] There are numerous examples such research projects. Besides the fact that "Nokia's R&D centers are located adjacent to leading technical universities in 12 countries."[280], "Nokia works with approximately 100 universities globally."[281] "Research collaboration with the industry and academic institutions has been a key element of Nokia Research Center's success. From the beginning, Nokia Research Center has participated in the work of various industry fori and in several research programs run by national or international agencies, such as the Tekes of Finland and the European Union Framework Programs." [282] Nokia also participated in The UWB (Ultra-WideBand) Program that was partially funded by the Finnish National Technology Development Institution (TEKES)[283]; cooperates with the Zhejiang University in China; and is planning to provide knowledge transfer in Symbian technology to 10 Chinese universities through training, seminars and coursework.[284]

However, Nokia mostly refers to cooperation with U.S. universities in their communications, especially with Standford University and the Massachusetts Institute of Technology (MIT). Nokia is to pursue joint research with Stanford University, as well as providing new project-oriented courses on mobile computing and services." Given their close proximity, researchers from Nokia and Stanford will work together using the Stanford campus community as an experimental testing ground for new technologies and services developed by Nokia Research Center."[285] There are even stronger links between Nokia and MIT including many research collaboration projects[286]and the establishment of a joint research center[287]

Nokia is linked to the region through its employees, encouraging them to develop their own ideas using tools such as the Annual Venture Challenge idea campaign[288] Nokia also exchanges knowledge with external sources of labour. Interaction with (independent) developers is achieved through Forum Nokia, a global developer program that connects over 2 million developers "to the tools, technical information, support, and distribution channels they can use to build and market applications around the globe."[289] "The total global revenue earned by third party developers from mobile Java applications running on device platforms from Nokia would be EUR 340 million in 2005 alone." [290]

Nokia believes their employees are their most valuable asset in attracting skilled labour: "Nokia's corporate research unit employs nearly 1,100 staff, with one in five employees holding a PhD. The best, most knowledgeable people attract others like them and our diverse teams bring together both newcomers and distinguished experts"[291] Further studies are therefore actively encouraged, and "many internal processes, such as internal job rotation, promote personal development and the transfer of competencies"[292]

Other contractual and informal ties with the local region

There are several linkages with the EU and cooperative projects that stimulate innovation on a European level. For example, in the European 6th Framework Program Nokia leads the MobiLife research program on user driven communications solutions for the future. "The MobiLife consortium consists of 22 partners in 9 countries, 5 application owners and SMEs, 3 operators, 8 manufacturers and 6 academic partners."[293] Nokia also participates in three EU-ITEA projects with the goal of enabling the construction of open configurable middleware for consumer devices. "All three of these projects are examples of open innovation involving Nokia Research Center, Philips Research (Project coordinators), Fagor, IKERLAN, academia, and research institutes."[294] Another example of cooperative research project on a European level includes a collaborative project of Ericsson, Helsinki University of Technology, Nethawk, Nokia, Secgo, TeliaSonera Finland, University of Helsinki and VTT (MERCoNe)[295] and Nokia also contributes to the development of a market for more environmentally friendly products through a cooperative pilot project with the European Commission. "Nokia contributes to this cooperation with its background in environmental work experience based on product life-cycle thinking."[296]

Volkswagen

Headquartered in Wolfsburg, Germany, and with 44 production facilities spread across eleven countries in Europe, and another seven countries in America, Asia and Africa, Volkswagen is "one of the world's leading automobile manufacturers and the largest carmaker in Europe." In total the Volkswagen Group owns 8 strong brands ; which are "divided into two brand groups. Under the leadership of the Group, the Audi and Volkswagen brands are responsible for the performance of their respective brand group worldwide" "The Audi brand group is made up of the Audi, SEAT and Lamborghini brands. The Volkswagen brand group includes the Volkswagen Passenger Cars, Škoda, Bentley and Bugatti brands. Each brand has its own character, and operates autonomously on the market. (…)The Commercial Vehicles brand is responsible for the Group's commercial vehicle products"

Figure 20. The global network of Volkswagen R&D centres

Following a corporate restructuring effort that started in 2001 , "the Group's decision to form two brand groups in the Automotive Division was driven by the desire to tap synergy effects in the development sector, for example, by using our platform and module strategy, as well as in purchasing and logistics" The brands are united under Volkswagen AG, which is the parent company of the group. Therefore, "in its function as parent company, Volkswagen AG holds interests in AUDI AG, SEAT S.A., Škoda Auto A.S., Volkswagen Financial Services AG and numerous other companies in Germany and abroad." However, each individual brand or company conducts business at their own responsibility with "considerable leeway to develop their own strategies" , albeit under the general leadership of the Group: "Each brand in the Volkswagen Group is managed by a senior brand manager. The Group targets and requirements are aid down by Volkswagen AG or the Group Board of Management. The companies of the Volkswagen Group are managed separately by their respective management."

Besides developing vehicles and engines for the Group in its function as a parent company, Volkswagen AG also produces and sells vehicles under the Volkswagen Brand Group and the Commercial Vehicles brand.[297] Within the Audi brand group, "the Audi brand is the technology leader,"[298] and "the Financial Service Division's portfolio of services ranges from dealer and customer financing and leasing, through banking and insurance activities, down to vehicle rentals and the fleet management business"[10]

Although there are group-wide platform and module strategies that aim to unite the development activities of the two brand groups, publicly available information on group wide research and development is scarce. Considering the fragmentation between the brand groups, this is to be expected. To illustrate, specific details on R&D centres that fall under in the Audi brand group can only be obtained from the Audi website. For example, the Aluminium and Lightweight Design Centre in Germany which developed the Audi Space Frame for the Audi A8 and the Lamborghini Gallardo[299] is not mentioned in any communications on the Volkswagen Group website. "Clear lines have been drawn between brand functions and Group functions, meaning that responsibilities have been unequivocally defined."[10] To create a complete picture of R&D activities of the Volkswagen group, it would therefore be necessary to investigate each brand separately. However, given this case-study's group-wide focus, the profile will be based on descriptions obtained from the group-website.

Departments such as the Future Research function and the electronic research department fall under Group Research at Volkswagen AG. "Volkswagen's research and development is the driver for innovation within the group. In 2005, around 10,000 employees in Wolfsburg initiate new solutions and concepts to ensure the technical advantage of our company," [10] total R&D costs amounted to €2.0 billion, and 1,340 patents were granted of which 1,024 were in Germany and 316 abroad.[10] "In fiscal year 2005, research and development activities focused primarily on improving functionality, quality, safety standards and the environmental compatibility of Group products. In the case of all new models, advances that we achieved during the development process were systematically implemented in the product" [10]

Market or demand-side factors

The market or demand-side factors that have induced Volkswagen to internationalise certain R&D activities include the need to close to the main customer markets they serve. This is actually included in their Group Values and Group Guidelines, which state that they give their customers' interests priority, and their "internal standards consistently reflect our customers' needs, expectations and wishes."[300] In line with these guidelines, one of their strategic goals is to increase their presence to move from being a European exporter to establishing a worldwide integrated network.[301]

Global presence is necessary to learn about local trends and preferences as well as being able to appropriately integrate innovations into new models to reflect technological advances or customer demand. "This is because customer preferences vary enormously in our markets across the globe. Individuality is prized everywhere, and the characteristics of different regions must be taken into account in order to succeed in the local market."[302] "It was with a view to zoning in more closely on this regional influence that, for instance, an interdisciplinary team of engineers, sales people, marketing experts and designers was sent to the USA."[15] The motivation behind establishing the "Moonraker" project in the USA was to employ "scouting activities" to capture the demands of American consumers, which were translated into technological terms and transferred to the development departments.

The Moonraker project is only one of the examples of the cross functional teams that are established before work starts on the development of new models, and in 2004 Volkswagen dedicated an entire section within Group Research to analyse trends and draw up scenarios.[303] This is especially significant with respect to China, which will be "the world's largest car market", and requires the "development of cars to be targeted to tastes and prices of growing Asian markets."[304] To defend its current position in China, the Volkswagen Group's activities are therefore being redirected to focus on "the development of a product range that takes greater account of the dynamically growing needs and expectations of Chinese customers."[305]

Technology or supply-side factors

The necessity to access a wider range of scientific and technological skills and knowledge than is available in the home markets also influences the location of R&D activities. In this respect, the technology or supply-side factors that make have motivated Volkswagen to internationalise R&D activities include proximity to sophisticated suppliers, universities and links with clusters of SMEs and knowledge hubs related to the region.

Proximity to key suppliers is increasingly important especially in Europe, as "supplier integration continues to be a key factor in our procurement strategy." Workshops were recently held with suppliers to work together on technical development areas, among others.[306] "Germany and its West European neighbors continue to be the main sources of procurement for the Volkswagen Group, primarily owing to their technical expertise and geographical proximity to our production locations and extended supplier base."[307] Volkswagen's presence also stimulates the development of clusters of suppliers, for instance at SEAT's research and development centre in Martorell, Spain: "Over the past few years, the activities of SEAT have also been instrumental in promoting the development of the area around the Martorell plant. Some 15 companies have now relocated to the industrial estate established by SEAT for its suppliers, creating a total of around 3,000 new jobs"[308]

"Nonetheless, in addition to traditional markets, emerging countries such as China, India and Russia are increasingly attractive for us as supply sources."[309] In Russia Volkswagen has decided to build a new production plant in the city of Kaluga. Some 70 sites had been examined but "taking everything into consideration, the Kaluga location offered the best framework for the investment." In addition to allowing Volkswagen to substantially increase their share of the rapidly-growing Russian automotive market, the Kaluga location was specifically attractive because it "is well known for research and industry and is the seat of the regional administration."[310]

In the USA, proximity to Stanford University and a knowledge hub were key factors for the location of Volkswagen Group's Electronics Research Laboratory (ERL) in Palo Alto, California, (in the middle of Silicon Valley) in 1998. The employees at this location operate as "trend scouts", and "their early recognition of technology, research and initial development leads to innovative new ideas with which Volkswagen Group products can gain a competitive advantage."[311] Volkswagen also pursues joint projects with Stanford University, "using the unique chance to work with one of the most renowned universities and prove what is currently technically possible"[24]

Competitor factors

The Electronics Research Laboratory (ERL) in Palo Alto also allows Volkswagen to target specific firms in the centre of innovation to collaborate with. "The ERL is the Volkswagen Group's central research centre in the USA. In the heart of Silicon Valley, it is able to work directly with globally leading high-tech and start-up companies. The close working relationship between the ERL and these partners facilitates the design and development of innovative features and applications, which are then applied to test vehicles of the Volkswagen Group brands for further analysis."[312] This illustrates the third type of locational determinant, which refers to locations of R&D units being chosen to learn from target competitors or industrial partners.

For example, the Electronics Research Laboratory has collaborated with the graphics card manufacturer nVidia and Google to develop a new navigation system that uses data from Google Earth to generate 3-dimensional images of the route.[25] Volkswagen has also collaborated with DaimlerChrysler to develop "a mini-van to meet the specific needs of our American customers,"[313] and in China, joint ventures are a way to reinforce the strategic orientation of activities, as they allow Volkswagen to achieve cost-effective production and the ability to meet the legal requirements governing in-country manufacture under local management.[314] For example, in 2005, two joint venture companies were established in China - Volkswagen FAW Engine (Dalian) Company Ltd. and Shanghai Volkswagen Powertrain Company Ltd. - but joint ventures have been important in China as far back as 1984, when Volkswagen AG and Shanghai Automotive Industrial Corporation signed a joint-venture contract with a duration of 25 years[315] "The Development Center of SVW consists of a Research & Development Center and a Proving Ground,"[28] which will remain to be important since in 2002 the contract was extended by another 20 years. Other joint ventures in China include one with the FAW Group, established in 1990, which was also extended by 25 more years in 2003.[316]

Political Factors

Cooperation with local governments is one of the political factors that motivated Volkswagen to set up R&D facilities in the third German state Hesse and the States of Brandenburg and Lower Saxony. Volkswagen is collaborating with these states on the development, production and introduction of synthetic BtL (biomass to liquid) fuels. "Developing the scientific foundations for a new technology such as the production of BtL fuels by one German state requires early and close co-operation with the commercial sectors involved and with other state governments. Research plans need to be coordinated, for example, as does the acquisition of EU financing." "One of the driving forces behind this agreement was the stipulation contained in the Kyoto Protocol of 1997 that Germany reduce its CO2 emissions by 21% by the year 2010, another is the fact that the European Union expects its member states to increase the share of bio fuels used to 5.75% of overall fuel consumption by 2010.(…) For the states party to it, the agreement is also significant from a broader research and eco-political perspective, since the scheme holds the promise of generating added value and securing jobs, most notably for the agricultural community."[317]

At an investor conference in 2006, Dr. Suixin Zhang, Executive Vice President of the Volkswagen Group China, mentions how the changing Regulatory Framework in China might affect the attractiveness of China as a location. In line with new national strategy "To build country of innovation", the Chinese government is focusing on Chinese dominated innovation and aims to decline the country's reliance on foreign technology to 30%

(currently: 60%). The supporting policies and measures will aid Chinese brands to gain market share, which will put pressure on foreign companies.[318]

The final motivating factor for the location of certain R&D activities is historical development. The image of the brands that make up the Volkswagen group are strongly tied to their country of origin, where development of new models still takes place, for example Bentley in England, Lamborghini in Italy and SEAT in Spain. Another example is Bugatti where "the production of the Veyron 16.4 began on historical ground. This is the site where Ettore Bugatti once created four-wheeled legends"[319]

Local R&D

The headquarters Wolfsburg, Germany are home to the Group Research site, including Volkswagen Commercial Vehicles and Volkswagen technical development. The remaining Volkswagen brand group technical development sites are located in California, Mexico, Brasil, China, Japan, and South Africa, and also include the Bentley, Bugatti, and Skoda sites in England France and Germany respectively. The local R&D site in California Volkswagen is a specialized competence centre in Electronics Research. "Their early recognition of technology, research and initial development leads to innovative new ideas with which Volkswagen Group products can gain a competitive advantage"[320] The Audi brand group technical development sites are located in Germany, Spain (SEAT) and Italy (Lamborghini).[321]

Each individual brand conducts their business at their own responsibility[322], which has resulted in R&D being strongly centralized in the original home countries of the brands that make up the Volkswagen Group. This implies that at the R&D sites across the different brands strong research must take place, and the geographically dispersed units maintain technological capabilities in the same or similar fields of technology. Only the Volkswagen brand has dispersed R&D activities at local production sites, primarily aimed at facilitating the transfer of technology from the parent to local manufacturing, as well as to learn about local trends.

Vertical ties with home country R&D

Coordination of research activities is achieved by using platform and module strategies, which is stimulated by Group Research, located at headquarters in Germany. Group Research employs some 8,361 people for Volkswagen Technical development, 736 people for Volkswagen Commercial Vehicles Technical Development, and 542 people for other Group research functions such as Future Research, which supports Volkswagen brands with innovations, and long-term vision.[35]

There is no evidence that decisions concerning R&D activities of the other brands are centralized at Group Research, it rather seems as if local R&D sites are primarily linked to each individual brand, and perform their own research. This is research is however supported by the Group platforms and modules, and ultimately communicated to the research functions of the other brands (rather than directed) by Group Research. "At Volkswagen, knowledge management aims at making available knowledge at any place and at any time and subsequently passing on innovative local solutions to the entire Group."[323]

Lateral ties with other R&D

Contacts between R&D units are promoted through software solutions such as the "Expert finder" - the electronic Volkswagen Yellow Pages[324]; the "Expert room" - a virtual network of technical experts[325]; and common Knowledge bases - e.g. a central database that allows users to access information from any development site.[326] "Finding the right contact person and enabling people to find you as an expert are the two essential aspects of a pioneering knowledge offensive at the Volkswagen Group,"[327] and "teams improve and intensify their collaboration in the knowledge networks."[328] "These knowledge networks are a new form of global cooperation in the group. In this manner, experts in the group can learn from one another and based on existing experience, can now take important decisions quicker and more securely"[41] Additionally, using a centralized system, allows Volkswagen "to keep track of innovations based on customer requirements and new technological solutions. In this way, we are able to match innovations with individual models, thereby increasing their competitive edge. 2005 also saw the introduction of product workshops, events where employees from all parts of the company involved in the product development process come together."[329]

Lateral ties with other functional areas

Volkswagen has reorganized activities into two brand groups, the Volkswagen and the Audi brand group, "to tap synergy effects in the development sector (…) as well as in purchasing and logistics."[330] Even though the board of management has agreed to make changes in the process organization including an increase in cross-divisional cooperation[43], there still seems to be little cooperation between R&D units from one brand and functional areas from another. This is also because "the brands and companies each define their individual policies and thus focus on different aspects in their activities."[331]

So while R&D activities may be closely linked to functional departments within an individual brand or company, there are few ties with functional areas from other brands. However, following the unification of production standards by joining employees from the individual brands and plants, Volkswagen is now planning "to develop new production technology across the Group by implementing a uniform system known as "scouting". By adopting this approach, which is closely linked to the research and development scouting process, we can ensure that scientific innovations are used early on in the production process"[332], thus strengthening the ties between R&D and functional areas across the company.

Type of Organisational Structure

Local R&D is primarily linked to the individual brands that make up the Volkswagen Group. Since these brands operate independently, and strong research activity takes place at their respective R&D sites. However, there is little cooperation between R&D units across different brands; knowledge sharing is only achieved though Group Research. In this respect Group Research has a coordinative role; however ties with local R&D units are not formal in the sense that Group Research controls the type of activities they engage in. It rather acts as a centre that facilitates knowledge sharing between R&D units (through platforms, module strategies, portals etc.) and explores long term research objectives for the entire Group.

The fragmentation between the different brand groups and the resulting structure of R&D activities is changing however, as Volkswagen aims to "develop from a European exporter to a worldwide integrated network of human resources, know-how, complex products and services (…) by 2010" [333]

Linkages between MNE R&D and the region

By describing the type of interactions between the Volkswagen Group and regional actors, this last section will give an overview of how Volkswagen investments in R&D contribute to regional innovation and growth. These ties are used for knowledge acquisition or knowledge transfer, and "the ability to manage knowledge and incorporate it in future products and services is an essential factor in the success of our company. Our aim is to furnish relevant, contemporary knowledge for decisions-making. The following questions come to mind: How can knowledge become accessible to all? How can knowledge and experience of individuals be obtained? How can knowledge be augmented?"[334]

"In the global working world, quick, flexible implementation of business processes and the provision of information and applications is decisive for success." [335] Knowledge sharing with regional actors is therefore facilitated through internet portals, namely the B2E employee portal, the B2B supplier portal and the B2C customer portal, which respectively provide information, communication services, processes and IT-systems for local employees, optimisation of business processes for suppliers, and better and new services for consumers. [48]

Contracts and informal ties with local firms

Volkswagen acquires knowledge from local customers to reduce the risk that they "will not accept these products"[336] through a scouting process whereby information is gathered directly from customers. They also acquire knowledge from local firms such as suppliers or venture partners. In creating these (and manufacturing) linkages, they transfer knowledge, therefore having "an important part to play not only as an employer but also in terms of infrastructure and regional development(…) - a responsibility we live up to worldwide by offering above-average working conditions and compensation, contributing to local structural development and ensuring the Group-wide transfer of modern processes and technologies"[337] Volkswagen further contributes to certain regions by creating "a framework for further entrepreneurial activities around those locations. Opening up the regions to new industries in the long term will result in their sustained strengthening."[338]

Volkswagen collaborates with specific local firms because of their unique expertise. For example the Braunschweig-based solar energy and heating specialists Solvis collaborated with Volkswagen to create the first solar filling station in lower Saxony, which started "operation on the grounds of the Volkswagen Technology Center in Isenbüttel near Gifhorn.[339] In addition, Volkswagen maintains links with local firms for the purpose of advancing certain standards, such as with other European manufacturers to develop universal standardization of Car-to-X communication. [52]

As supplier integration continues to be a key factor in their procurement strategy, Volkswagen has been also been exchanging knowledge with suppliers. "For this reason, the first ever supplier workshop meeting was held in the year under review; over a number of days, selected suppliers worked together with staff from our procurement and technical development areas with a view to optimizing costs"[52] Besides acquiring knowledge from local suppliers, price advantages also play a role: "In the wake of the eastward expansion of the EU, we have also increased procurement activities in Eastern Europe and are already enjoying additional price and locational advantages. North America also plays an important role in our procurement activities."

In China, to become a "Focus Supplier" cost advantages are required to be "at least 20% compared to Europe"[340] However, Volkswagen will contribute to the development of the regions they source from through the relationship between their Chinese joint venture partners and their supplier networks. Volkswagen sees an opportunity to achieve a platform strategy by establishing a Common Sourcing Process for their Chinese Joint Venture partners (SVW, FAW-VW & VW AG), thereby "enhancing competition, generating economies of scale

& scope due to high volume, and increasing volume and depth of local content,"[53] among others.

Contracts and informal ties with research institutes

Volkswagen cooperates with research institutes and universities for the development of several new technologies. They collaborated closely with the Paul Scherrer Institute to develop the Bora HY.POWER, which is driven by a hydrogen PSI fuel cell and an electric engine.[341] "The new technology platform has been developed by Volkswagen's research unit in co-operation with our project and technology partner - the PSI in Switzerland working closely together with the Federal Technical University of Zurich (ETH) and the German FEV Motortechnik GmbH in Aachen."[342] Other examples include the Volkswagen research department in California, which collaborated with Stanford University to create an autonomous automobile. "Many aspects of the autonomous automobiles will eventually be used in other, more conventional driver assistance systems. 'In this joint project, we are using the unique chance to work with one of the most renowned universities and prove what is currently technically possible,' emphasises Dr. Carlo Rummel, head of the ERL in Palo Alto.'"[343] Another type of linkage has been created with the Westfälische Wilhelms-Universität in Münster, where Volkswagen established a unique professorship for Applied Material Sciences for Energy Storage and Energy Conversion, the only professorship of its kind anywhere in Europe. "For Volkswagen AG, advances in the area of energy storage are one of the keys to further advancing drive technology. The deal sealed today lays the foundation stone for a very promising collaboration between industry and university-based research," said Prof Jürgen Leohold, head of Volkswagen Group Research."[344]

In China, "Volkswagen AG and the car producing joint venture Shanghai Volkswagen (SVW) are to develop a vehicle with a combined electric motor and petrol engine. The market launch of the hybrid vehicle is set to coincide with the 2008 Olympic Games in Beijing. Development will run parallel in Wolfsburg and Shanghai."[345] Volkswagen has enhanced these efforts by setting up a joint research project with the Tongji University in Shanghai for developing a fuel cell vehicle. Winfried Vahland, CEO and President of the Volkswagen Group China emphasised: "With the development of a hybrid vehicle in China, Volkswagen is supporting the efforts of the Chinese government to foster alternative technologies with the objective of conserving natural resources."[58] Another effort that Volkswagen is supporting in China is improving road safety standards, for which the group has taken a number of measures. "These include an accident research project funded by the Group at Tongji University, Shanghai; the "Volkswagen Experience" training course for drivers; and the use of ESP in vehicles for the Chinese Market." The accident research project with Tongji University employs a "multi-disciplinary team of specialists from the areas of vehicle development, medicine and psychology. Volkswagen has sent members of its German accident research team to China specifically for this project" with one of the objectives to "find out how to optimise European safety technology for use in China."[346]

Volkswagen also transfers knowledge to the region by establishing vocational training schemes such as the training of automotive technicians at the VW Argentina plant, where a 183 people have already qualified as automotive technicians. This has resulted from agreements between the company and technical schools in Córdoba and Pacheco[347] "Vocational training for young people is on the agenda at all our plants and training measures are adapted to local requirements by the respective companies."[348] Volkswagen also has its own university, which "serves as a center of competence and culture at Volkswagen AG and addresses the upper echelons of Job Families and management elites."[349] "The AutoUni is its own internationally recognised Institution for postgraduate education with a scientific profile," which for now only "focuses on the Volkswagen World. In a second step, it will open up to suppliers and partners. In a third step, opening up to the public is planned."[350]

Besides training for upper management through the AutoUni, "Volkswagen Coaching GmbH provides tailor-made vocational training, continuing professional development and executive development programmes for Volkswagen, as well as offering its services on the open market. In 2004, at its bases in Wolfsburg, Hanover, Brunswick, Kassel, Emden, Salzgitter, Zwickau, Chemnitz and Dresden the company held approximately 4,100 training events for some 36,000 participants"[351] "In additional to an extensive range of technology and quality seminars and team training, we offer staff development programs tailored for individual target groups such as supervisors, planners and developers." One of these programs is the ForMotion program, which has "a view to boosting employee know-how, generating new knowledge and communicating this across the Group."[352] "At Volkswagen, the employees create knowledge for the company with their experience. This knowledge in its entirety is the 'intellectual capital' of a company. The knowledge resource is not consumed by its application, rather it proliferates. Managing knowledge means handling this resource with awareness and promoting its application in the company specifically."[353]

Volkswagen specifically supports employees in acquiring IT skills, making a "decisive contribution to enhance the performance of our employees and to improve the competitiveness of our Group as globalisation intensifies."[354] They are "convinced that tomorrow's world of work at Volkswagen requires a minimum level of IT skills at every workplace, in every country" [355], and are "assuming responsibility for the regions in which the Group facilities are located." [356]

In assuming responsibility for regions throughout the structural change in the automotive industry,[357] "our employment research has shown that regions characterised by a high degree of 'cluster formation' also present strong increases in employment. We implement this finding with our AutoVision concept. The concept aims to reduce unemployment at Volkswagen Group locations and to create a framework for further entrepreneurial activities around those locations. Opening up the regions to new industries in the long term will result in their sustained strengthening."[358] The "Spreading Our Wings" project in Poznan, Poland is an example of how Volkswagen is "driving forward the development of a region that is set to become an automotive centre of competence (…) In parallel with the expansion of the plant into an advanced automobile production facility, the second stage of the process - transforming the employees into multiskilled operatives who can lead a team with initiative and take responsibility - began in the autumn of 2004." "The third stage will comprise of function-oriented measures designed to boost competitiveness, enhance quality and create jobs." [71]

Other contractual and informal ties with the local region

The example of the activities taking place at the VW Poznan plant demonstrates another type of linkage with the region. "As in the past, in these activities too, VW Poznan can count on support from the surrounding region. Consequently, growing together with the region and giving something back as a good corporate neighbour is all part of plant policy. The outcome is that, like VW in Wolfsburg, VW Poznan has triggered a process of social development that opens up great opportunities for the region and for the plant itself – not least by consistently involving local suppliers in the value-added chain." Volkswagen also collaborated with local authorities, environmental groups, local people, companies and the media. [71]

“Ever since it was founded in 1999, Wolfsburg AG (WOB AG), a public-private partnership between the Volkswagen Group and the City of Wolfsburg, has been responsible for implementing the AutoVision programme. The objective is to reinforce the regional economy in a sustainable way and to create new employment prospects.” The partnership focuses on supplier relocation, support for business start-ups, the expansion of the service sector, and the development of “business clusters” combining expertise from the fields of mobility, leisure, tourism and health. “This mainly means using new ideas to create and maintain jobs. By the end of 2004, some 8,000 new jobs had been created in Wolfsburg, reducing unemployment in the city to 8.2 percent” Other links with governmental bodies to advance development of the local region include investments in regions designated by the Commission of the European Communities as qualifying for special support. “Through our investments in these disadvantaged regions and the transfer of know-how, we are contributing to their economic development. Among the measures supported by the European Regional Development Fund (ERDF) and various national programmes are our projects in Portugal, Spain, Germany’s new federal states and four new EU member countries (Poland, Czech Republic, Slovak Republic and Hungary). In addition, our Group companies are also engaged in the educational sector, as well as in research and development work in a wide range of projects that are subsidised by the EU.”[359] Volkswagen also contributes to the development of the Brazilian state of Pará, where “Volkswagen is cooperating with the Brazilian research and development programme ‘Poverty and Environment in Amazonia’ (POEMA) and creating new jobs in a region with structural problems”[360]

Furthermore, they also maintain ties through alliances and partnerships. This includes the Alliance of Synthetic Fuels in Europe (ASFE), comprised of DaimlerChrysler, Renault, Sasol Chevron, Royal Dutch Shell and the Volkswagen group. “The objectives of ASFE are to promote synthetic fuels and support a range of activities in the field of sustainable mobility including research, projects demonstrating the benefits of synthetic fuels including vehicle trials, cooperation with governments and promotion of public awareness.” [361] Volkswagen has also joined the Clean Energy Partnership- an international association of Aral/BP, BMW, Berliner Verkehrsbetriebe (BVG), DaimlerChrysler, Ford, GM/Opel, Hydro, Linde, TOTAL, and Vattenfall Europe [362]- and the Car-2-Car Communication Consortium - comprised of Audi, BMW Group, DaimlerChrysler, Fiat, Renault and Volkswagen[363]

Finally, Volkswagen promotes contact with its customers through autoshows across the globe, for example in New York, Lisbon, Geneva, Madrid, Düsseldorf, Los Angeles, Sydney and Tokyo, where in 2005 the “Volkswagen brand presented the prototype of the EcoRacer” [364] Volkswagen even has its own “theme world” Autostadt. Located in Wolfsburg, Germany, this is where they bring “its brands and all their facets to life for more than two million visitors and delegates per year. The Autostadt is the ideal platform for dialogue with various social groups, for developing relations with local residents and for enhancing the acceptance of the Group among the public, potential future employees and business partners.[77]

Motorola

Motorola is a global communications company "known for innovation and leadership in wireless and broadband communications."[365] Following reorganization in 2005, "the Company was organized into four main business groups, focused on mobile devices, government and enterprise, networks and the connected home (…) In addition, the Company's key support functions, including supply-chain operations, information technology, finance, human resources, legal, strategy and business development, marketing, quality and technology have been architected centrally and distributed throughout the Company"[366]

Figure 21. The global network of Motorola R&D centres

"Throughout history, Motorola has relied, and continues to rely, primarily on its research and development (R&D') programs for the development of new products, and on its production engineering capabilities for the improvement of existing products"[2]; allowing its four operating segments to remain competitive in industries with constant changes in technology.[2] Corporate technology consists of 5 R&D divisions; Motorola Labs, Motorola Software, Technology Solutions R&D, Innovation Acceleration and Standards.[367]

"R&D expenditures relating to new product development or product improvement were approximately $3.7 billion in 2005, compared to $3.4 billion in 2004 and $3.0 billion in 2003. (…) Approximately 25,000 professional employees were engaged in such research activities during 2005."[2] In 2004, 572 patents were granted in the U.S., adding to a total of 8,416 patents owned in the U.S. and 12,885 in foreign countries.[368] Another source states they "have over 21,300 patents and counting".[369]

Global headquarters are in Schaumburg, Illinois, but Motorola Technology's innovation centres are spread all over the world, in order "to have a global footprint."[370] These R&D

centres support the operating business segments. In addition, the Networks business segment and the Connected Home Solutions segment also have number of R&D facilities in the U.S.[371]

Market or demand-side factors

The *market* or *demand-side* factors that have induced Motorola to internationalise certain R&D activities include the need to support local business units as well as the need to understand the demands of the customers they serve, in order "to develop technological solutions specific to each region's needs."[372]

This especially applies to the Asian regions that Motorola is active in. For example, The Taiwan Technology Center in Taipei, the second R&D center in Taiwan, has been established to provide a "vital link to the overall development of Motorola's Connected Home solutions which are tailored to customer needs in the region"[373] The Advanced Communications Laboratory at the Motorola Asia Pacific Customer Solutions Centre (CSC) in Penang, Malaysia has been "designed to serve as a critical Asia Pacific system support backbone with strong software development and application integration capabilities to meet the future needs of Motorola's customers across the region."[374]

Motorola has established 18 R&D facilities in China to date, in order to be close to key customers.[375] The Hunan Innovation Center, for example, "demonstrates Motorola's commitment to driving global and local innovation through strong investment in innovation activities. With the advantage of local access, the new center will help operators adopt advanced technologies, seize time-to-market advantages and increase customer revenue, thus enabling them to benefit from the rapid development of China's telecommunications"[376] "With the establishment of the new Hangzhou R&D center, Motorola is taking another step towards addressing the specific needs of operators in the China market"[377]

In addition to supporting the Networks operating segment to develop, test and launch product offerings for their customers, the Hangzhou R&D center also contributes to the development of "local talent while driving network innovation and the growth of China's wireless communications industry."[13] This reflects that besides internationalising R&D activities to adapt products to regional needs, it also allows Motorola to work "with some of the best scientists and engineers in the world"[378]

Technology or supply-side factors

Access to skilled labour is included in the second type of motivating forces to internationalise R&D activities. These are *technology* or *supply-side factors*, which make it necessary to access a wider range of scientific and technological skills and knowledge than is available in the home markets. "Motorola wants to be close to customers, university partners, and the best talent pools worldwide."[379] For example in China, the Broadband Wireless China Research Center "will bring deep technical expertise to Motorola business teams in China and will drive research partnerships with customers and universities in China."[380] "The opening of the center is a further testament of Motorola's China strategy: to develop China as a production and R&D base"[16]

"The company has also identified India as a technology development (R&D) base, a fact that is reflected in its scope and scale of operations in India"[381] Especially in India the establishment of R&D facilities is motivated by access to local talent pools: "With access to India's proven best-in-class scientific and engineering talent and the ability to collaborate with world-class universities and institutes, Motorola believes India is the ideal market for applied research and software development."[382] "We were among the first telecom companies to realize India's software potential and invest in establishing a development center here"[383] Opening its first R&D facility in Bangalore in 1991,[384] the company "today has the largest, most versatile and fastest growing R&D presence in the country among all telecom MNCs."[385]

In 2005, Motorola's R&D investment in India added up to US$85 million in technology and R&D. With plans to grow this investment by 10-20% per year[386], Motorola is rapidly expanding its R&D presence in the country. "Between April and July 2005 it launched Motorola Labs, expanded the presence of its Global Software Group to Hyderabad and launched new facilities for its Core Network Division (CND) and Embedded Communications Computing (ECC) businesses. All of this represents very high-end cutting edge software development and R&D work."[387] "The investment reflects Motorola's commitment to India and its confidence in the software talent available in India."[388]

Competitor factors

This locational determinant refers to the need to closely monitor the technological developments and strategies of competitors. The locations of R&D units are chosen to learn from target competitors or industrial partner. "We currently partner with industry leaders to meet customer product and service requirements and to develop innovative advances in design and technology. Some of our partnerships allow us to supplement internal manufacturing capacity and share the cost of developing next-generation technologies. Other partnerships allow us to offer more services and features to our customers"[389] The nature of knowledge acquisition ranges from one-time collaborations to joint ventures and acquisitions.

Motorola's "success is dependent, in part, upon our ability to form successful strategic alliances" For example, the Crolles2 Alliance with ST and Philips, means "three of the semiconductor industry's most innovative suppliers are working together to develop the leading-edge technology platforms."[390] The alliance has been formed to pool their respective research and development strengths; sharing costs and accelerating the development and availability of advanced technology.[26] Another example is the acquisition of an R&D center from BenQ, which makes Denmark "one of its R&D and development hubs in the region." "This transaction provides Motorola with another highly skilled R&D team and high-tech facility with a proven product track record, the team will support Motorola's development of innovative new mobile devices that increase our ability to deliver breakthrough products and experiences that integrate the technologies of both Motorola and our strategic partners"[391]

To gain a competitive edge Motorola also gains knowledge by acquiring competitors. For example, Motorola "has acquired next-generation cable network technology assets from Broadband Innovations, Inc.", which strengthens Motorola's solutions with patented innovations. "Many of Broadband Innovations' employees will join the Motorola Connected Home Solutions business, and will continue to be based in San Diego."[392]

Local R&D

Two of the four operating business segments have their own R&D facilities, but they primarily rely on Motorola's R&D programs for the development of new products[393] These R&D programs are organized under one of the five divisions of corporate Technology. Each division has its own R&D units located across the globe, where strong research activity takes place: "locally-driven innovation has enabled Motorola to take a leadership role in the industry."[394]

Vertical ties with home country R&D

R&D at the headquarters in Schaumburg, Illinois, U.S.A. does not have a particular hierarchical function over other R&D Centres. Corporate R&D activities are centrally architected under Motorola Technology, which consists of the divisions Motorola Labs, Motorola Software, Technology Solutions R&D, Innovation Acceleration and Standards. With 25,000 engineers and scientists[395] distributed across the company, these divisions support the operating business segment units located across the world.

Although all these divisions are grouped under Corporate Technology, there is limited central coordination. Each division consists of a set of interconnected specialized competence centers or teams that support the Motorola business segments:

- Product development is concentrated at Motorola Labs, which are organized "into discrete Centers of Excellence in key research areas"[396] "In Motorola Labs' 14 centers around the world some of the brightest minds in their fields to work collaboratively on applied research crucial to the advancement of Motorola's businesses."[397]
- "The Motorola Software organization devotes more than 6,000 engineers in 18 design centers worldwide", "to support and enhance Motorola's Seamless Mobility reality by providing custom software products, component system solutions and platforms for Motorola business units and their customers."[398]
- Technology Solutions R&D consists of the R&D teams that are located across Motorola, "pushing innovation and leadership in our four major market businesses: carrier, home, enterprise, and government"; to creating a competitive advantage for the business segments through technology.[399]
- Innovation Acceleration initiatives consist of research teams that identify "promising developmental projects, and then to manage their growth."[400] "Our goal is to commercialize technologies so that they may graduate to product groups in Motorola's businesses."[33] One of these teams is the Motorola the Early Stage Accelerator (ESA). Created to be "the prime commercialization engine for the company, "ESA's focus is to incubate ideas that are disruptive and/or cross business units" [36]
- Standards teams develop and execute Motorola's strategies in leading industry standards "Dozens of Motorola managers are actively involved in leading industry standardization efforts. These managers volunteer their time and the experience they have gained in the management of technology to help industry groups advance and promote standards. They hold positions as chairs of technical committees as well as positions on the board of the organizations developing standards."[401]

Lateral ties with other R&D

Lateral ties between the units or teams within an R&D Decision are strong, and knowledge is also shared with other R&D divisions. For example, the Early Stage Accelerator, "a multi-disciplinary team of business and technology professionals, is leading cross-business knowledge sharing and investment"[402], and "Motorola Labs is aligned to deliver solutions in eight crucial technology areas. Each has a specific role in delivering the vision of Seamless Mobility. It is a fluid model that allows for knowledge sharing among the dedicated centers." [403]

Lateral ties with other functional areas

There are strong contacts between the R&D units and other functional areas, as the R&D units provide support to the business segments. For example, “the work of Motorola Labs is strongly aligned with the company’s business units and their growth targets”, “Motorola Software Group provides key research and development of production-level software to support product development for Motorola businesses” , and the “Early Stage Accelerator (…) works across businesses to identify and accelerate commercialization of technologies and innovations into marketable products.”[404] In turn, “technical data and product application ideas are exchanged among Motorola's business segments on a regular basis”[405]

Type of Organisational Structure

At local R&D units there is strong research activity, and ties between R&D units and other functional areas are also strong. Corporate Technology acts as a weak center with little central coordination of activities at the R&D divisions. Instead, the R&D divisions function as a network of interconnected specialized competence centers and teams, with strong communication and information flows between them. “Our organization is based on a fluid, functional model”[406], and it’s this “global research network and locally-driven innovation has enabled Motorola to take a leadership role in the industry.”[407]

Linkages between MNE R&D and the region

By describing the type of interactions between Philips and regional actors, this last section will give an overview of how Motorola investments in R&D contribute to regional innovation and growth. “Around the globe, we are working to make a positive impact and address the needs and concerns of our stakeholders - employees, customers, investors and the community at large (…) each local Motorola facility is able to identify deserving organizations to assist, based on locally-relevant issues and the needs of individual communities.”[408]

Contracts and informal ties with local firms

Motorola contributes to regional innovation by stimulating the local environment through collaborations with firms. In the Hangzhou development zone “Motorola’s new R&D center will help to further drive talent and innovation in the region and beyond. The center will focus on improving the capabilities of enterprise platforms and mobile applications, providing a venue for Motorola to work with operators, service providers, content providers and end-users on wireless application innovation and development, thus driving innovation across the entire value chain”[409] But knowledge is not only transferred to local partners, the co-development of new technologies makes “the most of Motorola’s ability to work with the entire industry, including operators, service providers, application developers and end users.”[410]

Motorola maintains close links with users: “We build long-term relationships with our customers and partners based on trust and integrity. We work closely with customers to develop and test new products and to ensure satisfaction.”[411] In addition, there are a series of Motorola initiatives “designed to demonstrate mobile communications technologies to the end user and to assist customers when choosing technologies appropriate to their subscriber needs” One of them is the EMEA Motorola Innovation Centre in its facility in Swindon, UK, which “signifies our commitment to working closely with our customers and partners to bring new communication solutions to the market to enhance consumer experience.”[412] Another way Motorola has communicates with customers is at conferences like

MOTOINNOVATION, where customers from the Asia Pacific region and beyond were able to have a first-hand look at many of its leading edge technologies[413]

There is also extensive involvement with suppliers, which is included under Motorola's "third-party arrangements for the design or manufacture of certain products, parts and components."[414] Especially the Mobile Devices Segment and Government & Enterprise Mobility Solutions Segment utilize electronics manufacturing suppliers ("EMS") and original design-manufacturers ("ODM") "to enhance our ability to lower our costs and deliver products that meet consumer demands in the rapidly-changing primarily in Asia" [415] Knowledge exchange is important in these relationships. For example, "the Wireless Broadband China Research Center plans to work with Chinese partners to achieve their goals together, and at the same time to prepare Motorola for the exciting future brought by wireless broadband technologies"[416], and a licensing agreement has been formed with Mitsui that will allow Motorola to implement Mitsui's commercial foil into its own products. "The licensing agreement with Mitsui adds a new dimension to Motorola's ability to transform laboratory innovations to world class solutions for use in converged mobile devices." [417]

Besides contacts with local firms, Motorola is also linked to more than 40 standards bodies. "Motorola will maintain and expand its participation and leadership in formulating the industry-wide standards that facilitate new innovations."[418] "Standards teams develop and execute Motorola's strategies in leading industry standards" and "managers volunteer their time and the experience they have gained in the management of technology to help industry groups advance and promote standards." [419] "Working within global standards bodies, Motorola has helped to define new markets. (…) We have also helped existing customers adapt to new standardized technologies.[420] Specific examples of how Motorola is driving industry standards can be obtained from the previous reference.

Contracts and informal ties with research institutes

There are numerous examples of linkages between Motorola, schools, universities and research institutes. Cooperation with research institutes includes the establishment of a joint "Things-To-Things Research Center" in Seoul with Electronics and Telecommunications Research Institute (ETRI) as part of an effort by the Korean Institute of Information Technology Assessment (IITA). [421] Located in a region that is considered "one of the world's most advanced hubs of high-tech and microelectronic research", the Crolles2 Alliance facility also cooperates with many research institutes. "The Alliance will benefit from an outstanding pool of competence in the region through close cooperation with leading engineering schools and labs, including CEA-LETI, IMEC, France Telecom R&D and other cutting-edge centers in France, Belgium and the USA." Spill-over effects are multidirectional, and affect all players located in the region.[422]

Furthermore, R&D facilities are located close to universities to enable collaboration. This has already been explored in the section supply-side factors, especially in emerging economies like India and China this has a large impact on the local innovation environment. For example in India, access to local knowledge and "the ability to collaborate with world-class universities and institutes"[423] is given as the most important determinant, and in China "Motorola China has a long history of cooperating with local Chinese research institutes and universities in R&D projects. Through developing local partnerships, Motorola has gained deeper understanding of the China market as well as shared the latest telecommunications technologies with our partners. To date, Motorola China has over 30 technology cooperation projects with more than 20 Chinese partners."[424]

Linkages with universities and schools go beyond establishing joint research projects benefit Motorola directly. Motorola also transfers knowledge to the region by supporting "educational institutions and programs that inspire students - especially women and minorities - to embrace science, technology, engineering and math and give them the tools to become the next generation of innovators."[425]One of the Motorola projects that aims to inspire students is the Building Bridges and Futures project in the United States, which engages high school students in analytical research of Motorola's new products.[61] "Motorola gets valuable consumer insights while giving students an incredible learning experience and exciting them about business and technology." [61] Another example is the Ulwazi E-Learning initiative in South Africa, which aims to develop educational opportunities among five schools in the Pretoria area. "The project, the result of a partnership between Motorola, Inc., South Africa's Department of Education and Communication, and Omega Digital Technologies, endeavours to address teacher shortages in underserved areas."[426] In general, "Motorola supports systemic and continuous improvements in schools at all grade levels, concentrating on mathematics, science, and engineering, especially for under-represented groups. We fund best-in-class organizations around the world that inspire and target innovation generation."

"Motorola University is globally recognized as a leader in corporate education. This provides prospective clients with the assurance of consistent, high-quality services."[427] Motorola is the globally recognized creator of Six Sigma and offers clients the option to partner with Motorola University for Six Sigma implementation. For the client, this ensures that services are based upon first-hand experience, continuous improvement of the methodology and awarding Six Sigma certification.[63]

Motorola is linked to the region through its employees, and they "embrace and value diverse individuals, opinions, cultures and abilities"[428]. "Motorola embeds diversity into our business practices,"[64] in multiple ways. For example the Global Diversity Office, besides providing resources and tools for embedding diversity into business practices, is also responsible for Motorola's five Diversity Business Councils.[429] "Led by senior executives and emerging leaders, the councils provide opportunities for employees to connect, develop professionally, advance Motorola products and extend a helping hand to their communities"

To develop employees, knowledge is also transferred by offering "training opportunities that meet both business and personal development needs." [64] Motorola acquires knowledge form employees by fostering "an open-door policy and encourage clear, constant two-way communication through employee surveys, face-to-face meetings, question-and-answer forums and our company intranet" [64] Motorola also "encourages R&D employees to pursue innovative technologies and ideas"[430], for example through a symposium such as the annual Technology show of Motorola China. "Researchers and engineers from Motorola and our partners come to show how their innovative technologies can improve our products, user experiences and our life," said Ruey Bin Kao, president of Motorola (China) Electronics Ltd. "And the best technologies and the best innovators will be awarded for their achievements."[431]

Other contractual and informal ties with the local region

There are also several linkages between Motorola and local governmental and non-governmental organizations. These linkages range from support from local governments to "relationships with local, national and international non-profit organizations to extend resources to communities in need."[432]

Collaborations with local governments have contributed to developing regions to become innovation hubs. In China, this applies to the new R&D centers in Hangzhou and in Hunan.

“With the close participation and support from the Hangzhou government, Motorola’s new global R&D center will further help transform Hangzhou into a global telecommunications development and innovation hub.”[433] In building the Hunan Innovation Center, "Motorola had strong support from the Hunan government”, which “hopes to take the lead in hosting mobility enterprises and advanced telecommunications applications and services. Motorola Hunan Innovation Center will help Hunan to build experience that will be valuable for the whole country.”[434] In France, the Crolles2 Alliance facility benefits from the fact that “the Grenoble area already was one of the world's most advanced hubs of high-tech and microelectronic research - thanks to more than two decades of consistent policy by the French central and local authorities' to encourage public-private partnerships in the sector.”[435] On another level, Motorola has partnered with the local government of Chicago to transfer knowledge about the benefits of technology through a Technology Innovation Week. The City of Chicago is “proud to partner with Motorola to build awareness among our schools, companies and the community – celebrating Chicago’s spirit of innovation.”[436]

On a national level, Motorola also maintains links with governments, actively engaging in the public policy dialogue of countries and communities where they do business “We maintain ongoing dialogue with legislators, regulators and others involved with policy leadership. We also engage policy-makers and regulators through our membership in trade, advocacy and business organizations.”[437] “With 320 facilities in 72 countries and more than 50 percent of our revenues generated outside the United States, Motorola supports policies that promote trade and foster growth in emerging markets,”[73] as well as supporting “an increase in the U.S. president’s fiscal year 2007 budget request for research, development, acquisition and operation in the Homeland Security appropriations bill.”[73] “In the United States, political campaign contributions are one way Motorola advances our views on public policy. Where permissible by state and local law, we support, on a bipartisan basis, candidates and elected officials who share Motorola’s public policy views.”[73]

Motorola is also linked to non-profit organizations, because they “recognize the power of strategic partnerships and nurture them in the many communities in which we live and work. (…) We also know the impact of arts and cultural programs on the fabric of communities.[438] “In 2005, Motorola worked with leading non-governmental organizations and advocacy groups on issues of mutual interest and concern, including supply chain responsibility, community engagement, education, conservation of natural resources and wildlife protection.”[439] Motorola engages with these organizations directly in meetings, conferences and forums, as well as indirectly through the Global eSustainability Initiative. For example, Motorola is a founding member of the FuTURE Mobile Communication Forum; “an open and international, non-governmental and non-profitable telecommunication organization”[440] Examples of collaborating with a non-profit organization to support educational needs include Project Hope in China and Junior Achievement in China, Hungary, Ireland, Russia, the United Arab Emirates (INJAZ) and the United States (Arizona, Florida, Illinois, Massachusetts and Texas) “Project Hope improves teaching conditions and promotes the development of education in China” and in “Junior Achievement Motorola volunteers teach students from ages five to 17 about financial market activities, and high school students how to set up and run a business.”[75]

To advance environmental needs of the communities they operate in - besides supporting NGOs - Motorola also contributes with its *own* ECOMOTO program. “Through our ECOMOTO program, we explore innovative ways to measure and improve the environmental characteristics of Motorola products. (…) Our research also has provided product and material test methods that are driving restriction of hazardous substances test standards for the global electronics industry.”[75]

Shell

Employing more than 108,000 in 130 countries and territories worldwide, Royal Dutch Shell, with headquarters in the Netherlands, is one of the world's leading energy firms focusing mainly on the extraction of oil and gas. The vision of Shell is to "engage efficiently, responsibly and profitably in oil, oil products, gas, chemicals and other selected businesses and to participate in the search for and development of other sources of energy to meet evolving customer needs and the world's growing demand for energy"[441].

To accomplish these aims Shell is involved in searching & recovering of oils and natural gas, refining and selling of oil and oil-based products, alternative energy, trading and shipping, as well as global consulting services to the petrochemical and processing industries.[442]

Under the motto of "more upstream and profitable downstream"[443] Shell's strategy focuses on delivery, growth and strengthening Shell's strong portfolio of upstream activities. Consequently, over 80% of capital spending will be allocated to upstream activities, covering both conventional and unconventional hydrocarbon projects. Also, as part of the program, emphasis is put on CO_2 management including sequestration and energy efficiency, although it is difficult to determine the investment in real terms in these sustainable technologies.

Technology and innovation remains central to the group's strategy, involving both development and application of technology as well as innovation in financial and project management skills. Some leading projects of Shell includes the Athabasca oil sands project, Pearl gas to liquids in Qatar, Groningen gas field in the Netherlands, Bonga deepwater project in Nigeria, Na Kika in the Gulf of Mexico, Nanhai petrochemical complex and the Sakhalin II in Russia.[444]

Figure 22.   The global network of Shell R&D centres

R&D spending of Shell in 2006 was EUR 741M or EUR 1040M including field tests and involvement of third party technology is included, out of annual revenue of EUR 276Bn or approximately 0.27% of revenue allocated for R&D. The R&D spending in 2005 was EUR 483M out of annual revenue of 265Bn, an increase of 53% between 2005 and 2006.

Technology and R&D are central to Shell's global strategy: "Meeting the world's growing energy needs in an environmentally responsible manner is a tremendous challenge. Technology is essential to answering that challenge."[445] The results of R&D can furthermore be seen in some of the examples in the following chapters underlining the impact on parameters such as costs, production and accessibility of oil and gas reservoirs based on innovations in detection, extraction and refining technologies. Consequently, R&D is prioritised as the one of the four critical functions identified in the company to require specialised directors after the recent restructuring efforts; "I am convinced that technology is key to delivering our business strategy and the complex projects of the future. In 2006 we appointed a Chief Technology Officer to head our technology drive with seven Chief Scientists and thousands of technical staff at our worldwide technology centres, including our new one in Bangalore, India." – Jeroen van der Veer, CEO[446]

The activities of Shell are organised into upstream; exploration & production, gas & power, downstream; oil products, chemicals and other industry segments; renewables, shipping, trading & shell global solutions. [447] R&D however, are organised into distinct areas aimed to "produce energy and petrochemicals sustainably and economically"[448]

These R&D areas are exploring, developing & producing, difficult hydrocarbons, gas commercialisation, refining and supply and new energy sources. Breakthrough innovations often come from innovations in other fields than direct oil & gas technology related research areas such as 3D imaging, catalysts, or chemistry. This realisation demands a broad portfolio of R&D skills in Shell's extended R&D organisation, and is also supported by the availability of experts in diverse fields among senior R&D researchers in Shell. Consequently, the specific Shell R&D projects are linked according to scope and scale of the business lines, and have thus geographical, thematic as well as organisational dependencies.

One of the central issues of R&D in the extraction and energy industry is the strategic importance of costs, efficiency and other basic strategic drivers, which takes many years to develop and maintain competitive. One example is the gas to liquids technology of Shell: "Scientific advances provide only part of the answer to our challenge. Tomorrow's increasingly complex energy projects – often in frontier locations like ultra-deep water or the Arctic – will oblige us to apply new technologies at an unprecedented scale. To do so often requires long-term commitment and many billions of dollars of investment. Our proprietary Gas to Liquids (GTL) technology, for example, took 25 years to develop. It offers new ways of delivering natural gas as clean-burning, efficiency-boosting liquid transport fuel and other products to consumers around the world."[449]

Consequently, although radical changes in technologies can happen, and are often part of a long-term perspective to main a lead in costs of exploration, return on capital or other fundamental KPIs often develop incrementally in the long view, requiring Shell to have a long-term view on R&D.

Large part of R&D is linked to collaborative projects and joint ventures with other partners or foreign oil companies. In China, for example Shell has formed a large scale partnership with CNOOC, and in other parts of the world such Australia, Europe, US and Russia projects are done on a joint-venture basis with varying degree of Shell ownership in the ventures.

Shell has established research centres across the world with primary R&D centres in the US and Netherlands and other technology centres in India, Canada, Germany, Belgium, Qatar, Norway, Singapore and the UK.[450] Research themes involves areas such as Liquid Natural gas (LNG), Catalysts, Seismic Imaging, Smart Wells, Deep water drilling, tight gas, CT Fuel, Coal Gasification. Shell is also active in the alternative energy sector including wind and solar energy, biofuels, hydrogen, coal-to-liquids and oil shale.[451] The new possibilities of outsourcing R&D to Asia is also on the agenda at Shell, including the new research centre in Bangalore: "Shell Technology India was established in Bangalore in 2006. Its staff could eventually grow to more than 1,000 people"[452]

In addition, in in-house R&D, Shell has developed partnerships with a number of universities in the US, UK, China, Norway, Russia and the Netherlands. These university partnerships are expanded with competitions, innovation contests and other activities involving also the student core in innovation, R&D and for recruitment purposes.

Technologies such as LNG, smart wells and snake drilling has been pivotal to the success Shell is enjoying as one of the leading companies in the LNG market, with Shell being part of projects involving more than 40% of the world's LNG.[453] Smart Field technologies combines several technologies including digital information to enable engineering to remotely change extraction methods to optimise the extraction of oil and gas from complex fields, a technology which increases the average amount of oil and gas recovered by 10% and 5% respectively[454] Other technologies such as snake wells and new extraction technologies have helped to lower the costs of exploration and extraction to sustain Shell's competitive position through R&D.

To enable researchers and engineers to work together on optimising exploration, extraction and research, 12 virtual R&D centres have been set up to allow geologists and engineers to collaborate at different locations with 3D images of underground reservoirs using advanced imaging techniques.

Locational Determinants

As a natural consequence of the extraction of gas, oil and other energy sources from the environment, geography, proximity and local determinants has traditionally been very important to the place of activities, and thus indirectly R&D activities. A number of projects underline the importance of location in R&D related to activities, some examples are:

- The R&D project related to oil shale in Colorado is linked to the rock in the Green River Basin, which potentially could convert into kerogen using a heating technique developed by Shell called in situ conversion, potentially yielding large amounts of high-quality liquid hydro-carbons, estimated by the US government to be equal to one trillion barrels.[455]
- In China, Shell has formed a 50:50 joint venture with CNOOC for developing a new petrochemical plant in Nanhai, one of China's primary oil fields in Daya Bay in Guangdong with a high degree of recycling of waste and water thus combining both technologies in extraction with the emphasis on R&D into new technologies in recycling and sustainability,
- In Norway, Shell is part of a joint project with Norway's Statoil to develop one of the world's biggest operations to capture carbon dioxide in the Draugen oil field offshore Norway, and using R&D from this venture to recover more oil from the existing oilfields in the region.

- In the North Sea, Shell has deployed its first offshore wind farm 10 kilometres off the Dutch Coast with a capacity of 108 megawatts in a joint venture with electric company Nuon, to developing alternative energy technologies for Northern European countries focusing on increased reliance on sustainable sources of energy with lower CO2 emissions.

Consequently, examining the global map for Shell R&D centres, nearly all R&D centres are located near existing or future energy sources of energy markets, except in the Netherlands although there are fields in the North Sea as well as experimental in alternative energy projects nearby. However, a number of factors might change the future outlook for the locational determinants of R&D in the context of the energy industry.

With the rise of alternative energy sources, the future might be less dependent on the availability of natural resources such as oil and gas in special geographical areas. Instead, more widely available sources of energy such as sunlight, wind, nuclear, nanotech and waves makes the localisation of energy extraction sites in broad terms less dependent on specific geographic characteristics, and might also be less dependent on the proximity of researchers and engineers on location or within short distance. This in turn allows for R&D to be placed independently of resource extraction sites, and consequently, other factors might influence the placement of R&D centres in the future having more to do with intangibles, costs or proximity to headquarters or talent.

The rise of new markets such as China, India and Russia with growing energy demands and growing economies might result in an increased emphasis on the political aspects of the outplacement of R&D for political reasons or reasons of market access. In this aspect the placement of R&D can be seen to evolve along the lines of supply networks, such as being anchored in China for purposes of catering to Chinese energy needs, even though extraction sites feeding the energy networks are found outside of China, such as in Africa, Polynesia or the Middle-East. Similar, Russia's growing position as an energy super-power, puts pressure on Shell to develop strategies which makes the company able to manage its relationships with the state-controlled oil companies on right issues and access to exploration.

Safety-issues and security concerns are currently becoming a more urgent point on the agenda, and might have the effect that R&D centres are prioritised in centres with stability to be able to attract the right talent; "The security situation in Nigeria – which has shut in significant production in the Delta region – remains a serious concern and we do not know when production will resume."[456]

Consequently, the rising violence in certain oil-rich countries in Africa and the Middle-east might result in R&D centres not being prioritised along the geographical lines of business, emphasis the rise of soft factors such as quality-of-life in the quest to attract top talent in R&D.

Another issue, for the energy sector is the environmental discourse, which can be a double-edged sword for the competitiveness of the large MNEs. Shell felt this the hardest with the Brent Spar in the North Sea, and subsequent Ken Sora-Wima incident in Nigeria.[457] This has forced Shell to develop a clean energy or environmental technologies business line, and to allocate considerable resources to R&D into sustainable / alternative energy, as well social responsibility programs; "In the drive to slow the build-up of greenhouse gases, Shell is pursuing cost-effective ways of capturing carbon dioxide from large sources such as power plants and storing it safely underground. Shell's commitment to renewable energy is plain to see in projects like our first offshore wind farm and our involvement in biofuels."[458]

However, other emerging players in the global energy industry might not play by the same rules, leaving Shell in a dilemma between the pressure from the Western markets to maintain a responsible corporate profile, and the competitive pressures of Eastern energy companies with less domestic pressures to focus on environmental issues.

Finally, the energy industry is constantly under pressure from political events and developments, and requires the players such as Shell to accommodate local requirements for gaining access to energy resource; "In Sakhalin, we cleared the way forward by agreeing to partner with Gazprom on what is the world's largest integrated oil and gas project under construction."[459]

The further quote, explaining the terms for this 'way forward' where; "In December 2006, the partners in Sakhalin Energy, of which Shell owns 55%, signed a protocol to sell half of their shares to Gazprom, clearing the way for possible expansion, as well as further exploration opportunities around Sakhalin Island. The partners also reached agreement with the Russian government on the project's amended budget."[460]

The requirements can both have influence on the structure of local relationships and on the decision on where to place R&D facilities to accommodate local markets and national political requirements.

Organisational Structure

Shell has a complex organisational structure comprised of four types of company. The parent companies are Royal Dutch Petroleum Company N.V of the Netherlands, and Shell Transport and Trading Company plc of the UK, which owns the shares of the group holding companies with 60% and 40% respectively. The group holding companies Shell Petroleum N.V. of the Netherlands and The Shell

Petroleum Company Ltd hold shares in the services companies and operating companies of the group. The service companies provide advice and services for the operating companies, but are not responsible for operations. The operation companies numbering more than 200 companies in over 100 countries with varying ownership by Shell are responsible for the actual operations are usually joint-ventures with local contractors, public or private companies from the industry covering a wide range of activities including exploration, extraction, marketing and sales.[461]

The many-sided R&D activities in Shell are organised along the lines of the corporate structure of the Shell group. Historically Shell has been organised in a matrix-structure based on a geographically-oriented principle. As opposed to other oil & gas companies, Shell has not been through large restructuring in the 1980's, but managed to achieve efficiency through organisational flexibility and the large degree of freedom enjoyed by the matrix organisation. The operation companies bought services from the services companies and reported to the central management, but otherwise knowledge sharing, R&D and services where done through the services companies on the basis of the requirements for services by the country-based operations companies.

However, in the end of the 1990's Shell financial performance indicated that Shell lagged behind companies such as BP, which had gone from bureaucratic government owned companies to a more lean and innovative profile through wide-reaching restructuring programs. Consequently, Shell went through re-organisation efforts which completed in the beginning of 2000, and lead to an organisation along the now established business-lines.[462] In this process it was acknowledged by Shell that the different business lines required different logics regarding knowledge transfer technologies and services, and doing this within different business within a country or region, did not provide for critical mass. Exploration, for example, requires new technologies and knowledge sharing, whereas downstream are more focusing on methodologies for rationalisation and efficiency.

Today, Shell has a decentralized structure, divided into business organisations, which reports to the Committee of Managing Directors. R&D in Shell is organised under a business director for research and technical services, who is part of the business committee heading each business organisation. The business organisations ensure the focus on the business-lines, and are thus also staking the directions for R&D based on the long-term requirement of each business line for technology and innovations. The operation companies are still focused and countries, but the larger units have been split up according to business lines to ensure that focus is directed towards the global natural partners within the same business line, within the Shell group, in relation to access to R&D resources.

Linkages Between MNE R&D and the Region

The organisation of operation companies focusing on special countries and regions, ensures that each operation companies can be set up in a number of different configurations that serve the necessities of the local markets. In Qatar, this has lead to Shell investing in an R&D centre alongside the oil & gas exploration and extraction operations, in exchange for access to the resources, but also to extract knowledge from the local conditions, which can be of benefit to other operations in the middle-east and elsewhere; "Shell, as a committed technology partner of Qatar and global leader in technological development and innovation in the oil and gas industry, is bringing a world-class technology programme to Qatar, a move which has been facilitated by the development of Qatar's Science & Technology Park. The Centre will be part of Shell's global research and technology organisation and will commence operation in early 2006. The activities of the Centre will initially focus on Upstream and Gas to Liquids (GTL) technologies; technical services; and a related training centre."[463]

As parts of R&D in the exploration, extraction and distribution of oil & gas is still linked to the knowledge of local conditions and markets, local presence means that knowledge can be transferred from one region or market to the other. For example Shell has experienced that knowledge gained on subsurface geology in the Gulf of Mexico and offshore West Africa could be shared across the two regions leading to discovery of new resources. The linkages to the region also extends into other areas such as developing new refinery technology in one place, and using this in other places or local understanding of markets and cultures.[464] "In many of these pioneering projects, Shell works with partners – governments, universities, research institutes and other companies. We know from experience that good ideas often bear fruit through collaboration with organisations whose strengths differ from our own. In turn, our partners benefit from our technology and our ability to apply it on a large scale."[465]

The efforts in Qatar to develop gas-to-liquid fuels (GTL) as part of the Pearl GTL project, is mirrored by a joint venture in Canada with Iogen that produces a similar fuel based on straw. In Germany, Shell has established a partnership with CHOREN Industries for the purpose of developing biofuel based on woodchips, similar to the GTL fuel. In this way Shell is exploiting the local knowledge and resources, and adding extraction, manufacturing, distribution, refinement or other knowledge to the particular partnership needed to come full circle. The location in Germany has the added benefit that it is also the location of Shell collaboration with Volkswagen Audi-brand for using GTL-diesel for fuel in the Le Mans races. By leveraging its knowledge globally, Shell can enjoy the benefit of distributed knowledge resources, and focusing this within one business-line such as biofuels / renewables as well as developing future downstream opportunities for the extraction industry in e.g.Qatar.[466]

Through the joint-venture model, Shell obtains access to markets and to mitigate the risk and investments associated with exploration as well as R&D related to developing new means of developing energy sources. Some examples are:

- In Germany, Shell is taking advantage of the government subsidiaries to solar panels, by partnering with AVANCIS GmbH for developing thin-film panels, thus ensuring a lucrative local market for early-adaptation of technologies.[467]
- In Nigeria, Shell is involved in e.g. partnerships at the Bonny Island with a 27.5% minority stake. However, although the field has the potential to become as big as Qatar, the security situation means that little R&D is expected to placed in the local region.[468]
- In Canada, Shell holds 60% stake in a joint venture to develop extract oil from oil sands, and to develop new technology and methodologies for this purpose. The potential in oil sands makes Canada the second largest potential source of oil after Saudi Arabia according to estimates, and already now supplying 10% of Canada's oil needs.[469]

Contracts and Informal Ties with Research Institutes

Shell employs a wide network of university related research and research contracts with leading universities worldwide with specialisations in the key industrial areas and R&D areas related to Shell's activities. Selected partnerships in R&D activities are the following:[470]

- Colorado School of Mines, Golden, Colorado, USA
- Imperial College, London, UK
- Institute of Coal Chemistry, Taiyuan, China
- MIT, Cambridge, Massachusetts, USA
- NTNU-SINTEF, Trondheim, Norway
- Qinetiq, Farnborough, UK
- Russian Academy of Sciences, Moscow, Russia
- St. Petersburg State University, St. Petersburg, Russia
- Tsinghua University, Beijing, China
- TU Delft/TNO, Delft, the Netherlands
- University of Texas, Austin, Texas, USA

In the area of developing new skills, professional services and for purposes of knowledge sharing, Shell has set up programs with four universities to develop curriculum and complement expertise:

- Cranfield School of Management
- Delft University of Technology
- University of Texas at Austin/McCombs School of Business
- Queensland University of Technology.

GlaxoSmithKline

GlaxoSmithKline (GSK) is a research-based pharmaceutical company with headquarters in London, UK. The company employs over 100,000 staff worldwide, of which 15,000 are working with discovering new medicines, and is one of the world's leading pharmaceutical companies with an estimated seven percent of the world market for pharmaceutical products. The mission of GSK is expressed as "to improve the quality of human life by enabling people to do more, feel better and live longer".[471] Consequently, the company is strongly promoting a profile of responsibility and is active in a number of areas for both medicines and vaccines for the World Health Organisation's three priority areas, HIV/AIDS, tuberculosis and malaria. GSK is also promoting other areas such as corporate equality, as has among other factors over 33% women in managerial positions. The company employs over 40,000 sales people, and sells products in more than 160 countries. It has 24 major and minor research sites in 11 countries and 82 manufacturing sites in 37 countries worldwide. For 2006 and forward, the four key strategic objectives are cancer, diabetes, malaria and further the development of a strong business culture.[472]

The primary areas of GSK are medicines for the six areas of asthma, virus control, infections, mental health, diabetes and digestive conditions, as well as cancer treatment. In addition, the company is a world leader in over-the-counter market in areas such as dental products, smoking control products and nutritional healthcare drinks. GSK supplies one quarter of the world's vaccines, supports over 2,000 new products and line extension launches annually, and has over 1,400 branded products, including 10 of the world's 60 top-branded products such as Augmentin, Imigran/Imitrex, Avandia, Lamictal, Seretide/Advair, Seroxat/Paxil, Coreg, Flixotide, Wellbutrin and Zofran.[473] Turnover in 2006 was EUR 37Bn with investments in R&D of EUR5.5Bn.[474]

Organisational Structure

GSK is an English public limited company, with headquarters in English and operational headquarters in the Philadephia, USA. The company was incorporated in 1999, and acquired the two companies Glaxo Wellcome plc and SmithKline Beecham plc by way of a scheme of arrangement for the merger of the two companies.[475]

The top-management is organised with one chief operating officer, and a corporate executive team comprised of eight non-executive officers. The operations are divided into market related activities; Consumer Healthcare, Pharmaceuticals Japan, Pharmaceuticals US, Pharmaceuticals Europe, Pharmaceuticals International, Global Manufacturing and Supply, supporting functions including human resources, information technology and corporate communications & community, and Research & Development.[476]

Figure 23. The global network of GSK R&D centres

The Organisation of R&D Activities

The R&D strategy of GSK is summed up as: "We aim to create the best product pipeline in the industry for the benefit of society. This includes developing a focused strategy to support the pipeline and manage the full life cycle of compounds from launch as prescription medicines through to potentially becoming over-the-counter products. We measure R&D productivity by the number and level of innovation of the products it creates, and by the ability to address unmet patient needs."[477] Currently, GSK has 154 projects in clinical development, 31 major products in phase III development or registration, and 94 chemical entities and 23 vaccines in clinical development.[478]

R&D is organised in two research organisations; Centres of Excellence for Drug Discovery (CEDD) and Medicine Development Centres (MDC).[479] The CEDDs are organised as small, multidisciplinary entrepreneurial groups focusing on research and development projects. Consequently, the CEDDs have faster decision-making processes, in order to shorten R&D cycles and lower costs. CEDDs have been created for the research areas of biopharmaceuticals, cardiovascular & urogenital diseases, metabolic & viral diseases, microbial, cancer, musculoskeletal & proliferative diseases, neurology & gastrointestinal diseases, psychiatry, respiratory & inflammation, and external drug discovery, the latter CEDD focused on GSK's Alternative Discovery Initiatives (ADI), used for handling external R&D.[480]

The MDCs are matrix-based teams responsible for global development opportunities for research & development done by the CEDDs, and support this process with registration, safety programs, pricing and formal negotiations and procedures. The MDCs are linked to the GSK's Global Commercial Strategy Team; "which ensure regional marketing needs are fully integrated into development plans at an early stage, in order to deliver differentiated products of value."[481] In addition, the MDCs are linked to the Worldwide Development organisation, focused on the aspects of global development. In sum, based on this structure, all the major components of the drug development process are integrated in one organisational structure, with its own management and necessary activities areas covered.

GSK estimates that it takes on average upwards of 10-15 years and costs more than EUR 750M to discover and develop a new drug.[482] Consequently, as the pharmaceutical industry is characterised by these long and complex development cycles, with significant risks and high development costs, GSK have developed a number of strategies for maintaining a strong product pipeline for its worldwide markets and ensure business development through the ADI program. Some of these strategies are in-licensing, co-marketing and co-promotion, in which GSK in exchange for access to promising products, provides access to their expertise in R&D, regulatory management and marketing, as well as global market access through GSK's distribution and marketing networks; "Developing new medicines and vaccines is an expensive and risky business. We need to ensure that we have a strong pipeline of new products that will enable us to carry out our mission to improve the quality of human life. One of the ways that we do this is by in-licensing, co-marketing and co-promoting new products with other businesses. This helps to ensure that our business can grow and complements our existing products with new ones that offer new or more effective treatments for disease."[483] Currently in-licensing agreements in 2007 include arrangements with companies such as Genmab, HGS, Gilead/Myogen, Akros/Japan Tobacco, ChemoCentryx, EPIX, Kissei, Pharmacopeia and Sirna.[484]

GSK also offers other means of collaboration with external parties in the areas of research and new products. These models include research collaborations, out-licensing arrangements, academic liaisons, and alternative discovery initiatives. In total, GSK has established over 50 compound alliances, which is now over 40% of the development pipeline. In addition, GSK has entered into a number of technology and academic alliances.[485] One such example is the new partnerships with Hammersmith Hospital in London; "In 2007, GSK's new clinical imaging centre at Hammersmith hospital in London will be fully operational. We have invested £46 million in the Centre. It is an exciting collaboration with Imperial College and evidence of our continuing commitment to experimental medicine. Research will focus on cancer, stroke, neurological diseases such as Parkinson's and multiple sclerosis, and psychiatric diseases.", Moncef Slaoui, Chairman of R&D[486]

Under the ADI programme, the external collaboration activities are organised under the Centre of Excellence for External Drug Discovery (CEEDD), to ensure that these collaborations have one management structure catering to their special needs, as well as securing the advantages of the CEDD and MDC structures for the partnerships: "Combine the revolutionary CEDDs with the MDCs — and GlaxoSmithKline emerges as a leader in product development and commercialization. Every step of the way, your product will be championed by these teams. We are global where it is critical, but small enough to ensure speed and attention to your product or technology."[487]

Locational Determinants

GSK is increasingly aware of having to seek talent for its R&D and external partnerships worldwide. This is the reasoning behind the emphasis on business culture and diversity in the workforce in the company. In addition, the company is also aware of the need to globalise R&D to get access to global talent pools; "We need to work with the world's best talent and globalise the R&D function. Having established a centre in Croatia in 2006, our next step will be to open a new research centre in China. We expect to announce further details on this during 2007," Moncef Slaoui, Chairman of R&D[488] Other pharmaceutical companies are already taking advantage of the markets in China and India, whereas GSK seems more reluctant to enter the markets and outsourcing R&D to research centres or local companies.

Another area of location determinants is the area of clinical trials for new drugs and vaccines. The placement of clinical trials does not have to be located in proximity of the R&D facilities, but can in effect be carried out anywhere in the world where there is sufficient infrastructure to manage and monitor clinical trials. Consequently, the prospects of lowering costs by doing clinical trials in countries such as India and China, carries interesting prospects for outsourcing of this area of R&D while simultaneously reaping potential political benefits of investing in the countries as a lever for improved market access. In Europe, pharmaceutical companies are in effect able to do R&D in one country, clinical trials in another country and get approval and IPR in a third country. However, the area clinical trials in third countries carry certain connotations that must be observed. Doing clinical trials in poor countries can by some be observed as taking advantage of the world's poor population for medical experiments and risks, and must as such be handled carefully. Secondly, the increasing awareness of evidence-based medicine and differences in DNA profiles and medicine response across the world's major populations, carriers the risk that clinical test results from one part of the world might not be completely transferable to the world market. Consequently, GSK cannot be indifferent as to where clinical trials are conducted and where the drugs or vaccines are sold and used. This becomes increasingly important with drugs and vaccines being developed for certain parts of the world such as Malaria medicine.

Lifestyle-related diseases such as diabetes create new markets in the world's emerging economics. Consequently, a country like China is now seeing a boom in diabetes and diabetes-related diseases following the rising income of the population. These and other factors might call for GSK to place R&D facilities in the growing markets partly for obtaining access to the growing population for purposes of research and testing, and also for ensuring that R&D facilities are present in a country where these diseases suddenly gets priority, which might be mirrored in the priorities of universities, R&D labs and government spending, thus creating a talent pool of graduates and more experience researchers.

Convenience and other-the-counter products are fast-growing markets in the developed countries. Consequently, products such as teeth-whitening, products to quit smoking, as well as treatments for non-life threatening but inconvenient conditions such as the flu are becoming an increasing interesting market. "2006 saw our Consumer Healthcare business unlock its growth potential across the portfolios. Consumer Healthcare sales were £3.1 billion, a 6 per cent increase over 2005. We are driving growth through greater innovation and more effective marketing strategies on strong brands.", John Clarke, President, Consumer Healthcare[489]

The emergence of products in these fields often relate to local demands and local culture, which signifies local presence to pick up on trends or to spot opportunities for commercialisation of new or existing products. These products can be carried through either from the CEDDs, the MDC, or through the sales organisation, which has local market contact, if sufficient feedback loops exists in GSK. A third alternative is an increased emphasis on innovation models such as open innovation or user-driven innovation that also carries proximity as a central component; "We are looking for innovation wherever we can find it, inside or outside the company – something we call Open Innovation. We have also increased alignment between R&D and our global brand teams so we understand consumers' needs better and can deliver more innovative products that meet those needs.", Ken James, head of R&D for Consumer Healthcare.[490]

Part of the R&D, which entails administration of drugs or vaccines, also carries requirements related to the location aspects. Regimes and processes for administering drugs that work in countries in the development world might not work in countries in the third world, for various reasons, which either require the innovation of new technologies of administration or development and enforcement of existing and new processes. Consequently, GSK has embarked on Positive Action community investment programmes, which play a part in developing or maintaining adequate structures for distribution, administration or monitoring of e.g. vaccine regimes in countries with inadequate healthcare systems in areas such as HIV/AIDS, malaria and tuberculosis. The programs covered a total investment of EUR483M in 2006 and run in more than 100 countries. In addition, there are special programs for diseases such as lymphatic filarisis. The programs also involve education in sanitation and hygiene, in countries such as Mexico, Nicaragua, Peru, Uganda, Zambia, Tajikistan, Bolivia, Bangladesh and Nairobi and are offered in collaboration with humanitarian organisations such as Save the Children.[491]

For major projects such as tackling malaria, GSK also investments in broader research collaborations with global networks of R&D organisations, universities and other pharmaceutical firms that are closer to the markets or specialising in certain areas of the R&D path. The networks and collaborations are funded either directly by GSK through special programmes, or by public-private partnerships such as the Medicines for Malaria venture.[492] In addition, GSK has granted voluntary licenses to eight drug-manufacturing companies in sub-Saharan Africa for the production of Anti-Viral Drugs (ARV) against HIV/AIDS.[493]

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Version 6

Summary of Regional Roundtables and Inputs to New Policies

Project LocoMotive

Regions of Knowledge 2

Contract No 030089

Work Package 3 (WP 3)

Deliverable 9 (D 9)

March 2007 (edited April 2007)

Interlace-Invent

Preamble

This LocoMotive project report provides summaries from a series of regionally organized roundtables on the location motives for R&D investments. The roundtables were set to screen and comment on the main points of the project and review the facts and findings from some 60 interviews with R&D managers in eight European city-regions. The R&D managers interviewed were representing mainly large multinational enterprises (MNEs), able to influence the size and in some regional cases even the direction of R&D investments and related innovation activity in the region.

The roundtables, which were conducted in seven selected regions, took place in 2006 and 2007 and were managed by the LocoMotive team in each region. Each organizing team provided inputs to this document in the form of a regional summary account.

In addition to the regional summary accounts, further inputs were drawn from the interviews of the R&D managers in selected companies in each region. Furthermore, other facts and findings were processed and added to the inputs by the persons who have written and edited this report.

This report provides a mosaic of key points made at the roundtables (illustrated by selected roundtable accounts). Some of the principal points are edited according to themes and main issue areas. There is no full report from any of the regional roundtables included in this document. Roundtable reports from any of the seven regions may be requested from the responsible regional team.

For more details on the objectives for this document and for information about the special context of this part of the LocoMotive project, see the section below on Deliverable 9 (D 9) in Work Package 3.

This document is Version 6. Comments on the previous versions were received from some of the team members. The comments from the other LocoMotive team members, especially from those who managed one or several of the regional roundtables, will be included in the final version.

Even after the regional roundtables, the ambition remains to keep the stakeholders involved in an open dialogue, aimed at creating optimal conditions for sustainable R&D investments and innovation strategies at the regional level. The stakeholder dialogue in each of the regions is intended to keep regional and other parties together so that they jointly or via the most committed and resourceful groups of stakeholders address the region's need for information and guidance.

In the project's methodology report (cf. Deliverable 3) the relevant regional actors were to include the following stakeholders:

- Local and regional government/policy makers (aim: include investment officers, local innovation policy makers)
- Subsidiaries of MNEs in the region (aim: include the most important firms whether or not they engage in innovative activities)
- A selection of regional SMEs (or their representatives; aim: include in any case important (high-tech) suppliers and venturing activities)
- Workers' representatives
- Local knowledge institutions (including relevant universities and consultancies)

The composition of the various roundtables across Europe varied considerably, but, taken together, the five groupings of stakeholders were all represented in one or several of the regional stakeholder meetings.

Contents

Introduction: R&D investments and diversity among EU regions

Regional diversity increases

The regions in Europe are ample evidence of diversity. As noted in many comparative studies of European regions and further emphasized in the reports from the LocoMotive project, there are wide varieties according to regional economic structure, competitiveness and growth, with considerable impact on living standards and social cohesion. Regional diversity is a main feature also for R&D investments and for the location of innovative capabilities among the multinational companies and their supporting institutions, located in various European regions. These diversities seem to increase.

R&D - one source of innovation among many

If regional diversity across Europe is a key feature, it should be underlined that the wider European society has become more multifaceted and that knowledge creation by universities and other R&D institutions and innovation processes by business firms have become increasingly complex. This is further stressed by a recent study by an expert group under the European Commission (DG Research), focused on the creation of new regional capabilities.[1] Regional sources of knowledge for innovation are countless and the variety of inputs to be used by organisations and firms when innovating tend to stimulate more of 'open innovation' processes relative to 'in-house' innovation. For example, using results from our regional roundtables or workshops and from the interviews of R&D managers, this phenomenon seems particularly strong in companies involved in innovation processes based on information and communications technology, while pharmaceutical and other 'life science' companies seem to avoid 'open innovation' at least in the most commercially sensitive stages of an innovation process.

[1] "Constructing Regional Advantage: Principles, Perspectives, Policies." Report prepared by Phil COOKE (chair) and Bjørn ASHEIM, Jan ANNERSTEDT, Jiří BLAŽEK, Ron BOSCHMA, Daneš BRZICA, Åsa DAHLSTRAND LINDHOLM, Jaime DEL CASTILLO HERMOSA, Philippe LAREDO, Marina MOULA, Andrea PICCALUGA, Brussels: European Commission (DG Research), 2006.

Open landscapes of innovation

'Open innovation' and other externalization of knowledge exploration and innovation to 'knowledge entrepreneurs' and innovators outside of the firms, including in universities, is shaping a new landscape for regional governances. Regional policy-makers need to chart this new landscape and explore it together with business firms and other stakeholders in order to take advantage of its opportunities for R&D investments and innovation.

During the interviews, we have taken note of new types of interdependencies among firms, new patterns of specialization, and new divisions of labor among the parties involved, especially in large innovation processes (involving individual entrepreneurs, business firms, R&D and intermediary institutions and other organizations). In the new regional context, firm-level shifts towards more of management of 'open innovation' compared to more of 'closed innovation' could be promptly summarized as follows:

"Closed innovation"	**"Open innovation"**
Largely internal ideas for innovation	**Many external ideas for innovation**
Firms perform R&D in-house	**Firms acquire desired technologies**
Strategic R&D – core business	**R&D in networks and outsourcing**
Low labor mobility	**High labor mobility**
Few, weak startup firms	**Numerous start-up firms**

Based on Henry W. Chesbrough, *Open innovation: The new imperative for creating and profiting from technology,* (Boston: Harvard Business School Publishing), 2003.

All economic activities are based on knowledge and processes of learning, also those activities which are commonly referred to as low-tech. One lesson learned from the regional roundtables is the fact that R&D is only one of many sources of innovation. And, 'investments in R&D' and 'level of technological complexity' are only two broad indicators, among many, for trying to measure and manage knowledge development and innovative capability.

Different ‘logics’ behind R&D

Another general lesson from the regional roundtables is more conceptual. For analytical purposes it is often necessary to treat research and experimental development (R&D) separately. The latter (“D”) is typically more cost-sensitive and project-specific, while the former (“R”) is usually less costly and, at least in principle, allows more creative freedom. Innovation, on the other hand, is oftentimes a more general process of change that typically could connect R&D with other socio-economic activities into commercial or other diffusible results in the form of products and processes. Hence, our preliminary findings as well as our early recommendations, which are listed in this document and in the final policy recommendations, may therefore apply differently to these specialized areas of inventive activity in the regions under scrutiny.

Global R&D links

From an economic point of view, successful processes of R&D and other knowledge creation and exploitation are increasingly becoming part of transactions among companies and institutions in networks at the regional, national and global levels. More and more, so it seems from the information in the interviews and at the regional roundtables, R&D and other forms of knowledge generation for the purpose of innovation require effective linkages of communication that go beyond the company borders. There is a strong need to engage regionally in dynamic interplay among companies, institutions and other organizations as well as among entrepreneurial individuals. At the same time, and increasingly so, global competition pushes even the small and medium-sized companies to think globally, when making R&D investments and considering future market opportunities while considering new products and services. R&D investments in the regional context have become part of the global positioning to achieve successful innovation.

Strategic public-private partnerships

European regions, which have come to grip with the networks of collaboration between firms as well as among firms and collaborating universities and other R&D institutions, appear to be more successful than other regions in energizing R&D capabilities and in fostering innovation. They also appear to have become long-lasting partners with multinational enterprises (MNEs) as well as more attractive hosts for inward investments of R&D.

Objectives for LocoMotive project Deliverable 9 (D 9)

More specifically, what is this report to bring forward? -This document summarizes some of (1) the determinants of R&D location in selected European regions, as presented at the regional roundtables and in the interviews with the R&D managers. It also depicts some of (2) the organizational structures that characterize R&D performed in companies in these regions, when they manage strategically their R&D investments and link up with R&D performed by others. The report also discusses (3) the various types of linkages of the R&D investments by the MNEs in relation to other companies and to universities and other institutions in each region. And, finally, as part of the reporting, the document begins to summarize some (4) policy conclusion and other recommendations, which – later in the project work – will become an essential part of the more general outcome of the LocoMotive project. Most of the policy conclusions are built into the text. They will be summarized in a different LocoMotive document in another Work Package.

LocoMotive Deliverable 9 is part of Work Package 3 (WP 3). Here, excerpts from the Description of Work for WP3:

"The basis of work in WP3 is fact-finding on private-sector R&D investments in each region represented in the project. Each investigatory team will follow the methodologies agreed upon in work package 2 and make use also of other primary and secondary sources of facts and figures on R&D investment localization.

Each partner will

- organize at least one, if appropriate, two events in their region, which provide a forum for competent discussion partners from the private and public sector to engage in an exchange of views about the research investment in the regional context and attainment of the Barcelona objectives.

- In addition, in each region interviews with the R&D managers from two private sector companies will be interviewed to find out the regional issues involved in the decision making process concerning R&D investments in the regions."

The principle objective for this deliverable (D 9) is to provide summaries of the regional roundtable deliberations which, originally, were to be based also on the interviews of R&D managers (and other senior persons) in selected firms in each region.

According to the Description of Work (DoW) for the LocoMotive research projects, all participating research groups should organize at least one, if appropriate even two roundtable in their region, which "provide a forum for competent discussion partners from the private and public sector to engage in an exchange of views about the research investment in the regional context".

This activity is part of Work Package 3 (cf. DoW) and is aimed at:

- Assessing private sector investments in R&D in the selected region, especially with a view to understand the involvement of MNEs in the regional economy as R&D investors;
- Comparing and contrasting the specific findings of interviews conducted with MNE managers (and in some cases local policy-makers) in order to reach general conclusions and policy recommendations for industry, R&D units and regional/governmental decision-makers;
- Connecting corporate level analysis to the investigation of global trends in MNE-driven R&D.

The results of the LocoMotive Regional Roundtables are summarized according to main points made or themes in the text below. Here, it should be noted that each partner in the project has been responsible for delivering a summary of the roundtable deliberations held in their region according to an agreed structure. Each partner was responsible also for managing these regional stakeholder workshops and for delivering from these workshops a series of observations on top of or integrated with the summary account.

The responsibility for this step-wise procedure in qualifying the further deliberations remains with each partner. All partners have agreed to contribute in this way and, hence, to ensure that the reports have reached the desired level of quality.

Accordingly, this report contains many of the points reported from the roundtables and it should appear as a thematically organized version of the edited summaries from each of the regional roundtables (or stakeholder workshops) for the LocoMotive project and from the interviews conducted with R&D managers prior to the roundtables.

Scope of the regional workshops among the stakeholders

The regional roundtables were all aimed to assess broadly the situation regarding private sector investments in R&D in each selected region, especially with a view to understand the involvement of globally oriented companies as R&D investors. Focus has been on how to attract R&D investments (and related innovative activities) by multinational enterprises (MNEs).

An ambition behind of this part of the workpackage is to put the interviews with the R&D managers into the most relevant regional contexts for, later, to deduce both general and more specific recommendations to industry, to R&D institutions and to regional and other decision-makers in the public sector. For example, the two roundtables organized in the cross-border Danish-Swedish region of Öresund were made highly selective from the beginning simply by inviting companies mainly with highly-competitive expertise in information and communications technology (ICT) and from institutions (such as technical universities, think tanks or research centers of branch organizations, etc.), which support ICT companies. The idea, when meeting in Copenhagen (Denmark) and Lund (Sweden), was to delve deeper into the various company perspectives on R&D investments to attain better insights and specialized knowledge into the companies' interests in doing regionally anchored R&D activity and in securing a high-level workforce that will allow them to reach science-based innovations.

It should be underlined that this deliverable (D 9) should be a bridge between the company-level analysis and the global trends in R&D investments by multinational corporations. The report should help situate these two types of analyses in a context relevant to public policy-makers. However, a focus should remain on the identification of locational factors that could attract regional R&D investment by MNEs, and the way in which MNEs typically structure and organize their international R&D in relation to the European regions under scrutiny.

The presentations below have been organized into issue areas, developed also during the roundtable conversations with the companies and institutions involved. For further details of each regional roundtable or regional set of roundtables, please look at the individual reports from these roundtables, as documented by the regional teams.

For in-depth insights into the interviews of R&D managers in each region, please consult the accounts of the interviews summarized by the region's LocoMotive team. For the general readership, a summary of all these interviews (some 60 interviews) is available as Deliverable D 10 ("The Final Report on Interviews with R&D Managers", prepared by CEU and Erasmus University with contributions from the LocoMotive project partners).

Before the results from the roundtables are listed and further elaborated, please find summaries of some overall conclusions, drawn (a) from the roundtables, (b) from the interviews and (c) from other fact-finding during the process of work. These summaries should address the "new regional context" which influences the conditions for R&D investments by multinational enterprises (MNEs) in the regions under scrutiny in this project.

Which regions organized roundtables on R&D investments?

Below, the list of regions covered in this document. Two regions have not reported any roundtables.

1. The Free and Hanseatic City of Hamburg
2. The Øresund Region
3. Budapest region (Central Hungary)
4. The Prague region
5. Toulouse Midi-Pyrénées
6. Helsinki metropolitan region
7. Oxfordshire

These two regions did not arrange regional roundtables or did not report from any roundtable:

8. Catalonia (not reported)
9. Rotterdam region (not reported)

From previous documents of the LocoMotive project, the following seven regional profiles are extracted:

1. The Free and Hanseatic City of Hamburg

FHH is one of the 16 states of the Federal Republic of Germany, and is the second largest city in Germany with a population of 1.7 million. Hamburg is the world's 5th largest port, well known as a trading centre, but over 5% of the workforce is engaged in R&D. It is home to Airbus and leading medical technology companies such as Philips who are supporting this project. Hamburg has many public and private R&D performers covering almost every field of research with particular emphasis on materials technologies, life sciences and related technologies, microelectronics, transport and logistics. Trading relations with China established over centuries also means there are clustering competences in developing relations with China which Hamburg seeks to exploit.

2. The Øresund Region (the greater Copenhagen area)

The opening of the Øresund Bridge between Denmark and Sweden in the summer of 2000 provided infrastructure conditions for a fully inter-connected cross-border region in which policies to foster clustering are aligned across the national boundaries. The region has 3.5 million inhabitants. The major cities are Copenhagen and Malmö-Lund).

The 'Øresund Science Region' program now forms a strategic policy backbone of the regional high-tech development. The Øresund Region lies at the forefront in areas such as medicine, pharmaceuticals and biotechnology, IT, environmental engineering and food technology. The Medicon Valley cluster accounts for approx. 60% of the Scandinavian pharmaceutical and medical industry making it the third most dominant region in Europe for R&D in these fields.

The Øresund Region has 14 universities and institutions of higher education employing nearly 12,000 researchers and providing third level education for 140,000 students in a consortium known as the Øresund University. Students can freely choose between their place of study on either side of the new bridge and attend courses in both countries.

3. Budapest and Central Hungary

Budapest is not only the capital of Hungary with approximately 2 million of inhabitants, but also the political, economic and commercial centre of the country situated in the middle of Central and Eastern Europe. Hungary, and especially the region of Budapest, is a particularly interesting target for foreign investors A huge number of large multinational companies found the region ideal for relocation. In addition to the private sector companies, significant public organisations, recognised research institutes and universities have their headquarters in the capital.

4. The Prague Region

Prague is the Capital of the Czech Republic and constitutes one of the European Union’s economically most developed regions, having a high innovative potential based on its diversified economic structure, growing economy, skilled population, and a large concentration of R&D and university institutions. Prague generates approximately 25% of the Czech Republic’s GDP. The unemployment rate here is roughly half the national average. The region is also highly attractive for foreign investors. Almost all central institutions are located here.

5. Toulouse Midi-Pyrénées

The Midi-Pyrénées region with Toulouse as its metropolitan center covers a region in France about the size of Denmark, with a population of almost 2,5 million. Industry in the Midi-Pyrénées relies mainly on agribusiness, aerospace, electric and electronic equipment, and metallurgy and metal fabrication. These four industrial sectors account for more than 40% of the region's industrial added value. The European aerospace platform mushrooming out from Toulouse where the Airbus family aircraft are built is the cornerstone of the regional economy. This sector alone accounts for 13% of the regional industrial workforce i.e., 19,000 direct jobs and a further 65,000 indirect jobs throughout the region, and is a wellspring of business for the metallurgy and metal fabrication industries employing 13,000 people.

The region ranks fourth in France in R&D with 400 public laboratories including CNES, ONERA, CNRS, INRA, and INSERM and more than 9,000 research scientists, including 5,400 in the public sector, are working out of Midi-Pyrénées. The region allocates 3.7% of its GDP to research. More than 110,000 students study at the four universities of the region where Toulouse is France's second largest university city after Paris. More than 7,600 executives are trained at the region's fifteen engineering schools with curricula geared to industry core skills.

6. Helsinki Metropolitan Region

The Helsinki Metropolitan Region forms an area of 1,2 million inhabitants and includes the capital, Helsinki, and the neighbouring cities Espoo and Vantaa with 22 other surrounding municipalities, within a wider region, Uusimaa. The region accounts for nearly one third of Finland's GDP. Half of Finland's facilities for research and experimental development are based in the Uusimaa region. One fifth of the region's population of working age has an academic degree and the student population in the 9 universities of the region is over 50.000.

The Helsinki region has been widely recognised for creating and cultivating a world-class cluster of businesses and research organisations in the field of information and communication technology, and high-tech manufacturing plays an important role in the Finnish economy.

7. Oxfordshire

Oxfordshire is a leading area in the UK for innovation and business enterprising. It is of significance both regionally and at a national and European level. There are over 1,400 high tech companies in Oxfordshire and major R&D-based employers in the area include AEA technology, Rutherford-Appleton Laboratories and Oxford Instruments.

Oxfordshire and its surrounding area, Southeast England, is one of the top high-tech locations in Europe. Of a total of 209 regions and sub-regions across the EU, only five have a higher proportion of their employment in high-tech areas. These strengths combine with high levels of investment in R&D to make Oxfordshire one the strongest knowledge-based economies in the UK. This recent success is due to a combination of factors. Its contribution to the ‘geography of talent’ is its mix of high-calibre individuals who have produced the science, supplied the funding developed the incubators and used the networks to bring together the local authorities, business and enterprises developing a unique innovation support system. The county has an extensive set of business angels and more incubators and science parks than any other country in the UK.

The University of Oxford attracts over £20m a year of research income from industrial sources, from spinouts, regional high-tech companies and international corporations. This is the second highest figure of any UK university. This collaborative research activity is fuelling Oxfordshire's growth rate in high-technology employment, which at 82% is the highest of any county in the UK.

The changing context for R&D investments in EU regions

Increasing regional disparities of R&D investments

From a European policy point of view, the observations made at the roundtables (and in many of the interviews with R&D managers which were conducted as part of the fact-finding for the project), point at major changes in the location of R&D investments by the business sector. For example, the project finds strong tendencies of an increasing, uneven distribution of R&D investments among Europe's city-regions. Other studies confirm this overall picture of change. It seems that R&D-based innovative capabilities across the European countries as well as the regional disparities of R&D resources are being enforced. In various parts of the continent, there is a swiftly increasing concentration of R&D resources, while, on the other hand, there is a decreasing concentration of local and regional innovation environments in a wide range of European cities. For example, there are regions without major R&D facilities and with no such investment in sight in a foreseeable future.

R&D centers supported by MNEs

In the age of swift globalization of trade and investments, the uneven distribution of invested R&D resources and related capabilities for innovation appears to be reflected in a Europe-wide division of labor or specialization. It was noted during the fact-finding process and reported from other studies of R&D that modern Europe has an archipelago of relatively advanced innovation regions in a sea of less R&D-intensive regions. Some of these 'islands of innovation' are closely connected with each other as nodes in continental and even in global networks. Typically, the intermediation is achieved by multinational enterprises (MNE) and supporting institutions, including universities and science and technology parks.

Hubs in trans-European flows of R&D results

Accordingly, the analytical framework for the LocoMotive study of private-sector R&D investment motives in regions, must include the hub-cities (and their regions), increasingly being structured around trans-border and trans-continental flows of goods, capital and services. The variety and diversity among localized hub functions seem to stimulate the mobility of specialists and other individuals in between the hubs and their regions. In Europe's metropolitan hubs, there is a multitude of advanced business services offered by private enterprises, both large and small, sometimes in cooperation with universities and other R&D or technology-related institutions.

For example, much of the two roundtables in the Öresund region and of the second regional roundtable in Hamburg circled around the notion of dynamic hub-cities (with vibrant R&D and innovation activities in and around them) and their regions. The stakeholders in Hamburg perceive their city as a 'Wissensmetropole' or a regional and global knowledge hub with many, functionally organized linkages across Europe and into the rest of the world. The roundtable discussion here focused on how to improve the linking of policies, industrial and research/academic activities to serve this type of combined regional and global interests with a focus on R&D and innovation.

Hubs and local innovation environments

The resourceful European hub-cities serve as important transaction points for the diffusion of new designs and know-how and other specialized information and knowledge. Together with multinational and transnational companies, these cities serve as nodes in the global economies of trade, investments and some other types of. Globalization, also of the kind just indicated, opens up the regional economy to competition, but globalization also allows a broader resource base for the MNEs and other large enterprises as well as for the SMEs.

All of the regions under study in this project do illustrate – in various ways and at various stages – the importance of a place that breeds a local innovation environment (or supports a cluster of competencies) as well as being an effective node in large, even continental networks. Increasingly, so it seems from the fact-finding, the MNEs look for resource-rich innovation environments in Europe's regions, where relevant research results could be made easily accessible as raw material for the experimental development by these companies, while designing and prototyping new products and processes.

R&D, regional governance and place marketing

The complexity of each place in offering a variety of services that meet a mixture of advanced demands from MNEs, and how these complexities are being managed in each location by the city-region and by stakeholder groupings, appears to be determining factors of real significance. Innovation environments, which are transparent to investors, with clearly defined roles and regulations, and which are able to bring together stakeholder involvement across all sectors (research institutions, industry and regional government), seem to be the most attractive to the MNEs.

As understood by some of the participants in the regional roundtables there seems to be no 'one-size-fits-all' solution, or a single principal pathway to success in attracting R&D investments from the private sector to a given location. On the contrary, MNEs and other companies call for combined efforts and undertakings that create a broad, sustainable platform for R&D investments and related innovation activity. Regionally anchored policies need to be coupled with business-oriented or broader mobilization of R&D resources.

What's new? –MNEs and entrepreneurial research universities

Increasing economic importance of universities

Well-endowed and well-functioning research universities (with an entrepreneurial profile) are one of the prime location factors for companies investing in and/or benefiting from R&D as part of their resource-base. This is a clear message from many of the interviews of R&D managers and from the regional roundtables. In Europe, as in many other countries and regions that have research universities with an entrepreneurial orientation, universities are perceived as powerful engines of technological development and innovation. However, the regional environment within which the universities operate, are currently generating strong pressures (including new financial restraints) that are propelling them further into commercial arenas.[2]

At the same time, judging from some of the statements in the roundtable deliberations, the business-research interactions are not expected to become merged into fully-fledged commercial operations or into a hybrid organization, which is neither fully academic, nor fully commercial. Greater value is seen in business firms participating in open, curiosity-driven and interpretive research in the relatively independent academic institutions, while professors and other academic specialists could engage – outside of their normal duties – in proprietary problem solving off-campus, such as in science and technology parks, business incubators or inside the firms.

While universities, by a regional authority, might be seen as important 'agents of economic development', and while new policies designed to encourage further university-industry collaborations are numerous across Europe, the general trend is not to submerge the university into the regional business arena. However, we have found many new forms of organized (as well as informal)

[2] Richard Lester & Michael Piore: *Innovation – The missing dimension*, Cambridge: Harvard University Press, 2004, especially chapter 7 ("Universities as public spaces").

forms of cooperation. In all the regions under study, there are many new communications linkages between the regional economy and the local universities. According to the regional roundtable reports, this communication trend will be further encouraged.

Co-location of R&D facilities

[The regional example of Oxfordshire]

The R&D intensive multinationals enterprises (MNEs) which participated in the study of the Oxfordshire region include three American, two European and a Japanese enterprise. With the exception of Sharp, which established a new European R&D laboratory in 1990, the other MNEs have been in the region for less than seven years and were either merged or acquired and subsequently (co)located on a site owned by previous companies. The additional inclusion of Monsanto in the study represents an interesting extra-regional example, and was included because of the close research relationship with the University of Oxford. The case of Oxfordshire is a case also for the proof that resourceful, advanced research facilities at the heart of a major university will always be an attraction factor for companies to co-locate with such research environments.

'Global centers' of corporate R&D in the region

[The example of the Öresund region]

With 13 universities and Europe's fourth or fifth largest production of refereed papers in scientific journals (medical and other science journals in particular), the Öresund region (combining the cities of Copenhagen and Malmö-Lund) has become an attractive site for the location of science-based and high-tech companies such as NovoNordisk, Novozymes, TetraPak, Ericsson, Sony-Ericsson, Microsoft, Nokia and IBM. Some of these companies are included in our sample for specialized study of location motives. All of these have made the Öresund region one of their global 'centers of excellence' for R&D and science-based innovation.

At the same time, resourceful universities with huge R&D capabilities and relatively large number of third level students (150 000 in the Öresund region) are not enough to secure the long-term presence of these and other MNEs. Several of the companies complained during the roundtables in both regions that the number of talents and the inward flow of skilled personnel are too limited. Even some of the most resourceful regions in Europe’s knowledge society lack specialized human resources, while other parts of Europe seem to have more than enough to meet the demand by the MNEs. In Oxfordshire, for example, there is a skills shortage in physics and chemistry. In Öresund, to take the other example, there is a serious skills shortage related to IT and electronics. These skills shortages seem to be structural rather than dependent on the current economic boom period.

Excellence in research = Excellence in innovation?

[The regional example of the Hamburg region]

Starting with a remark from industry that the typical MNEs finds it increasingly difficult to recruit relevant staff for their company R&D and for other innovative activity, the regional roundtable spun around the problems for universities to become a magnet for industrial funding. It was agreed that the most important way to attract MNEs to invest in R&D in this region and to foster innovation environments together with the universities is to create and maintain excellence in research at the relevant university departments, while fostering a profile of entrepreneurship in order to link up better with the broader business community.

Universities need to develop a strategy for excellence which must not be changed every five years or with the ending of a major research contract. In addition, universities should bid farewell to trying to cover all areas of research but should concentrate on developing a distinct profiles of excellence. At the same time, the universities should be careful not to loose their advantage of interdisciplinary research capability by more specialization. Moreover, the key to the achievement of excellence for the universities is to try to compete globally, being benchmarked with their international peers. In a world of globalization, excellence has to be defined accordingly.

What's new? –City-regions as nodes of knowledge and innovation

European hubs in global competition

A relatively new feature, related to the hub-city and the regional node perspective, is the fact that three city-regions listed in the previous section (Oxford, Öresund/Copenhagen, and Hamburg), as well as many other European city-regions, have to compete with city-regions on other continents, including Asia, for R&D investments by MNEs. More and more, the local innovation environments in Asian cities like Shanghai, Singapore, Bangalore and other major city-hubs with a metropolitan resource-base nearby effectively compete for R&D investments with Oxford/London and Lund/Copenhagen.

Loudly and clearly, R&D managers interviewed in this project spelled out a trans-regional perspective on R&D investments in competing city-regions, even competing on the other side of the globe. These investments are not only part of outsourcing of some of their R&D, but could also be the re-location of core R&D activities from Europe to city-regions in North America and in East and South Asia. For example, since 2002, NovoNordisk has located new, core R&D activities to Beijing and Novartis has done the same in a new R&D facility in Shanghai. This list of re-distribution of core R&D functions from Europe could easily be made much longer.

Creating a 'global hub' vision and a supporting strategy

[The regional example of the greater Helsinki region]

In Finland, the regional workshop reported a strong need for a commonly shared vision for the future development of the Helsinki metropolitan area. The vision should be developed, shared and fostered among key stakeholder groupings in the region. The greater Helsinki region should situate its development within a global context, regardless of the (artificial) borders that earlier may have set limits to cooperation between the three cities in the region.

The strategy should include goals and ideas for the organization of future development processes, help attract and mobilize relevant R&D investments and other resources for innovation, and create a basis for cross-sectoral coordination of major projects.

The overall strategy for the Helsinki region should also include branding and marketing elements. The participants in the regional workshop found it vital to strengthen the Helsinki brand in international fora and to global investors and potential clients. The stakeholders in the Finnish metropolitan area should share a vision and the overall image, work together in implementing the strategy, and promote a common message related to the innovation capabilities in the region.

Shaping a regional high-tech brand

[The example of the Öresund region]

In the first Öresund roundtable, the Danish and Swedish participants (mainly from the private sector) shared the ambition to establish a more functional network or a joint cross-border program to position the region's already richly endowed, resourceful mobile & wireless technology effort and make it truly competitive for new applications and user-centered mobile solutions. To achieve early success, many of the participants underlined the importance of strategic resource mobilization in industry as well as among public R&D establishments and higher education institutions. Others emphasized place branding, strategic marketing and making the region attractive for talented individuals, like R&D specialists, computer design engineers and other professionals in support of new ventures and start-ups, entrepreneurial companies, risk capital investments and business partnering in high-tech industries.

New needs for comprehensive service provision

As indicated in the text that follows, the location motives identified in the interviews and at the LocoMotive regional roundtables across Europe include a range of factors that previously might not be considered important for regional policy-makers. Yet, companies of today, while in a process of determining R&D facility locations will not only consider the economic rationale according to standards textbooks in R&D and innovation management. They must consider the broad picture of regional attractiveness, which includes a variety of factors as follows. Examples of such attraction factors are extracted from selected interviews and the roundtables in Oxfordshire (Oxford) and Öresund (Lund and Copenhagen):

- Competitive salaries and possibilities to compose attractive incentive packages (including pension schemes, education, medical services);
- Taxes on wages and labor (also to attract and keep the best international R&D scientists and engineers and other experts).
- University brands, quality of local schools and daycare centers
- Skills on various scales (including technicians and other supporting personnel)
- Entertainments and sports related to life styles
- Transportation and telecom infrastructure
- Environmental qualities in the work and living environments
- Affordable housing
- Direct and indirect subsidies for R&D and related services
- Public services such as procurement, based on advanced requirements for new or even future technology

Public policy as a strength – and as a weakness

In addition, the regional policy environment is considered an important factor for locational decisions for R&D, while being related to the supply of advanced services in a given region. Depending on their quality, public policy and regulation are sometimes considered as weaknesses for locating R&D in a particular region or country. For example, corporate taxation schemes and the great regional and national varieties of regulation force companies to continuously consider the location and re-location or their R&D investments.

To manage a corporate R&D facility in a globalizing world, the companies will have to consider these and other factors as determinants for medium-term and long-term effectiveness of their operations. As indicated, policy makers in the same regions (and nationally and in Europe) will also need to meet the variety of demands in order to be able to attract firms and the talents needed for R&D and innovation. It comes out clearly from many of the roundtables that the combinations of these and similar factors for the future of the regional attractiveness are part of a growing concern among the MNEs. The importance of each factor may also vary over time.

Joint regional scouting for talents

In one region in particular (Öresund), its second roundtable was dedicated simply to human resource development and the search for the appropriate specialists and other potential personnel to occupy the many empty positions in the R&D and engineering labs of the MNEs. For example, it was agreed among companies, which normally compete fiercely in the marketplace, will join forces and engage in joint 'road shows' elsewhere in Europe to secure the recruitment of more specialists to the regional labor market.

For smaller science-based or high-tech companies, the same issues of regional positioning for attracting talents are becoming a major concern. R&D and other specialized activities at the level of the company cannot expand in some regions due to the low, general level of attractiveness. Some of these needs seem to temporary and dependent on a local economic boom; others seem to be more structural and of a long-term nature.

What's new? –MNEs and R&D in Eastern European regions

While the Oxfordshire and Öresund regions both represent some of the oldest and most well-known universities in Europe, which have managed to respond effectively to some of the needs of a more science-based and high-tech industry, the new, still emerging market economies in former Eastern Europe have very different problems to attract R&D investment related to regional innovation.

R&D not 'embedded' in the economy

[The case of the Budapest region (Central Hungary)]

Although foreign direct investments (FDI) since 1989 have been very significant for the Hungarian economy (and especially in the Budapest region), the mounting presence of MNEs has led to the emergence of a 'dual economy'. The term articulates the fact that while MNEs generate nearly a third of Hungary's GDP and approximately 70% of its exports (and employ roughly 20-25% of the total workforce), the same companies remain weakly linked to or poorly embedded in the domestic economic environment.

There is a significant gap, the Budapest regional roundtable concluded, between MNEs on the one hand and local companies and regional institutions on the other hand in terms of competitiveness, productivity, participation in European or global networks, R&D activities and openness towards innovation whether technological or otherwise. For this reason, cooperation between MNEs and domestic SMEs as well as with other organizations (e.g. universities, local governments, etc.) remains low.

Lack of operational R&D linkages

[The case of the Prague region]

The lack of linkages between R&D investments by MNEs and the universities and other R&D centers in the Prague region is similar as in the Budapest region.

In addition, in both regional cases, the roles for R&D played by the local and regional companies are minimal. The overall problem of 'embeddedness' by the MNEs and their R&D activities remains a central issue for the analysis of the long-term R&D activities by MNEs operating also in the Prague region.

How to position local partners to MNEs?

[The case of the Budapest region]

The roundtable in the Budapest region (Central Hungary) also sought to determine whether domestic stakeholders in R&D (e.g. universities, innovation-oriented SMEs and local policy-makers) really are able to successfully cooperate with MNEs. Will the issue of the dual structure of the Hungarian economy continue to appear as a major feature also for R&D by the MNEs?

So far, perhaps the most important result of the LocoMotive project in the Central Hungarian region is the fact that further growth of investments into R&D will depend primarily on the positioning of potential local partners with regard to the MNEs. Here, incentives by national/local governments and the European Union could play a crucial role. Decision-makers representing these political bodies could facilitate relations and help 'empower' local actors to make them more capable of entering into extensive and even institutionalized R&D cooperation with MNEs.

Main Issue 1: Locational determinants

The regional roundtables do not add new, general information on locational determinants for R&D investments by MNEs. Such general information has already been processed from the interviews with the R&D managers of the 39 firms selected for fact-finding to this project. In Deliverable 10 (D 10) from the LocoMotive project, these interviews plus some other location-relevant information have been summarized. The summary was made from six overall categories of locational decisions. At the same time, some early policy conclusions have been drawn on the basis of what the R&D managers have suggested.

The regional roundtables do not add any specific implications or new proposals for changes in policy, compared with what has already been reported in Deliverable 10 (D 10). However, several cases could be made by anchoring the available proposals in the particular regional setting and historic situation, thereby going beyond what an individual company may have of ideas for regional improvements. This includes technology considerations, market availability, factor costs, advancements of infrastructure, etc. all related R&D investments.

How to achieve inward investment strategies?

[The case of the greater Helsinki region]

Finland – and particularly the greater Helsinki region (the communities of Helsinki, Espoo and Vantaa) – stands out in recent international statistical surveys of R&D capabilities (investments/GDP, researchers/population, patents etc) as one of the most competitive innovation environments in Europe and in the world. However, and this remains intriguing, the global recognition of inventiveness has not been transformed into increased attractiveness of Finland as a major destination for R&D investments by MNEs. The Helsinki region of today has very limited international R&D investments compared to many other European regions which host some MNE headquarters. The roundtable concluded that much more active promotion is needed to attract R&D investments, to recruit talented researchers from Europe and from the rest of the world, and to support international networking of Finnish R&D projects and other research-related efforts.

In Helsinki a new promotional agency for the Helsinki metropolitan area should serve as platform for brand development and promotional activities. The communications platform should create a stronger message, based on the truly differentiated strengths of Finland, served not only by the Finnish companies but also by R&D and intermediary organizations such as Tekes, Sitra, and VTT, which have proved to be effective in fostering regional innovation activities with a global edge.

The regional workshop in Helsinki also concluded that a changing R&D environment geared towards investments by multinational enterprises (MNEs) with new type of innovation processes, including open innovation and service innovations, will require new R&D infrastructure and new innovative capabilities in the greater Helsinki region. Moreover, recognition of future needs and concrete actions to support such internationally-oriented capability building should be promoted. For example, new support and funding programs should be introduced to activate emergence of ‘open innovation’ environments.

Connecting ‘upstream’ R&D by joint public/private initiatives

[The case of the Toulouse Midi-Pyrénées]

At the Toulouse Midi-Pyrénées regional roundtable, it was acknowledged that there is relatively little involvement by academic and other public-sector researchers in EU-funded R&D initiatives such as the Joint Technological Initiatives (JTIs) and the European Technology Platforms (ETPs). The JTIs and the ETPs are led by industrial companies and operated according to agreements with the European Commission (DG Research, DG INFSO, etc.). It was recommended that many more researchers from public institutions could become actively involved in the ‘upstream’ parts of the R&D of these projects.

The universities and other R&D institutions located in the region already employ specialists recognized for their ability to perform multi-disciplinary and trans-disciplinary research in nano-sciences, new materials and other advanced target areas, which are close to commercial exploitation, yet still being scientifically demanding areas of specialty. These specialists already do research work that could lead to break-through results and to commercially interesting technological advancements. New science-based innovation could be fostered by making combined public-private efforts of the kind just indicated. A first step could be to associate public researchers in the 'upstream' activities of the JTIs and ETPs.

The industrial representatives at the regional roundtable in Toulouse also called for substantial organizational improvements at the level of the universities, thereby creating a regional Pôle Recherche Ensignement Supérieur (PRES) "University of Toulouse", which would allow a higher intensity and speed in the collaboration between public and private R&D centers, a better use of the scientific potential (resting in the public institutions) and improvements in higher education and training.

Another way to make the linkages between the R&D of the MNEs and of the public labs in the region is to co-locate labs or to form joint laboratories, which is an emerging feature in various high-tech industries. The roundtable participants also discussed various modes of advanced consultancy services in the regional context and the experiences gained from the National Thematic Network for Advanced Research (RTRA).

Universities need model strategies for excellence in research

[The case of the Hamburg region]

Changes in the remuneration of professors, introduced recently in the Hamburg region, might help to change the culture for competitive research. The provision of pecuniary incentives to researchers and research groups could help in fostering excellence in research. Role models for how to achieve excellence in research are very much needed.

Universities should build up interest profiles and be concerned with openness to foster a dialogue with industry on new research topics. This could involve not only individual companies, investing in R&D. In addition, the Chamber of Commerce could become involved in the discussions. However, in the regional workshop in Hamburg, it was emphasized by some speakers that the universities should not expect industry to tell them what to do, but the universities should develop their own strategies for research and concepts for innovation – also in terms of new roles for the university in the regional development.

In the light of the proposed academic changes, the entrepreneurial culture of technology-driven enterprises in the Hamburg region needs to be assessed and further improved. Better innovation environments need to be created and managed throughout the Hamburg region. There should be an active policy from the region in using international funding programs (EU and other such programs) to promote the networking capacity of Hamburg's science and industry for cross-border cooperation.

Values and attitudes

[The case of the Budapest region (Central Hungary)]

The regional roundtable in Central Hungary concluded that the growth of MNE-driven R&D in the Budapest region is hindered not only by clearly tangible factors, but also by some intangibles. For example, there is often a lack of trust and a feeling of insecurity. More is needed of entrepreneurial courage. The participants in the roundtable agreed that there must be more of openness to cooperative ventures in R&D with MNEs, while also consensus building among local players could prove to be crucial for success.

More generally, there seems to be too little of readiness to finance innovation without clear expectations of immediate return. At present, the region lacks risk capital, seed funding, business incubation initiatives, etc. One recommendation from the workshop is to enhance education and furnish the insights and skills needed for business venturing. Another recommendation from the roundtable is to recognize the roles of science parks and innovation center, which could play important roles also in transforming attitudes to entrepreneurship, innovation and business venturing.

Mixing key attraction factors

[The case of the Oxfordshire region]

The two most significant location determinants identified by the multinationals were 'Technology/Supply Side' and 'Policy' factors. The University of Oxford was identified by three MNEs as the most important technology/supply side factor. Other factors identified in the regional roundtable included the presence of other companies in the region for collaboration and service provision, while the availability of highly skilled labor in the region was also highlighted by two of the MNEs. The importance of the UK regulatory environment was indicated by four of the five MNEs, with two citing the favorable taxation system to be a determining factor.

The presence of competitors was considered unimportant for the sample of Oxfordshire MNEs, as none identified this factor as being significant to their location decision. Indeed Sharp identified this as a disincentive, and identified a consideration in their decision of location was that they were the first company on the Oxford Science Park and did not want to go where there were already similar Japanese companies.

Human resources and the mobility of talents

[The case of the Budapest region (Central Hungary)]

Originally an appealing locational factor for R&D-intensive foreign direct investment into the Budapest region, the Hungarian highly-educated and otherwise skilled workforce is becoming harder to find (particularly engineers and natural scientists). Moreover, some researchers and other professionals lack project experiences, management skills and business insights, often necessary prerequisites for becoming engaged in a R&D project by a MNE. Scarcity in Hungary remains of proficient foreign-language speakers. Computer literacy is not as high and comprehensive as in many other European countries.

The regional workshop participants noted that the introduction in Hungary of the Bologna-process for third level education has brought mixed results as it seems to have led to the lowering of overall standards at the undergraduate level.

A general recommendation from the participants in the roundtable is to open up the Hungarian labor market. It is important also to strengthen higher education in the relevant disciplines (returning to traditionally successful areas of the Hungarian school system such as mathematics and natural sciences). There is a need for a general overhaul of the institutional structure, funding and educational priorities of higher education in Hungary. More attention should be given at the university level to research and project management skills and to attain business expertise even among researchers. Training in foreign languages is also much desired priority.

Human resource development as an attraction factor

[The case of the Hamburg region]

Universities should remind themselves that they must not only concentrate on advanced research but also on advanced education. Excellent researchers may also attract very good students. Hopefully, a larger part of the graduates of today will stay in the region after their studies have been completed. This in itself will become an attraction factor for R&D-based companies, the roundtable participants in Hamburg concluded.

Not 'brain drain', but 'brain circulation'

[The case of the Öresund region]

The two roundtables in the cross-border Öresund region covered six themes, cutting across the public/private sectors. The most important one related to R&D investments (by MNEs and by small and medium-sized companies alike) proved to be access to human resources or, more specifically, recruitment of researchers, R&D engineers and technicians, the enhancement of skills among specialists, 'brain circulation' (not 'brain drain') across Europe's border, etc. In short, the principal strategic issue among all the stakeholders in R&D and innovation, including globally operating stakeholder companies in the Öresund region – such as Microsoft and Sony-Ericsson as well as companies and institutions from several other countries (Spain, Italy, Germany, France, etc.) – was the availability of highly-skilled personnel.

Focusing solely on this issue during a second roundtable, the deliberations became very concrete both in the short-term perspective and in a long-term or 'visionary' perspective. The second workshop systematically reviewed the human resource situation – as seen from the R&D-intensive companies in the region and was able also to identify practical solutions to some of the problems posed and considered in the roundtable.

- **New ideas at the industry level:** The regional roundtable concluded that there is need for ideas for new programs, methods and activities to be launched at the firm level and, even more importantly, at the industry level to help solve the challenges of shortage of particular skills in the short-term and in the medium-term (especially for electronics and the mobile and wireless ICT industry, which is a major segment of the high-tech industry in the region). The future development of R&D capacities in the Öresund region was defined as a crucial point, currently hampered by human resource deficiencies.

- **Selected actions:** A platform for inter-firm collaboration for the purpose of addressing constructively employment and recruitment challenges by selected actions (such as a joint road show and recruitment program) of particular relevance to the mobile and wireless ICT industry.
- **Availability of specialized skills:** Appraisals of various short-term and medium-term actions, including assessments of the current demand and supply for specialized ICT-related skills within particular regions in the EU and in some of the EMEA member countries (including Russia).
- **Joint activity plan:** A program or a set of scheduled activities addressing the needs for early recruitment of specialized skills to the mobile and wireless ICT industry to be initiated soonest and, if possible, completed by the summer 2007.

Broadening the R&D funding base

[The case of the Budapest region (Central Hungary)]

At present, one of the most critical bottlenecks to increasing R&D is the severe under-funding of universities/research institutes/R&D places. The government appears to be unsure whether it should continue to finance basic scientific research. This is a problem because universities cannot act as partners of MNEs as long as they do not command the necessary resources in terms of financing and skilled management.

Universities in the Budapest region cannot rely on private money to expand their R&D resources, since a considerable share of corporate funding of R&D remains intramural.

The recommendation to the government from the regional roundtable participants in Budapest is as follows: Do not reduce public expenditure in education and R&D. In particular, provide incentives to MNEs to cooperate with universities on a long-term, institutional basis (e.g. MNEs should finance not only 'one-shot' projects but also R&D centers and labs at universities as well as special teaching streams, department research activities, professorial chairs, special training programs, etc.)

On top of these, the recommendations to government by the regional roundtable are to improve interactions between R&D units of MNEs and R&D organizations by altering regulation, improving education, fostering networks, providing governmental subsidies for actual cooperation. The workshop noted that applied innovation cannot thrive without continued inputs from basic research.

Main Issue 2: Organization of R&D in the MNE: The driving forces behind

The second main issue in the regional roundtables and in the interviews with the R&D managers in the regions is on the organizational structure of the MNE in terms of its international and regional R&D activity. And, to some degree, how the region organizes its R&D to capture inward R&D investments from the private sector.

One conclusion – also from the roundtables – is that the modes of the MNE's R&D organization regionally (and globally) and the roles to play by this R&D organization in the region do influence the level of R&D investments and the driving forces behind these investments. The main organizational issues, extracted and summarized from the interviews with the R&D managers, are presented in Deliverable 10 (D 10).

However, there is no easy conclusion to be drawn from the roundtables, since the varieties of organization of R&D in a region are vast and depend on a series of considerations, often unique or otherwise special for each company.

None of the regional roundtables was able to draw a general set of conclusions during its deliberations of organization of R&D by the region's MNEs. Yet, there are observations from some of the regional roundtables that might have a general value. These are summarized below.

Regional anchoring of global chains of innovation

[The case of the Oxfordshire region]

The R&D organizational structures of the MNEs scrutinized by the regional LocoMotive team were mostly of the type with central coordination from a global, or at least regional, headquarters. All of the MNEs identified strong lateral ties in R&D, as well as more generally within the region/locality. The exception in terms of organizational structure was Infineum, which identified its organizational structure as different from the others due to the specialized nature of the R&D centers and the cross-coordination of national teams in addition to the strong lateral R&D ties. The fifth MNE, Novartis, was unable to identify itself with an organizational structure as although its R&D is in Sienna and it several thousand other research staff in Europe and the US, the company is currently are reconfiguring its operations in order to overcome problems of coordination within the various research groups.

Patterns and processes of mergers and acquisitions have had, and continue to have a profound influence on the location and organizational structure of R&D, especially in the bio-pharma sector. MNEs are very selective about which sites they will keep open post- merger and/or acquisition: for example, Novartis has virtually closed the operations of Powderject which came with the acquisition of Chiron; and Siemens having acquired Mirada, is now likely to merge its diagnostic activities with their magnet technology operations already in Oxfordshire.

Science parks and other intermediaries

[The case of the Budapest region (Central Hungary)]

The regional roundtable took stock of the science and technology parks and found little progress. For example, there is little support forthcoming for the incubation of small and medium-sized enterprises and innovative R&D activities whether in science parks or elsewhere in the Budapest region. Early attempts to create science/industrial parks have typically led to the establishment of office centers rather than of genuine innovation centers.

The roundtable participants reasoned as follows: Through initiating networking events and training programs, science parks could play a crucial role in fostering missing R&D skills and in encouraging the rise of an innovation-friendly entrepreneurial culture. Since science parks and innovation centers can act as indispensable interfaces for the transfer of knowledge and information, they are to be financed in the long-run funding cycles in order to ensure their sustainable development.

Compensating for bureaucratic procedures

[The case of the Budapest region (Central Hungary)]

The regional roundtable in Budapest addressed also bureaucratic procedures and delayed financing with regard to R&D. The participants noted that the success of existing governmental initiatives to support innovation and R&D cooperation oftentimes is seriously jeopardized by red tape and the requirement that participants are to pre-finance programs before gaining access to governmental funds. They noted that the regulatory environment is at best overly complicated and unstable, and at worst positively obstructing R&D and innovation (e.g. by protecting monopolies), which could be a hotbed for corruption.

To pave the way for more efficiency and transparency, also for inward R&D investments, the roundtable recommended a reduction of bureaucracy, the acceleration of access to R&D subsidies and other funding, and a more stabile regulatory environment.

Main Issue 3: Linking R&D by MNEs to the region: Quest for impact

The third main issue in the interviews with the R&D managers in the regions and in the regional roundtables focused on the impact of the linkages between R&D by the MNEs and the region's economic and other development. Technology transfer and the diffusion of related know-how and know-what and even know-who could be very important inputs to the region's innovation capabilities. There are in fact a number of examples at the regional level, where spill-over from the MNE R&D labs substantially enhances quality, productivity and growth in companies and institutions able to capture these spill-overs, while operating in the region.

A conclusion from several of the regional roundtables is that linkages between the regional economy and the global economy – intermediated by the MNEs – typically have an impact on a whole range of growth factors. Likewise, an MNE that is able to tap into the local and regional resources for R&D and innovation will also find benefits that could influence decisions on further investments and location of R&D.

More detailed information on company-level considerations is summarized in the interviews with a selection of R&D managers in each region, presented in Deliverable 10 (D 10).

Below, an attempt is made to bring forward what the regional roundtables were able to draw of conclusions of a more general character during the deliberations on effective linkages to the regional economy by the MNEs.

The regional R&D base and infrastructure

[The case of the Budapest region (Central Hungary)]

As indicated elsewhere in this document, the availability of R&D and manpower resources, a modern regional R&D infrastructure and advanced qualifications on the part of potential Hungarian R&D partners are principal location factors on which the further growth of MNE-driven R&D depends. Although some factors are beyond their control (e.g. global economic trends and pan-European investment patterns), making domestic stakeholders fit for cooperation with global players is where local and European policy-makers shoulder the greatest responsibility.

Encouraging MNEs to integrate their R&D operations based in the region is in the host country's prime interest if it is to avoid loss of R&D investments by the MNEs and the brain drain of its well-qualified experts. But the MNEs, too, must have an interest in avoiding costly relocation of their R&D units to other regions and other continents.

Crafting functional business linkages to a research university

[The case of the Oxfordshire region]

The MNEs generally exhibit a low level of embeddedness in the region, although there is some evidence of embeddedness in relation to specific areas of research, skill development and networking activities. Three MNEs (Siemens, Novartis and Sharp) have formal research linkages with Oxford University, reflecting their corporate histories with the first two having acquired Oxford University spin-offs and their associated research patterns. Infineum has established embryonic links with Oxford University, as is the case with GE Healthcare who are looking to extend their linkages, although both have found it difficult to establish links with the relevant departments. In addition to connections with the University's scientific base Siemens and Sharp also participate in wider university-based networks, for example Sharp works closely with the Said Business School on the MBA programme, while Infineum has strong links with Oxford Brookes' MBA programme.

Further to the engagement with the university, Sharp also has strong links to the high-tech community through their participation in broader networks (for example on skills developments). However, there are few examples of local contracting and/or sales linkages. Only Siemens presently engage in a technical collaboration with another local high-tech firm and benefit from the support of local/regional policy organisations, while Sharp explained their most significant local impact is through the salaries paid to its staff and the purchase of local services. At the regional roundtable, there was a general interest in improving local networking, especially by the non-bio firms which found the county's networks to be dominated by the biotech sector. GE Healthcare which is located on the edge of the Oxfordshire region, and Infineum which was new to the county identified the need for networks in order to find specialised contractors etc.

Cross-sectoral cooperation to foster clusters of competencies

[The case of the Budapest region (Central Hungary)]

As already indicated in an earlier section of this report, and according to findings from the interviews of R&D managers in the Budapest region, the local and government policy-makers in Central Hungary confirmed the view that R&D - in many ways - is a key to improving the embeddedness of the MNEs in the region's economy and in the Hungarian economy as a whole. This is especially the case if R&D activities can be concentrated in the more dynamic cross-sectoral clusters, which could rely on cooperation among private investors, research and educational institutions and the involvement also of local and regional decision-makers.

Making science and technology linkages to the region more functional

[The case of the Toulouse Midi-Pyrénées region]

The regional roundtable of Toulouse Midi-Pyrénées recommended the creation of quality procedures to guarantee property rights, privacy and consistency of commitments (also in the scheduling of work) to better link science and technology between business firms and the supporting R&D institutions. Such procedures should help shape the region's innovation environment and make the science and technology linkages more functional and thereby effective, as seen from all parties concerned.

For example, there is a concern among the regional industrialists, representing also the high-tech MNEs (in the aerospace industry), that quality procedures at the level of the public laboratories and in their research teams are not always at the very high standards required by industry. It was noted that public labs, more and more, take the issue of advanced quality into account. This will ensure a close cooperation, cost-effectiveness in the collaboration and, ideally, more useful results. Nevertheless, the companies involved need to be able to assess better the performance of the public laboratories in the region in order to be able to integrate the research of these labs into their own R&D and innovation activities.

The roundtable in the Toulouse region recommended the option of creating ‘scientific councils of higher education and research’ to incite public laboratories to create quality assurance methods and means. Furthermore, the roundtable participants discussed a special ‘charter’ document as a means to stimulate and improve contractual relations between public R&D labs and private industry.

Cluster support needed – also from policy-makers

[The case of the Hamburg region]

The roundtable in Hamburg focused on the universities saying that they must position themselves to the region as a whole, not only towards company-specific needs and other explicit business demands. More and more, to have a good general standing in the region is seen as a prerequisite towards working globally.

The clustering of industrial biotech in Hamburg might be seen as an excellent example of university/industry co-operation in the Hamburg area. Clustering is a long process and may need political support to become successful. This lesson can be drawn from the relatively slow start of the cluster development around

Airbus in Hamburg, which may need further political support at least in the phase of collaboration that cuts across industries.

How to improve interaction between R&D places and companies?

[The case of the Budapest region]

More often than not, R&D units of the MNEs in Hungary operate as enclaves with hardly any interaction between them and to other R&D stakeholders. This was a conclusion reached during the roundtable at Budapest. One strongly supported recommendation was to find better cooperation between R&D places and the R&D performing companies.

Existing links are often based on personal, informal contacts. Frequently, joint ventures are in reality 'one-shot' projects, while a more institutionalized cooperation is atypical, even exceptional. It was recommended that the national and regional governments should undertake a much more pro-active role in alleviating this situation.

Contrary to current practices, governmental support should be market neutral. At present, the key priority should be – not the finding of new partners through direct subsidies given to individual firms, but – improving the positions of Hungarian stakeholders, in particular that of the universities, and support for the development of an innovation-friendly environment and sustaining infrastructure.

Diffussion of R&D results and technologies across sectors

[The case of the Toulouse Midi-Pyrénées region]

At the regional roundtable of Toulouse Midi-Pyrénées a point of special attention was the successful diffusion across sectors of applied research results and new technology. Potentially, a technology device or other process developed for one purpose could be transformed into new sets of usages, if there would be means and methods to make such transformations easy and effective. However, the transfer of science-based technology may need special methods and means. It was recommended that public labs and business firms should work together to increase the value of given technologies, achieved in specific areas of application, by making the transfer and transformation of the technology to other areas of application more easy.

For aerospace applications, medical devices and a range of other high-tech specialties of the region, there are already examples of successful transfer and transformation, but these examples need to become better known to serve as models. The involvement of R&D managers directors of laboratories, policy-makers, etc. is needed to anticipate and develop new approaxches to the transfer of technology and related knowledge. The migration of specialists across sectors and fields of specialty, particularly the careers of young researchers, were considered a means for such transfer of technology and related know-how. Formally, there is an organization (Regional Advisory Committee for Research and Development) in Toulouse, but in realty id does not have the time and the means to develop new methods for the diffusion of R&D results and technologies across sectors.

There is a plan to create a regionally anchored ‘Aerospace Institute of Technology’, which could promote the whole range and the full potential of aerospace-related fields of knowledge (in scientific, technological and educational terms) for the purpose of knowledge transfer across sectors. There is also a related concept for a regional strategy or technology-focused ‘Plan in Aeronautics and Space’ that could be made operational for the purpose of cross-sector transfer of knowledge.

Linking R&D and business development by public service

[The case of the greater Helsinki region]

For many years, Finland has been relatively strong in R&D investments, much stronger than most other European countries. However, in order to increase innovation productivity, based on the R&D efforts, there is an urgent need to focus more on building effective processes or commercialization of R&D results.

Moreover, universities and other R&D institutions in the greater Helsinki region, where most of the country's R&D is currently located, will need to strengthen the links between industry and research and extend the know-how of R&D scientists and engineers into the broader business community.

The newly established national TULI Program in Finland, managed by TEKES; is set to promote new business activities on the basis of research results. The services provided under the program support commercialization mainly of public research projects or R&D projects performed by publicly employed researchers, engineers and other specialists. This program and other such linkage programs should set new targets for industry involvement in research. A range of tools should be tested from mentoring of new business development to academy–industry platforms of cooperation.

'Role models' to advance industry-university interaction

[The case of the Hamburg region]

The regional workshop underlined the need to foster an entrepreneurial spirit among researchers, which will lead to closer and more functional university-industry interactions. Unfortunately industrial cooperation today does not imply career benefits and ad value to the academic reputation of a researcher, especially as more applied research organisations and intermediary agencies (e.g. the Fraunhofer Gesellschaft) are not well-represented in the Hamburg region. This seems to have led to the absence of good role models and therefore too little interest among academic researchers and engineers in acting entrepreneurial.

Furthermore, it was stated that universities needed industry contracts to keep jobs in industry. A warning was expressed however that companies would not want universities to act as if they were companies and position themselves as competitors to business enterprises.

Training of entrepreneurs and trans-disciplinary research

[The case of the Helsinki region]

The regional roundtable concluded that entrepreneurial studies are needed to complement specialized knowledge and to serve as platform for networking different capabilities (technology, economics, design, and business). Special focus should be in building entrepreneurial spirit and understanding commercialization (how to turn research to solutions serving customer needs).

The Helsinki innovation university-project, combining technology, economics and design studies, should be actively promoted. Pilot projects on cross-disciplinary studies should be initiated as means to collect best practices for innovation university, e.g. the Helsinki School of Creative Entrepreneurship.

Upgrading of research management skills

[The case of the Budpest region]

In today's Budapest region, there is a severe lack of research management skills. Industry-university cooperation, especially the cooperation between the MNEs and the universities, suffer from the fact that universities have inadequate expertise in organizing and professionally managing R&D projects with the objective also to provide relevant knowledge to industry and for other practical purposes. This was identified as one principal reason why MNEs are reluctant to outsource the management and coordination of R&D activities to universities and other research institutes in the region.

Furthermore, the current disciplinary organization of research and the curricular structure of higher education do not meet the expectations of the MNEs in the Budapest region. Reforms will have to be instituted in consultation with experts from the private sector.

The roundtable recommends that more attention is given at the university level to the advancement of research and project management skills as well as business insights even among researchers. It also recommends the introduction of some form of talent promotion, possibly through the adoption of a two-track system.

Dedicating special linkages between companies and public R&D labs

[The case of the Toulouse Midi-Pyrénées region]

MNEs considering investments in a region or contemplating to leave the region for other city-regions may have a lack of knowledge of all relevant R&D resources available. The regional roundtable of Toulouse Midi-Pyrénées discussed this lack of intelligence on the local and regional scene as a weakness among its attraction factors.

On the other hand, the public R&D labs, whether in a university or elsewhere, may lack insights of the current and future R&D needs of the MNEs, both the ones already in the region and those who may consider coming. Hence, the roundtable recommended organizing regular information days, dedicated to explore the incentives to cooperate. Such information days could also be seen as match-making events. Here, in a favorable, informal environment, research teams from different laboratories could present their on-going and planned activities in relation to the industrial interests expressed by the companies prior to the event. This would be a search for convergence of interests and the groundbreaking for common activity. Such match-making events could be focused on a selected techno-scientific area (nano-materials, safety in embedded systems, etc.) or focus on the activities performed at a particular lab of special interest or on the activity plans by a group of public R&D centers.

The format of such thematic days will help determine their success. The operational objective is to match-make among interests in science and in business and thereby help dedicate special linkages between companies and public R&D labs.

Main Issue 4: Additional notes on R&D location in EU regions

In addition to the three groupings of main issues listed in the sections above, there are a number of observations and proposals made at the regional roundtables, which deserve to be included in this document.

How to compensate for missing stability and predictability?

[The case of the Budapest region (Central Hungary)]

The roundtable in the Budapest region observed that R&D investments in the region actually suffered heavily from ever-changing regulations and shifting priorities for the region's and the country's development. Decision-makers at all levels altered the goals and re-oriented the development strategies, which influence the local, regional and national contexts for R&D investments.

The roundtable participants recommended that the political leaderships should create more stability for the region's R&D investment environment. For example, it is recommended that the regional and national governments should carefully develop more long-term governmental blueprints for R&D investments to be adopted as part of the national/regional/local R&D and innovation strategies. A more conducive environment for R&D will encourage MNEs and other potential investors in R&D to locate in the Budapest region. Long-term institutional and other commitments from other stakeholders (such as the universities, science parks and other intermediary institutions) in support of such inward investments would also be helpful.

R&D, public procurement and user-centered innovation

[The case of the cross-border Öresund region]

As indicated earlier, the Öresund region is relatively unique in the sample of regions within this project. It is a truly cross-border area between Denmark and Sweden united not only by advanced transportation (a regional and European hub) and other infrastructure, but by a range of institutional and other support schemes that entail policies for innovation and human resource development. For example, there is a general policy that public procurement of technology-based services in most sectors should help drive the advancement and diffusion of technology. The Öresund region is considered richly endowed with inventive companies in many areas of science-based venturing and high technology business operations. The region has more than a dozen universities, seven science parks plus other intermediary institutions and benefits from a well-functioning public sector, sensitive to public-private partnerships in support of innovation. With relatively small means – it has been claimed by regional stakeholders contributing to this project – it would be possible to advance new mobile services and to actively pioneer radically new solutions based on communications technology for citizens, companies and institutions in the Öresund region.

The focus of the regional roundtable deliberations was on R&D and innovation and how to achieve more of world-class technology for mobility by the optimal use of the resources in the region (the regional cluster dimension) and by linking up better with resources elsewhere (the hub dimension). A key strategy question put to all participants individually and to all as a group was: How to develop more of competitive solutions and create useful applications of ICT for end-users in the Öresund regional context?

As importantly, it will be feasible to open up for much more investments, to stimulate the creation of new market opportunities and to strengthen the innovative capabilities among the region's firms and institutions. Some of these achievements are already being made, but much more could be achieved by a more elaborate, strategic approach, involving end-users and user communities even at the early design stage of a new product or process.

Europe-wide issues that influence regional R&D

[The case of the Oxfordshire region]

At the regional workshop in Oxfordshire, a review was made of general attraction factors that would influence R&D investments in the region and across Europe. Apart from having an exceptionally resource-rich university like Oxford, there are factors that influence the location of R&D investments, which go beyond the region. Europe-wide issues that influence regional R&D as well are especially important for European policy makers to consider. At the roundtable, four key themes were identified from the interviews with the sampled R&D-intensive MNEs. They are:

- **Functional linkages**: Developing more, better and broader links and means of communication, even for firms with well established linkages.
- **Public regulations**: The regulatory environment in Europe need to be improved – and particularly, in the UK, for science-based technologies such as in biomed, biotech and pharmaceuticals. For example, the drug approval process and standards are important location factors. Specific areas such as improving the system of clinical trials were highlighted.
- **Skills shortages**: Addressing the skills shortages in physics and chemistry. (This was identified as starting with problems at school level because of a lack of good teachers.) This is a regional problem for Oxfordshire as well as being an issue problem for the UK and EU. More generally, the skills shortage relates to a general lack of investments in the science base of the universities and other research institutions. (Cf. also the next section on the Helsinki region.)
- **Global competition**: Competition from R&D centers in countries like Russia, India and China is an issue of concern to the Oxford region and to Europe more generally, not only due to new market opportunities but also because of the growing volume of highly qualified labor being trained in those countries.

Changing the focus in higher education

[The case of the Helsinki region]

At the Helsinki LocoMotive roundtable, it was agreed that the Finnish education system should consider changing some of its focal points from ‘quantity’ to ‘quality’. The roles and images of the different types of education should be made clearer (for example, differentiating between the polytechnics and the universities). This will help advance each type of specialized education, attract highly-motivated students, and increase productivity (time period needed to complete graduation, issues of quality, share of graduates).

Generally, the numbers in university intake should be reduced followed by an increased focus on post-graduate studies. Polytechnics and universities should differentiate their offering and build platforms for cooperation rather than strive for overlapping activities.

Creating a more international academic environment

[The case of the Helsinki region]

Another type of re-orientation of the third level education system was discussed at the Helsinki roundtable. It will not be enough to increase university funding (funding per student should be doubled from the current ratio), although this remains important also for the promotion of high-level research and to attract internationally recognized talent at all levels of the university education system. The universities, at least in the Finnish capital region, must also become more international. Interesting research opportunities should be the prime motivation for attracting foreign post-graduate students to Finland (as opposed to free tuition).

Student exchange programs should be activated. The exchange programs should be oriented towards areas where Finland has internationally recognized research projects and special opportunities.

* * *

LocoMotive

Managing the Links
Global Trends and Regional Policies in R&D Location
Hamburg 5-6 June 2007

Programme

Day 1 - Industrial perspectives and the changing role of universities

	Opening and introduction
09:30-09:45	*Opening and welcome* State Secretary Reinhard Stuth, Free and Hanseatic City of Hamburg Commissioner for Federal, European and Foreign Affairs
09:45-10:15	*The LOCOMOTIVE Project* Monica Schofield, LOCOMOTIVE Project Coordinator
	Research and innovation in Europe: threats and opportunities ***Chair: Monica Schofield***
10:15-11:00	*Enabling Europe to Innovate* Andrew Dearing, General Secretary European Industrial Management Association (EIRMA)
11:00-11:45	*Linkages across regions: the challenges to open innovation* Rob van Tulder, Professor Erasmus University Business School
12:00-13:30	Lunch
	Can Europe compete as a research location? Some views from industry ***Chair: Rob van Tulder***
13:30-13:55	*The Good and The Bad ... A Global Perspective of Europe R&D* Carlos Orzoco, Dow Chemicals Global R&D Director for Performance Plastics and Chemicals
13:55-14:20	Francisco Escarti, Director General, Boeing Research and Technology Europe
14:20-14:45	*Why Indians invest in Europe* Risto Niva CEO Wipro Technologies-Wireless Solutions
14:45-15:15	Coffee
	Advancing the role of universities as partners for innovation ***Chair: Helen Lawton Smith***
15:15-15:45	*Innovation Systems and Culture in Oxford University* Mark Mawhinney, General Manager ISIS Enterprise, Oxford University
15:45-16:15	*E-learning: an opportunity or a threat for regionally based inter-working between universities and industry* John Slater, Professor Institute of Educational Technology at the UK Open University
16:15-16:45	*Merging the boundaries between science and innovation: The Biocatalysts 2021cluster Initiative* Dr Helmut Thamer, CEO TuTech and Hamburg Innovation
	What can regions do to attract researchers and research investment?
16:45-17:45	*Panel debate* *Moderation: Mary Lisbeth D'Amico, Journalist*
19:00-	***Cocktails and networking dinner at the Museum für Völkerkunde (Museum of Ethnology)***

LocoMotive

Managing the Links
Global Trends and Regional Policies in R&D Location
Hamburg 5-6 June 2007

Programme

Day 2 - Creating regional policies for global links

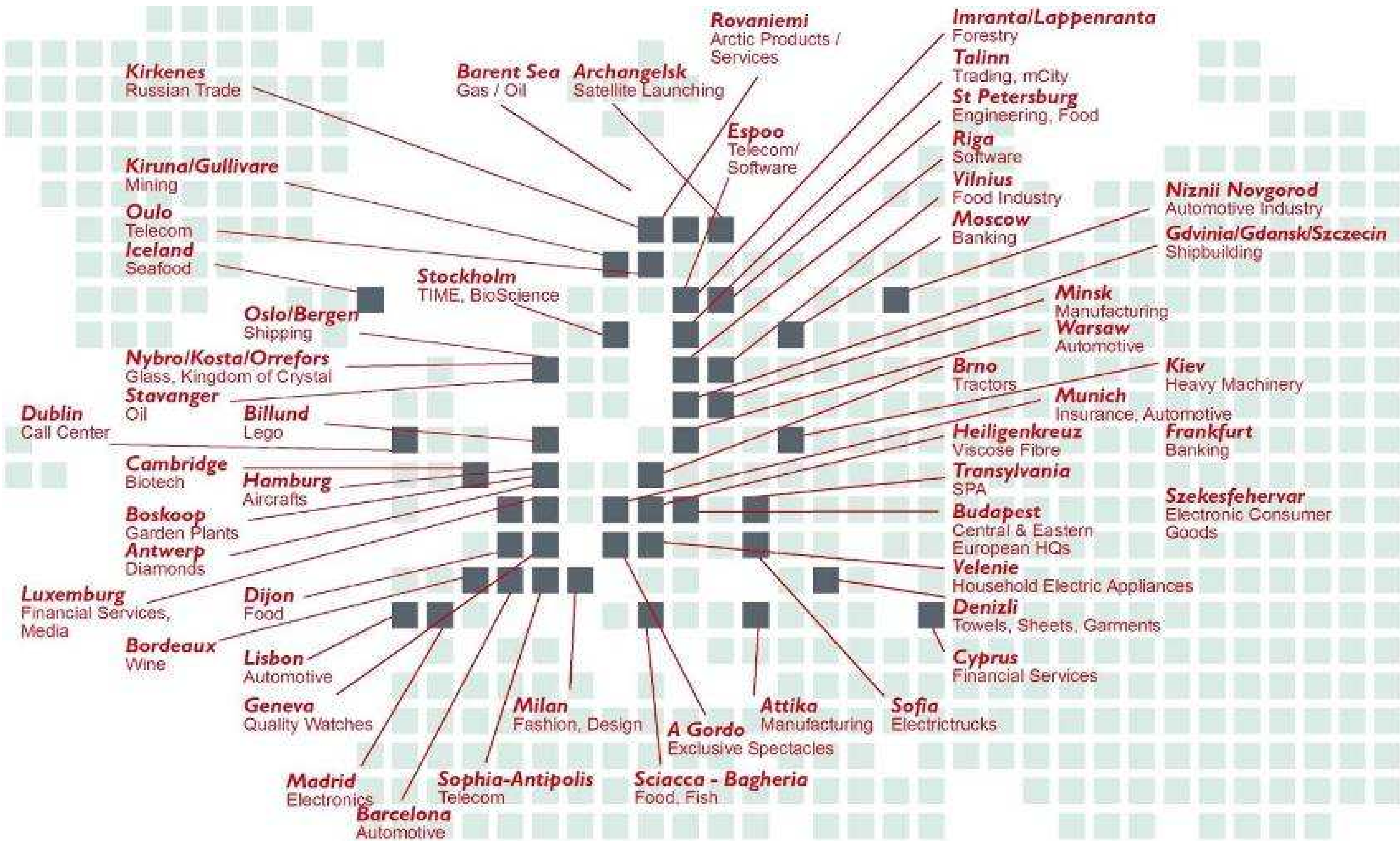
Creation of regional brands to support research clusters. Chair: Irma Patala	
09:30-10:00	*Establishing a reputation as a region for innovation: practical experiences* Tatu Laurila, CEO Greater Helsinki Promotion Ltd.
10:00-10:30	*The Toulouse Cancerpole : an example of public/private diversification strategy based on R&D* Cécile Chicoye, Director of the Association Cancéropôle, Toulouse
10:30-11:00	*Promoting R&D Development in the Czech Republic* René Samek, Director, Investment and Applied Research Support Division, CzechInvest
11:00-11:30	Coffee
New approaches to inward investment promotion in Europe, North America and Asia.	
11:30-13:00	*Panel discussion : Shaping Innovation Environments by opening innovative markets, partnerships and unique knowledge resources.* Moderation & Introduction: Christer Asplund, Interlace-Invent ApS and former Managing Director Stockholm Economic Development Agency *Shanghai Biomedical Centre and Hongkou Shipping Services Cluster: Two examples of inner city investment environments*. Sascha Haselmayer, Interlace-Invent ApS *22@Barcelona: Shaping an Urban Innovation District,* Sergi Guillot, Director Corporate Development 22@Barcelona S.A. *Supporting Regional Innovation in Toronto* Jen Nelles, Research Assistant Munk Centre for International Studies, University of Toronto
13:00-14:00	Networking lunch
From policy to action: EU initiatives in support of using research and innovation as part of regional development	
14:00-14:30	*European Initiatives in support of regional development* Robert-Jan Smits, European Commission Directorate-General for Research
14:30-15:15	*Summary & Conclusions* Helen Lawton Smith, Oxford Economic Observatory Fabienne Fortanier, University of Amsterdam
15:30	Close

Locomotive Final Conference in Hamburg
6 June 2007

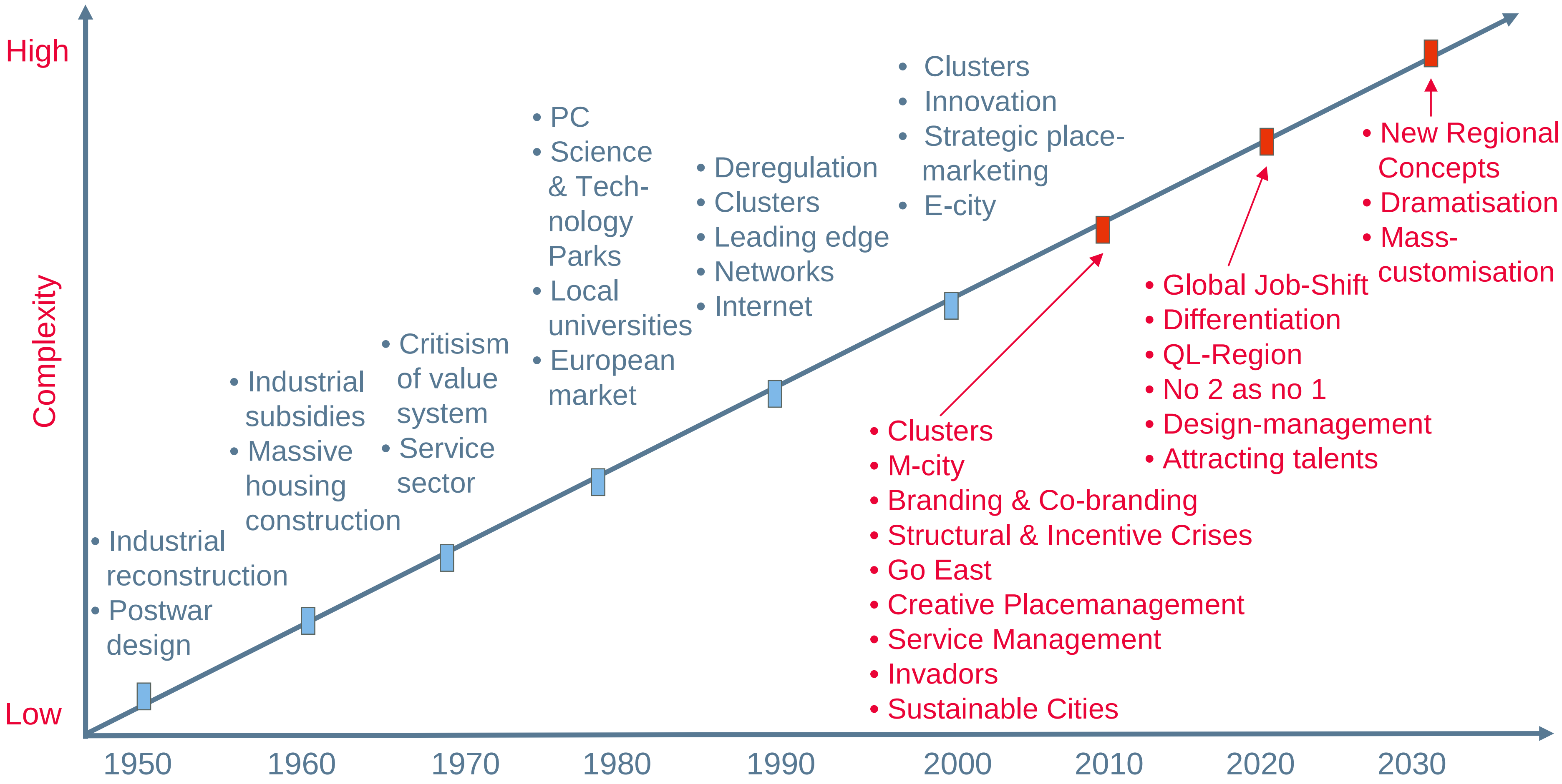
Panel Discussion
Shaping Innovation Environments by Opening Innovation Markets, Partnerships and Unique Knowledge Resources

Moderator Christer Asplund
Interlace -Invent

Creating Regional Policies for Global Links



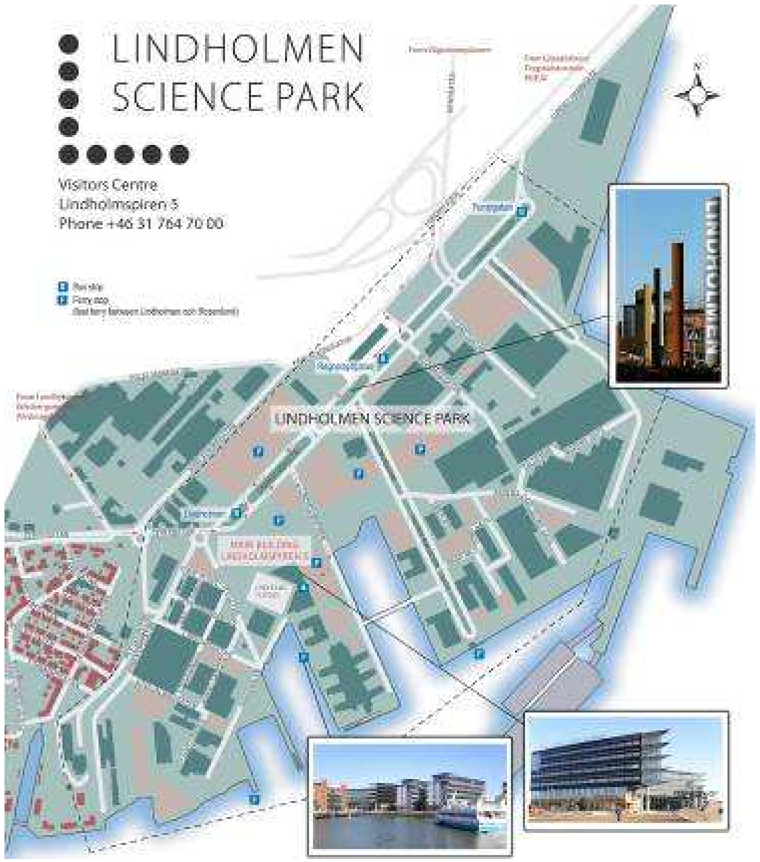
The Changing Place Climate



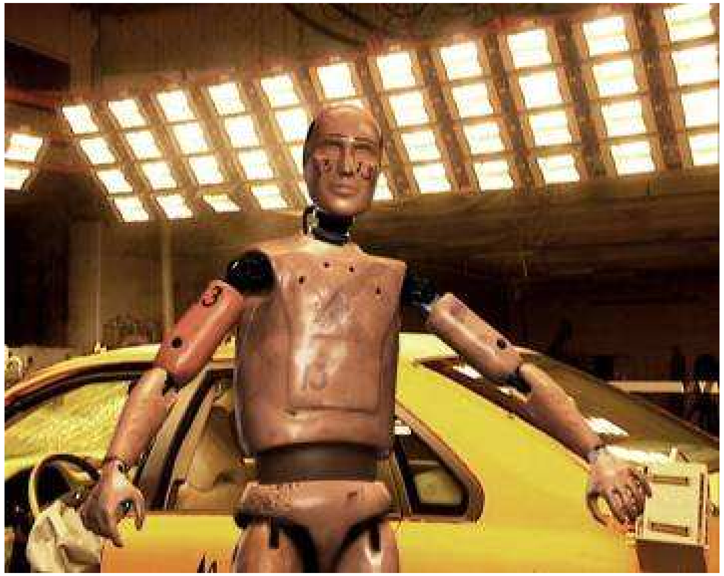
Source: Marketing Places Europe, Asplund & Kotler.

Telematics Valley - Gothenburg

- Network formed in 2001, 60 companies in the network
- Promotes Western Sweden as the centre of the Telematics industry – in the world
- Re-orientation of historic naval and automotive industries towards establishing a globally leading hub for Telematics.
- Telematics: Dataservices for vehicles
- Building on historical strengths (Volvo, Ericsson, Chalmers University)
- Urban Hub: Lindholmen Science Park, at the heart of Gothenburg



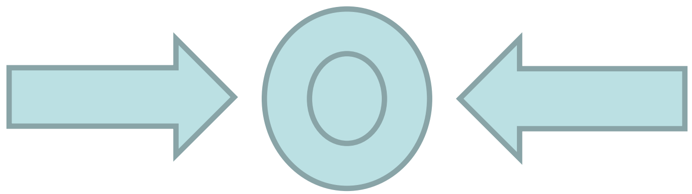
Safety City - Gothenburg



- » Henry Ford said in 1950's: "Safety doesn't sell"
- » Since then innovation policy at Volvo was focused on safety, inventing the safety belts among others
- » Volvo attracted Ford to set up the global Ford Centre for Crash-testing
- » Around the Ford Centre, talented engineers are recruited to Gothenburg to expand the innovative capabilities
- » Gothenburg is marketing success heavily, upgrading also the urban environment, new traffic infrastructures – all to build up attractiveness for talented firms and people
- » Business Region Gothenburg, with close integration of business leaders and public sector
- » The Chinese Connection

The Demand and Supply Challenge of European Places

Demand by enterprises



Supply by places

- Quick and responses
- A stable decision making structure
- Understandable strategy
- Openness for business values
- A vibrant place brand
- An innovative tender policy

Gothenburg: Added-Value for Innovative Businesses

1. Urban Dynamics: Innovation Environments

» Urban Life-Style – International Metropolitan Culture

» Specialised Global Competence thriving in an Interdisciplinary, Creative, Interactive innovation environment

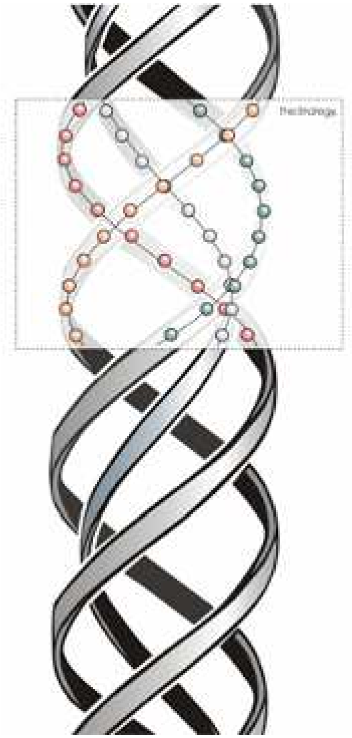
» Innovation Functions are embedded in socio-economic fabric

- Historically grown networks evolved with time
- Core companies (Volvo / Ford) link local suppliers to global markets and standards

→ Unique territory for outsourcing and in-sourcing

→ Global Ford Crash-Test Centre was localised and is a key player for a broad range of activities

Gothenburg: Added-Value for Innovative Businesses



2. Innovation Drivers: Triple-Helix

» Dynamic relationship between Science-Industry-Government + Entrepreneurial Culture

» Gothenburg's tight cross-sectoral relationships have grown of the historically strong Public-Private relationships

» Important Chalmers University of Technology as internationally renowned local scientific hub.

» Science Parks (Lindholmen), Chalmers University Innovation Centre, Public and Private R&D Centres are managed to collaborate.

Collaboration: an attraction to investors and growing companie

- » Cluster of sub-contractors in the vicinity, supported by a highly sophisticated logistical infrastructure
- » Gothenburg is now more successful than it has been in the past – more than 1700 foreign-owned companies in the region.
- » Trucks, buses & personal cars – a growing portfolio of applications for telematics in automotive sub-sectors.
- » Long history of Triple-Helix collaboration.

INDUSTRY

Altran Technologies Sweden
Appello Systems
Caran (WM-data Caran AB)
Carmenta
Combitech Systems
Ericsson
Gatespace Telematics
Göteborgs Posten
HiQ
IBM
Impsys Digital Security
Kapsch TrafficCom
Mandator
Mecel
Michael L. Sena Consulting
Microbind
Mitsubishi Electric
Moveup Consulting
NAVTEQ Europe B.V.
Nimway
On Position
Pilotfish Networks
Qinetiq
QRtech
Saab Automobile
Scania
Semcon
Sony Ericsson
SpeechCom
Syntense
Syrén Software
Teleca
TeliaSonera Sverige
TietoEnator
Vehco
Vodafone
Volvo Car Corporation
Volvo Group
Volvo Technology Corporation
Warpp
WirelessCar
Wyless
ÅF-Industri
Öhrlings
PricewaterhouseCoopers

ACADEMY

Education
Chalmers University of Technology
Göteborgs Tekniska Gymnasium
Göteborgs University
IT-university

Science and Technology parks
Chalmers Innovation
Lindholmen Science Park

Research Institutes
Viktoria Institute
VTI

PUBLIC ORGANISATIONS

National Organisations
Invest in Sweden Agency
ITS-Sweden
Vinnova
Vägverket – Swedish Road Association

Regional Organisations
Automotive Sweden
Business Region Göteborg
Västra Götalandsregionen

National Projects
Intelligent Vehicle Safety Systems

Source: Telematics Valley Member's Handbook 2005


IDEON Science Park - Lund, Sweden
Industrial zone
with research labs
Ideon
Research
Park
University

Gothenburg: Added-Value for Innovative Businesses

TELEMATICS VALLEY

3. Governance Structure

- Key Clusters: Telematics, Safety, Logistics
- Telematics Valley: a Membership association with of more than 60 key cluster companies and institutions
  - Accountability – report to stakeholders
  - Brand development
  - Marketing
  - Market Intelligence

→ Avoid Risk of 'Election Cycles' – change of policy
→ Opportunity for Sector Agents to shape their own Cluster-policy
→ Influence over Investment Environment

Business Region Gothenburg

4. Entrepreneurial Culture

- » Grown business culture rewarding best entrepreneurs
- » Grown advanced business services providers of international standard, like business intelligence, engineering or design
- » Growth 2000 / Growth Micro Programmes, supporting entrepreneurs in leadership skills, and Venture Cup Participation
- » Chalmers Innovation, business focused high-tech incubator

→ Venturing Environment where best services, businesses, and ideas can flourish (Venture Cup)

Gothenburg: Added-Value for Innovative Businesses

5. Brand Development (Local / International)

» Continued local / international promotion of each cluster

» Telematics Valley is locally and internationally branding its resources – in the interest of member companies and institutions

» Co-branding companies with *Gothenburg*
  - Volvo & Gothenburg: co-branded historically (Hasselblad)
  - Today: Gothenburg and Safety, Telematics and Logistics pick up on the legacy (Ford is an additional player)

» Branding of Products & Innovation Environments
  → Mutual benefit of international place brand
  → Local Brand enables sustainability of cluster

Gothenburg: Added-Value for Innovative Businesses

6. Value Networks – Global / Regional Hub Linkages

» International knowledge, business and production networks:
  - » Strategic Partnerships with Shanghai, Oslo
  - » Euro Office Supporting SME's
  - » Scandinavian Arena (Oresund, Gothenburg, Oslo)
  - » Chalmers has overseas Campus in Shanghai / Beijing

» Platform to access global resources and markets
  - → Ensure World-Class competences in all cluster activities including secondary services)
  - → High-speed availability, often at lower cost (i.e. Advanced Patenting Services – modularised in key Hubs)

Sophia-Antipolis - Côte d'Azur, France

Founded almost 40 years ago, Sophia-Antipolis is Europe's leading Science Park, catalyst of development in the Alpes-Maritime Region into a 'Global Innovation Hub'.

Sophia-Antipolis is a policy-driven regional development instrument, fostering the transition to a more knowledge-based economy.

25,000	Employees (+10,000 in last 10 years)
14.000	Engineers and
4.000	Researchers employed
53%	of jobs are highly-skilled
25,4%	Foreign Enterprises
18.5%	Foreign Employees

Source: Sophia-Antipolis

Venture Finance Landscape in Sophia-Antipolis

Local Finance

- Incubators
  (linked to Universities, pre start-up)
- Business Angels
- Venture Capital (all rounds)
- Institutional Capital
- Regional (Public) Capital
- National Research Funding

International Finance

- International Venture Capital
- Institutional Capital
- Investment Funds
- EU Research Funding
- Corporate M&A Operations

Sustainable Added-Value: Objectives for an Intelligent Region

- » **Attractiveness**: continually improve service-offering to residents, businesses and visitors, and maximise accessibility
- » **Competition**: address transcontinental and regional competition for foreign direct investments
- » **Focus Innovative Capabilities**: develop core competences for ground-breaking innovations and localise leading solutions pioneered in other cities *(Invaders)*
- » **Create Collaboration Platforms** for user-centric pioneering of new technologies and applications across sectors (Living Labs)
- » **Develop ‘Innovation Hubs’** for trade and ‘knowledge-intensive’ activity in a globally networked environment

Six dimensions of adding value to innovative businesses

The Cancer Toulouse Biopark and the CBS cluster

An example of public – private partnership

Cancer-Bio-Health
CLUSTER

The *Cancer-Bio-Health Cluster* : a unique & broad approach throughout the continuum of Cancer

Cancer-Bio-Health
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Agenda

- Toulouse and its region
- The Cancer-Bio-Health Cluster
- The Toulouse Canceropole Biopark

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- A 1 Million inhabitants urban area
- A demographic explosion: 230.000 new inhabitants in 10 years
- 400.000 jobs including + 50.000 new jobs since 1999

- Toulouse in the top 3 french urban areas in terms of job creation and in terms of metropolitan functions (with Paris and Grenoble)
- A dynamism that should not weaken: : 20.000 more inhabitants each year (INSEE)

- A major economic, research and higher education potential (100.000 high tech jobs - 110.000 students – 20.000 jobs in public and private research – 500 research units)
- An innovative region: Midi Pyrenees, 30 th in Europe and 2nd in France in the European Innovation Scoreboard for 2006

- 3 main economic sectors linked to a rich research and higher education background
  - **Aeronautics and space**
  - **Agrofood**
  - **Pharmaceuticals**

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The french cluster policy

- **A national call for projects in september 2004**

- **Selection in July 2005**

- **68 projects selected :**

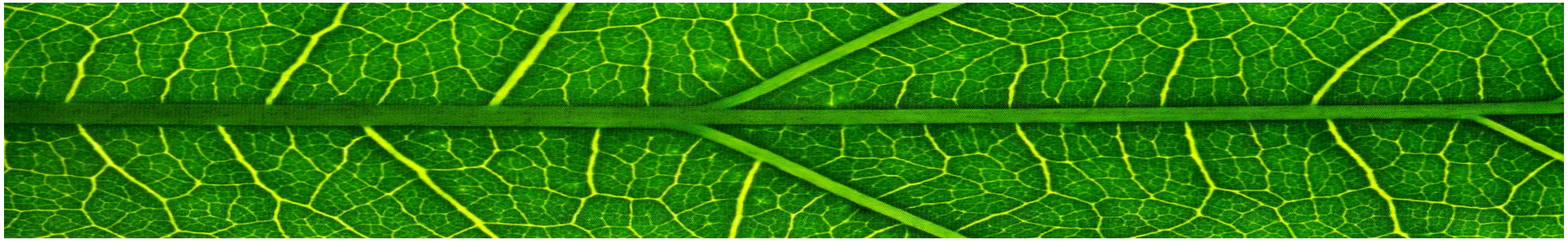
  In Toulouse:

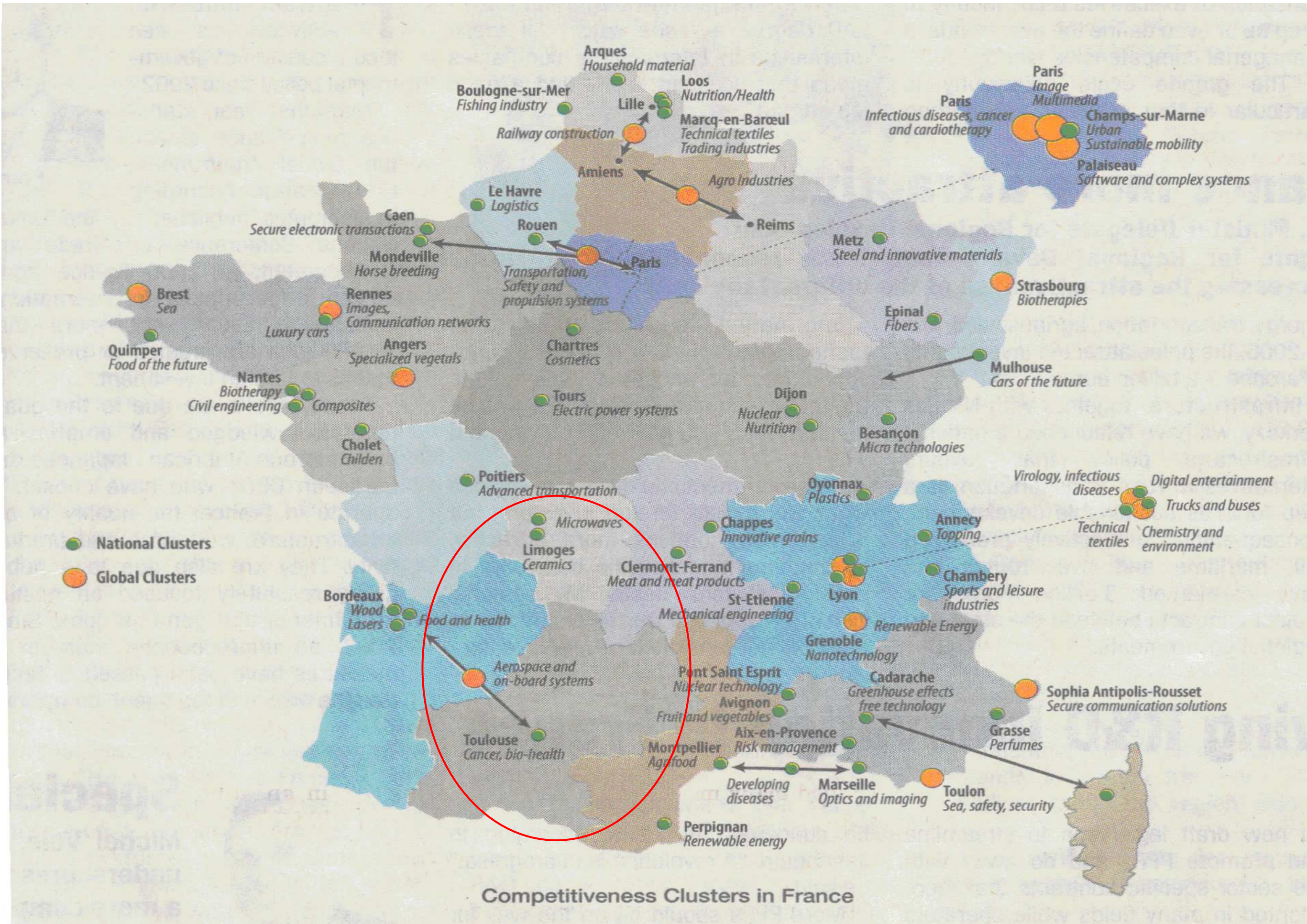
  The Aeronautics and space cluster

  The Cancer bio health cluster

  A 3d cluster on the way : the Agrimip cluster

The Cancer-Bio-Health Cluster





Boundaries: Toulouse, Albi, Castres, Mazamet, Limoges

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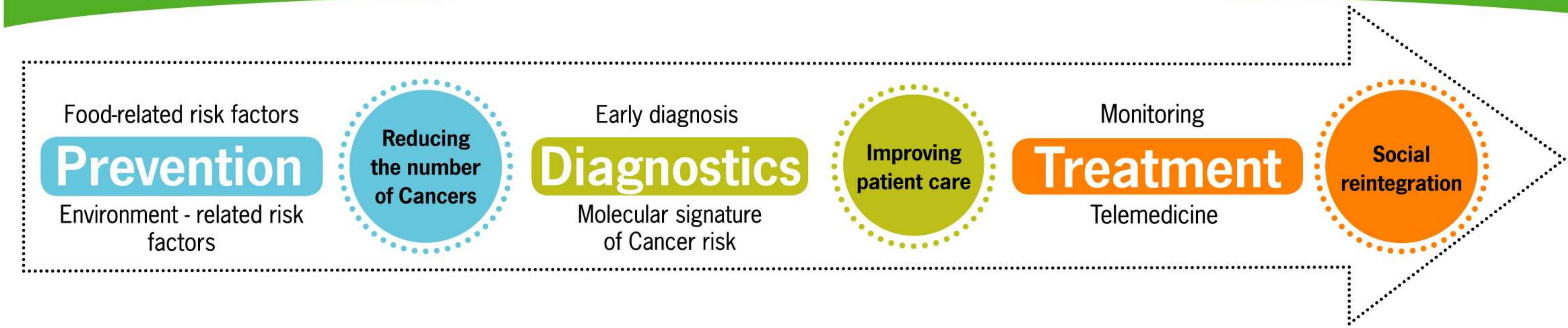
A unique and broad approach throughout the continuum of Cancer

Research • Industry • Education



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Research and Education

- CHU de Toulouse
- CHU de Bordeaux
- CHU de Limoges
- CNRS
- CRITT
- EFS Pyrénées-Méditerranée
- Ecole des Mines d'Albi-Carmaux
- ENVT
- ESAP
- ESCT
- Génopole Toulouse Midi-Pyrénées
- INPT
- INRA
- INSA
- INSERM
- INCA
- Institut Bergonié
- Institut Claudius Régaud
- Institut Européen de Chimie et Biologie
- ISTMT
- ITAV
- Université de Limoges
- Université Paul Sabatier
- Université Toulouse I
- Université Toulouse II

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Industry

Actigenics
Affichem
Alcatel Space
Avogadro
B-cell design
Beckman Coulter
Biophoton
BT Pharma
Cayla Invivogen
Communication et Système
Cyclopharma
Dyn'r
Endocube
Fonderephar
Génibio
Groupe Santé Recherche
Glaxosmithkline (Phase I)
GTP Technology
Helmodia / Newmedic

IBM
IEB
INEUM Consulting
Innopsys
Isochem/SNPE
LFB
Laboratoires Pierre Fabre
Lallemand
Lara Europe Analyses
Libragen
Magellium
Midi Biotech
Millegen
Novaleads

Picometrics
PraXell
Sanofi Aventis
Scanelis
Siemens
Sinters
SISMIP
Spotimage
Thalès
Union des Insdustries chimiques

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Regional Government Bodies

- Agate
- CEEI Théogone
- Communauté d'agglomération de Castres-Mazamet
- Communauté d'agglomération du Grand Toulouse
- Communauté d'agglomération de l'Albigeois
- Conseil Economique et Social Régional
- Conseil Général de la Haute-Garonne
- Conseil Général du Tarn
- CRCI Midi-Pyrénées
- CCI Albi-Carmaux
- CCI Castres-Mazamet
- CCI Toulouse
- DRRT Midi Pyrénées
- Incubateur Régional Midi-Pyrénées
- Ligue contre le Cancer
- Midi Pyrénées Expansion
- Ariège Expansion
- Limousin Expansion
- Réseau ONCOMIP
- Prologue Biotech
- Région Midi-Pyrénées
- SICOVAL
- Ville de Toulouse

A Strong Industry Network

Health (130 companies, 9,000 employees),
Biotechnology (63 companies including 36 start-ups),
Pharmaceuticals (8,000 employees),
Health & Food (30 companies, 1,100 employees)
Information Technology (2,100 companies, 14,000 employees).

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Major Industry Stakeholders

Laboratoires Pierre Fabre	The second largest private French pharmaceuticals group. Employs 9,000 people, 3,100 of them in Midi-Pyrénées.
Sanofi-aventis	The third largest pharmaceuticals group in the world and European leader. Employs almost 100,000 people around the world, including 28,000 in France and over 1,000 in Midi-Pyrénées.
Glaxosmithkline	The second largest pharmaceuticals group in the world. Employs 100,000 people around the world and 6,000 in France.
IBM	The largest information technologies company in the world. Employs 300 people in Midi-Pyrénées.
Communication et Systèmes	The French leader for high-performance, critical, scientific and industrial applications. Employs 3,400 people.
Thalès	A leading French technology and electronics company. Employs 61,500 people around the world including 1,300 in Toulouse.
Siemens	Leader in the medical solutions market. Employs 430,000 people around the world including 11,000 in France.
Lallemand	A Canadian company which is one of the main world producers of yeast and enzymes for the agro-food industry. Employs 60 people in Toulouse.

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30 R&D collaborative projects for > 100 M €

SMEs, Industry

Research, Hospitals, Education

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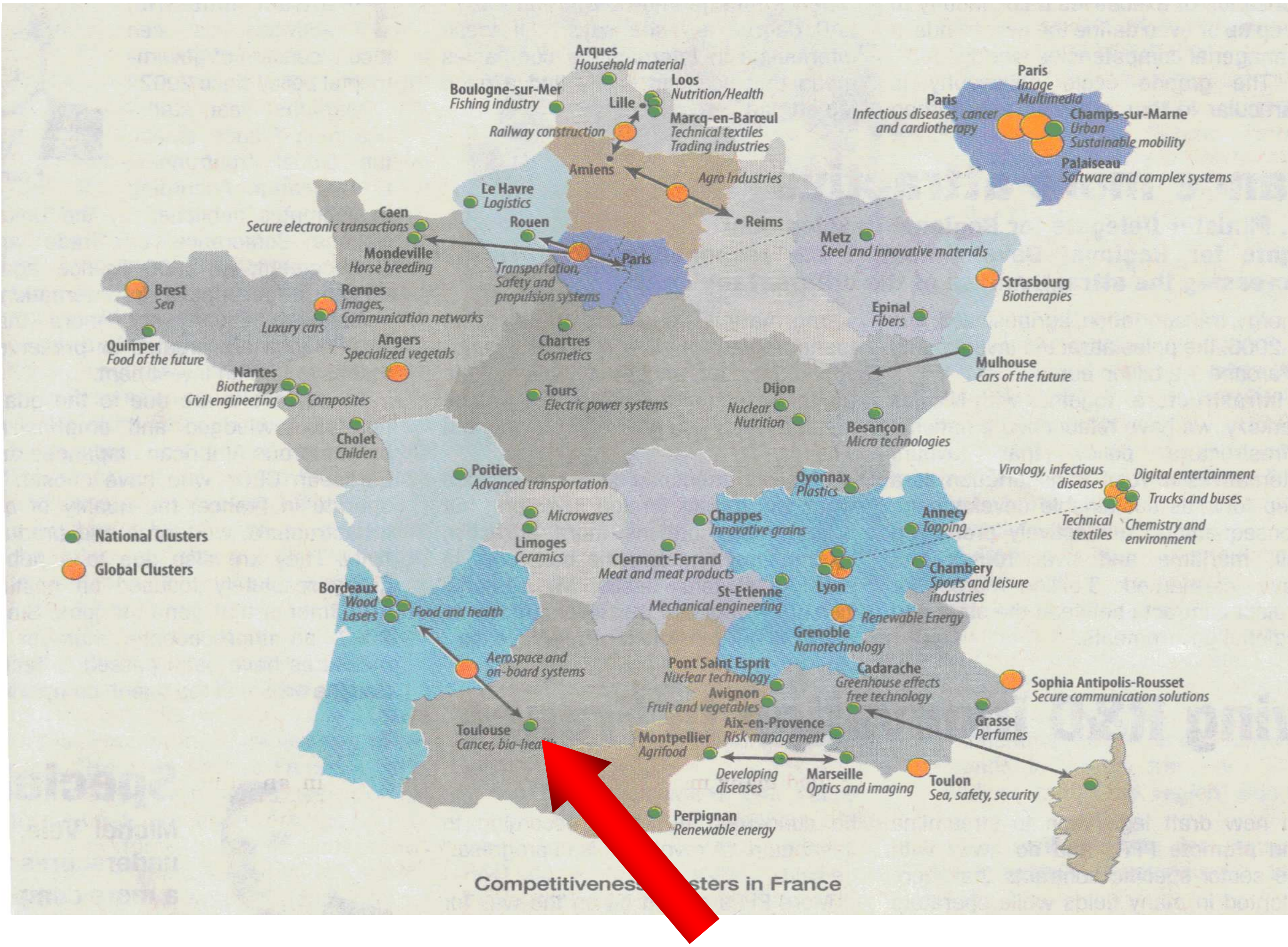

Toulouse Canceropole Biopark

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Toulouse Canceropole Biopark
a landscaped campus dedicated to Cancer

An integrated Biopark dedicated to Cancer

Cancer-Bio-Health
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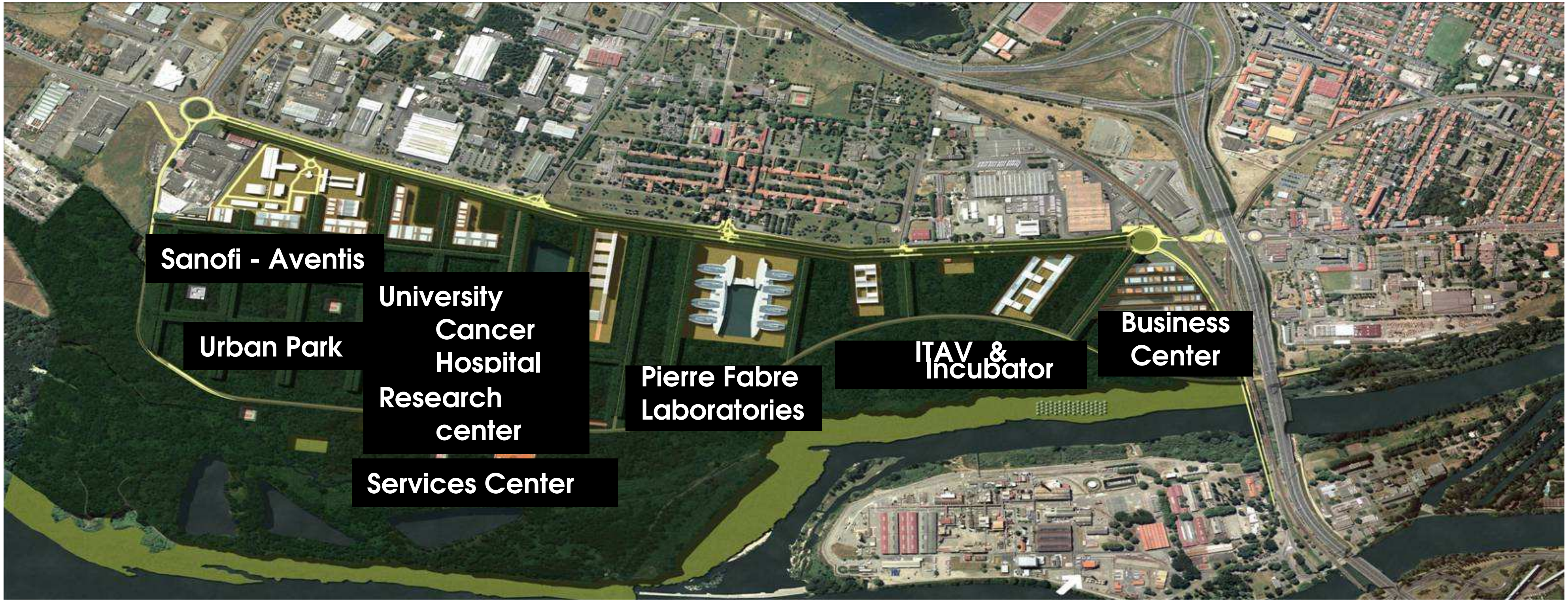

540 acres, involving 4,000 employees and gathering resources from Public & Private, Scientific, Clinical, Teaching and Industry to prevent and fight cancer.

A total of 1.1 Billion € invested on the campus

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State of the Art Facilities

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The University Cancer Hospital

A comprehensive cancer research consortium

for patient care and validation of new products and technologies

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ITAV (Advanced Institute for Life Science Technologies)

A multidisciplinary life sciences research institute

Business Center

Incubator and Business Center facilities

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Sanofi-Aventis

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- Sanofi Aventis

sanofi aventis

More than
1 000 individuals
300 M€ investment
95,680 sq yards

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Research Institute Pierre Fabre

Toulouse Canceropole Biopark

- Research & Application
- Clinic & Clinical trials
- Product & Technology validation
- Incubator & Industry
- Education

In all segments of the Cancer Care Continuum

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The canceropole Toulouse biopark : a story

- **A catastrophe: sept 21, 2001 a chemical plant exploded.**
- **A place: what to do with a 220 hectares site on the Garonne river**
- **Men : the politician and the entrepreneur**
- **Time : first announcement on march 30 2004 , and 3 years later, the site is decontaminated, and new buildings are under way : Sanofi, Pierre Fabre, the ITASV and the incubator**

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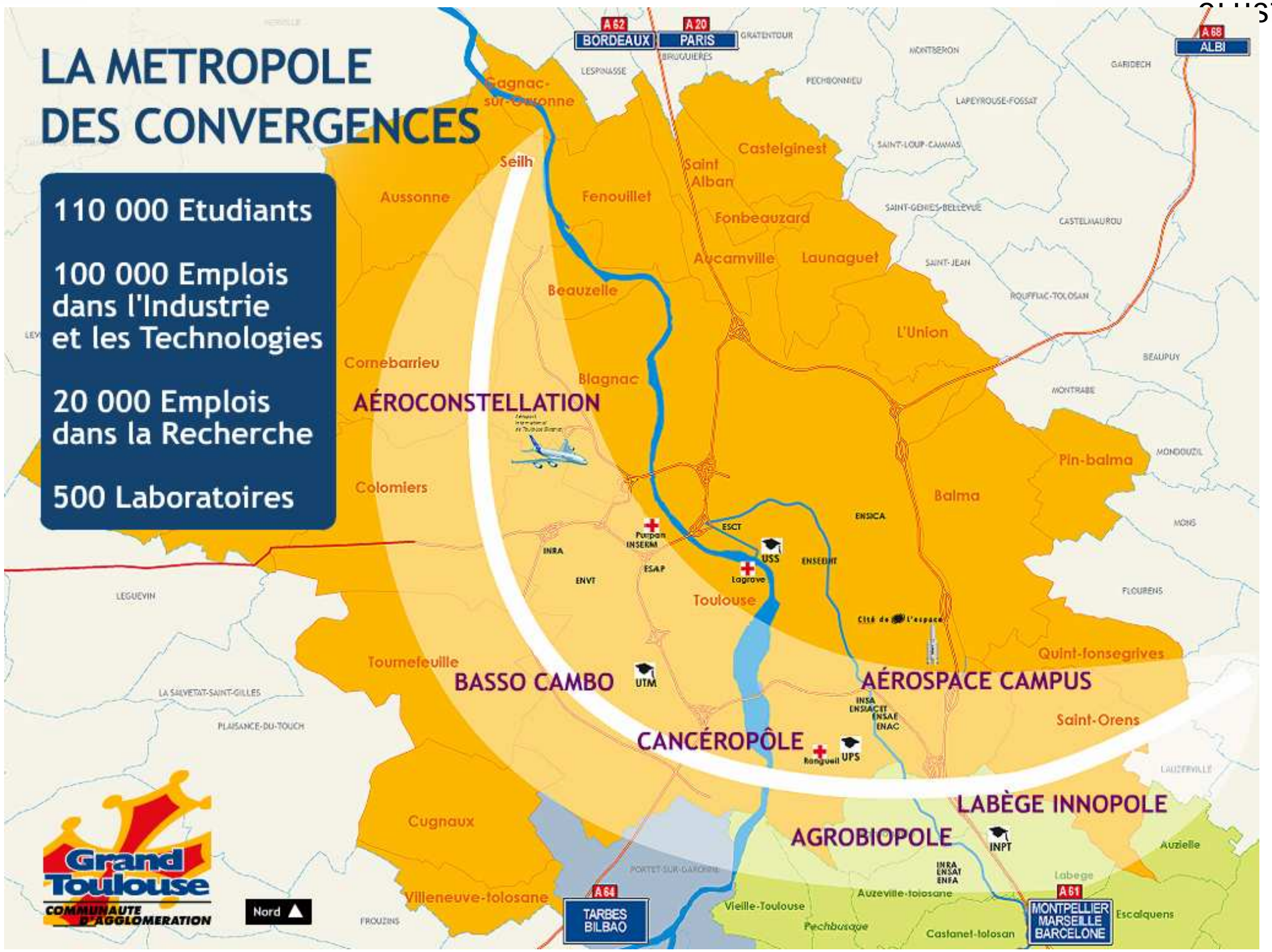
- **A Site**



A company

- A pharmaceutical company of worldwide reputation which was founded in the Midi-Pyrénées region, Laboratoires Pierre Fabre, the second largest independent pharmaceutical company in France, employs around 9000 people and achieved sales of nearly €1.5 billion in 2005, 43% of them in other countries. With more than 1100 researchers, Pierre Fabre Médicament devotes a **quarter** of its annual income to research and development in five therapeutic areas of major importance to public health.
- Characteristics;
  - **Half in pharmaceuticals : cancer = ½ the R and D budget**
  - **A number of public private partnerships in R and D**
  - **Half the turnover in dermo-cosmetics**
  - **A number of partnerships with big pharmas on specific products**

The canceropole: a challenge for the company

And then !

- With political will and political union over the project ,and the drive of industry , the research and medical community has followed :
  - **A physical investment : brand new labs and the proximity of the university cancer hospital**
  - **A coordination and animation structure that has benefited from a national label: « réseau thématique de recherche et de soins » (thematic network for research and care)allowing it to benefit from public and private funds : this structure aims to promote translational research on cancer , and to facilitate pluridisciplinarity especially with chemistry, nanobiotechnology, information technologies.**

- The private sector has followed too:

  - **by putting money in :**

    A foundation: Innabiosanté foundation (with Pierre Fabre, GSK, Siemens, Amgen and Total) that will finance research projects (a first call for ideas has been launched a few days ago)

  - **With the creation of start ups**

  - **With the increase of collaborations between toulouse research units and big pharmas (ex GSK, LFB..)**

The canceropole Toulouse Biopark : a reality

- research team working together in the RTRS

- industry and public research collaborating

- doctors from the public and the private sector working together for the benefit of the patients

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Thank You

www.canceropole-toulouse.com

Enabling Europe to Innovate

Andrew Dearing

Hamburg, June 2007

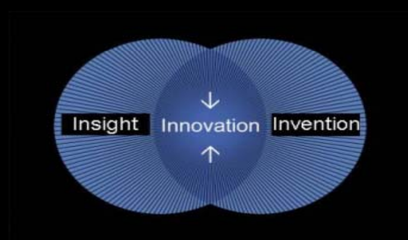
Road Map

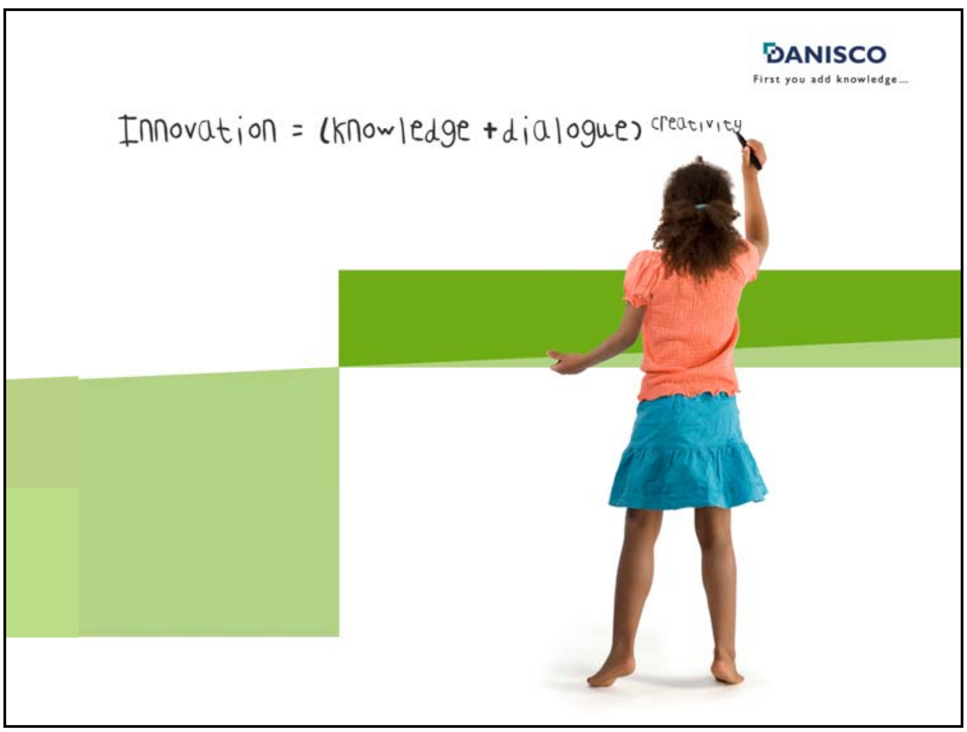
- What's happening to business sector R&D
  - Managing internally, managing the network
- People, places, institutions, globalisation
  - Critical mass and company growth
  - Universities, industry and effective knowledge transfer
- Implications

What is Innovation?

Innovation occurs at the intersection of invention and insight.

It's about the application of invention;
The fusion of new developments and new approaches to solve problems.

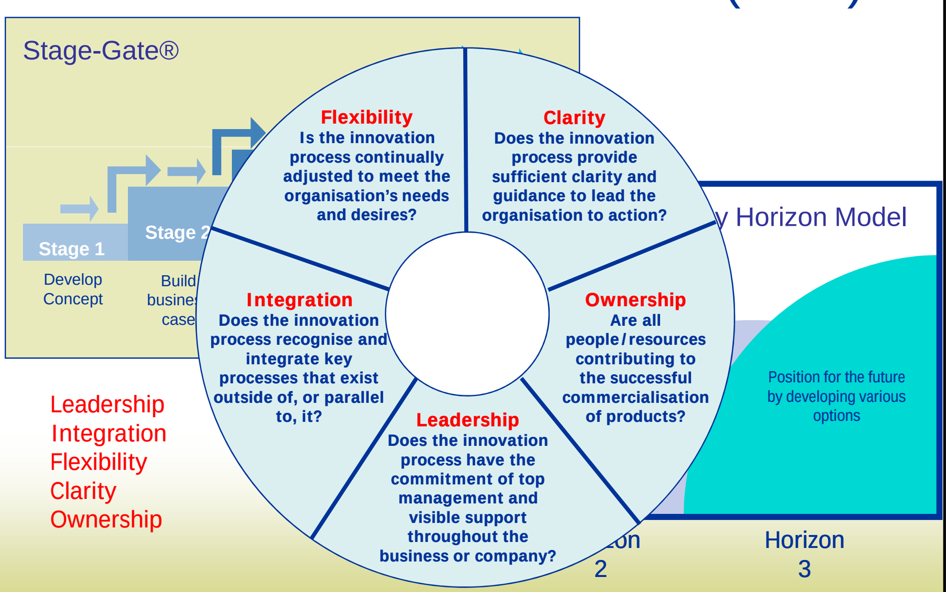




Company R&D - Then and Now

"Safeguard the corporation's future"	"Unambiguously business driven"
Basic -> applied research -> development	Innovation as much more than R&D
In-house corporate + BU	Partnerships essential
Physical products	Growing service content
Proprietary "stuff"	Business model
Protective IP management	Active IP portfolio mgmt
Technology as driver	Customer as business driver
Western brains	Brains are everywhere
Western standards	Whose standards?
Start in the West	Which lead markets?

Established Internal Processes (2000)



Patent Policy
Old Definition of Competitive Advantage

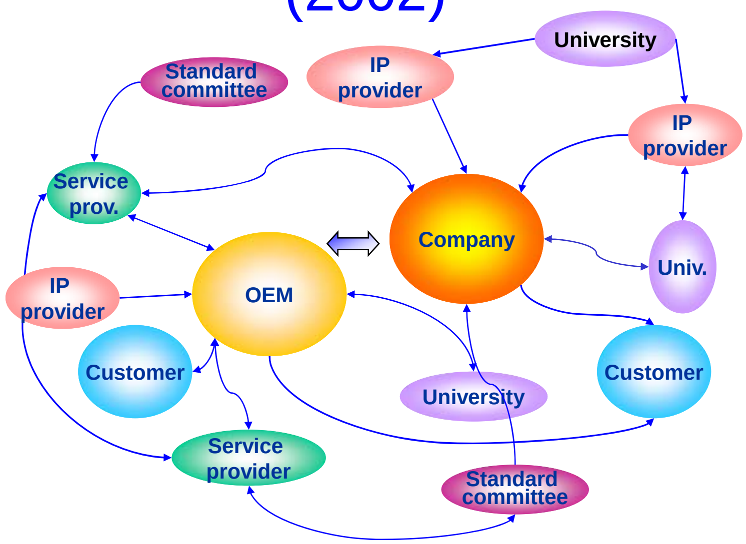
- I've got it!

- You don't!

Patent Policy
New Definition of Competitive Advantage

- I've got it, you've got it . . . *but*
  - *I've got it* ***cheaper****.*
  - *I've got it* ***with no less capital***
  - *I've got it* ***with 18 months lead time****.*
  - ***You follow my technology****.*
  - *I* ***get to market two years faster than alone****.*
- I've got it, you've got it . . . *and I make money when I sell it, and I* ***make money when you sell it****.*

A World of Opportunities (2002)



Rediscovery of the Science Base (2004)

Technology leads Change Not Customers

Sustained investment in long term scientific research delivers breakthroughs that change how the industry operates and the dynamics of the market

If you don't have in-house research teams, you won't sense the breakthroughs and won't know how to exploit them

Strong collaboration with leading academic researchers on "grand challenge" problems

Strong in-house teams turn academic research results into prototype technologies and applications ready for product unit exploitation, outbound licensing

2020

SCIENCE

A scientific revolution is just beginning. It has the potential to create an era of *science-based* innovation that could completely eclipse the last half century of *technology-based* innovation; and with it, a new wave of global social, technological and economic growth.

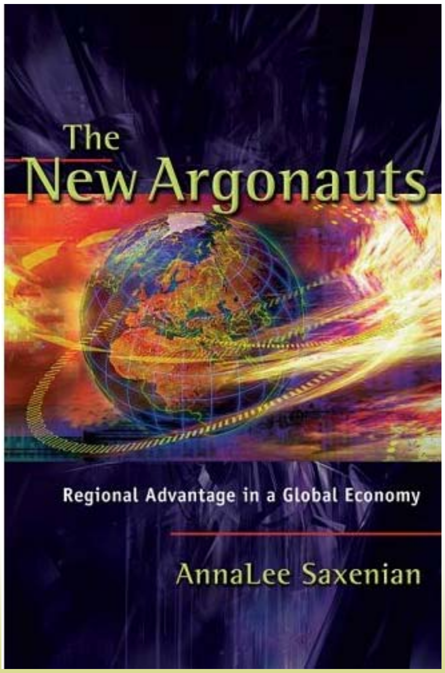
Creative People
“Holst’s Rules” [Philips, 1914-1946]

1. Engage competent scientists, if possible young, with academic experience.
2. Do not pay too much attention to the details of previous experience.
3. Give them a good deal of freedom and leeway to their idiosyncrasies.
4. Let them publish and take part in international scientific activities.
5. Steer a middle course between individualism and strict regimentation; base authority on real competence; in case of doubt prefer anarchy.
6. Do not divide according to disciplines: create multidisciplinary teams.
7. Give independence but ensure that leaders and staff are thoroughly aware of their responsibility for the future of the company.
8. Do not try to run research laboratories on a detailed budget system.
9. Encourage transfer of competent senior people from the research laboratories to the development laboratories of product divisions.
10. In choosing research projects, be guided not only by market possibilities, but also by the state of development of academic science.

Creative People [2007]
“7 Building Blocks of the Creative Climate”

1. Hire the best people - “the best of the best”
2. Maintain many direct contacts with customers
3. Ensure researchers feel that their initiatives and creative ideas are appreciated
4. Use contacts across the boundaries of discipline as a source of the most creative ideas
5. Ensure sound balance between structure and “anarchy”
6. Provide a good infrastructure
7. Cooperate with the best research players in the world

Philips

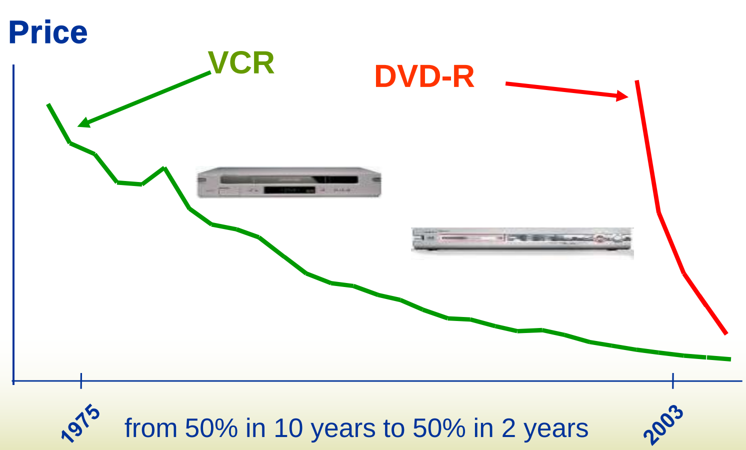


- Labour market structure
  - Who moves around
  - Who rises up the ladder
  - “Brain circulation”
  - Linguistic/Cultural Skills
- Market opportunities
  - Growth, Interests, Specialised high wage niches
- Community support
  - For people
  - Returnee receptiveness
  - For prospective businesses
- Win-Win or Win-Lose?
  - Invest in Education
  - Aggressively develop it!

PHILIPS

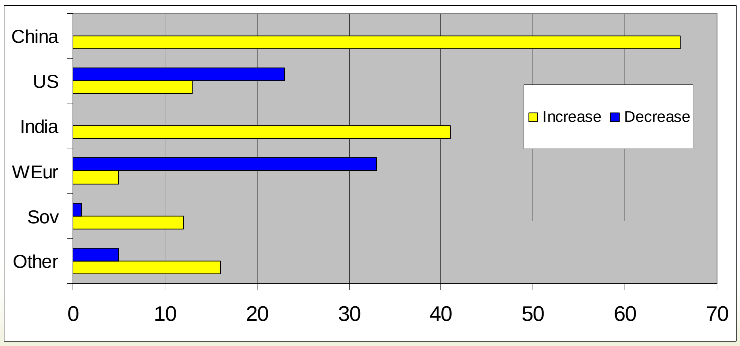
From “NatLab” to High Tech Campus (2005)

Globalization : Managing Product Life-Cycle (2006)



Globalisation
Global Technology Management

When companies anticipate increase (decrease) in technical employment, what is/are the location(s)?



Thursby & Thursby (2005/06)

Globalisation: Increasing Inward R&D Investment

	UK	FR	DE	US
1997	32	16	17	11
2001	45	19	25	14

R&D expenditure by foreign affiliates as a % of Business Expenditure on R&D (BERD)

Source: OECD/UK Government

Achieving Critical Mass
Sector Concentrations

Company distribution (# firms in "global 700"):

	Europe	Americas	RoW	R&D/Sales
Global 700	**192**	**334**	**174**	4.3%
IT hardware	15	93	22	10.1%
Auto/parts	16	14	17	4.2%
Pharma/biotech	22	42	18	13.7%
Electro/electrical	10	14	28	6.0%
Software/services	9	57	2	9.0%
"High R&D"	**72**	**220**	**87**	
Other sectors	**120**	**143**	**131**	2.0%

UK DTI R&D Scoreboard

Achieving Critical Mass
Networks of People and Money

Innovation Clusters

EU	Cambridge, UK
Researchers	9,200
Publications	15,000
Public companies	11
Biotech companies	110
University licence income	€3 mln

US	Cambridge, Mass
Researchers	23,500
Publications	38,000
Public companies	38
Biotech companies	200
University licence income (MIT)	€35 mln

European Innovation Scoreboard

Venture Capital Investment

EU
€3.1 bln / 4,354 companies
€0.7 mln / per company
2.3% / 5 year IRR
7.2% / 20 year IRR

US
€13.7 bln / 2,208 companies
€6.2 mln/ per company
22.8% / 5 year IRR
15.5% / 20 year IRR

DG ECFIN, 2005

Achieving Critical Mass
Steady Investment and Purpose

1984

Established by state government of Flanders in Belgium

Non-profit organization

Initial staff: ~70

2006

One of the largest independent R&D organizations in this field, worldwide

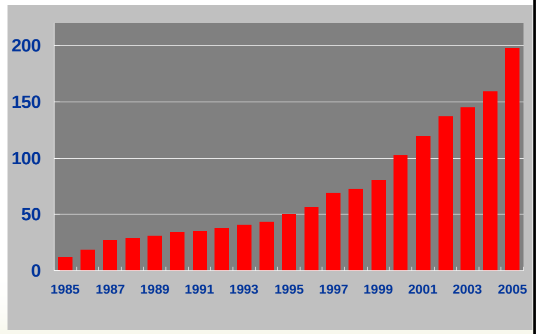
Annual budget : close to 200M€ (includes 35 M€ grant from government)

Staff: more than 1400

Collaboration with >500 partners

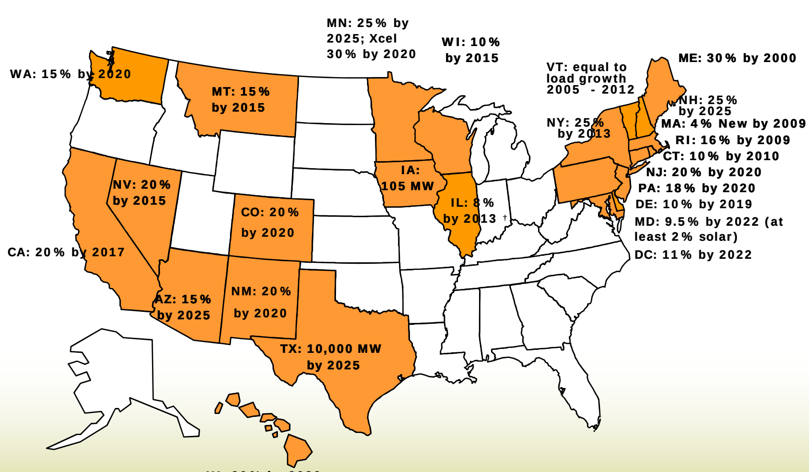
< 18% government/state funding

1984 Initial Investment: 62 M€



2005 Budget: close to 200 M€

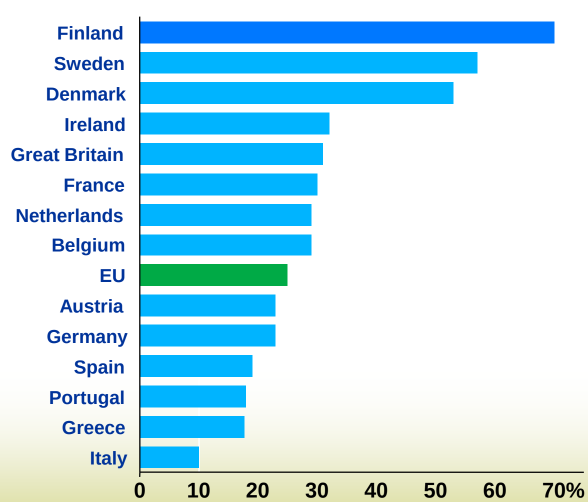
Achieving Critical Mass
Ambition: Renewable Portfolio Standards



Achieving Critical Mass
Interdependencies – Health Care

Academic groups	Can't apply knowledge without the industry and thereby gain value from their intellectual property
Clinical groups	Do not have capability to develop the new biological tools
The SME's	Need academia for ideas, cannot maximise value from tool discovery unless applied by industry
The pharmaceutical industry	Cannot maximise use of new tools unless accepted by the regulators, which can only be done by sharing and pooling data
Government agencies	Face pressure to speed patient access to new medicines without increased risk, need better information for risk/benefit and cost/benefit analyses
The patients	Need to feel part of the process to ensure their willing co-operation

Achieving Critical Mass
Cooperation Among Companies



	Competitiveness Growth	Business (2005)
Finland	1	2
USA	2	1
Sweden	3	12
Denmark	4	4
Taiwan	5	14
Singapore	6	5
Iceland	7	17
Switzerland	8	7
Norway	9	21
Australia	10	15
Netherlands	11	9
Japan	12	8
Great Britain	13	6
Canada	14	13
Germany	15	3

Share of cooperating companies of all innovating companies

Global Location of R&D
Key Decision Factors

1. Potential for market growth
2. Environments that foster development of a high-quality work force
3. Opportunities for productive collaboration between corporations and universities

Sources:
 Thursby and Thursby (2006)
 European Commission (2006)

Public Research
Making More Use of Knowledge

Intellectual Property available for licensing

Spinouts

Collaborative Research Opportunities

University/Industry Collaboration
Identified Problems

- Failure to recognise that it is more often knowledge that is transferred than specific technologies
- Too much focus on IP leading to drawn-out contract negotiations
- Technology transfer offices at universities staffed with people who often do not understand the technology and have no commercial experience
- Universities trying to act as businesses – without being in a business environment

Facts and Figures

- **Between 1972 and 2001, industrial support to US universities and colleges grew more rapidly than any other source of support for academic research and development.**
- **Between 2002 and 2006, the absolute value of industrial R&D dollars to academic institutions declined and the percentage of industry funding in total academic R&D dipped from a high of 7.9% to 4.9%.**

From NSF InfoBrief
Published September 2006

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Why Is It So Hard to Reach Agreement?

- **Negotiation of intellectual property rights in sponsored research agreements has become a barrier to industry-university research collaboration in the United States.**
  - more contentious
  - takes longer
  - increases transactional costs
  - little/no benefit results

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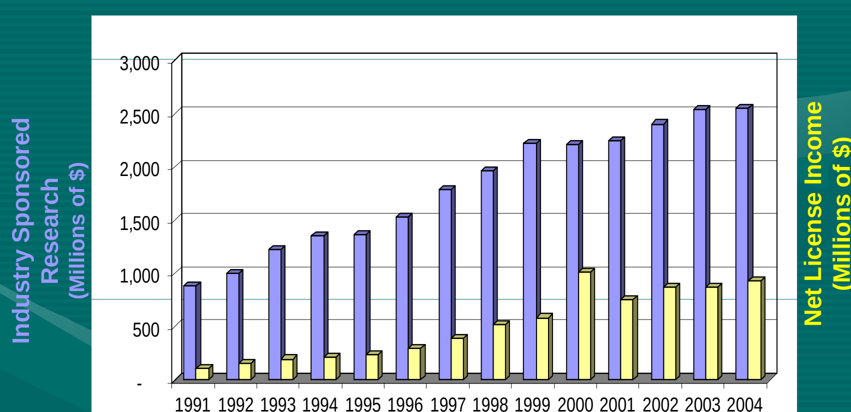
Sponsored Research Funding Exceeds Licensing Revenue



Source - AUTM Licensing Survey, Fiscal Year 2004

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Key messages for Universities

- Treat collaborative research as part of university excellence
- Recognise different partners' legitimate interests
- Invest in strategies that develop professionalism in collaborative research
- Young people are key to the change process

Georg Winckler
Rector University of Vienna, EUA President

Problem with models
"Direct Technology Embodiment" is highly ineffective

- Technology-driven innovations fit into a complex web of products, services, technologies, commercial relationships and markets. They cannot easily be pursued as discrete propositions.
- For typical "breakthrough technology" The Valley of Death is at least **10 years wide and €20m deep**
- Most research output is too 'raw' to be used directly:
- Cannot be adequately captured as formal IP
- Transformation into practical, advanced technologies takes time and expert resources
- Results usually emerge in very different applications to those originally envisaged, with unexpected costs and timing
- Process of company formation and growth is fraught with many difficulties and risks not related to the potential of the IP

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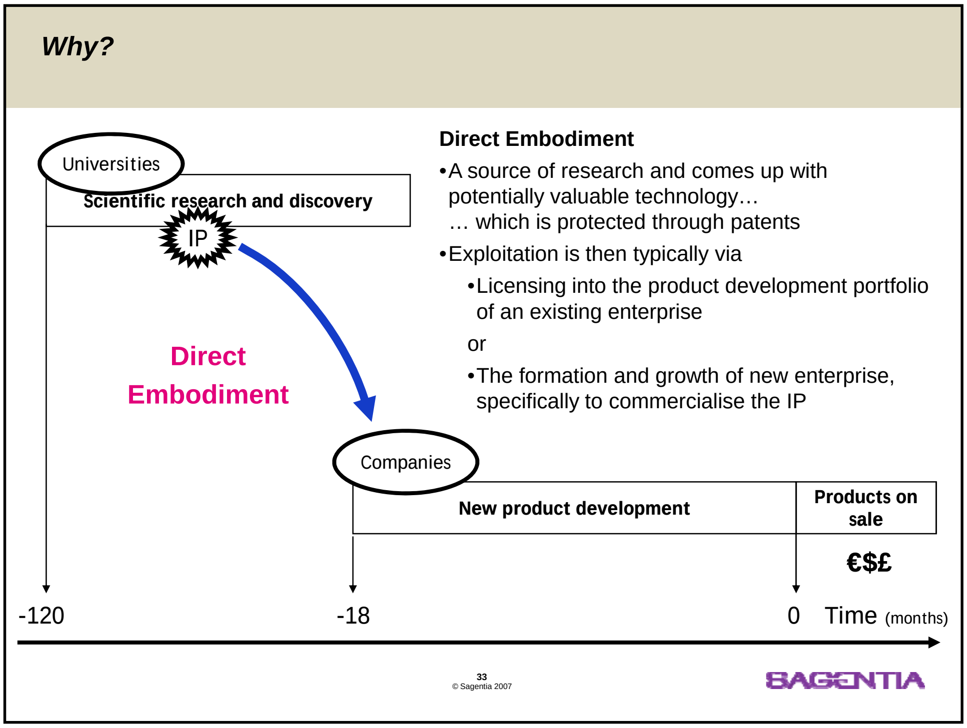
Why?
Universities
Scientific research and discovery
IP
Direct
Embodiment
Companies
New product development
Products on sale
€$£
-120
-18
0
Time (months)
Direct Embodiment
•A source of research and comes up with potentially valuable technology…
… which is protected through patents
•Exploitation is then typically via
•Licensing into the product development portfolio of an existing enterprise
or
•The formation and growth of new enterprise, specifically to commercialise the IP
33
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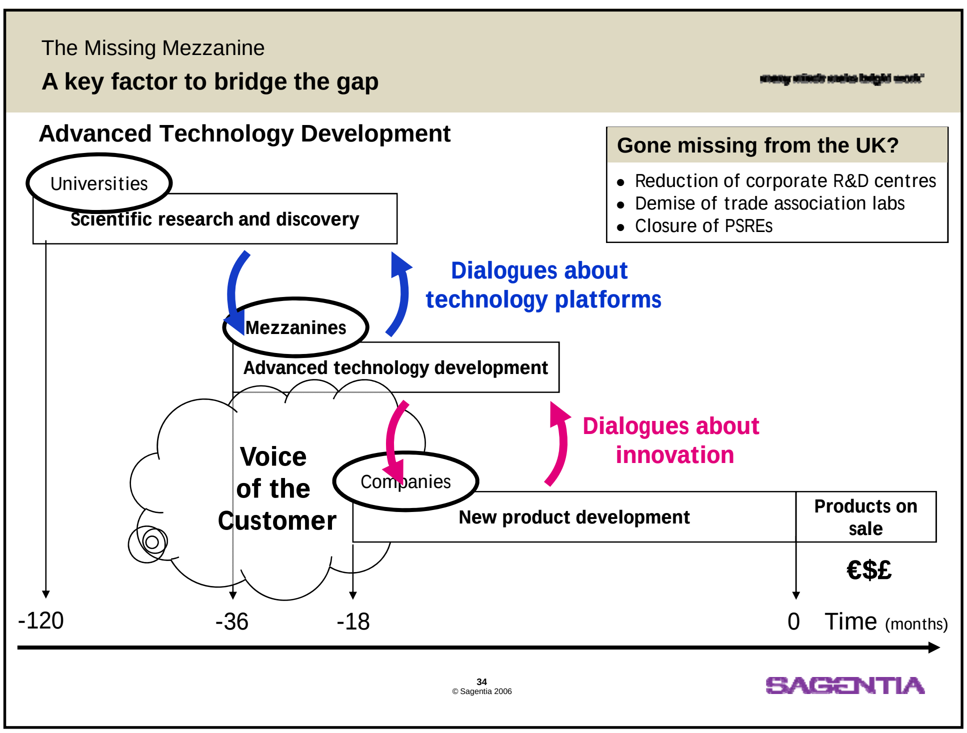
The Missing Mezzanine
A key factor to bridge the gap
Advanced Technology Development
Universities
Scientific research and discovery
Mezzanines
Advanced technology development
Dialogues about
technology platforms
Gone missing from the UK?
• Reduction of corporate R&D centres
• Demise of trade association labs
• Closure of PSREs
Voice
of the
Customer
Companies
New product development
Products on sale
€$£
Dialogues about
innovation
-120
-36
-18
0
Time (months)
34
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Competitiveness
Corporate and European

- "Unambiguously business driven"
- Innovation as much more than R&D
- Partnerships essential
- Growing service content
- Business model
- Active IP portfolio mgmt
- Customer as business driver
- Brains are everywhere
- Whose standards?
- Which lead markets?

- Identify where Europe needs innovation
  - Focus on outcomes not inputs
  - Link market pull with research push
- Create effective ecosystems
  - Locations, public procurement, lead markets, regulation, standards
- More effective partnerships
  - Role of Research and Technology Organisations
  - University reform (but not at expense of primary mission)
- Magnify efforts, achieve critical mass!
- Attract talented people to work here

Boeing Research and Technology Europe

Can Europe compete as a research location ?

June 2007

- **The answer is yes**
- **I'll give you an example: Boeing Research and Technology- Europe**
- **In this presentation**
  - **A general overview about R&D activities inside the Boeing Co**
  - **What's BRTE role**
  - **What we do**
  - **Results conclusions and benefits**

- **Founded in 1916 in Puget Sound, Washington**
- **Became a leading producer of commercial and military aircraft**
- **Undertook a series of strategic mergers and acquisitions to broaden its portfolio that included McDonnell Douglas, the space and defense business of Rockwell Intl., and Hughes Space & Communications, among others**
- **Today positioned as a broad, balanced and global enterprise defining the future of aerospace**

Company's heritage mirrors the history of flight

What we do Today

- Design and manufacture commercial jetliners
  - Boeing 7-series of airplanes leads the industry
  - Offer a broad range of services to passenger and freight carriers
- Produce weapons systems and networking technology
  - World's largest designer and manufacturer of military aircraft
  - Provide services and support to governments worldwide
- Provide satellites and launch vehicles
  - World's largest provider of commercial and military satellites; leading rocket manufacturer; and NASA's largest contractor
- Integrate large-scale systems; develop network-centric solutions
- Provide financial solutions focused on customer requirements
- Develop advanced technology defining the future of aerospace

As a company we connect and protect people

Global Scope

- 2006 revenue was $61.5 billion from customers in more than 90 countries
  - International sales were more than 40 percent
- More than 155,000 employees in 48 states in the U.S. and 67 countries
- Nearly 6,450 suppliers in nearly 100 countries
- Research, design and technology development centers and programs in multiple countries
- Manufacturing, services and technology partnerships with companies around the world
- One of the largest U.S. exporters

Companies that change and adapt in a rapidly evolving global economy will survive, grow and prosper

Boeing Business Areas

Commercial Airplanes

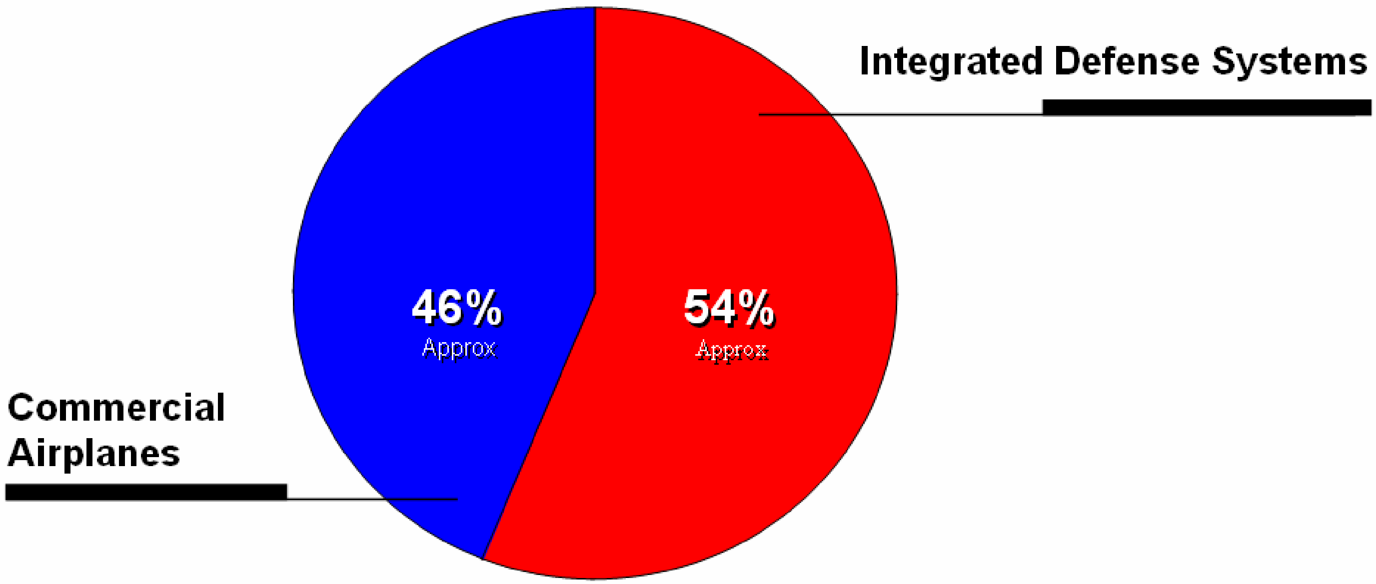
Integrated Defense Systems

Phantom Works–Technology and Advanced Concepts

Boeing Capital Corp

Revenue by Business Unit

Year-end 2006



Total = $61.5 billion

Phantom Works Vision, Mission & Values

Vision: Innovators and Integrators **working across the Boeing Global Enterprise to *create* the future of aerospace.**

• 1900 Employees

Mission: To be the *catalyst of innovation* for the Boeing Enterprise.

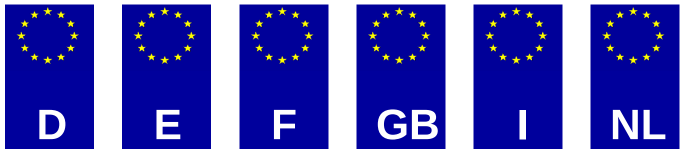
Boeing Research and Technology Europe in Phantom Works

Engineering, Operations & Technology | Phantom Works **Boeing Research and Technology Europe**

Phantom Works in Europe

- **Created at the start of 2002, first Boeing R&D company created in Europe**
- **Incorporated under the laws of the Kingdom of Spain: European Union Company**
- **Wholly-owned subsidiary of the Boeing Company**
- **Located near Madrid-Barajas Airport**

- **Technical and Engineering Staff recruited across Europe. Currently six different European nationalities**



Environmentally Friendly Air Transport Technical Lead

Dr. Nieves Lapeña

Systems Efficiency: Within the frame of the More electrical Airplane, more on-board electrical generation and distribution to power airplane systems for weight advantages and fuel efficiency

Market Drivers: Changing regulatory requirements make environmental issues such as noise, emissions, fuel efficiency and recycling prominent

- **Fuel cells**
  Hands-on experience for integrating fuel cells in aerospace applications: design, assembly and test of small experimental manned and unmanned prototypes with fuel cell-based propulsion systems

- **Environmental technologies** Working towards a greener air transport can give Boeing a competitive advantage:
  - Environmentally friendly (Cr-free) corrosion protection of aluminum alloys
  - Green composite materials for cabin interiors & non-halogenated flame retardants Cd-replacement in sacrificial coatings of high strength alloy steels
  - Computational toolset to assess noise/nuisance impact off of traffic simulation results
  - IVHM: enhanced microcrack diagnostics of aircraft components and structures
  - Nanotechnology (materials) applied to environment

The Fuel Cell Demonstrator

The Fuel Cell Demonstrator Airplane

Project Objectives & Rationale:

Aim: To demonstrate for the first time in aviation history that a straight level manned flight can be achieved with fuel cells as the only source of power

R&D effort: Hands on integration of novel technology on a prototype

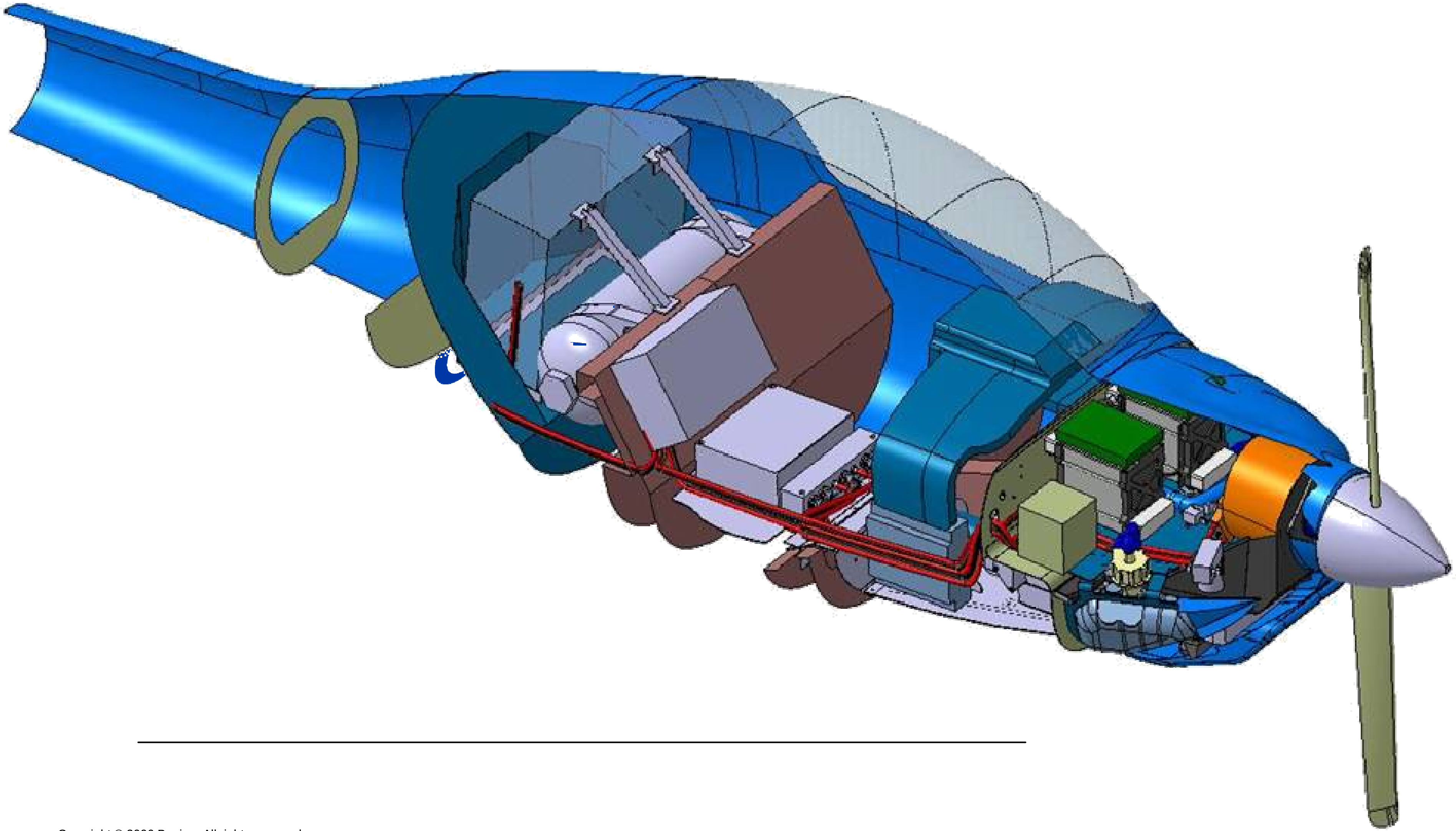
- The engine of a motor-glider (Diamond HK36TTC Super-Dimona) was substituted by a PEM Fuel Cell/Li ion Battery hybrid power source that drives an electric motor rotating a variable pitch propeller
- The Li ion battery is only used to assist during take off & climb
- During cruise (@100 km/h) all the power comes from the fuel cell
- The fuel is compressed hydrogen gas (5,000 psi) stored in a light-weight composite tank

Approach: Work with European Partners

- Specifications & tests protocols development for systems acceptance
- Size & weight reduction of all subsystems
- Systems electrical integration and on-board mechanical installation
- Safety requirements developed: flight, hydrogen, electrical system
- If bench tests are successful there will be a public flight demonstration

Benefits of Work: Develop capability for integration of fuel cell systems in aerospace applications

Airplane layout



Engineering and Programs: Flight Efficiency

Flight Efficiency
Technical Lead

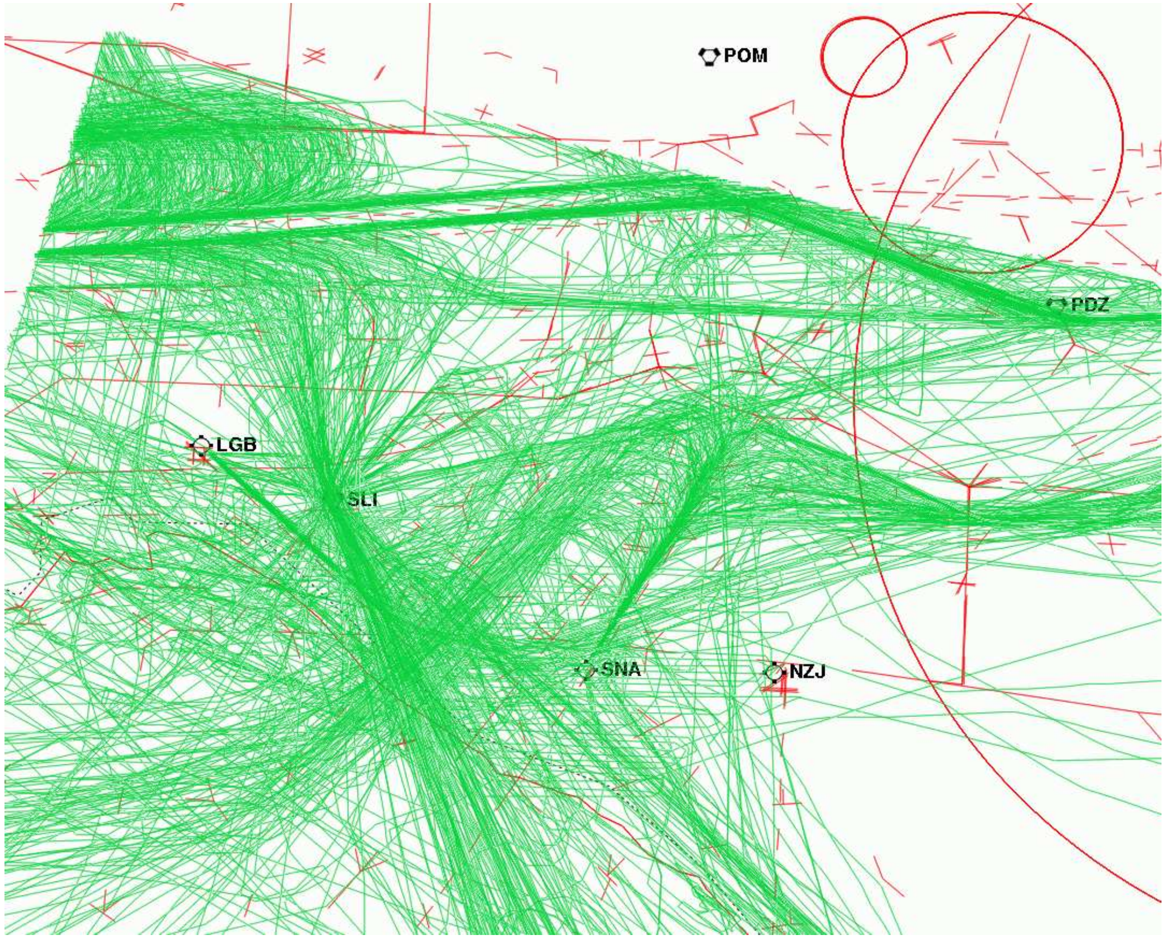
Dr. Ramón Gómez Ledesma

Operational Efficiency: Advanced operational procedures (i.e. noise abatement procedures). Studying ways to relieve crowded airspace

Market Drivers: Changing regulatory requirements make environmental issues such as noise, emissions, fuel efficiency and recycling prominent

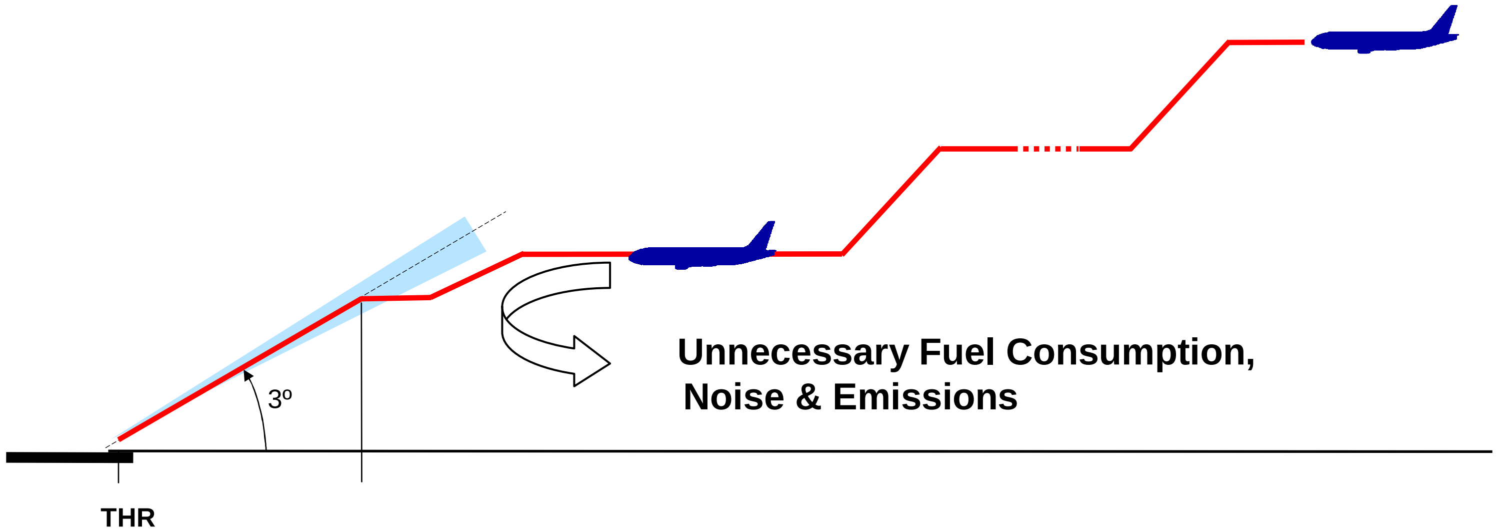
- **Advanced operational procedures:**
  - Advanced Continuous Descent Approaches (CDA)
  - Noise, fuel and time efficient procedures
  - Advanced flight guidance
- **Assessment of operational and fuel efficiency:**
  - Modeling and simulation of Air Traffic Control (ATC)
  - Assessment of fuel consumption, airport capacity, delay and throughput
  - Advanced applied statistics to air traffic
- **Assessment of environmental impact of aviation:**
  - Assessment of community noise and emissions of aircraft operation

Background: Arrival Traffic in Terminal Area



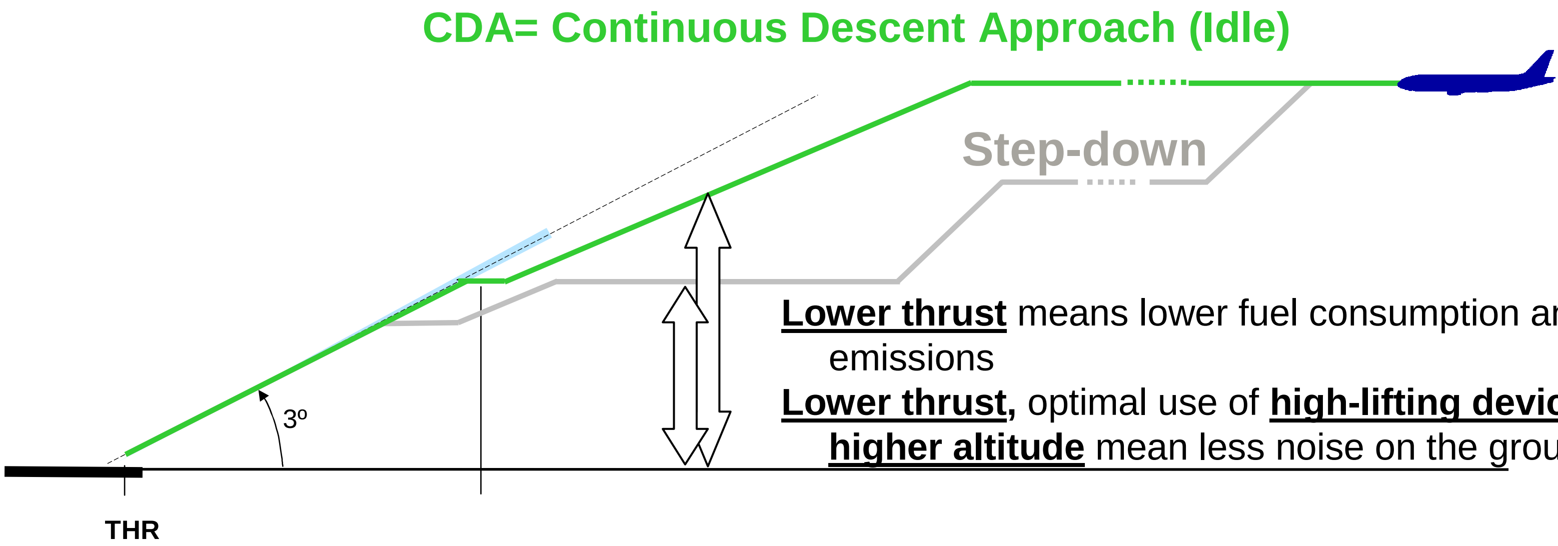
Dense arrival traffic in terminal area subject to tactical corrections

Background: Step-down Approach Procedures



- **Horizontal Segments:**
  - **High thrust**
  - **Deployed High-lifting devices**
  - **Low altitude**

- **Inefficiencies**
  - **Unnecessary Fuel Consumption**
  - **Unnecessary Environmental Impact**



Lower thrust means lower fuel consumption and less emissions

Lower thrust, optimal use of **high-lifting devices** and **higher altitude** mean less noise on the ground

- **CDA is an optimal descent**
- **Descent is performed in idle thrust (almost) until glideslope interception**
- **CDAs mean large fuel savings and less environmental impact**

CDAs & Numbers: BENEFITS

- Up to **500 lbs fuel** savings per operation
- **30% reduction of NOx** emissions produced below 3000 ft
- Noise benefits between **3.5** and **6.5 dBA**
- **100 secs time** savings in terminal area (TMA/TRACON)

*(1) – "Development, Design, and Flight Test Evaluation of a Continuous Descent Approach Procedure for Nighttime Operation at **Louisville** International Airport".* J.P. Clark. Partnership for Air Transportation Noise and Emissions Reduction.

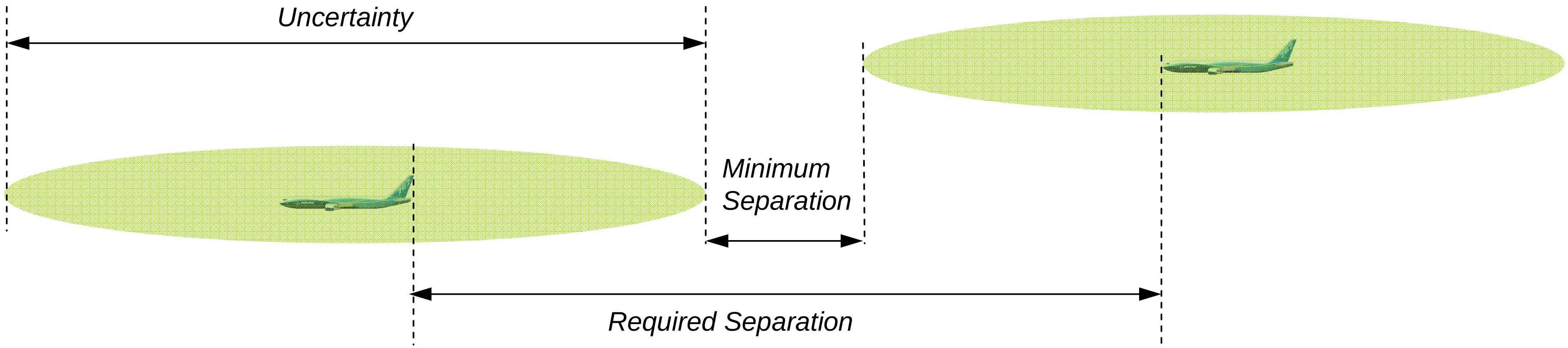
Why are CDAs not Widely Used?

CDA flights not to receive ATC tactical corrections to speed or altitude → CDA flights at the expense of the wind → **CDAs have poor predictability In horizontal position / ground speed**

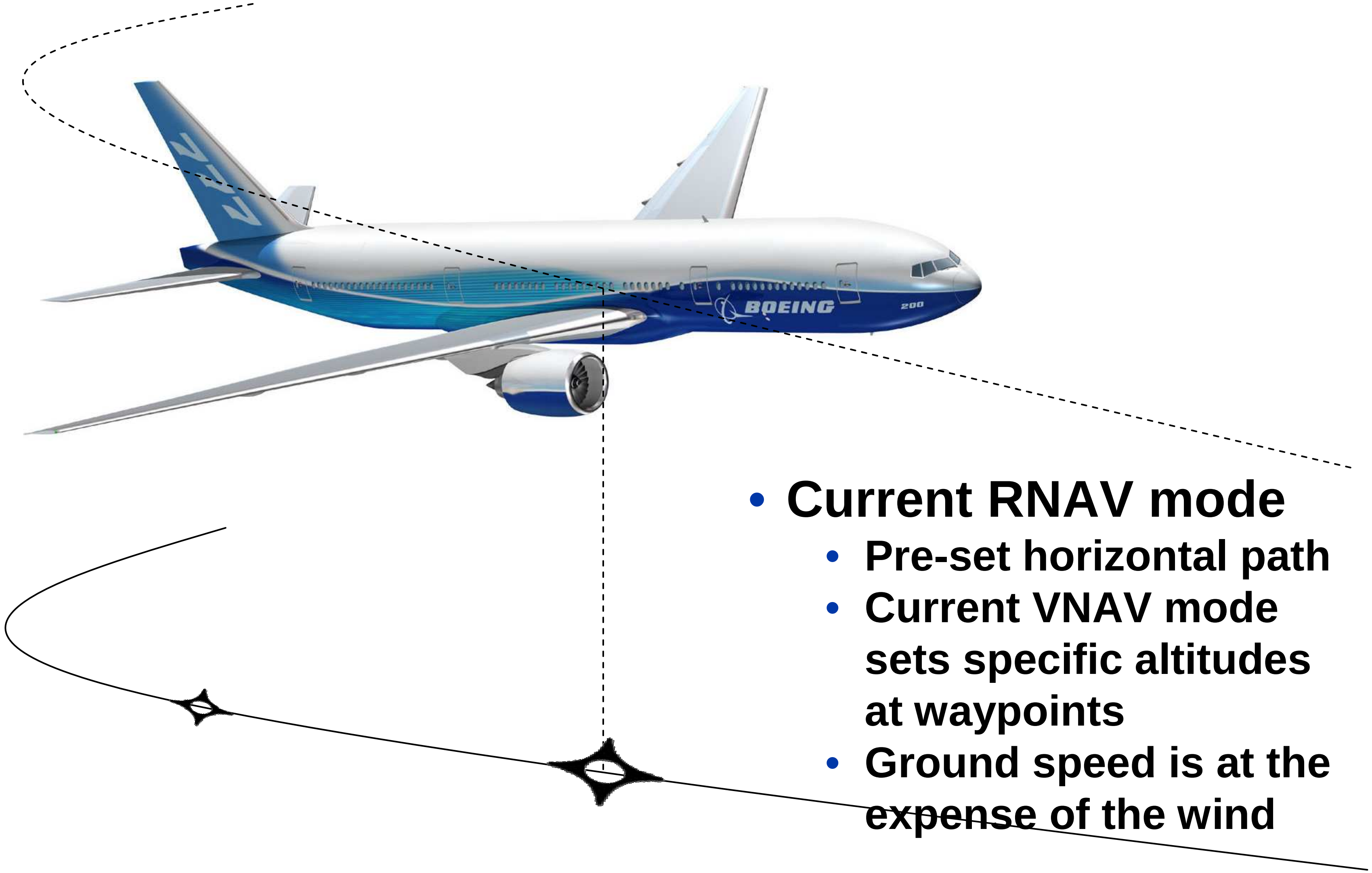
Airport Capacity Loss

- Larger Separation

- Non-efficient Use of GroundAutomation



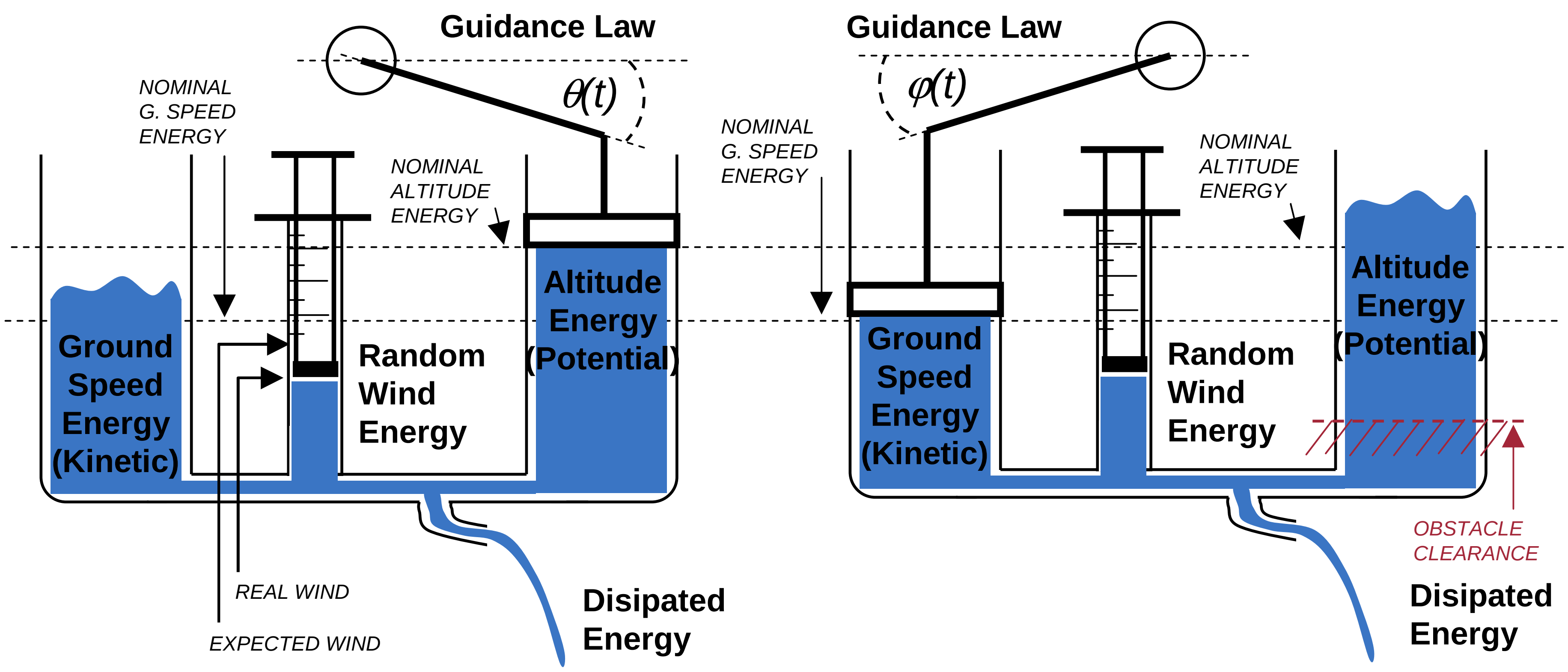
The Key to Predictability: VERTICAL GUIDANCE LAW



- Current RNAV mode
  - Pre-set horizontal path
  - Current VNAV mode sets specific altitudes at waypoints
  - Ground speed is at the expense of the wind

Guidance Law: Energy Management in Idle Descent

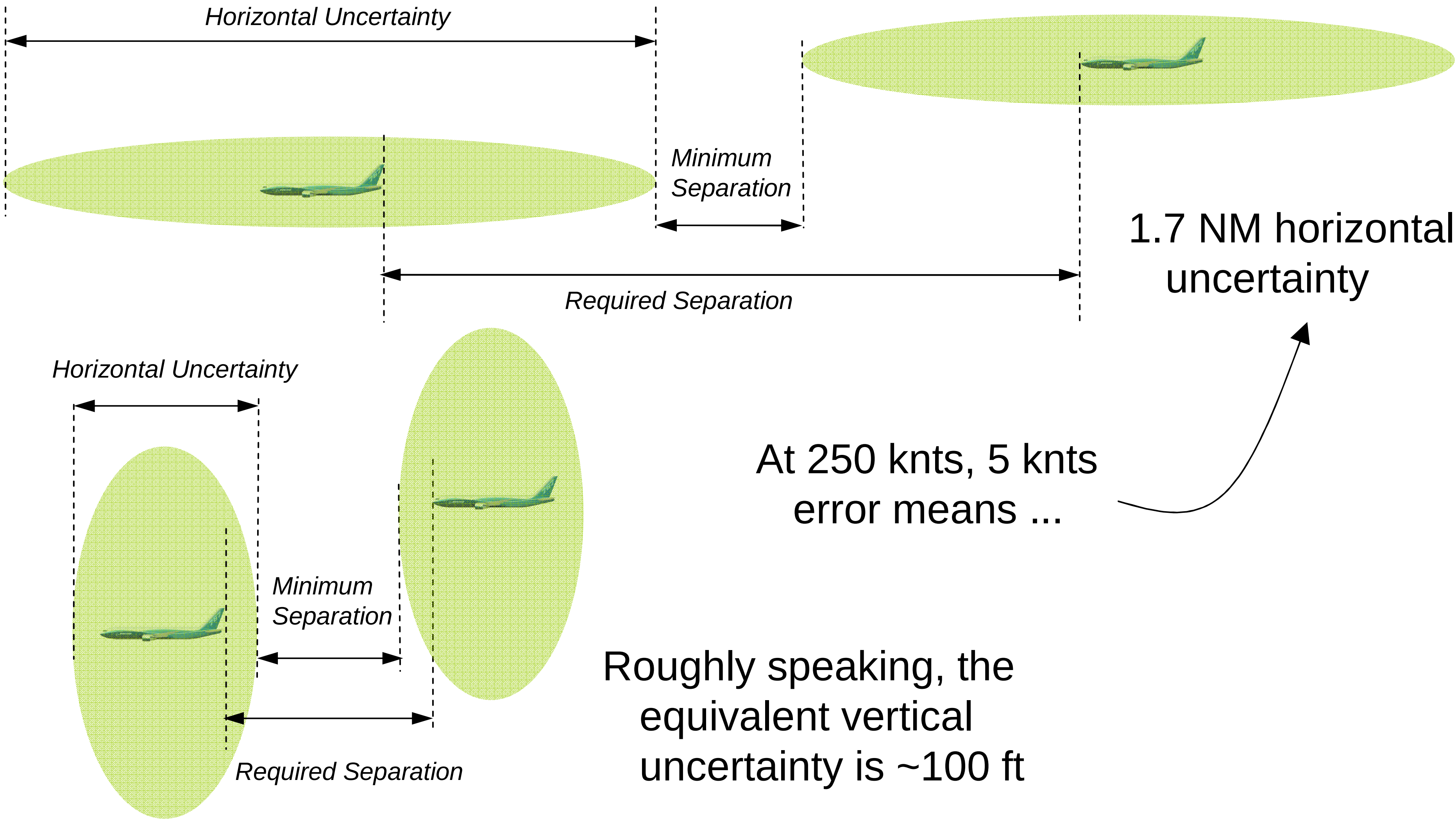
Engineering, Operations & Technology | Phantom Works **Boeing Research and Technology Europe**



- Guidance law based on altitude energy control
- **Current <u>VNAV mode</u>**

- Guidance law based on ground speed (kinetic) energy control
- **Proposed <u>new mode</u>**

Shift Unpredictability from Horizontal to Vertical



1.7 NM horizontal uncertainty

At 250 knts, 5 knts error means ...

Roughly speaking, the equivalent vertical uncertainty is ~100 ft

CDA-MP: CDA for Maximum Predictability

- **BR&TE has proposed an advanced CDA design based on an innovative vertical guidance law.**
- **Simulations have shown that BR&TE's CDA design is able to:**
  - **Keep similar noise and fuel reduction levels as other CDA designs**
  - **Improve predictability in arrival times up to 90%**
- **Further research simulations are conducted to validate and test the performance of the design.**
- **BR&TE's CDA design has filled a patent application.**

CDA Type	Time (s)	Fuel (lb)	SEL (dBA)	Lamax (dBA)	Predic (s)
Red. Time	**362**	+6%	+5%	+8%	22
Red. Fuel	+7%	**143**	+3%	+5%	24
Red. Noise	+16%	+8%	**66**	**51**	31
CDA-MP	+10%	+1%	+2%	+3%	**3**

Engineering and Programs: Advanced Trajectory Technologies

Advanced Trajectory Technologies

Dr. Miguel Vilaplana

Operational Effectiveness and Efficiency: relieve crowded airspace and airports in an efficient, collaborative and fair manner

Optimal Decision Making: distributed deconfliction, autonomous vehicle operations

- **Advanced Trajectory Prediction:**
  - Advanced aircraft modeling and trajectory computation algorithms
  - Multi-purpose trajectory prediction software
  - Trajectory optimization
- **Trajectory Management:**
  - Languages, protocols and simulation tools for air-ground and air-air trajectory negotiation
- **Decision-making Aids:**
  - Conflict detection and resolution tools to support trajectory-based operations
  - Advanced distributed and centralized deconflicition algorithms

Engineering and Programs: Air Transport Economics

Air Transport Economics Technical Lead

Javier García

Optimal Decision Making: information packages for effective business decision making: cost benefit analysis and business cases for R&D projects and complex investments

Market Drivers: Changing regulatory requirements make environmental issues such as noise, emissions, fuel efficiency and recycling prominent.

- **Dynamic methodologies, economic models and electronic tools for effective cost benefit analysis, business case development and R&D value assessment.**
- **Advanced representation techniques, sensitivity and probabilistic analysis technologies to support decision making processes.**
- **Risk modeling and simulation: quantitative economic analysis technologies based on advanced computational models.**
- **Market based economic methods addressing environmental issues**

Engineering and Programs: New Programs and Safety

New Programs and Safety Technical Lead

Dr. Richard Kennedy

Operational Effectiveness and Efficiency: System modeling, simulation and targeted enabling technology development to realize future aerospace operational concepts.

Optimal Decision Making: Knowledge and decision analysis tools for risk management in distributed and virtual organizations.

Market Drivers: Development of next generation safety and human factors approaches to enhance safety and operability of aircraft and ATM systems.

- **UAS in Civil Airspace Models, Reduced Aircraft Separation Minima for ATM, Flight Data Analysis Software, Multi-Modal Interfaces for UAS Operations.**
- **Analyst Associate for Maintenance Resource Allocation, GRID Computing Network in a Collaborative Work Environment, Security Case Analysis Methodology.**
- **Human Performance Uncertainty Safety Assessment Tools, Flight Operations Safety Survey, ATM Safety Culture Measurement Technique.**

Results Conclusions Benefits

For the Company doing R&D in Europe

There is a real possibility to create knowledge (Patents-Tech Transition-Breakthroughs)

Facts

R&D aligned with the European culture & way of life

Company products will take this advantage in a significant market

For the Company and the European based Industrial Community

European EU-driven-FP provides great collaborative R&D opportunities

Facilitates global R&D networking and market understanding

For the European Society

Creates knowledge for capturing knowledge

LocoMotive

The LocoMotive Project: Overview and findings

LocoMotive Final Conference,
5-6 june 2007 Hamburg

Fabienne Fortanier

University of Amsterdam Business School /
RSM Erasmus University

The LocoMotive Project

Aim:

"By providing a better understanding of the characteristics of, and motives for, the way in which MNEs organize their international R&D across European regions, the LocoMotive project aims to contribute to better and more effective policy making at the regional, national and European level."

Approach:

Combining detailed regional information on R&D facilities with an analysis of global trends in R&D (including increased internationalization of R&D, the rise of China and India, outsourcing, and the increased complexity of organization of international production).

The LocoMotive Project: Main Questions

1. What are the locational determinants for R&D activities by MNEs in European regions?

2. How do MNEs organize and coordinate their R&D activities within their firm and across borders?

3. What is the regional contribution of MNE R&D activities in terms of employment, innovation, and spillovers?

The LocoMotive Project: Methodology

Three main empirical components

- Interviews with R&D managers
- Round table discussions
- ‘Global View’

	Interviews	Round table	Global View
Theme 1 - Motives	●	◐	◐
Theme 2 - Organization	◐	●	●
Theme 3 – Impact	◐	●	◐

The LocoMotive Project: Interviews and Roundtables

Interviews

- 40 semi-structured interviews with senior R&D managers across 8 regions
  - Sectors: Electronics, Chemicals/Pharmaceuticals, Aerospace, other
  - E.g.: Siemens, Philips, Sanofi-Aventis, Airbus
- Pilot-tested with 1 interview in each region

Roundtables

- 1-2 roundtables in each of the regions
- Bringing together R&D managers, regional development agencies, government officials, tech transfer officers, academics, SMEs

1. Locational Determinants of R&D

Centripetal forces (innovation at home)

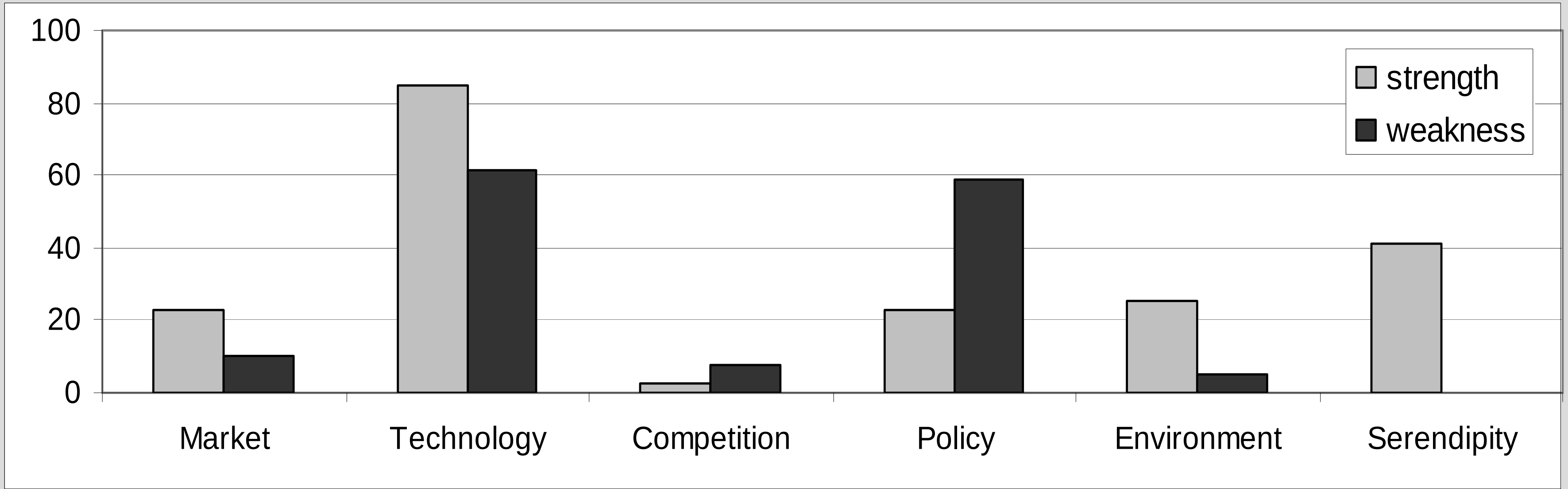
- protect firm-specific technology
- minimize organizational costs
- economies of scale
- home country embeddedness of R&D

Centrifugal forces (innovation abroad)

- Market/demand side factors
- Technology/supply side factors
- Competitors
- Policy
- Environment
- Serendipity

Interview Results – Motives

- Technology is a main historical and current locational motive
- Markets are less important, *for Europe*
- Many firms stay in a region due to policy factors and environmental factors
- History and path dependency play a major role
- At the same time, technology (costs and quality) is also an important weakness (often ‘threat’), as is policy



Interview Results – Suggested Policy Changes

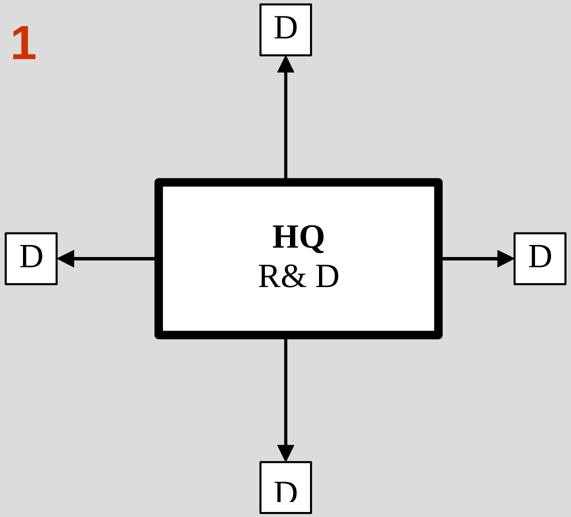
- Taxes (28%)
  - Lower to keep (staff) costs down in comparison to China and India
- Education (41%)
  - Better trained graduates
  - more attention for basic engineering
- Funding (41%)
  - More, but also more focused: no regional or thematic fragmentation
  - Support intra-industry cooperation and links with universities & governments
- Governance quality (31%)
  - Stability (no sudden changes)
  - Simplification and harmonization

Roundtable Results

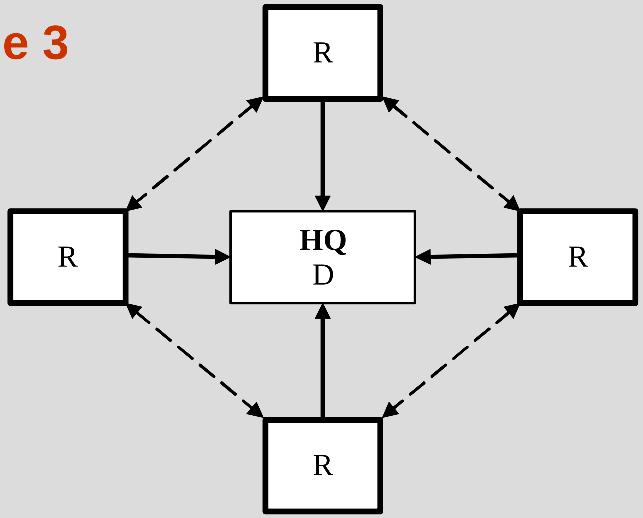
- In general: confirmation of interview results
- Discussions on specific (policy) solutions to specific regional problems, e.g.:
  - Helsinki
    - very innovative by all standards, but limited international investment → regional branding
  - Toulouse
    - Specialist knowledge available, but limited links with private sector firms →involvement of academics in EU initiatives (JTI)
  - Budapest
    - Local absorptive capacity (entrepreneurship, funding) → education and skills for business venturing

2. Organizational Structure

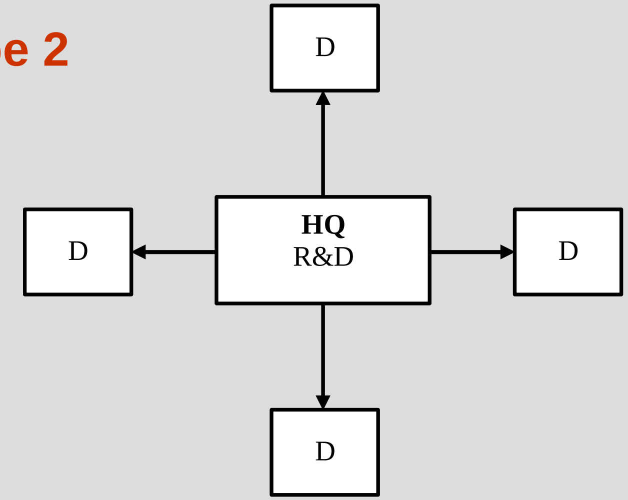
Type 1



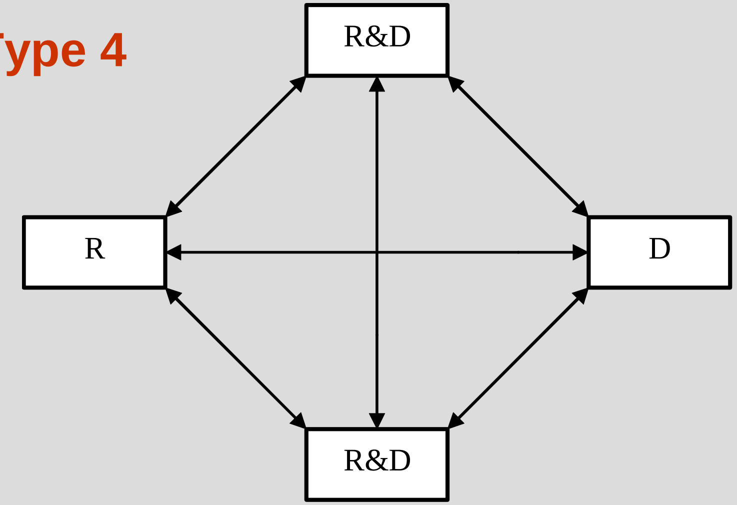
Type 3



Type 2

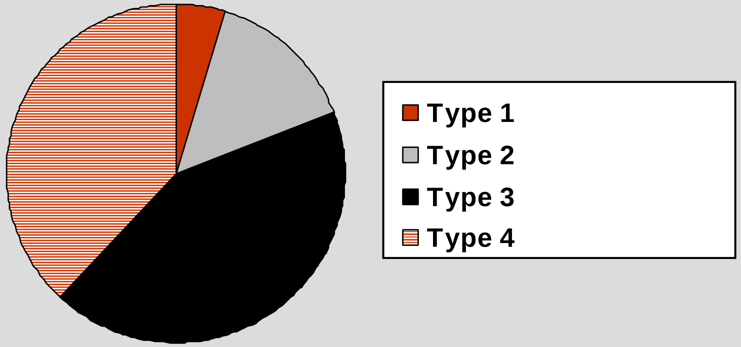


Type 4

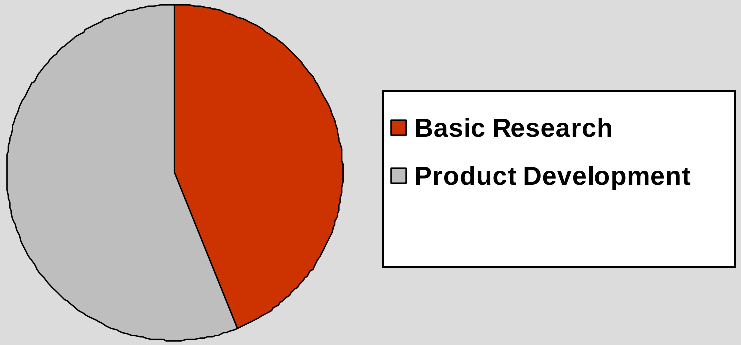


Interview Results – Organizational Structure

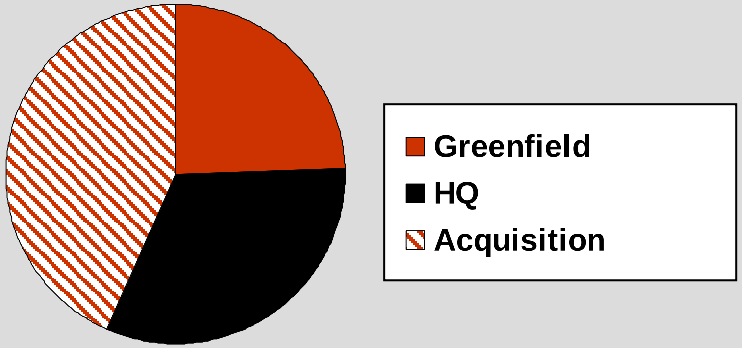
- Type 3 and 4 dominate ('network kind organizations')



- Predominantly Product Development, followed by Basic Research



- Distribution of HQs, acquisitions and greenfields

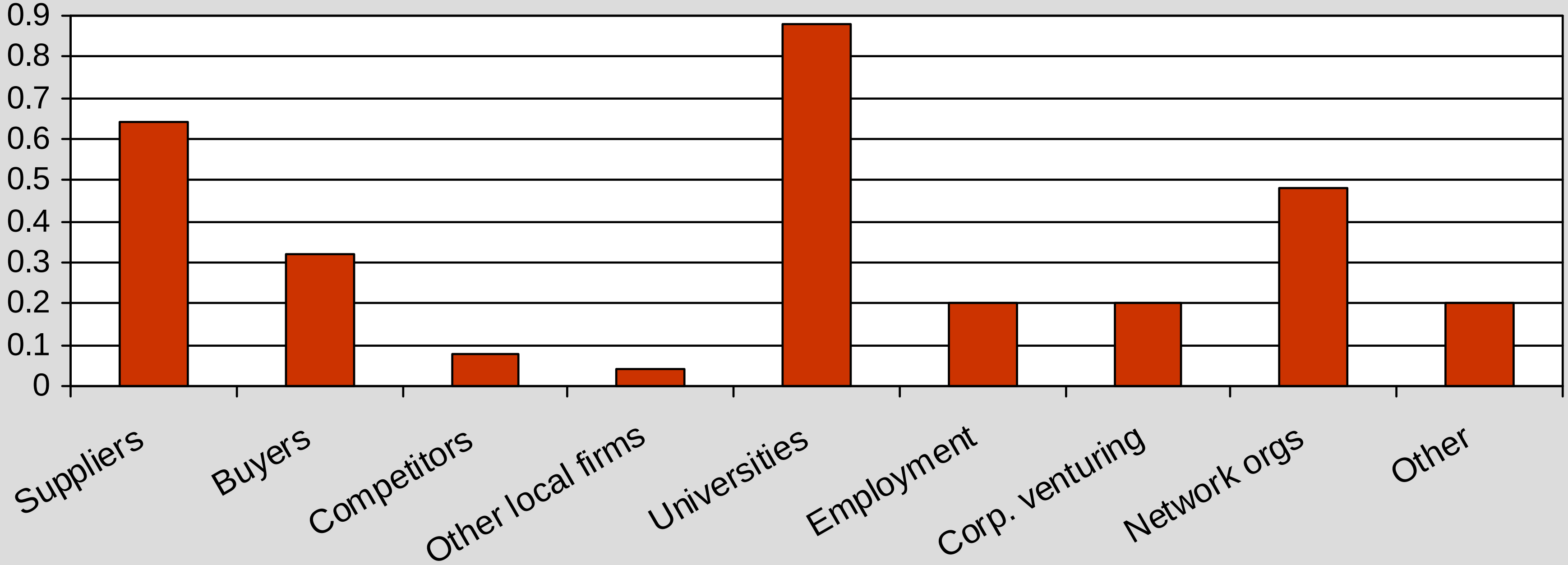


3. Regional Linkages

1. Contracts and informal ties with local firms
   - Suppliers (including multinational KIBS suppliers)
   - Buyers / consumers
   - Competitors
2. Contracts and informal ties with research institutes
   - Universities
   - Other research institutes
3. Employees
   - Labour migration
   - Proportion of native vs non-native employees in the workforce
4. Other contractual and informal ties with the local region
   - Corporate venturing; intermediary agents;
   - Policy makers and government

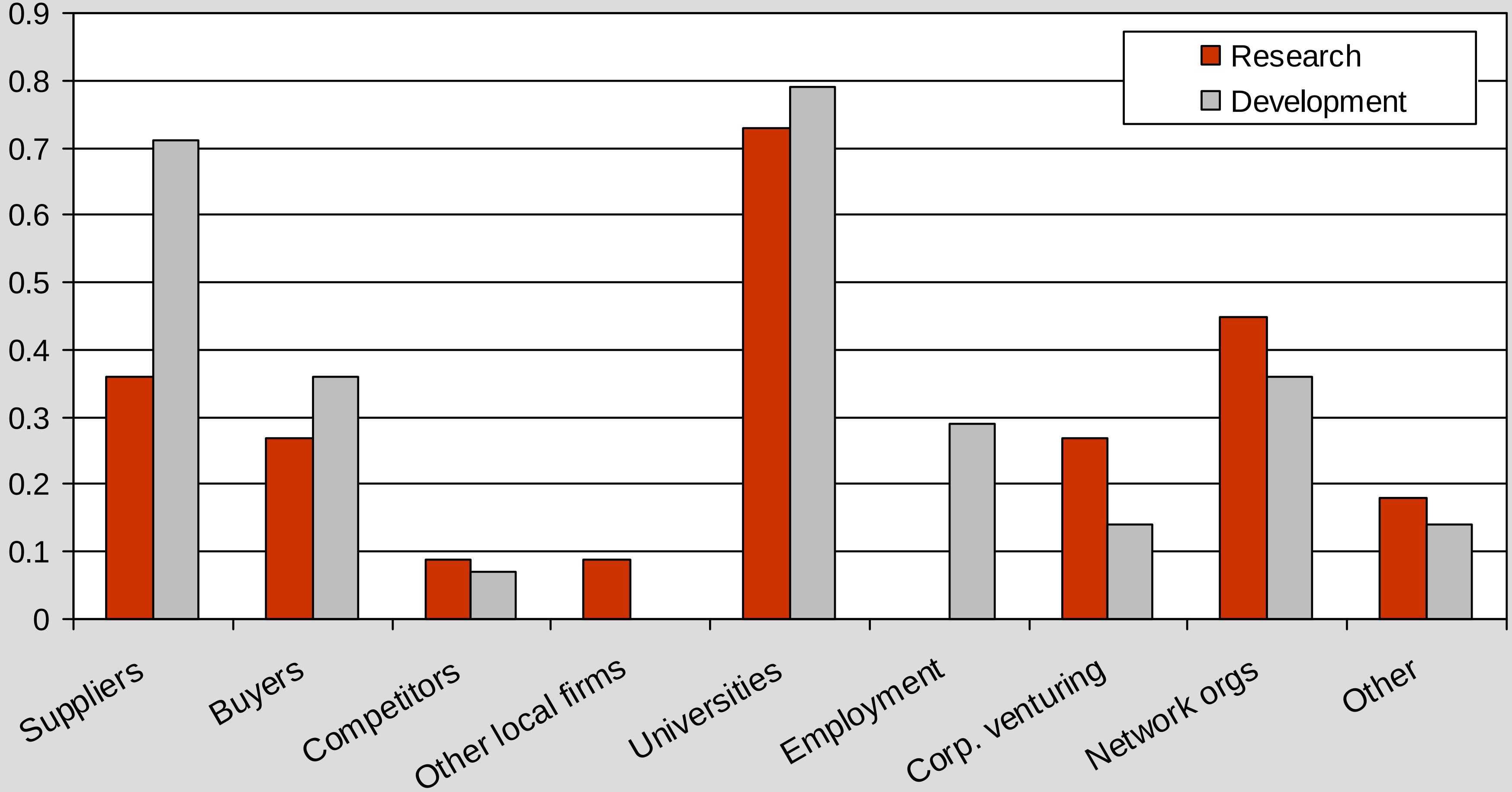
Interview Results – Regional Linkages

- Many links with local firms (particularly suppliers), universities and network organizations.
- Little information on whether used for knowledge acquisition, or knowledge transfer
- Degree of engagement not always clear (nearly every firm has informal contacts with university)



Interview Results – Synthesis (example 1)

- Differences in regional linkages between 'basic research' and 'product development' subsidiaries



Interview Results – Synthesis (more examples)

- Differences in regional linkages by organizational structure
  - Acquisitions have stronger regional links than greenfield investments
  - Headquarters (domestic firms) have stronger regional links than subsidiaries (foreign owned firms)
  - Hierarchically organized firms have more regional links than network firms (except for engagement in corporate venturing)

- Differences in regional linkages by investment motive
  - R&D units created for market-related motives have the strongest links with local firms (buyers, suppliers)
  - R&D units created for accessing technology have the strongest regional links with universities and suppliers, and engage most often in corporate venturing

Conclusions/policy issues

- Harmonization, reduced fragmentation, stability
- Don’t look down on product development
  - Regional ties are larger
  - May be a start for more substantial research
- Create quality: *“It is not rocket science: we go where the good people are”*
  - Education: move away from ‘mass-middle-class’
  - Import of experts: tax systems, immigration laws
  - Promote and help ‘home-grown firms’
    - Acquisitions often showed growth afterwards;
    - HQ have strongest local links
    - Spillovers require absorptive capacity

Thank you

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22@BARCELONA, THE INNOVATION DISTRICT

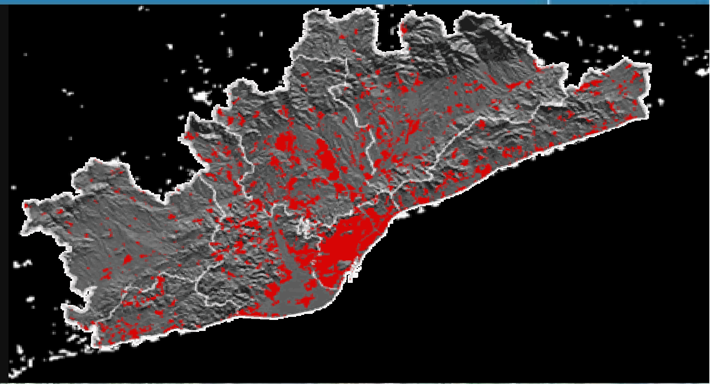
LOCOMOTIVE CONFERENCE

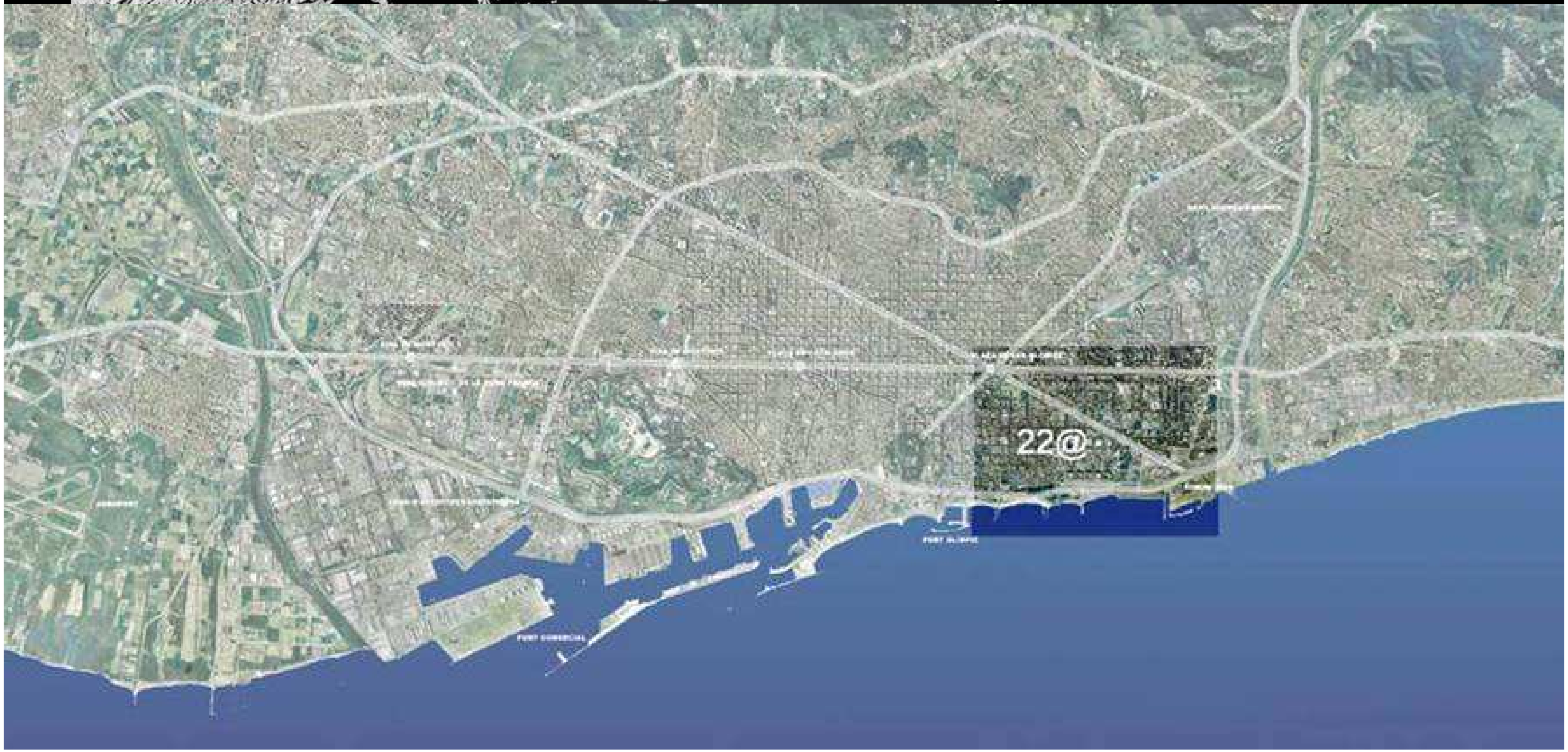
5th-6th June 2007, Hamburg

Sergi Guillot

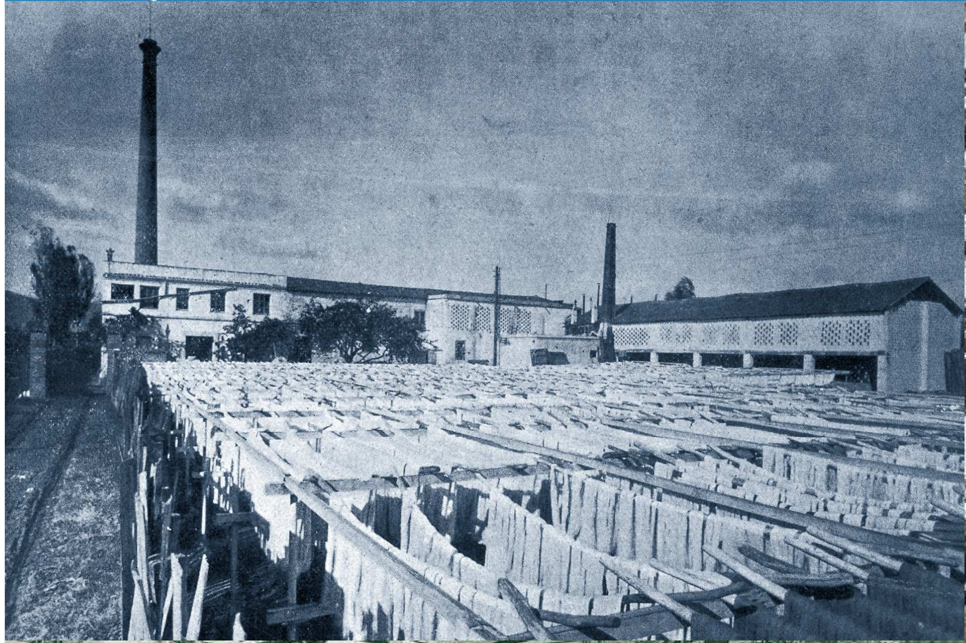
22@Barcelona

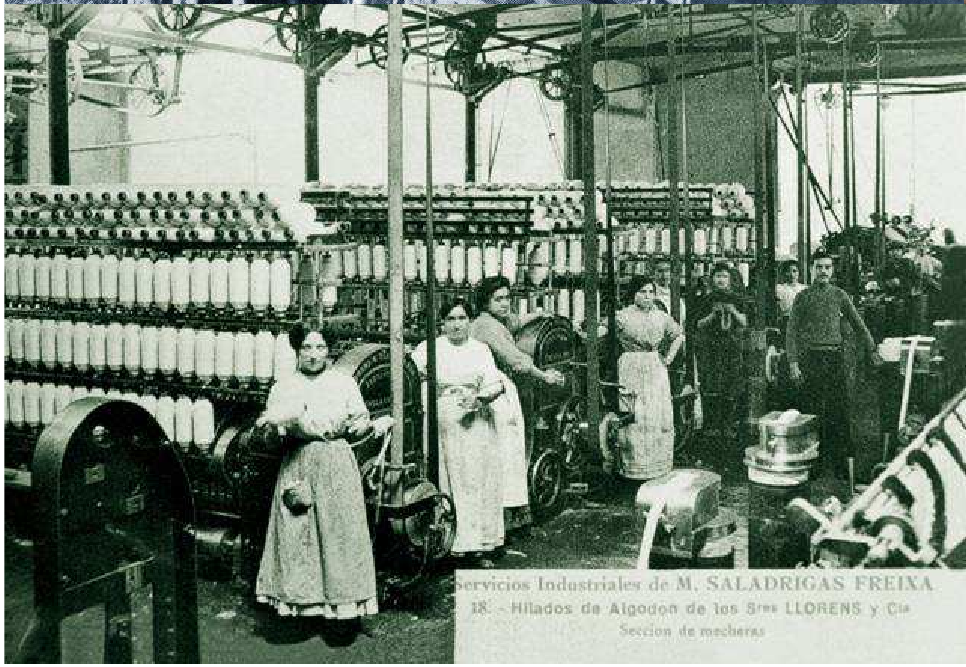
Barcelona's Metropolitan Area





1860–1960: The "Catalan Manchester"



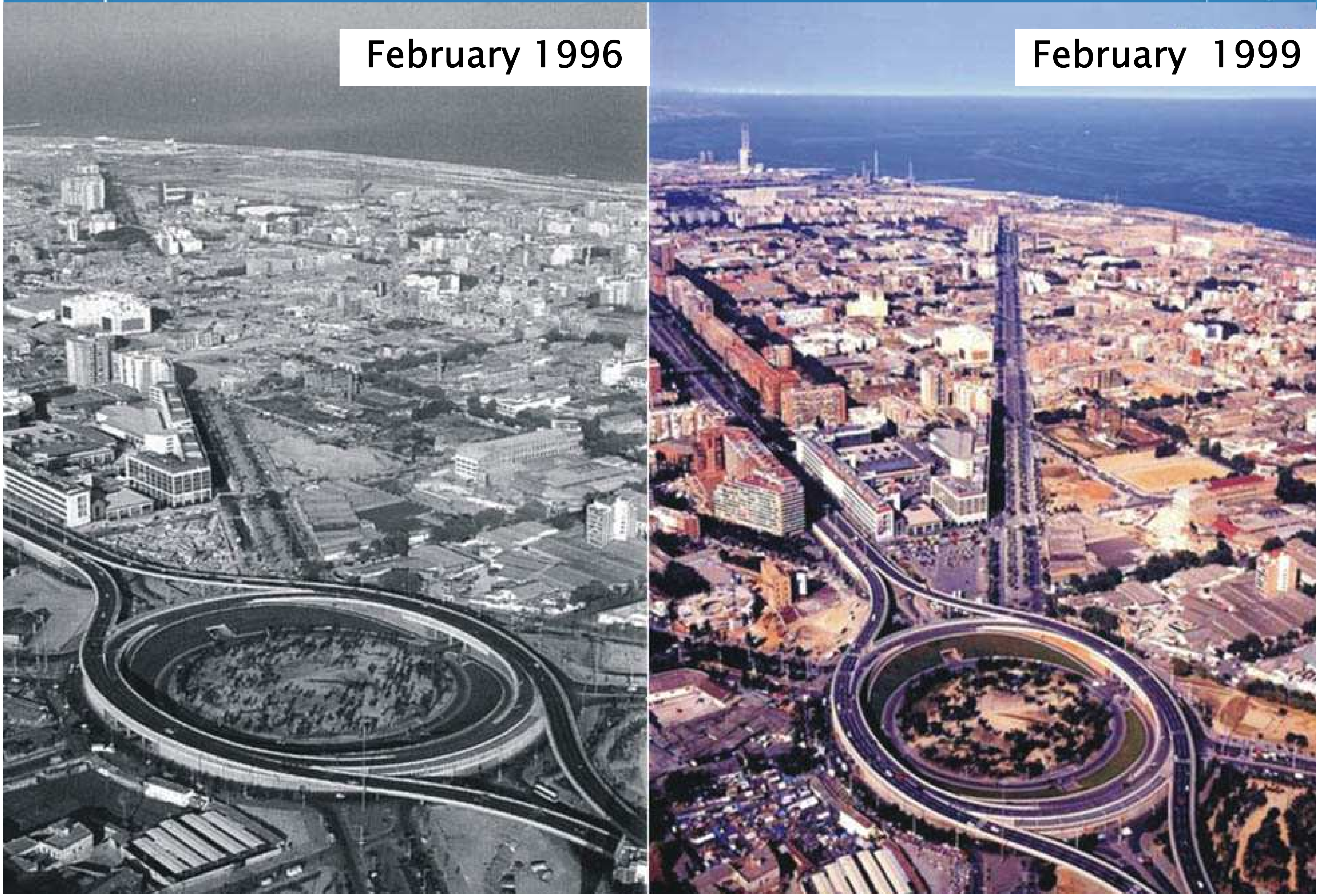


1960–1990: Obsolescence and Degradation

1986-1992: The opening of the waterfront




1996-1999: The opening of Diagonal Avenue

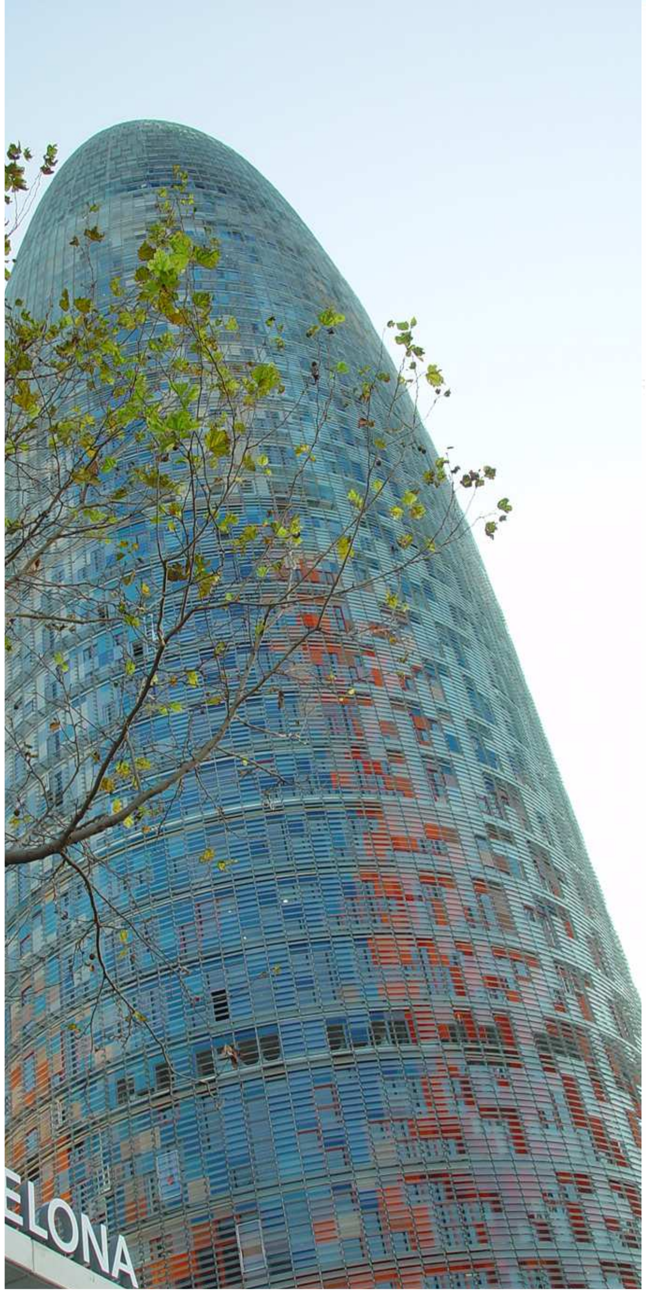


22@BARCELONA: THE INNOVATION DISTRICT

The urban planning process

2000	2001...	...2003...	...2004...	...2004/05	...2004/05 ...	...2006...
Industrial land, little used or in complete disuse, 100% privately owned, and part yet to be urbanised	Urban Planning	Urban Management	Infrastruc-tures	Construction	Corporate Projects, clusters	Compact city, with publicly owned land, fully urbanised and offering excellent infrastruc-ture, providing many more jobs in the field of knowledge intensive activities

The scale of the 22@Barcelona Project



THE SCALE OF THE PROJECT:

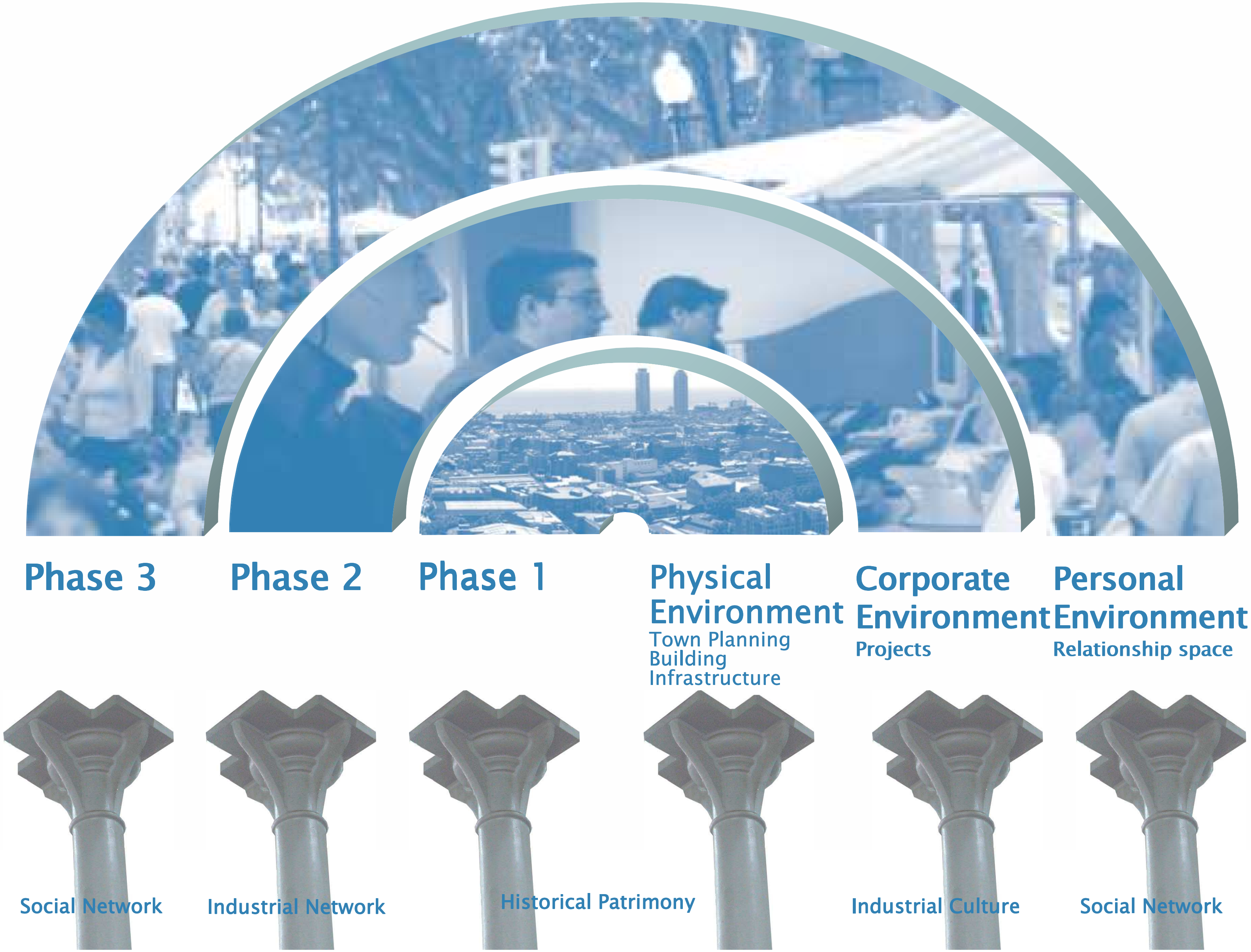
- **TERRITORY:** **198,26 Ha** (115 city blocks)
- **NEW GROSS FLOOR SPACE :** **4.000.000 m²**
  - Productive Activities: 3.200.000 m²
  - Housing, facilities and services: 800.000 m²
- **INCREASE IN GREEN SPACES:** **114.000 m²**
- **INCREASE IN FACILITIES:** **145.000 m²**
- **INVESTMENT IN INFRAESTRUCTURES:** **180 million €**

UPDAY EXECUTION 2006:

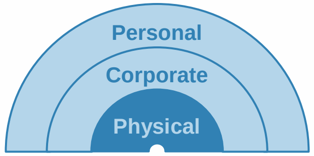
- **URBAN PLAN AND NEW ECONOMIC CEILING:**
  - **Rearrangement of 53% of the territory**
  - **811.500 m² of new economic ceiling**
  - **Near than 300 firms and institutions recently established**

- **SPECIAL INFRASTRUCTURE PLAN:**
  - **30% of reurbanization work initiated**
  - **Investment 2004-2007: 80 million euros**

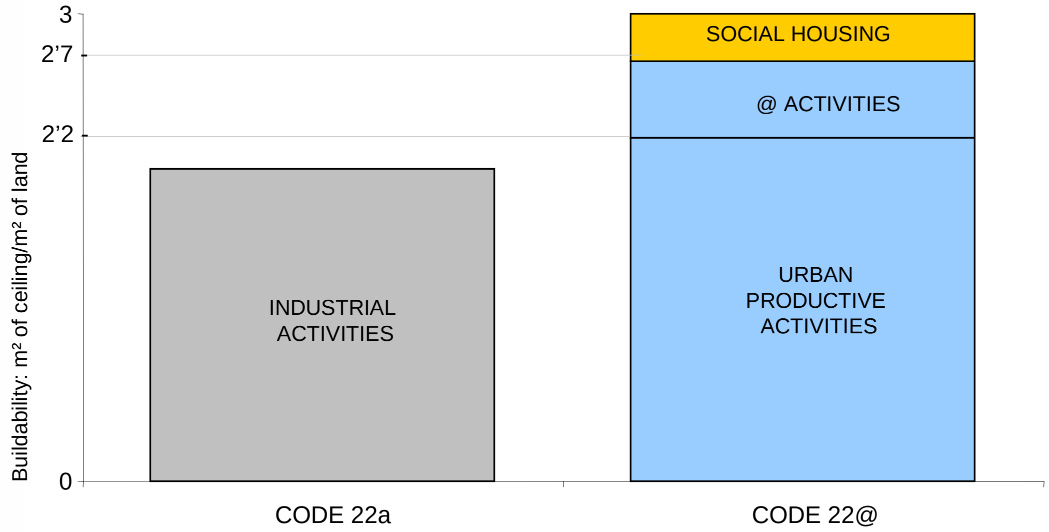
Conceptual model



Urban Planning. Density



INCREASE DENSITY:



BALANCE PUBLIC AND PRIVATE BENEFITS

PRIVATE BENEFITS	PUBLIC BENEFITS
• **More productive uses:** 22a ➔ 22@	• **Free cession of land:** • 10% for 7@ facilities • 10% for social housing • 10% for green areas • Eventual opening of streets
• **Higher density:** 2➔ 2,2 / 2,7	
• Leadind edge infrastructures	• **Financing a part of the Special Infrastructure Plan**

The 22@ Plan, a new model of compact city

@ Activities

Green space

Advanced Infrastructures

Industrial Patrimony

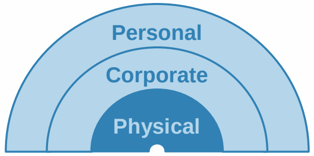
7@ Facilities

Social Housing

New mobility model

Revitalization public spaces

Special Infrastructures Plan



NEW MOBILITY PLAN

PUBLIC SPACE RENEWAL

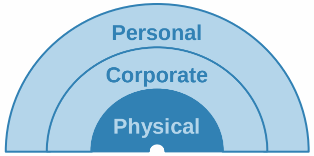
NEW ENERGY NETWORK

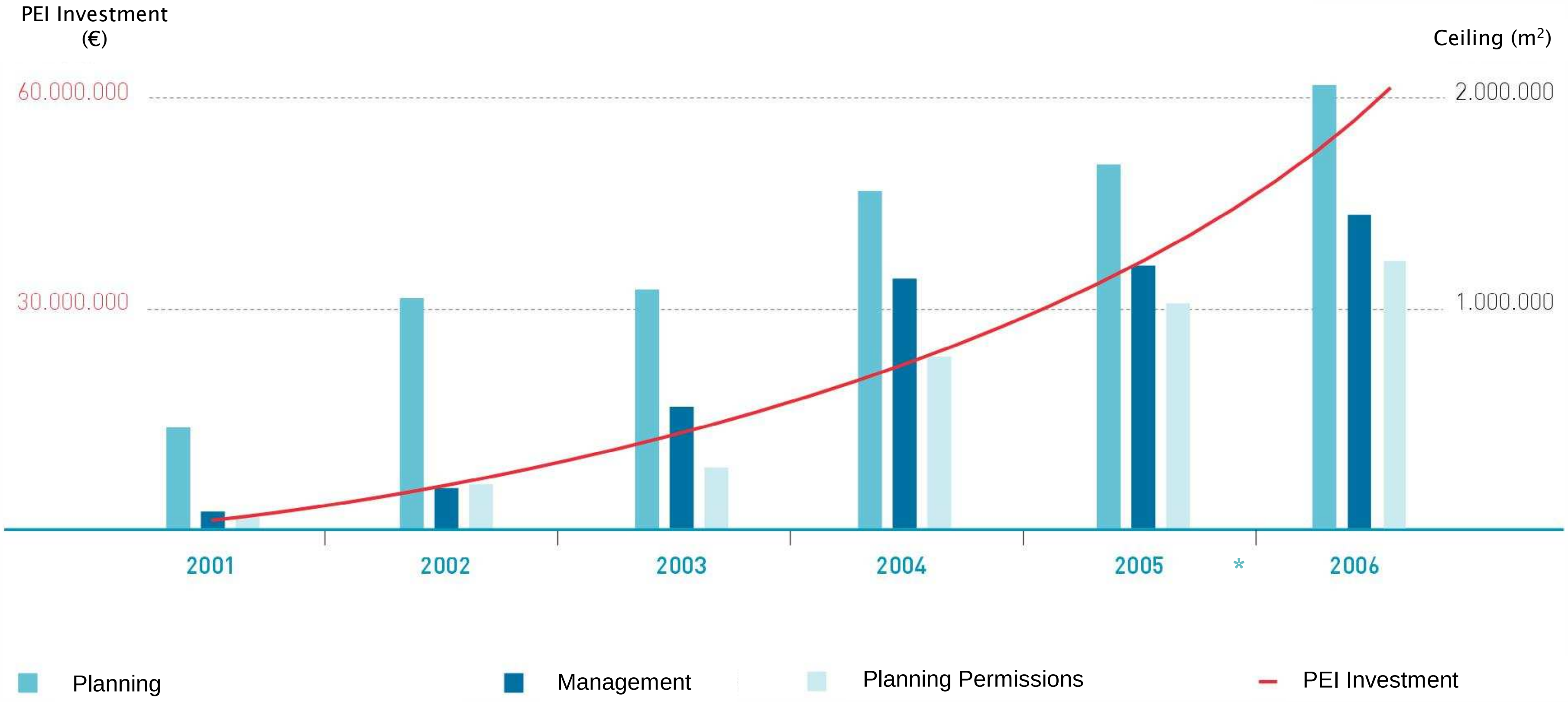
SELECTIVE PNEUMATIC WASTE COLLECTION

NEW HEATING AND COOLING SYSTEM

UNDERGROUND GALLERIES

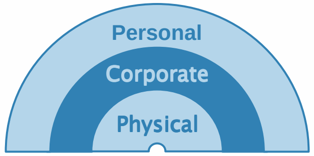
Indicators of the evolution of urban transformation

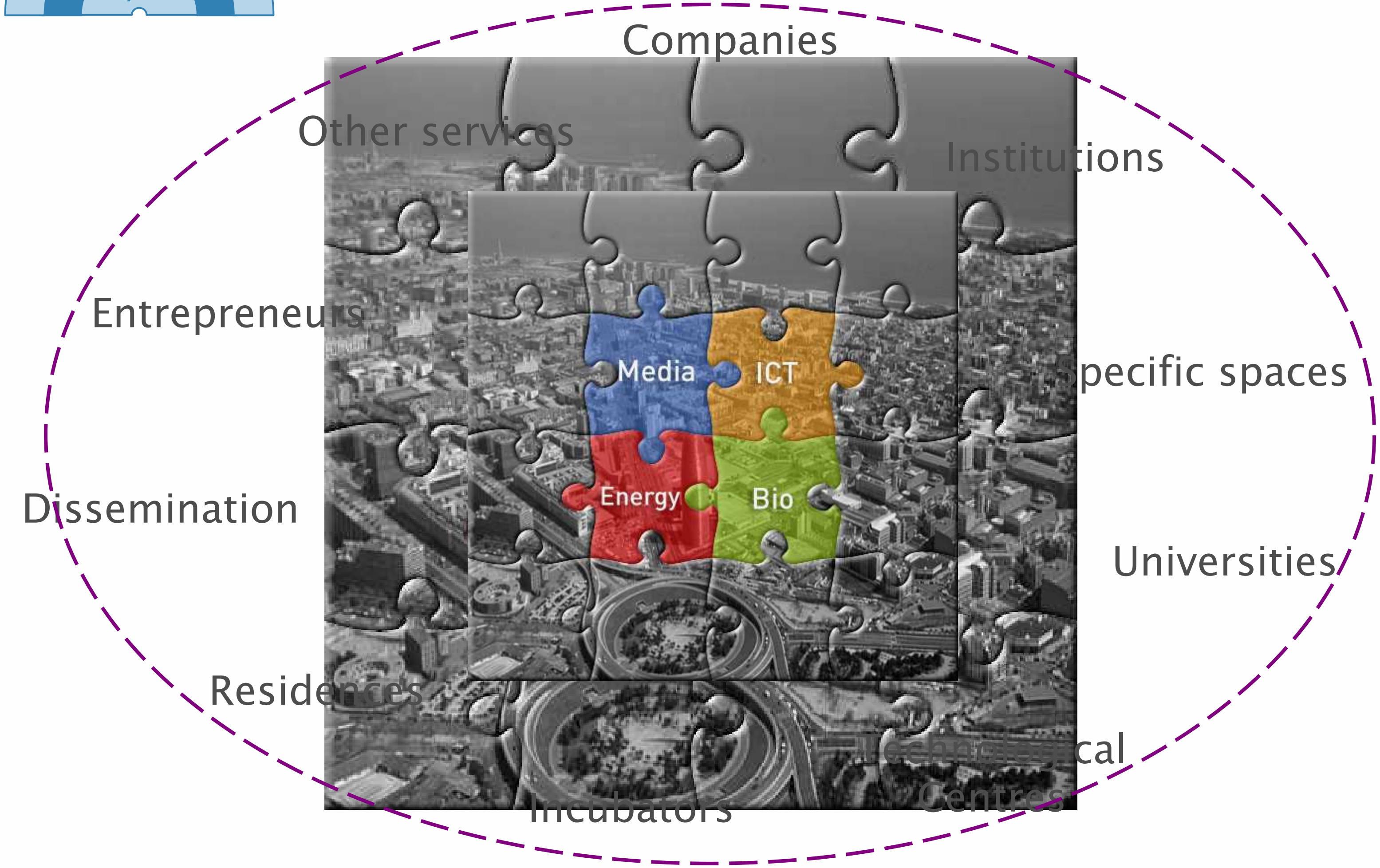




31st december 2006

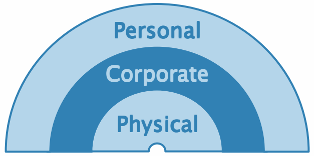
Leadership of projects: Current situation and forecast





Clusters and 22@Barcelona Activities

Media: Barcelona Media Park



Companies	Mediapro, Lavinia…
Institutions	RNE, CAC, Barcelona TV…
Specific spaces	Barcelona Media Production Centre
Universities	UPF, UB, UOC
Technological Centers	Barcelona Media Innovation Centre
Incubators	PBM Incubator
Residences	Zamora-Almogàvers
Dissemination	Media Factory

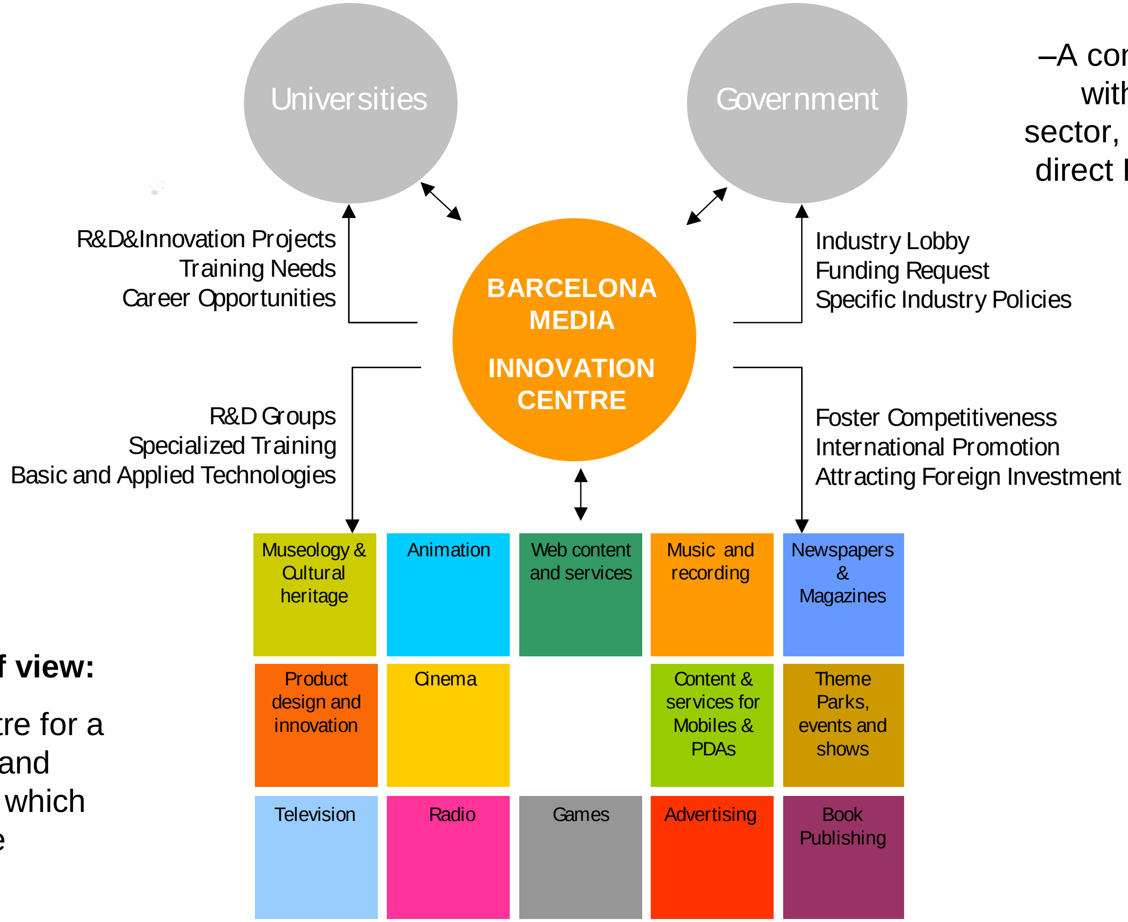
Barcelona Media Innovation Centre

From the university point of view:

–A transfer model for the industrial sector and for all universities and research centres

From the administration point of view:

–A connexion model with the industrial sector, through which direct R+D+i policies



From the industry point of view:

-A model of technology centre for a sector with great relevance and activity in Catalunya, and in which companies need to innovate continuously

–Implements quality research

Empresas:

54% representantes de empresas del sector (contenidos y tecnología)

Barcelona Media Innovation Centre: Intitutions and Universities

46% representantes de instituciones relacionadas con la formación, la investigación y la innovación

Administraciones:

Generalitat de Catalunya

Generalitat de Catalunya Departament de Treball i Indústria

Generalitat de Catalunya Departament d'Universitats, Recerca i Societat de la Informació

Generalitat de Catalunya Departament de Cultura

Ajuntament de Barcelona

Institut de cultura:

22 Barcelona

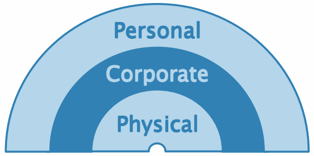
Universidades:

Universitat Pompeu Fabra

La Salle

UOC www.uoc.edu

ICT: Network of R+D centres related to ICT



Companies	T-Systems, Indra, Telefónica
Institutions	CMT, FBD, Localret
Specific spaces	Interface Building
	MediaTIC Building
Universities	UB, UPC, La Salle
Technological Centers	Technological ICT Center
Incubators	MediaTIC Building
Residences	Zamora-Almogàvers
Dissemination	ICT House

To Digitalize the internal processes and reinforce the current IS (ERP, CRM, SCM, RH…)

To Secure the networks and the systems
(Identification, Encryption, Anti-virus, Back-up, Fail-over..)

To Outsource and create new collaborating systems
(call center, online supplier selections, auctions, collaboration…)

To Extend the mobility and profit of the new convergence possibilities (click to talk, VoIP, Wi-Fi, 3G, videoconf…)

To Generate revenue exploiting fully the e-business boom
(e-tourism, e-advertisement, e-government, online video…)

To Center the organization around the employee
(BI, AI, E-learning, Data mining, score board…)

Differentiated Demand

Low Tech Industry: agriculture, textile, construction…

Medium Tech Industry: Metallurgy, energy, plastic and ship building…

High Tech Industry: Aeronautic, medical sector, transport, chemical…

Low Knowledge Industry: Commercial activity, tourism, postal services…

Intensive Knowledge Industry: Finance, Health services

Information Industry: ICT, Education, knowledge editing, videogames

To Digitalize the internal processes
and reinforce the current IS (ERP, CRM, SCM, RH…)

To Secure the networks and the systems
(Identification, Encryption, Anti-virus, Back-up, Fail-over..)

To Outsource and create new collaborating systems
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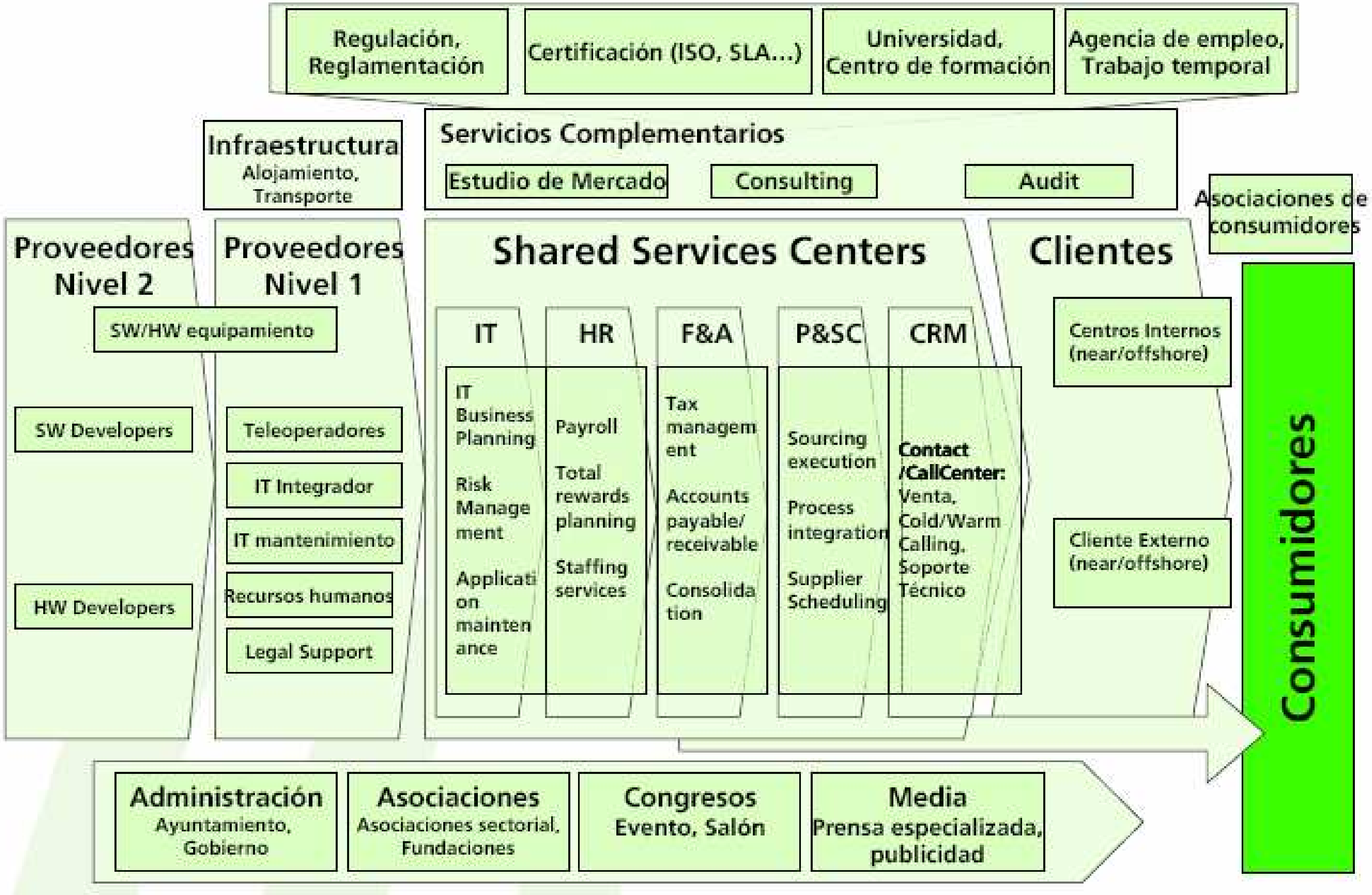
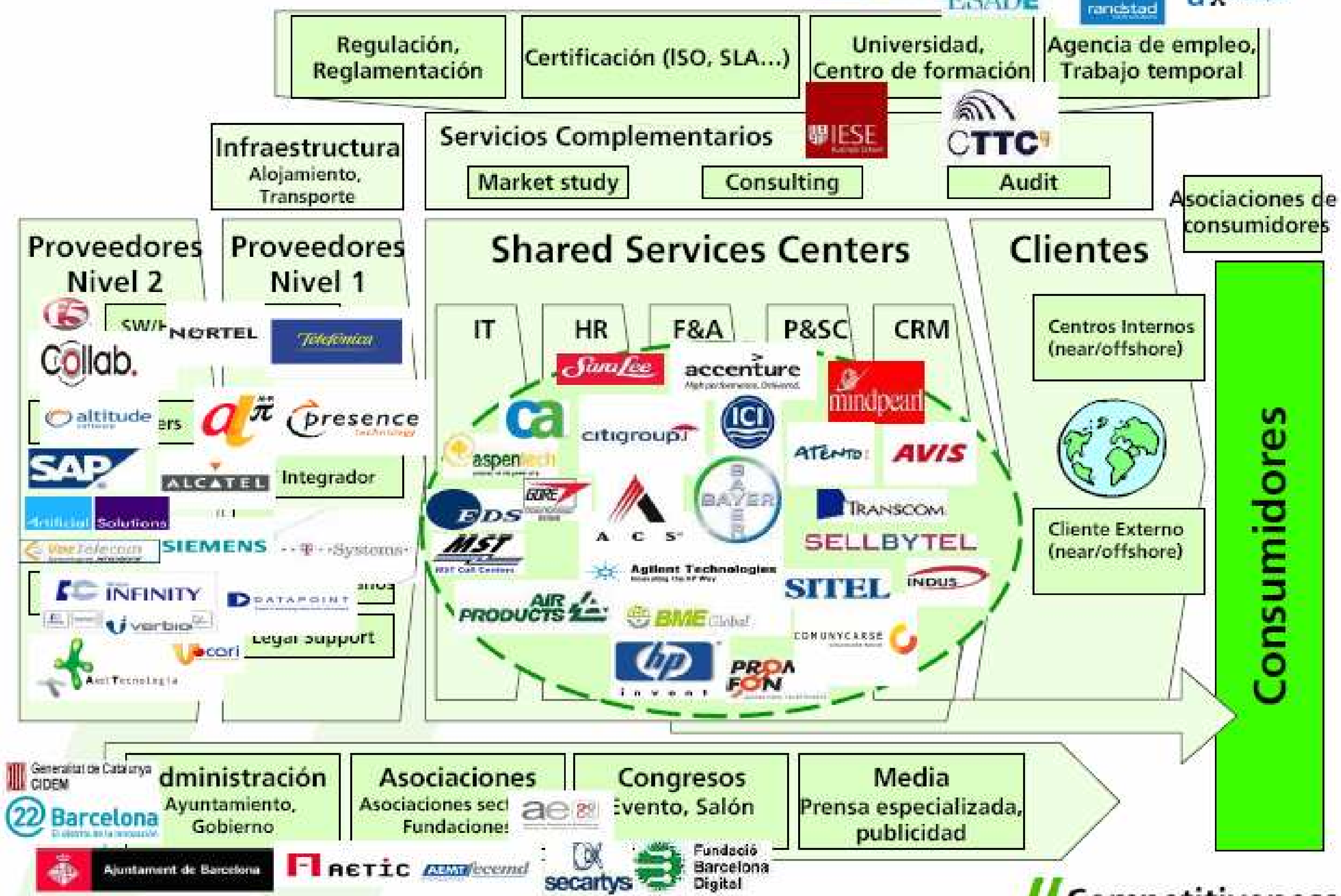


Regulación, Reglamentación
Certificación (ISO, SLA...)
Universidad, Centro de formación
Agencia de empleo, Trabajo temporal
Infraestructura
Alojamiento, Transporte
Servicios Complementarios
Estudio de Mercado
Consulting
Audit
Asociaciones de consumidores
Proveedores Nivel 2
SW/HW equipamiento
SW Developers
HW Developers
Proveedores Nivel 1
Teleoperadores
IT Integrador
IT mantenimiento
Recursos humanos
Legal Support
Shared Services Centers
IT
IT Business Planning
Risk Management
Application maintenance
HR
Payroll
Total rewards planning
Staffing services
F&A
Tax management
Accounts payable/ receivable
Consolidation
P&SC
Sourcing execution
Process integration
Supplier Scheduling
CRM
Contact /CallCenter:
Venta, Cold/Warm Calling, Soporte Técnico
Clientes
Centros Internos (near/offshore)
Cliente Externo (near/offshore)
Consumidores
Administración
Ayuntamiento, Gobierno
Asociaciones
Asociaciones sectorial, Fundaciones
Congresos
Evento, Salón
Media
Prensa especializada, publicidad

El Cluster Shared Services



ICT: Network of R+D centres related to ICT

Center ICT

- It belongs to the network of CT of the CIDEM. Its main activity consists of the **transference of the knowledge generated in the private and public centres of research**
- Specialized in a type of technology or sector, with excellence criteria at national and international level
- Mission: to reinforce the industry of the TIC
  – Adaptation of products to the necessities of the demand
  – To take advantage of the the Catalan system structures of research and development.

- Its operation:
  – Strategic lines defined
  – Internal and external groups/lines (collaboration in network with other centres) -
  – Network structure: to spread, to sensitize and to detect necessities and demand

Fuente: Centro de Innovación y Desarrollo Empresarial (CIDEM).

ICT: Network of R+D centres related to ICT

Universities of reference in matter TIC

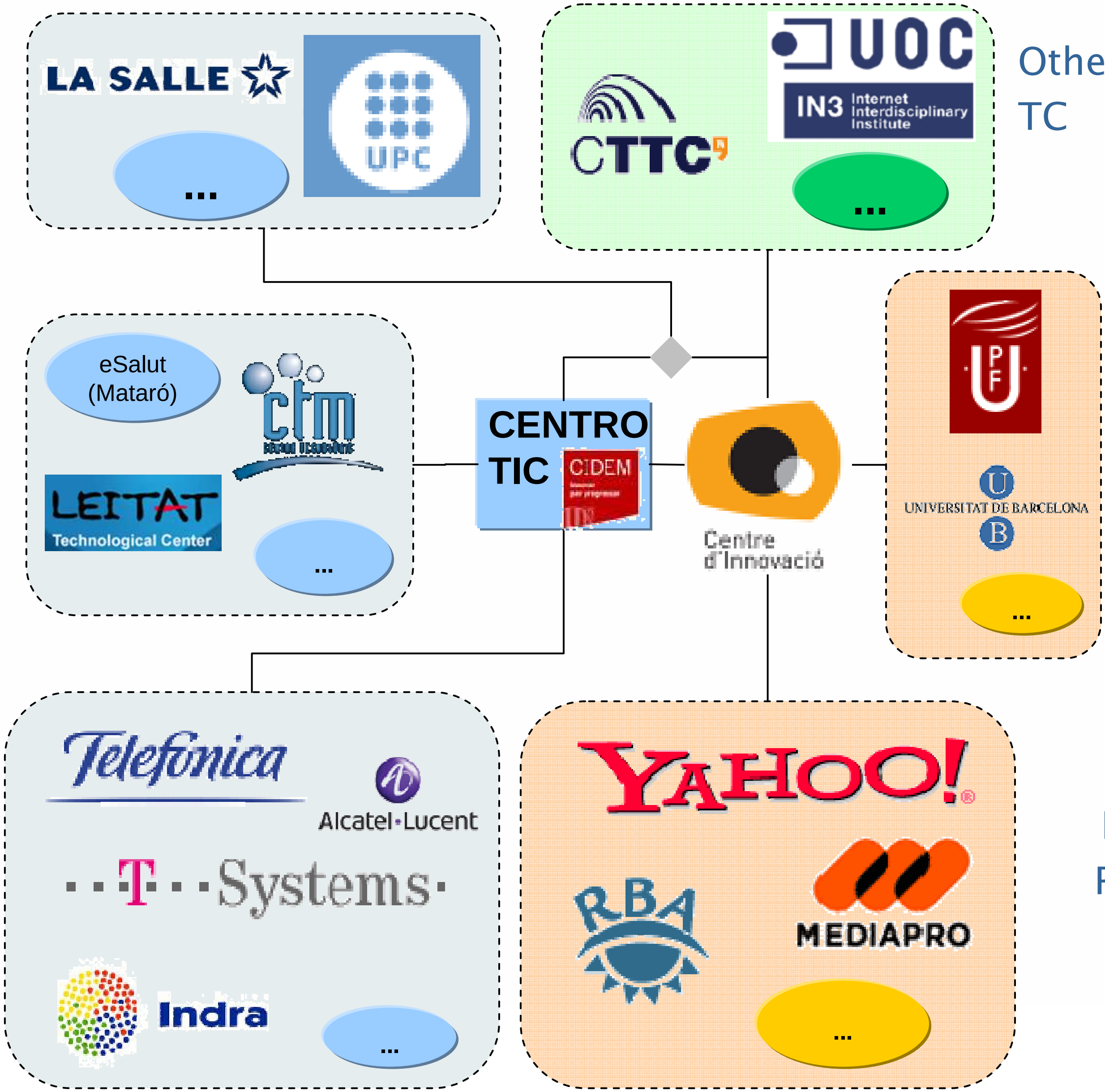
Other related TC

Public–private technological centers

Universities of reference in matter Media

Resources in R+D of great TIC companies

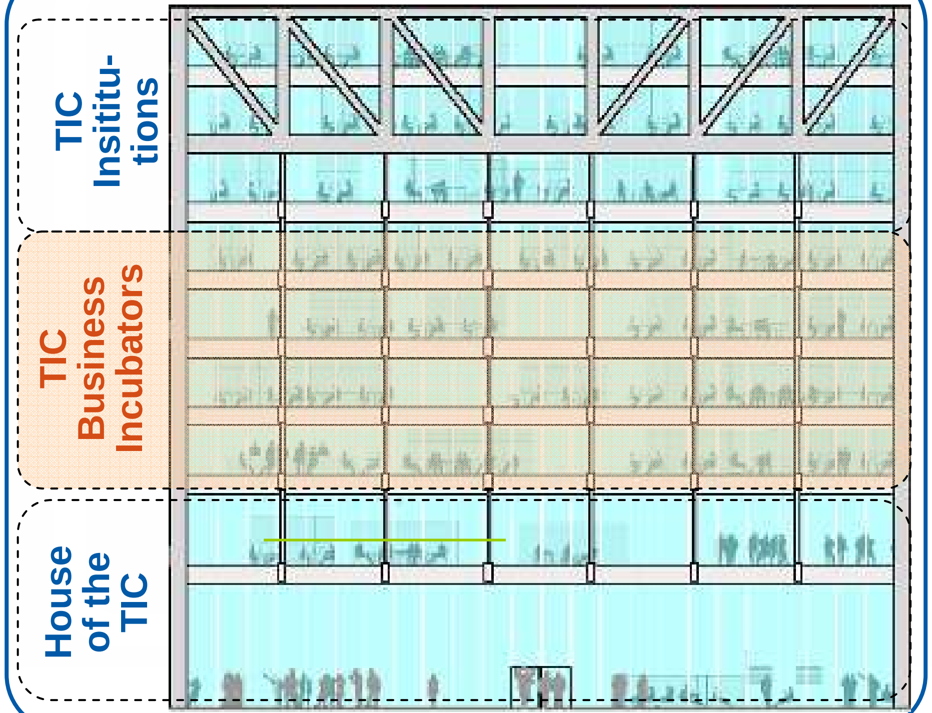
Resources in R+D of great Media companies



ICT: Network of R+D centres related to ICT

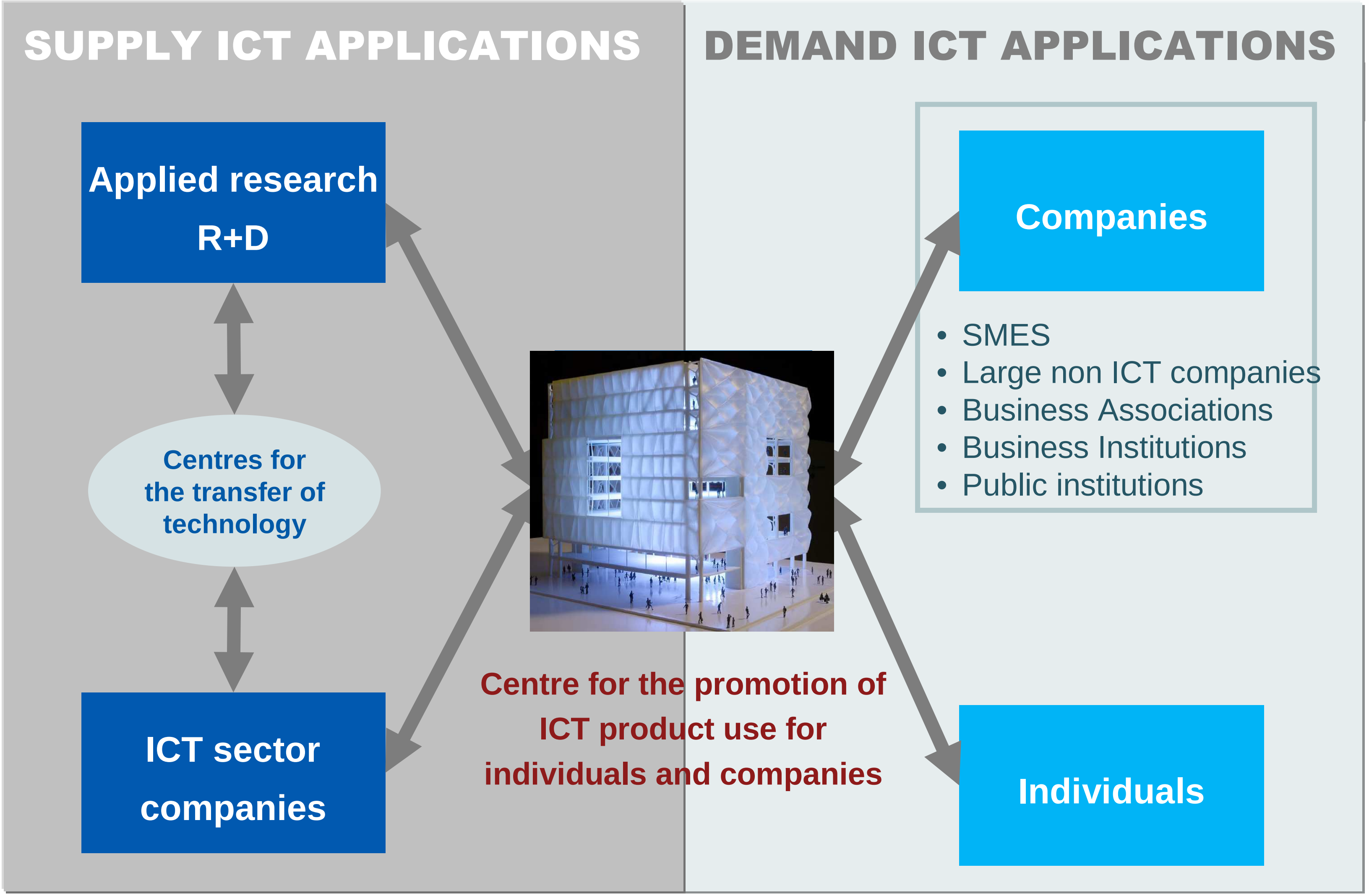
MediaTIC Building

Place of encounter for the Media and TIC community in 22@.

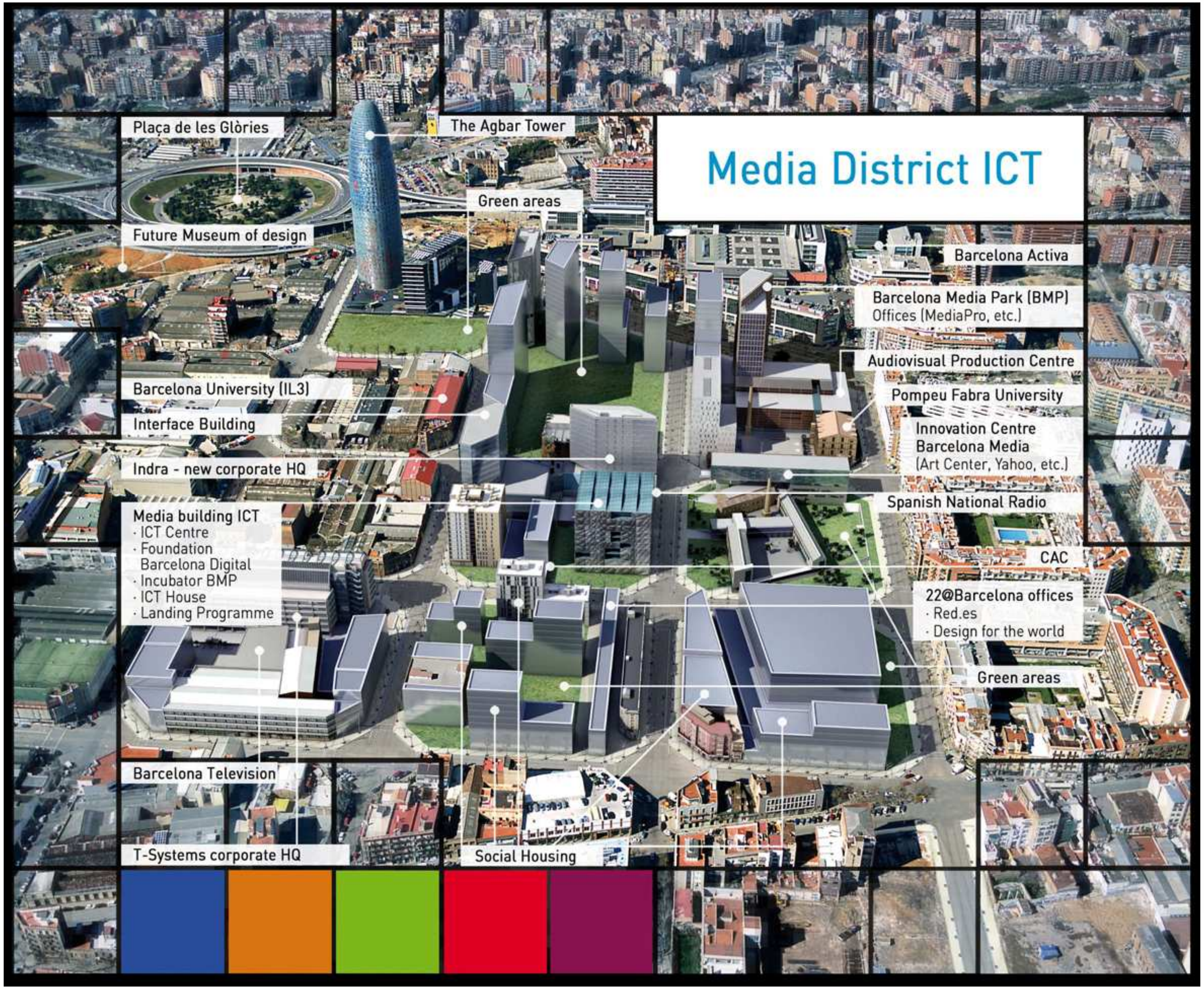


Spaces and services of high value added for new companies and professionals.

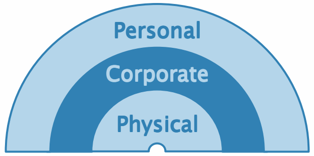
The House within the framework of the support value chain for ICT innovation



PROSPECTS 2007-2010
EXAMPLE: the MEDIA ICT environment



Energy: Interuniversity Campus of Besòs

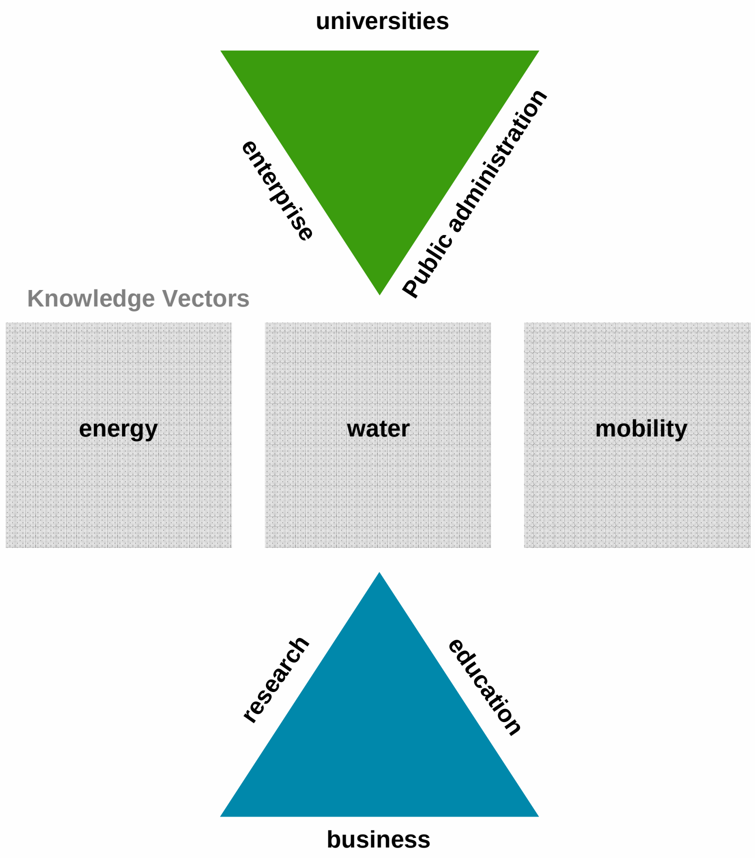


Companies	Endesa, Ecotècnia
Institutions	ITER, Cambra de Comerç
Specific spaces	Campus Offices
Universities	UB, UPC
Technological Centers	RC Energy, TC Energy
Incubators	b_TEC Incubator
Residences	b_TEC Residence
Dissemination	Campus services

b_TEC

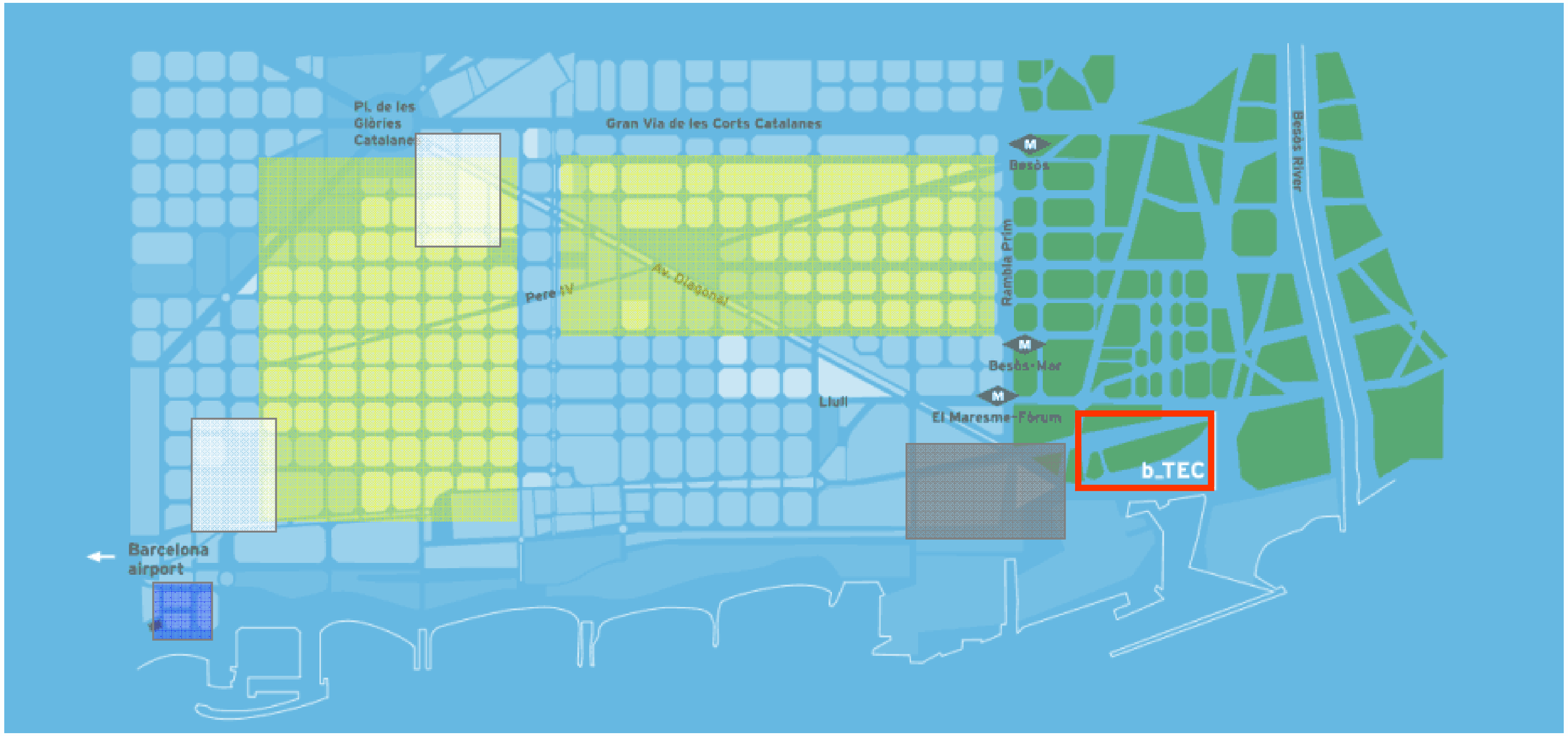
General overview

A scientific and technological cluster with local and international universities and companies working together in activities focusing on the determined knowledge vectors



b_TEC environment
the framework of 22@ district

b_TEC



- Urban and metropolitan centrality
- Focus on business
- Concentration of Training, R+D and Innovation Centres
- Clusters
- Advanced infrastructures
- Flexible spaces
- Quality urban environment
- Public transport networks

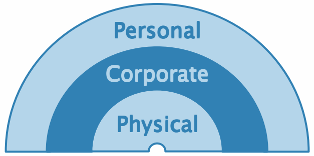
22@ district

university campus

congress centre

biomedical research centre

Biofirm-Medical Technologies



Companies	Gaes, Matachana, Sanofi Aventis, Semillas Fitó…
Institutions	IBEC, CIDEM, BioCat, …
Specific spaces	BIO Enterprise Park
Universities	UB, UPF, UPC
Technological Centers	IBEC
Incubators	HealthBuilding
Residences	Zamora-Almogàvers
Dissemination	HealthBuilding

Biofirm– Different projects

BIOTECH **Bio empresarial Park**

PCB

PRBB

...

...

R+D, TT, ... Company

22@ Barcelona:

Spaces for biotech companies (local & internacional)

- Offices
- Laboratories
- Possible small productions

MEDTECH **MedTech Cluster**

IBEC (UPC + UB)

Part of R&D, T Tech transfer, trainning, ...

Financing

Dissemination

Residences

. . .

22@ Barcelona:

Spaces for Medtech companies (local & internacional)

- Offices
- Laboratories
- Possible small productions

Business Atraction local & internacional

BIOTECH
+
MEDICAL TECNOLOGIES
+
PHARMACEUTICAL
+

Some examples:

- ✓ Gaes
- ✓ Matachana
- ✓ Sanofi-aventis
- ✓ Campi i jové
- ✓ Novartis
- ✓ Semillas fitó

UNIVERSITAT POLITÈCNICA DE CATALUNYA

CREB Centre de Recerca en Enginyeria Biomèdica UNIVERSITAT POLITÈCNICA DE CATALUNYA

Parc Científic de Barcelona

prbb

UNIVERSITAT DE BARCELONA

UNIVERSITAT POMPEU FABRA

COL·LEGI OFICIAL DE METGES DE BARCELONA

biocat BioRegió de Catalunya

Generalitat de Catalunya

FENIN

CataloniaBIO Associació catalana d'empreses de biotecnologia

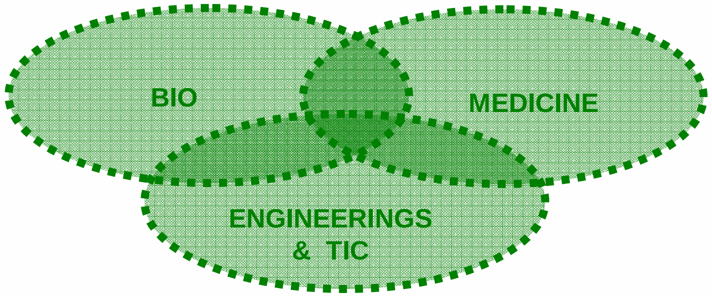
Biofirm-Medical Technologies

Objective:

To promote the development of clúster of activities related to the Medical Technologies of Catalan scope and to base in the district @Barcelona.

The impulse of the activities of clúster will be based on the concretion of the product, its positioning and the involution of the factors differentials:

•Investigation and Technological Transference
•Formation
•Creation and attraction of companies
•Entailment of the administrations specific
•Creation of spaces and services
•Diffusion/awareness of the sector
•Institutionalization and financing



Promoter team and support:

The project counts on an **promoter team formed by representatives of the public administration, research centres and of medical and enterprise sectors** and, in addition, it has **institutional and enterprise support of different administrations, business associations and concrete companies, public and privet hospitals and health organisms, international agents**, etc.

Among others:

CIDEM Innovar per progressar

ibec Institut de bioenginyeria de Catalunya

Col·legi Oficial de Metges de Barcelona

22@Barcelona El districte de la innovació

Universitat Politècnica de Catalunya

Universitat de Barcelona

FENIN

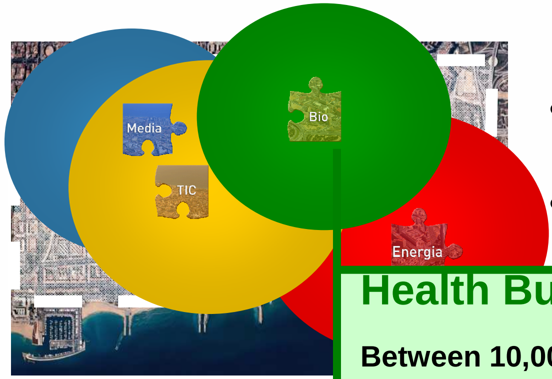
biocat BioRegió de Catalunya

Generalitat de Catalunya

Proposal: Creation of specialized equipment for the sector

HEALTH BUILDING

- **Representative building**: ideal for the companies of the sector of Lifescience
- **Unique and urban location**: Concentration of companies and innovating institutions of the sector, in the centre of Barcelona
- **Adapted to the companies' needs, with concentration of uses and economies of scale**: fixing the bases of the Bio offices of the future, it will have shared infrastructures, spaces of incubation, formation, and research centres.
- **Exclusive for the sector**: it will be the emblematic building for the Lifescience companies in Barcelona
- **Supported by key local and regional agents**



Health Building:

Between 10,000 and 20,000 m2 destined to Health related activities

Activities:

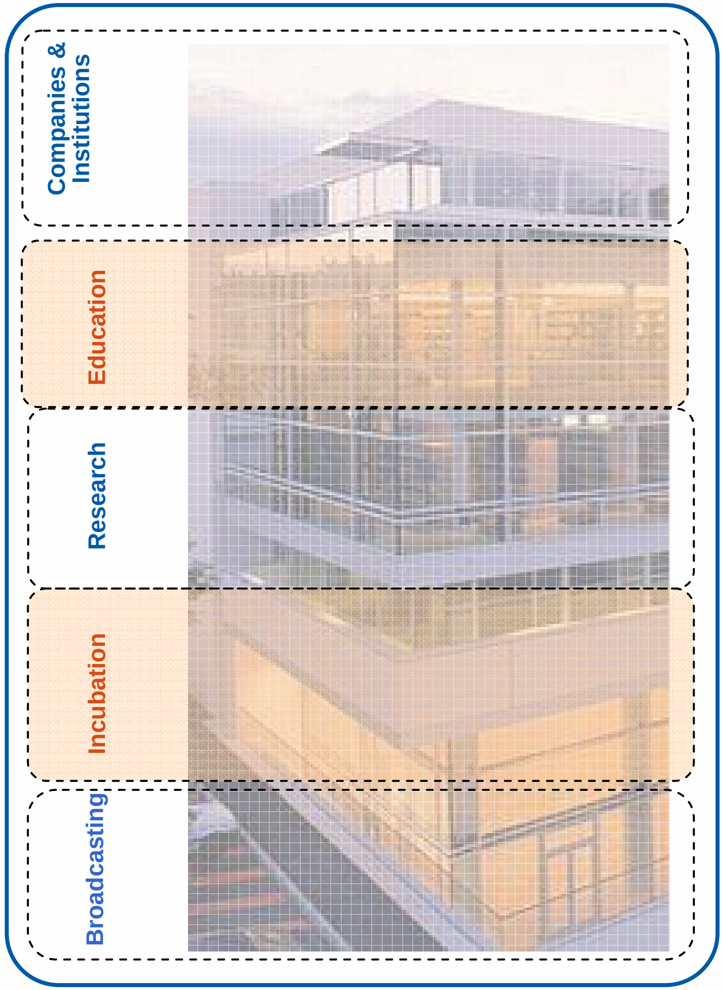
- **Technological transference and research centers (Ibec-UPC-UB, entrepreneurship research, etc)**
- **Educative center, formative activities and seminaries (Masters university and entrepreneurship education)**
- **Broadcasting spaces for the medical technologies**
- **Health Incubator with new companies and and university or hospitable spin-offs (strong relationship with existing programs of entrepreneurship : XTT, Medical doctors Association, Clinical Hospital, etc.)**
- **Institutions related to the sector**
- **Companies linked with the rest of activities of the equipment**
- **Ideally, possible "medical activities".**
- **Common services**

INCUBATION SPACES in the HealthBuilding (Pallars /Agricultura)

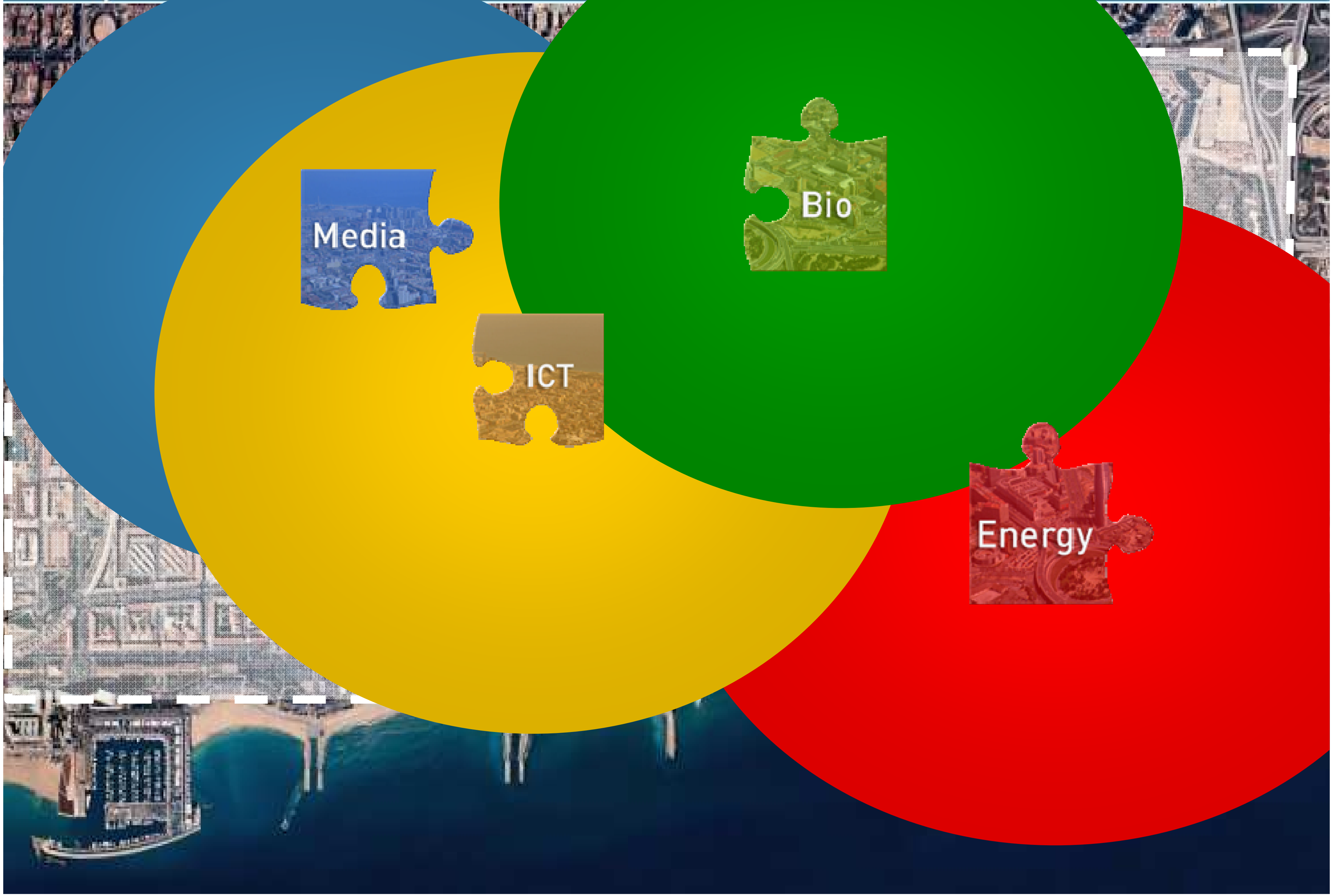
An emblematic building and a meeting point of the Health cluster, and, specifically, of the Medical Technologies at 22@Barcelona. It will contain spaces for companies and institutions and spaces for broadcasting, formation, and incubation reserved for entrepreneurship activities:

- Sectorial Incubators: Medical Technologies
- Barcelona Health Venture Lab

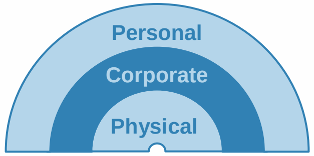
Inauguration in the 2010



22@ Spaces. Engines of transformation

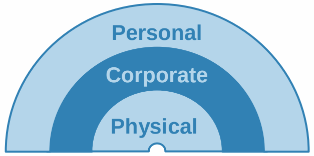


Entrepreneur Culture



22@Barcelona district: an international reference point for the creation and development of new businesses

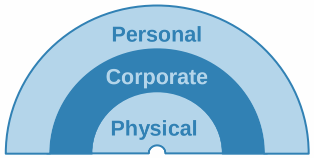
- Barcelona Activa
- Specialized Incubators
  - Media
  - ICT
  - Energy
  - Medical Technologies
- International Incubators
  - Landing Program
- Access to financing
- Residential Centres



Technological Centres network:

- Alstom Centre for Technology Research, Development and Innovation in Urban, Interurban and Rail Transport.
- Barcelona Media Innovation Centre
- ICT Technology Centre
- Innovation Centre for Energy Technologies
- Innovation Centre for Graphic Art Technologies

Entrepreneur Culture: Landing Program



Developing a financial and physical platform including mentoring and coaching services, to facilitate the establishment of global companies who want to be connected to the markets and innovation systems in southern Europe.

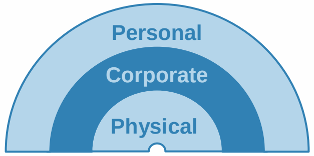
LANDING = Σ HARD (incubator) x SOFT (coaching) x (human capital)

BARCELONA, a Reference Point for Global Innovation

International Business Incubator

France	China	Korea
Mexico	BARCELONA *Zero Distance*	Escandina-vian ountries
Brasil	Chile	USA

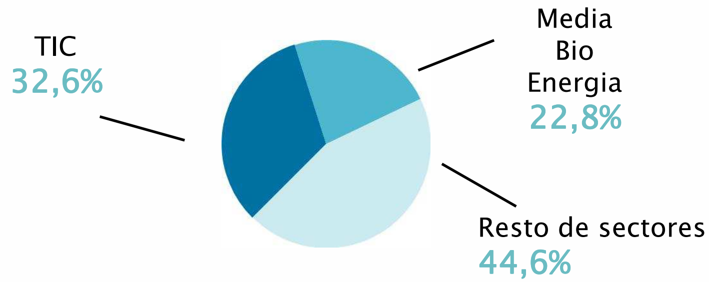
New companies & new jobs registered in 22@Barcelona district



New companies located in 22@Barcelona
(Accumulated data at 12.31.2006 in number of companies)

(31st december of 2006)	
Companies already located	258
Companies in process to be installed	36
Total	294

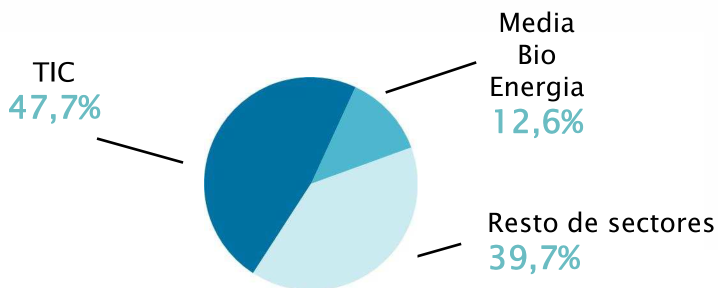
Comparing sectors of the **new companies** located in 22@Barcelona (Accumulated data at 12.31.2006, in %)



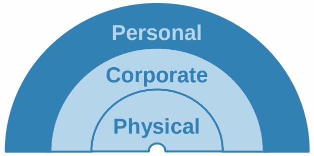
New jobs found in 22@Barcelona
(Accumulated data at 12.31.2006 in number of employers)

(31st december of 2006)	22@ environment	Rest environment	
Companies already located	10.724	7.100	17.824
Companies in process to be installed	6.870	3.269	10.139
Total	17.597	10.369	27.963

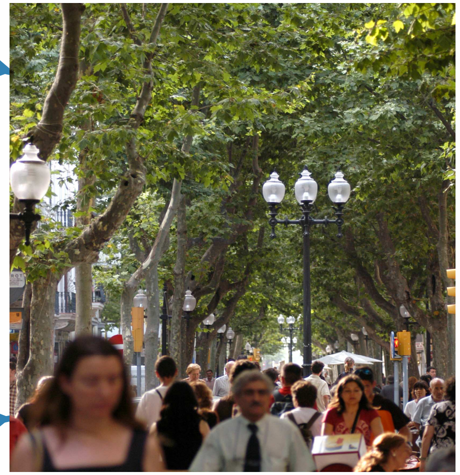
Comparing sectors of the **new jobs** generated in 22@Barcelona (Accumulated data at 12.31.2006, in %)



Space of personal relation



Space of
Personal Relation
22@



For the professionals

- Àgora Program
- Networking
- Relationship spaces
- 22@Network

For the neighbours

- Digital District Program
- Actions of direct communication
- Support to initiatives of the district
- Educative Project

Increase of the belonging feeling
Creation of the community 22@
Pride to work/live in 22@

Developing the International Community: Premise and Objectives

- English is the *lingua franca* of global business and knowledge exchange

- Growing, energising and connecting the international english speaking community in Barcelona can:
  - increase overall social and economic vitality
  - accelerate the transformation to a knowledge city
  - help Barcelona compete as a global city

- The 22@ District can be both a living lab as well as a new pole for the international community, and the new knowledge based industries in Barcelona

Objectives: Enhance the engagement of the English speaking international community already present in Barcelona, with the 22@ district, its firms, institutions and community so this district can lead the transformation to a knowledge city, and a global hub of innovation

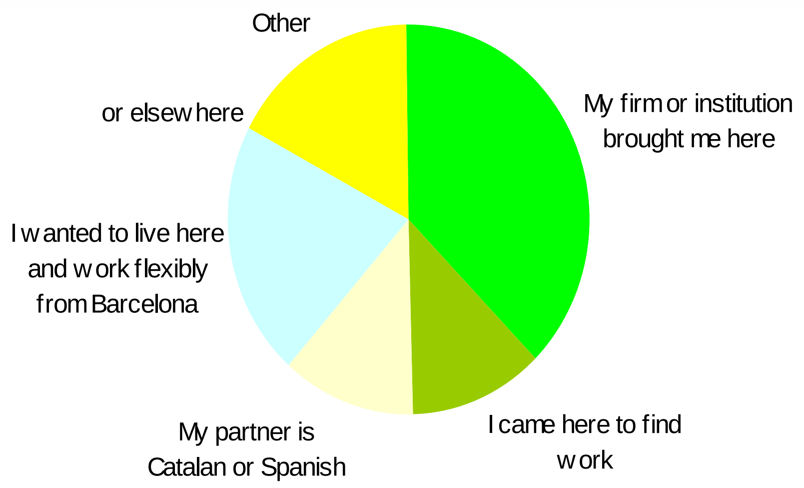
- Main reasons for coming were because company brought them here (36%) or decided they wanted Barcelona lifestyle and came seeking work or just to live (32%)
- The seeks far greater engagement both socially as well as with local firms and institutions
- What contact they have is through social or professional networks and the internet, and then through schools
- Engagement with local community is low at a social level (32%), a little higher in terms of business (49%)
- Key Barriers are Language, Workplace Culture, Openness to new ideas
- Lingua Franca within the international community is 90% English and communication with local community is 80% in Spanish, very little Catalan

Highlights Continued

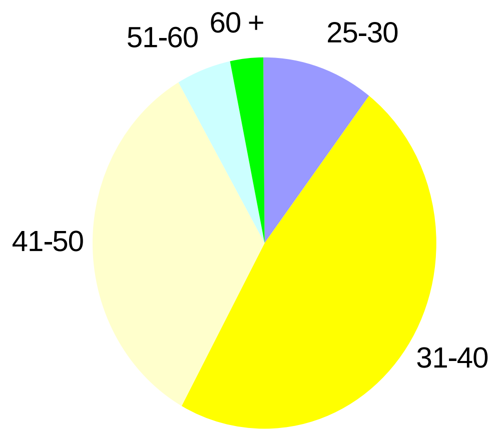
- Landings
  - At a personal level, need help finding and setting up home and schools
  - At a business level, they want to understand what programmes/incentives are available, and help in finding clients, and partners rather than offices
- Awareness of 22@ brand but not what it means and some feel it's just a real estate programme
  - However around half or respondents say they would be interested in working or living there
  - Awareness of other institutions and programmes is low
  - Concerned about lack of centrality, amenities, transportation
- Many comments on the need for the Ajuntament and associations to make city more cosmopolitan
- Their international network is extensive with 59 different cities with strong or very strong professional contacts

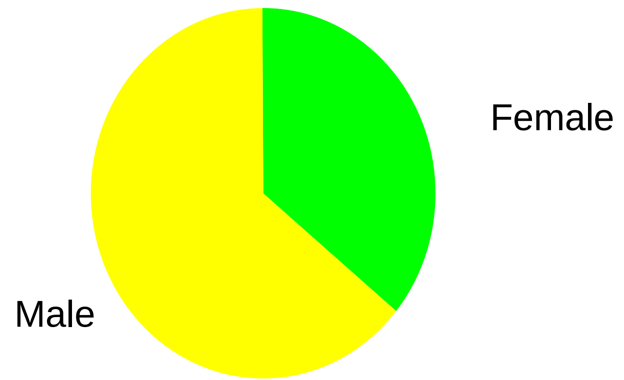
Survey Participants

Reason for Being Here

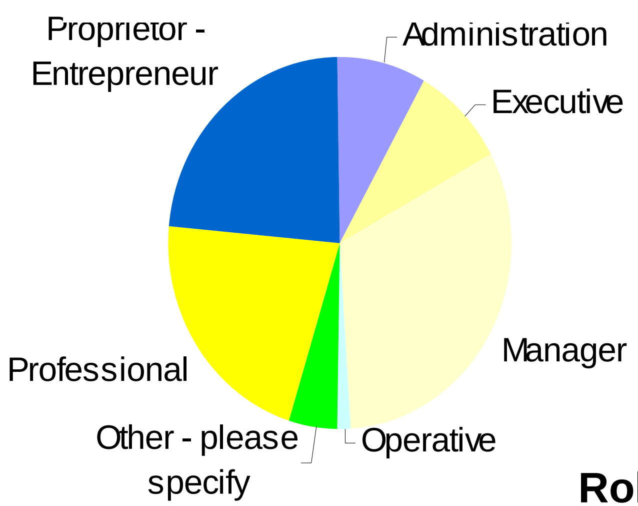


Age Range



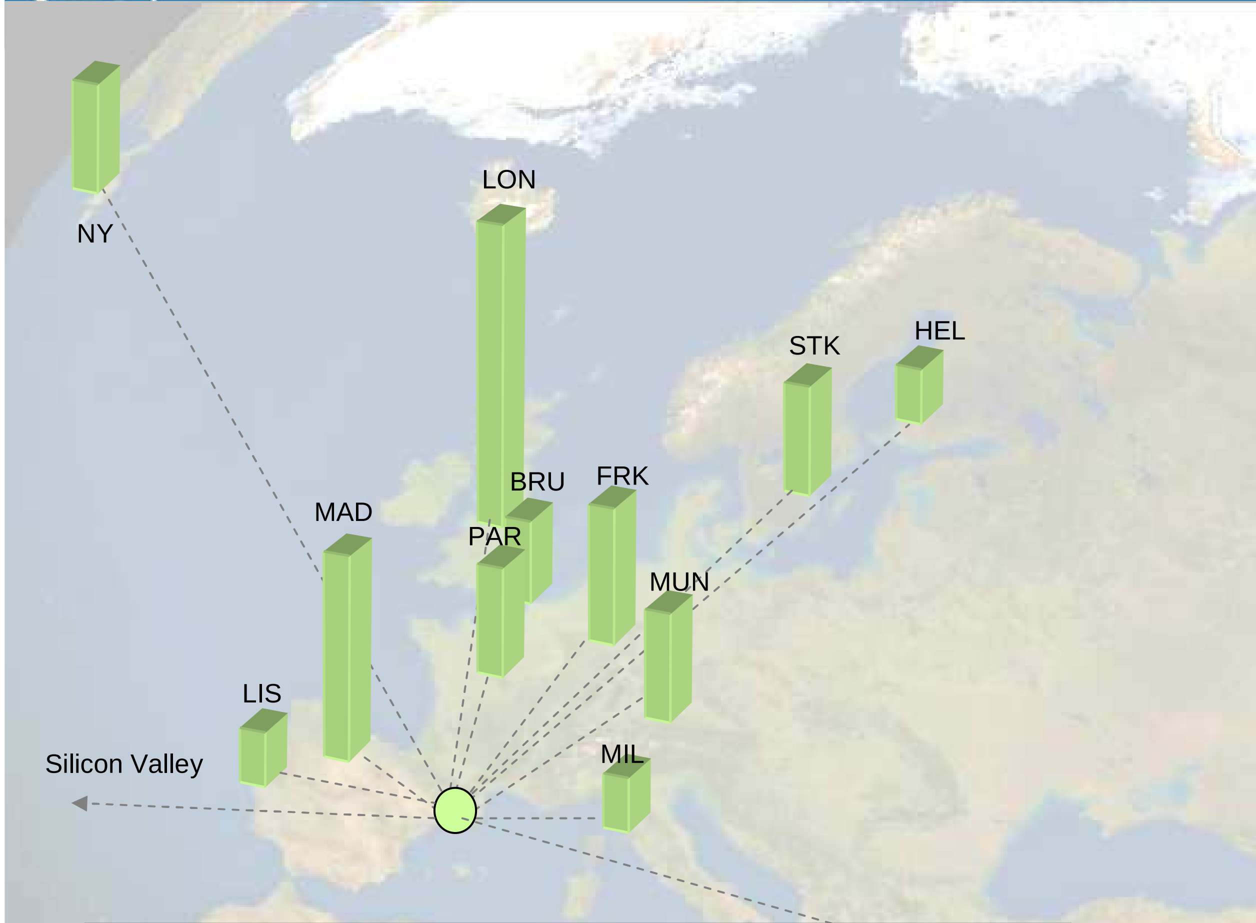


Gender



Roles

International Community’s City Connections



Top Cities and Number of Mentions	
London	41
Madrid	27
Paris	21
New York	14
Frankfurt	13
Stockholm	12
Amsterdam	9
Brussels	9
Munich	8
Silicon Valley (various)	8
Milan	6
Helsinki	5
Lisbon	5

- **59 Different Cities listed in 32 different countries**
- **The 13 Cities with more than 5 mentions are shown in the table**

Summary of Findings for 22@

- International community not only seek greater engagement but ready to be partners
- Modest awareness and low knowledge of 22@ in both private and business community
- Don’t see city or 22@ as proactively engaging with them
- And find challenges in engaging – language, work culture, openness
- English Language is the overwhelming language within this community at work and socially - Catalan is very low
- Concerns are on centrality, amenities, transport environment, housing
- Key issues around schools and education at a personal level
- At a business level:
  - Linkages and contacts in local firms – as potential clients and partners
  - Overlap, quality and responsiveness of local agencies
  - Finance and access to venture capital
  - Demand side incentives – Linking Public Sector procurement to local investment

Key Recommendations

- Enhance both business and personal landing programmes
- Step up awareness and education programmes, and do so in English
- Strengthen and extend English Language training in schools and colleges, and through associations
- Address International Schooling as urgent priority
- Build more effective networking programmes and infrastructure
- Mediate between local agencies and international companies
- Increase focus on enabling others to execute 22@ sponsored programmes, in addition to 22@ execution
- Translate 22@ District initiatives and Infrastructure into business value for each of the different stakeholder categories
- Balance “supply side” initiatives with more on the “demand side”
- Differentiate Industry Clusters through cross sector innovation not just within each pillar
- Identify key performance indicators / balanced scorecard for 22@ and then assess/priorities each initiative:
  - How do their objectives impact the overall scorecard and how are they performing in practice
- Rationalise and consolidate down the overall number of programmes/initiatives

Enhancing Programmes of 22@Barcelona

Transforming Physical/Logical Networks

- Schools Programme
- Mobility / Transportation
- Housing
- Pervasive ICT networks
- Community Portal and related services

WiFi Pilot
Community and Professional Portals

Enhancing Social Networks

- Enhanced Landing for individuals and employees – the Connect Club
- Multi-Lingual District
- Ambassadors

Workshops
Virtual Memoria
Families en Xarxa
Reciclatge de PCs
Discover Sant Marti
Clicportal etc

Building Business Networks

- Big Game Hunting and a total value proposition
- Entrepreneurs Connection
- Enhanced Biz Landing
- University Challenge
- Innovation Exchange
- Demand-side Stimulus

Agora,
Investors Forum
Business Breakfasts
Channel 22@IP
Newsletter/Bulletin
Business Bridges
22@Capital
MediaTic

Create a Community of 22@Ambassadors

Appoint well connected members of international community as ambassadors to key local and international resources on behalf of 22@

- There is a significant number of individuals within the international community seeking to make a contribution to their city
- 22@ can reach out, nurture them and invite them to be ambassadors for their barrio
- And assign them responsibilities, particularly in articulating the 22@ social, cultural and commercial transformation to other networks
  - International Clubs and Associations
  - Schools
  - International Finance
  - Business Community Groups e.g. BNI, MobileMonday, Alumni ESADE, IESE etc

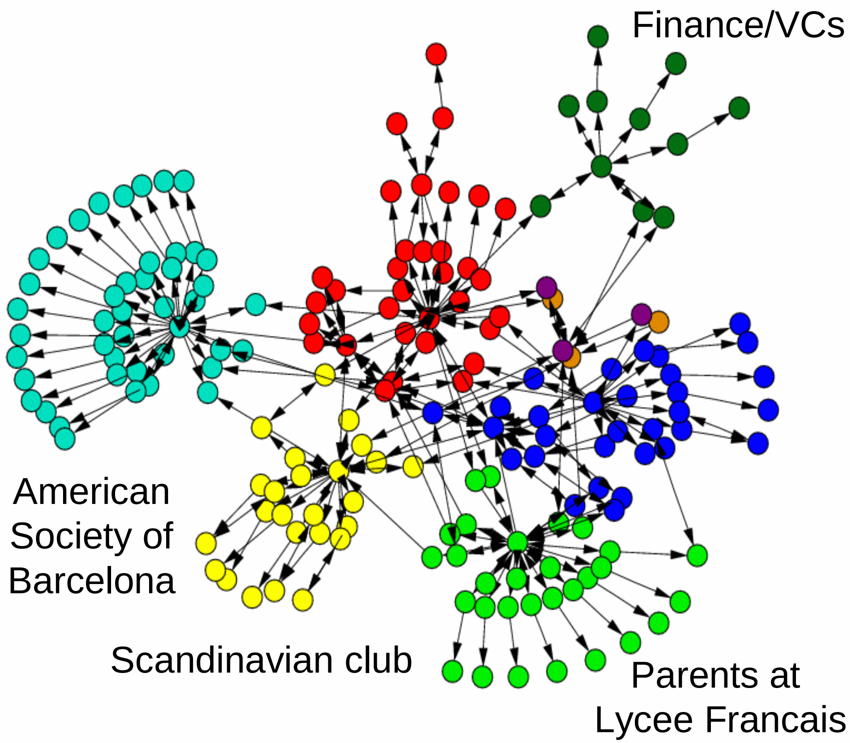
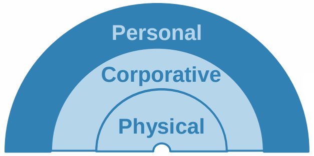


Illustration of Social Network Model

Professional Services



AGORA PROGRAM

SYMPOSIUM ON "URBAN CLUSTERS"

22@UPDATE BREAKFAST

22@NETWORK

BARCELONA WI-FI

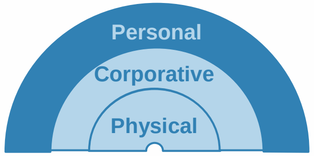
22@ CHANNEL

QUALITY OF LIFE

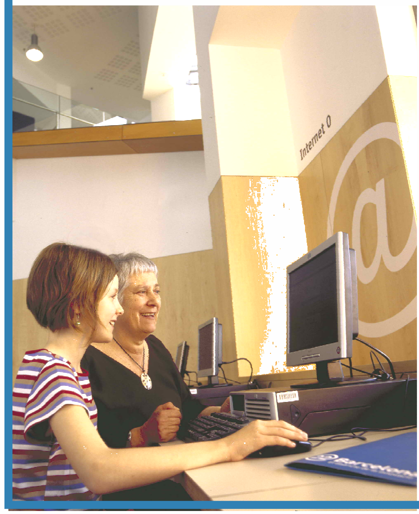
PROFESSIONAL PLATFORM

INTERNATIONAL PROJECTION

Citizens Projects



22@ Districte Digital



- Virtual Memory of the Sant Martí District's elders
- New multimedia classrooms
- Computer recycling network
- Families on line
- Teleworking
- Discovering Sant Martí

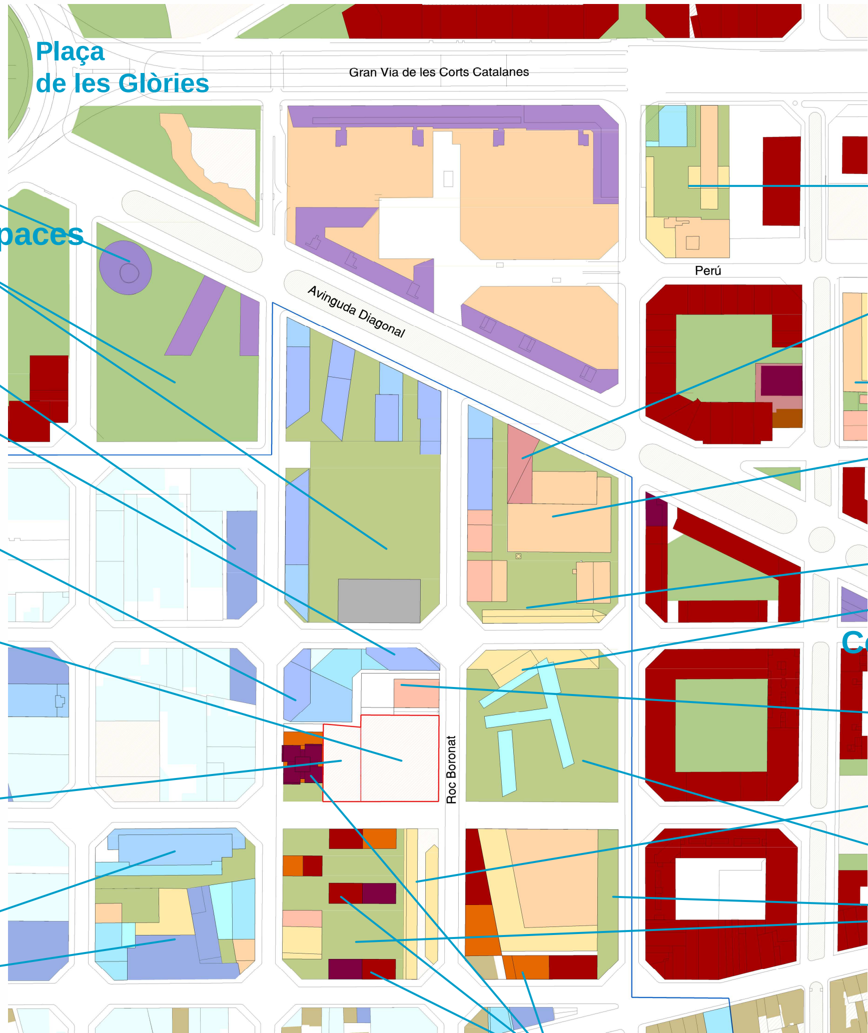
22@ Projecte Educatiu

- In-22@companies practice program
- Professional Education Center focused on Media and ICT areas

Sponsorship and participation in the neighbourhood activities
Direct communication actions
Neighbour needs analysis


Vielen Dank!

PROSPECTS 2007-2010
EXAMPLE: the MEDIA ICT environment



Agbar Tower

University of Barcelona

Green spaces

New Indra HQ

Interface Building (exclusive ICT SMEs)

MediaTIC Building:
- ICT Centre
- FBD
- PBM Incubator
- ICT House
- Landing

CAC
Audiovisual Consortium of Catalonia

T-Systems HQ

Barcelona Televisió

Barcelona Activa

Barcelona Media Park (PBM) Offices (MediaPro, etc.)

UOC

Audiovisual Production Centre

UPF

Barcelona Media Innovation Centre (Art Centre, Yahoo, etc.)

Radio Nacional de España

22@Barcelona Building

Green spaces

Social Housing

Biocatalysis2021 Cluster Initiative

TuTech INNOVATION
Wissen . Technologie . Märkte

BIO KATALYSE 2021

Nachhaltige Biokatalyse auf neuen Wegen

Merging the Boundaries between Science and Innovation

Dr. Helmut Thamer - CEO TuTech Innovation GmbH

management coordinator of biocatalysis2021

Bundesministerium für Wirtschaft und Technologie

Background

TuTech INNOVATION Wissen . Technologie . Märkte

- Since 1992 TuTech is successfully working on knowledge transfer and technology-management

- In co-operation with Prof. Antranikian (Head of the Institute for Technical Microbiology at University of Technology Hamburg (TUHH)) several research consortia are coordinated:
  - EU Network: „Biotechnology of Extremophiles“ and „Extremophiles as Cell Factories“ (1993-1999)
  - DBU network Biokatalyse (2000-2003)
  - DBU network InnovationsCentrum Biokatalyse (ICBio) 2000-2007

- In 2005 start of an initiative “Industrial Biotechnology North”
  - to coordinate the activities of Universities and Companies
  - to strengthen the visibility of the “white biotechnology” in Northern Germany
  - to initiate research cooperation between science and industry

Bundesministerium für Wirtschaft und Technologie

BMBF Competition "BioIndustrie2021"

- BMBF call "BioIndustrie2021" in May 2006

- In cooperation with the partners of the "Industrial Biotechnology North" initiative TUHH and TuTech start to form a national, sectoral cluster "Biocatalysis2021" and coordinate the proposals for the first and second phases of the competition

- In May 2007 the BMBF selects 5 of 19 competitors to be supported by the BMBF in the next five years with a total amount of 60 Mio. €.

  The cluster "Biocatalysis2021" wins the first price and will get a support of 20 Mio. €.

The Consortium

TuTech INNOVATION Wissen.Technologie.Märkte

Clustering of Excellencies with partners from Large Industries SME and Universities

- BASF, Henkel, Degussa, Merck and 11 other global players
- Direvo, SternEnzym, Dr. Rieks and 16 other innovative SME
- 10 Universities and 3 Research Institutes (IFM-Geomar, Institut für Katalyse, EMBL)

PLUS: 7 Regional Agencies

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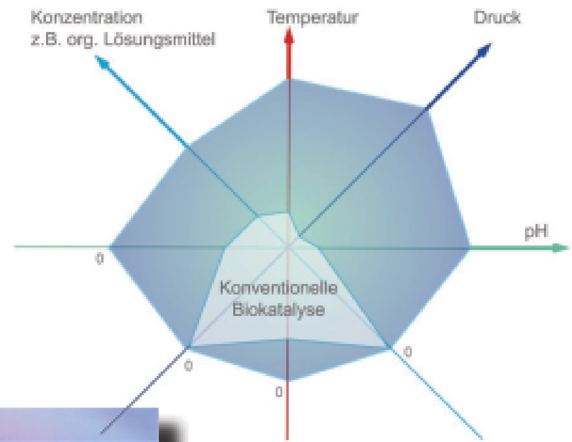
Biocatalysis on New Paths

Innovative biocatalysis under extreme conditions

- Exploitation of new biotopes as resource of new enzyme systems
- Optimization of biocatalysts
- Using the promiscuity of enzymes
- Establishment of the biocatalysis at:

  - extreme temperatures
  - extraordinary pH-values, solvent- and salt-concentrations
  - high viscosities and pressures

- Process-development and downstream-processing



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für Wirtschaft
und Technologie

Economical Potentials

Biocatalysis: Motor of the Industrial Biotechnology

- Innovative processes and products using biocatalysts
  - enzyme market: 3 Bio. € per year
  - white biotechnology: 55 Bio. € per year

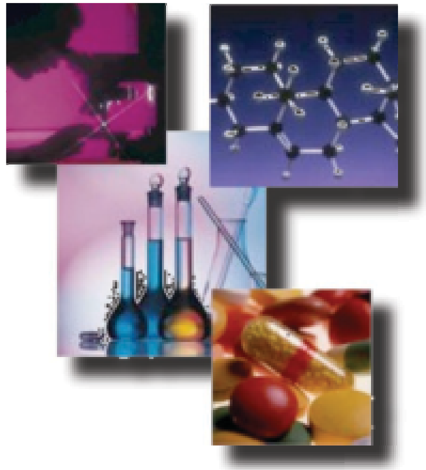
- Growth: 10 - 30% per year
  Prognosis: production of 20% of all chemical products using biotechnological processes until 2010

- Markets:
  - fine- and special chemicals
  - flavor, active substances, food
  - detergents, consumer goods

Chances for the Chemical Industrie

TuTech INNOVATION Wissen . Technologie . Märkte

Industrial Biotechnology - Innovations for the chemical industry



- Opening up new products and markets (new molecules, bioprocesses under extreme conditions)
- Lower endangering potential
- Strengthening the global competitivness especially against China, Japan and India

→ **Protection & Adding of New Jobs**

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Value Added Chain

Cluster activities along the value added chain

- From screening over process development to the end product
- Universities & Institutes...
  ...basic research, methods and know-how
- SME & Industry...
  ...process development, plant engineering, commercialization

→ stabile enzymes, process technologies, fine chemicals, special chemicals and active substances

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Connecting the Cluster Activities

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Interdisciplinarity and cooperation within the projects and within the cluster

- All projects are interdisciplinary co-operations between partners from industry/SME and Universities

- The different projects will be connected by the cluster- management to generate synergy

- A central technology- and service platform will be at the disposal of all partners (screening, enzyme- and metagenome banks, fermentation)

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Highlight: Concrete Projects

The cluster Biocatalysis2021 creates the basis for concrete innovative projects

- 25 concrete project proposals in cooperation of companies and research institutes
- 3 cross projects: ecological and economical evaluation, Consumer project and central project

open for additional partners and projects

Highlight: Central-Project

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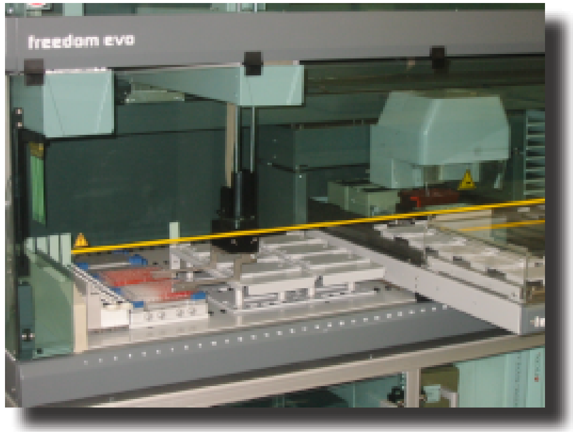
Wissen . Technologie . Märkte

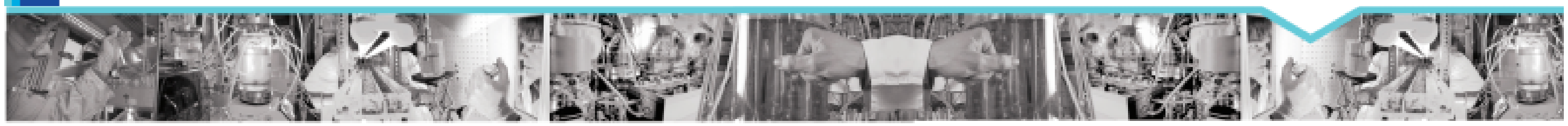
The project offers central services and connects the different projects



- Cross Cluster Service
  - automated highthroughput screening
  - Enzyme collection (BiocatCollection)
  - Metagenome bank (MetaCatCollection)
  - Fermentation up to 300-L
  - Protein cleaning

Aim: Supply of biocatalysts for all projects of the cluster

BiocatCollection
Making Diversity Available



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Cluster-Management

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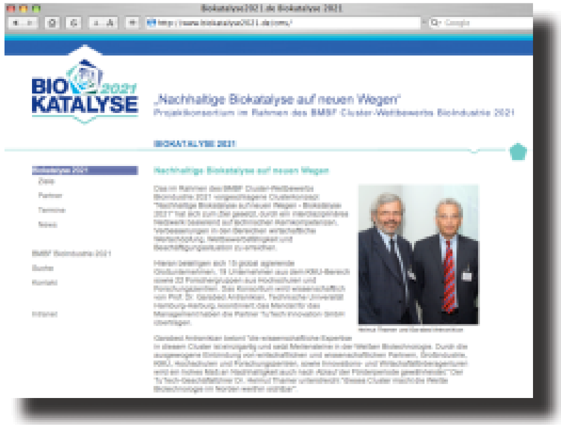
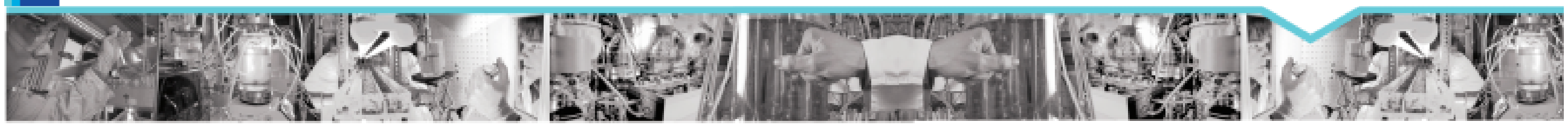
Quality management, communication and Know-how Transfer



- Quality management on Basis of ISO 9001:2000 with modern software tools (Agresso Business World)
- Inter- and Intranet www.biokatalyse2021.de - a portal for intern and extern communication
- National status seminars, workshops, fairs (BIO, Achema, Biotechnica) and international congresses (biocat 2008, 2010, 2012)

biocat 2008
HAMBURG



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Financing

Public/private financing

Implementation of innovative models for fonds to mobilize private money

- Industrial partners of the cluster: 24 Mio. €
- BMBF: 20 Mio. €
- Norddeutsche Länder: 2,3 Mio. €
- Private-Fond in cooperation with HSH N Financial Markets Advisory AG and Seed Fond in cooperation with Hamburger Gründungsfonds

HSH NORDBANK

AIM: Mobilization of private capital with an amount of 6 Mio. €

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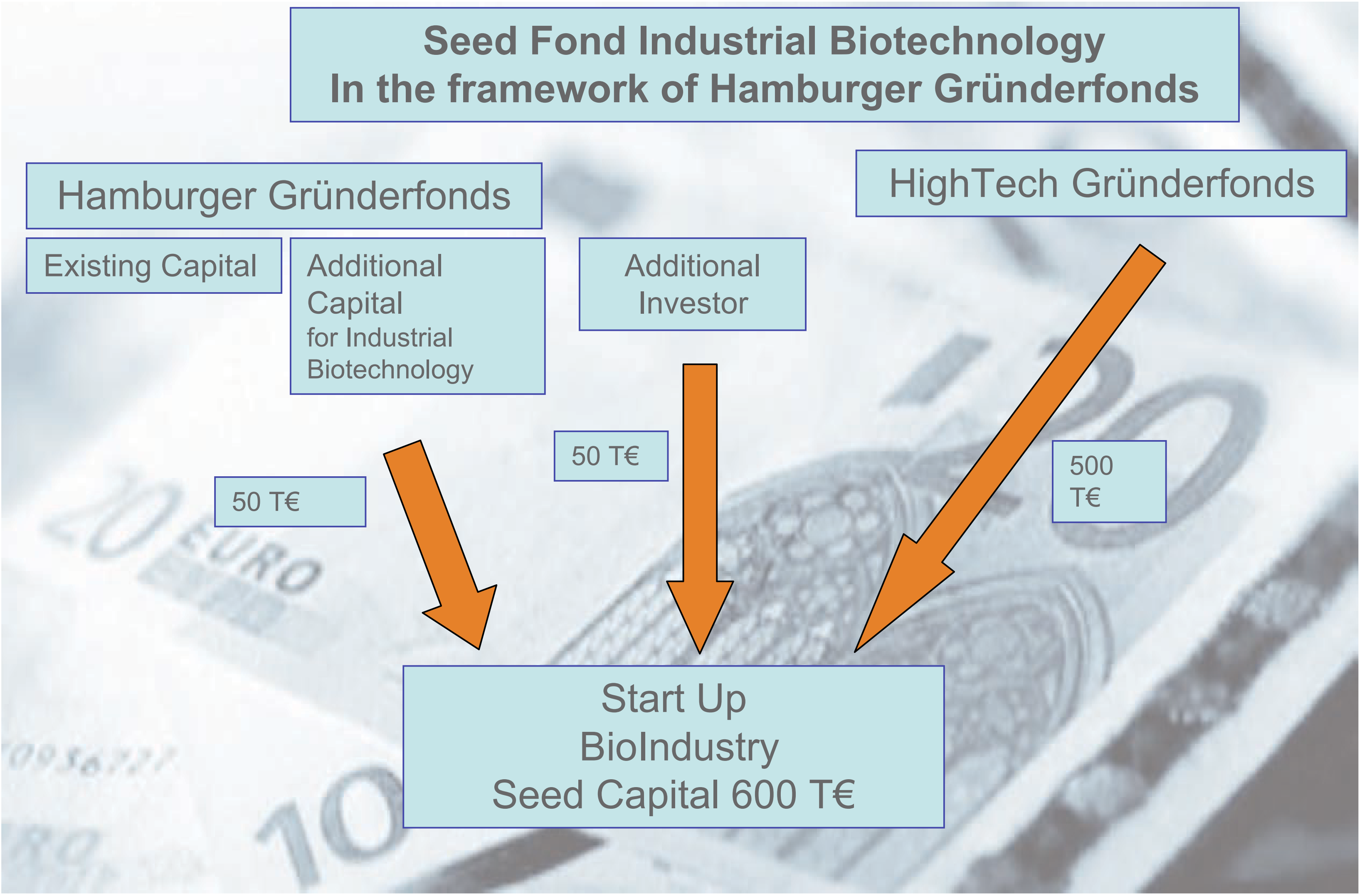
Biocatalysis2021 Seed Fond



Sustainability & Continuity

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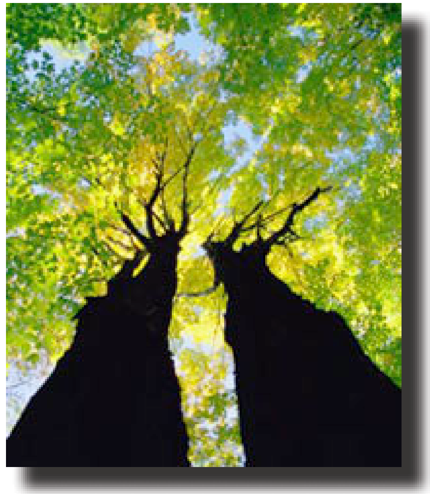
Actions to continually establish the cluster structures and following activities

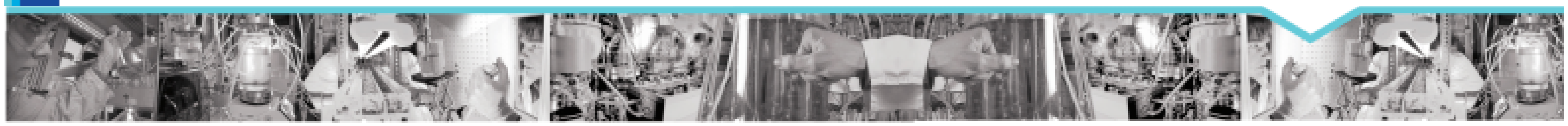


- Virtual Research Institute
  - based on IBN a virtual, cooperative research institute will be established with all partners of the cluster
- Foundation of Start Ups
  - BiocatCollection as individual GmbH
  - Start Ups financed by Hamburger Gründerfonds
  - Consultancy through the TuTech programs hep and PVA
- Protection and creating of jobs in the cluster companies

IBN Industrial Biotechnology North

hep

BiocatCollection
Making Diversity Available



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BIO 2021
KATALYSE

Nachhaltige Biokatalyse auf neuen Wegen

EUROPEAN COMMISSION

Community research

Building a Europe of Knowledge

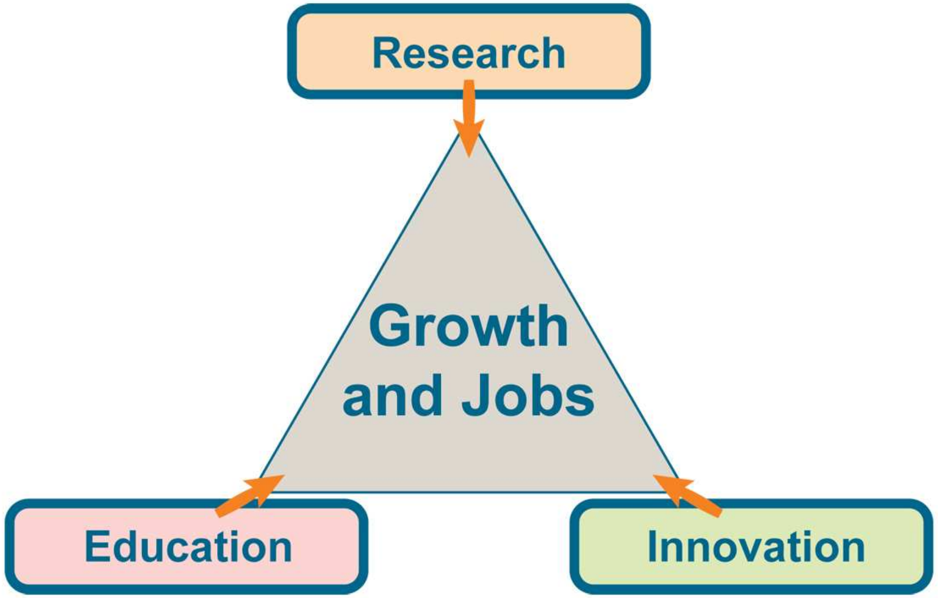
The Seventh Framework Programme 2007-2013

Robert-Jan Smits

DG Research

European Commission

Lisbon strategy



S&T contributes to the **Lisbon** objectives: economic **growth**, **employment** creation, **environmental** protection, **social** challenges: fight **poverty**, improve human **health** and **quality** of life (GSM, remote working, safe roads, etc.)

R&D – Europe's challenges

SEVENTH FRAMEWORK PROGRAMME

	EU-25	US	Japan
R&D intensity (% of GDP) (2004)	1.86	2.66	3.18
Share of R&D financed by industry (%) [(1)]	54.8	63.7	74.8
Researchers (FTE) per thousand labour force [(2)]	5.5	9.1	10.1
Share of world scientific publications (%) (2003)	38.3	31.1	9.6
Scientific publications per million population (2003)	639	809	569
Share of world triadic patents (%) (2000)	31.5	34.3	26.9
Triadic patents per million population (2000)	30.5	53.1	92.6
High-tech exports as a share of total manufacturing exports (%) (2003)	19.7	28.5	26.5
Share of world high-tech exports (%) (2003)	16.7	19.5	10.6

Data: Eurostat, OECD.

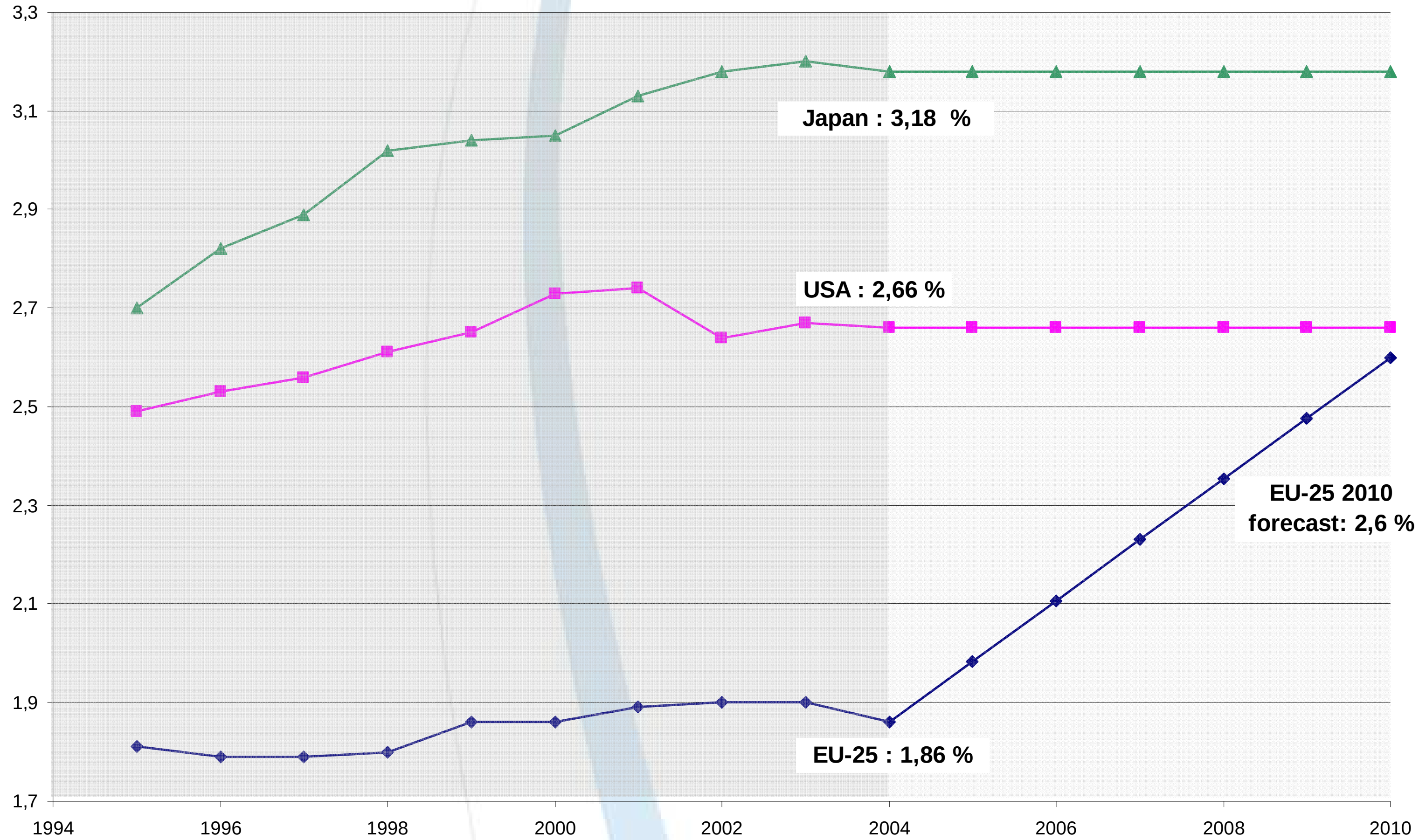
Source: DG Research

Notes: [(1)] EU-25: 2003; US, JP: 2004. [(2)] EU-25: 2004; US: 2002; JP: 2003.

Research: filling the gap

(total expenditure on R&D as % of GDP, 2004)

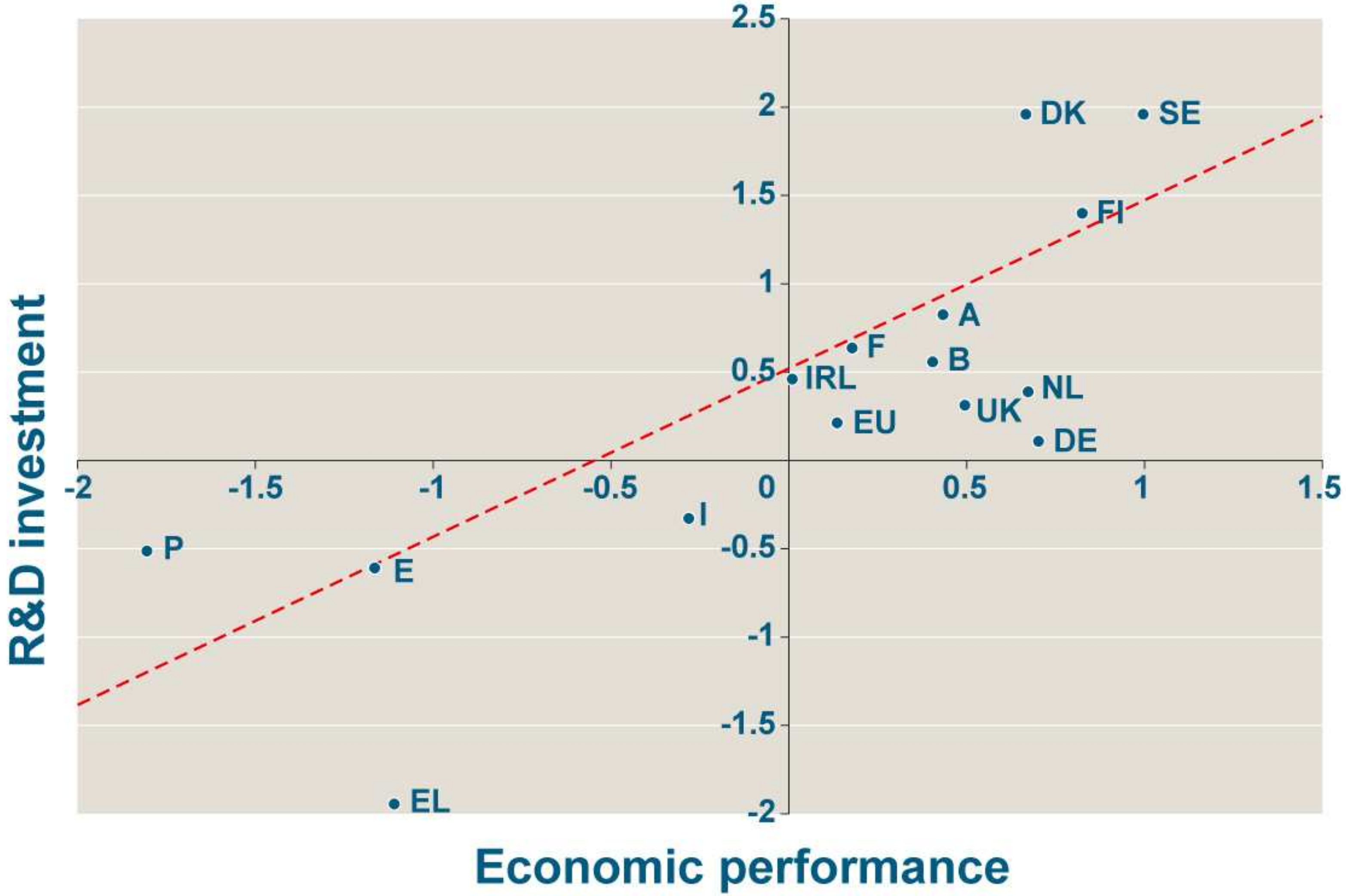
(EU-25 extrapolation based on R&D intensity targets put forward by Member States in their respective National Reform Programmes)



Data: Eurostat, OECD.

Source: DG Research

Research and economic development



Seventh Framework Programme: Objectives and activities

SEVENTH FRAMEWORK PROGRAMME

FP7 EC (current prices)

	Themes	Health	Food, Agriculture and Fisheries, and Biotechnology	Information and Communi-cation Technologies	Nano, Materials, Production	Energy	Environment	Transport	Socio-economic research	Space	Security	
COOPERATION	Collaborative Research	6 100	1 935	9 050	3 475	2 350	1 890	4 160	623	1 430	1 400	32 413
IDEAS	**European Research Council**											7 510
PEOPLE	**Marie Curie Actions**											4 750
CAPACITIES	Research Infrastructures	Research for the benefit of SMEs	Regions of Knowledge	Research Potential	Science in Society	Coherent development of research policies	International Cooperation					
	1 715	1 336	126	340	330	70	180					4 097
JRC (EC)												1 751
											Total	**50 521**

€ million

FP7 and the Structural Funds: more synergies (1)

SEVENTH FRAMEWORK PROGRAMME

- FP 7 has a new regional dimension, under “Capacities”
  - ➔ Regions of Knowledge
  - ➔ Unlocking Research Potential
  - ➔ Research infrastructures

FP7 / Structural Funds: more synergies (2)

- Structural Funds will reinforce R&D investment
  - ➔ R&D, innovation and entrepreneurship as the first priority in Convergence regions
  - ➔ Innovation and the knowledge economy as the first priority for the competitiveness and growth objective
  - ➔ Earmarking: at least 60% of funds for Lisbon priorities
- Complementary funding where possible
  - ➔ But no double funding…

Return to main presentation

Regions of Knowledge

Two objectives for all European regions:

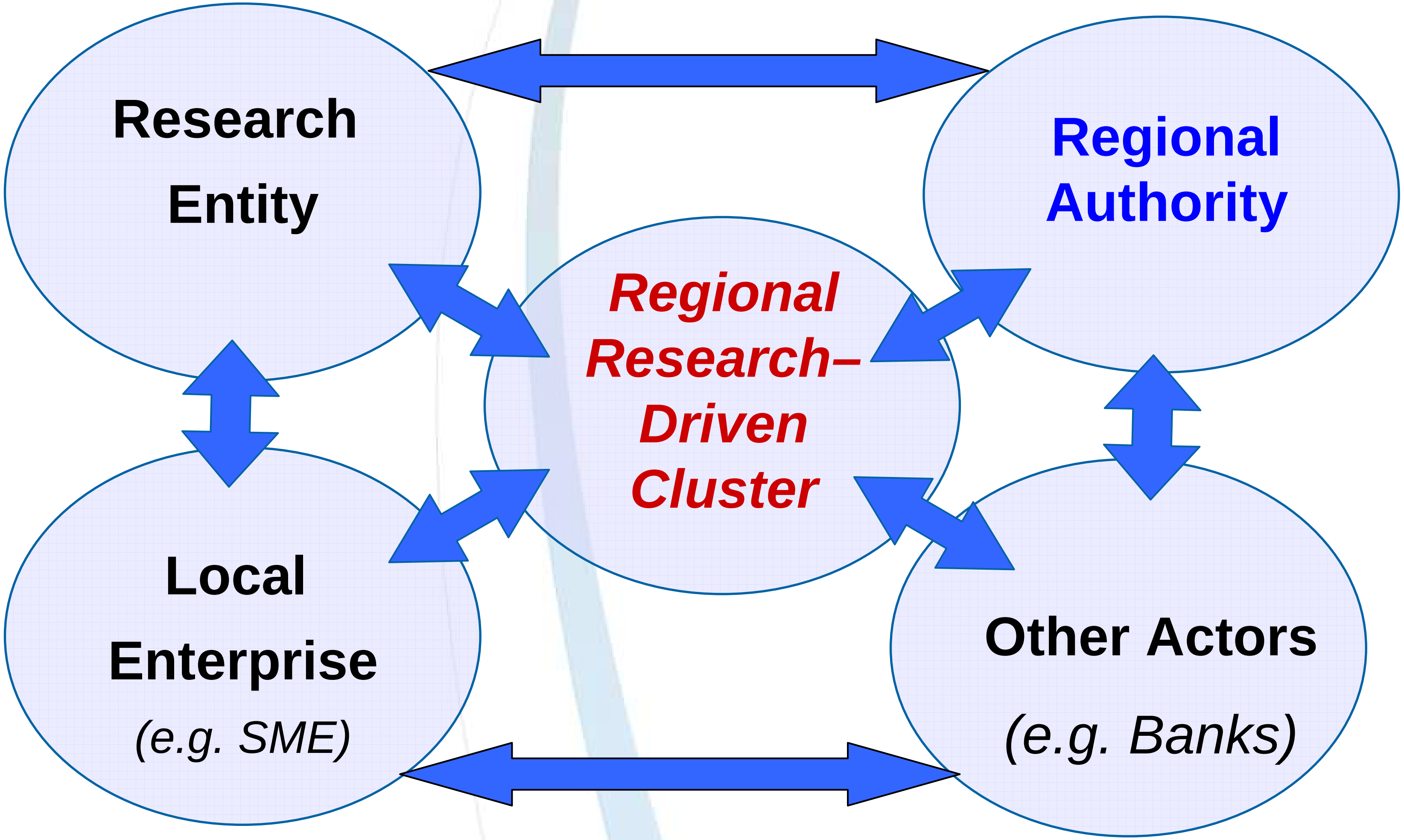
Strengthen their capacity for investing in RTD and carrying out research activities

Produce research strategies that contribute to regional economic development

- Through the development of regional 'research-driven clusters'

More on Regions

Regions of Knowledge: What is a cluster?



Regions of Knowledge

SEVENTH FRAMEWORK PROGRAMME

- Activities:
  - ➔ Analyse, develop and implement research agendas
  - ➔ Develop deployment strategies, including mentoring
- Expected outcome:
  - ➔ Improve links between stakeholders and local business community
  - ➔ Foster transnational / cross-border cooperation
  - ➔ Improve research networking
  - ➔ Enhance mutual learning of regional actors

Regions of Knowledge

- Expected impact:
  - ➔ Regional economical growth in selected domains
  - ➔ Better integration of research actors in regional economies
  - ➔ Response to the needs of regional business communities
  - ➔ Mobilisation of local, national and community funds to implement defined actions to support regional economic development
  - ➔ Synergies with other related EU policies

Research Potential

- *Two objectives for EU's convergence and outermost (RUP) regions*

Unlock and develop their research capacities

Foster an increase in their participation to Community research activities

To fully realise the European Research Area in the enlarged Union

- Through:
  - ➔ Transnational two-way secondments and recruitment of staff
  - ➔ Development of research equipment and the material environment
  - ➔ Workshops and conferences for knowledge transfer
  - ➔ 'Evaluation facilities'

More on Research potential

Realising the Full Research Potential of EU-25

- Objectives
  - ➔ Strengthen research potential in Convergence and outermost Regions through:
    - Increased international exposure and visibility
    - Demonstration of leadership capacity
    - Upgrading of equipment in excellence centres
  - ➔ Lay foundation for long-term development
    - Participation as equal partners in the EU research area

Realising the Full Research Potential of EU-25

- High-potential scheme
  - ➔ Strategic partnerships (twinning)
  - ➔ Selection on excellence criteria
  - ➔ In-built brain circulation, avoiding ‘brain drain’
  - ➔ Funding for:
    - Seconded researchers, visiting scientists, recruitments
    - Research costs incl. specific equipment
    - Conferences and workshops for knowledge transfer
    - Participation in international events
  - ➔ Evaluation facility for institutions

Return to main presentation

Realising the Full Research Potential of EU-25

- Expected impact:
  - ➔ contribution to RTD capacity building in the country,
  - ➔ enhanced participation in the 7th Framework Programme,
  - ➔ increased networking between research entities throughout the EU
  - ➔ upgrading of research capacities
  - ➔ better links with the economic and social environment,
  - ➔ increased job opportunities for young scientists

Website : http://cordis.europa.eu/fp7

Calls & Docs : http://cordis.europa.eu/fp7/calls

Helpdesk : http://ec.europa.eu/research/enquiries

SEVENTH FRAMEWORK PROGRAMME

Thank you for your attention!

Robert-Jan Smits

LocoMotive

Managing the links – global trends and regional policies in R&D Location

Hamburg 5-6 June 2007

WELCOME!

TuTech Hamburg INNOVATION
Wissenstransfer im Tandem
TuTech Innovation GmbH &
Hamburg Innovation GmbH

LocoMotive

Managing the links – global trends and regional policies in R&D Location

Hamburg 5-6 June 2007

The background to LOCOMOTIVE

Monica Schofield

TuTech / Hamburg INNOVATION
Wissenstransfer im Tandem
TuTech Innovation GmbH &
Hamburg Innovation GmbH

Europe’s salvation?

LocoMotive

“to become the most **competitive** and **dynamic knowledge based** economy in the world capable of **sustainable economic growth** with **more and better jobs** and **greater social cohesion**” (BY 2010!).

Lisbon European Council meeting March 2000

R&D spending to increase to 3% GDP with <u>two thirds coming from industry</u>

Barcelona Objective 2002

“…regional and local actors … urged to take greater ownership of the Lisbon strategy, and to actively participate in the achievement of the Lisbon objective …”

EU's Heads of State and Government, March 2005.

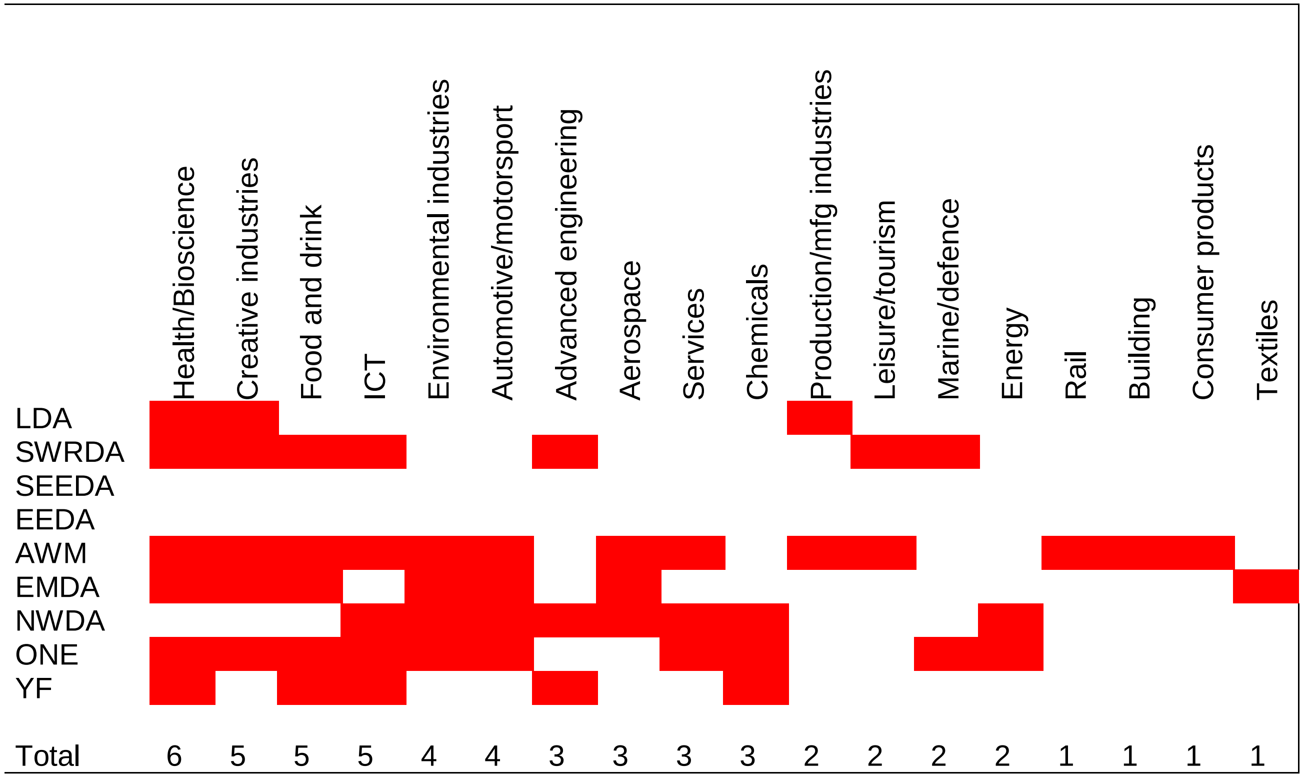
Underlying issues

- Role of universities
- Move towards open innovation
- “Mushrooming” of clusters
- Extreme focus on SMEs
- A lot of policies and programmes
  (and money being thrown at the problem)
- Is Europe attractive for
  “knowledge economy workers”?

LocoMotive

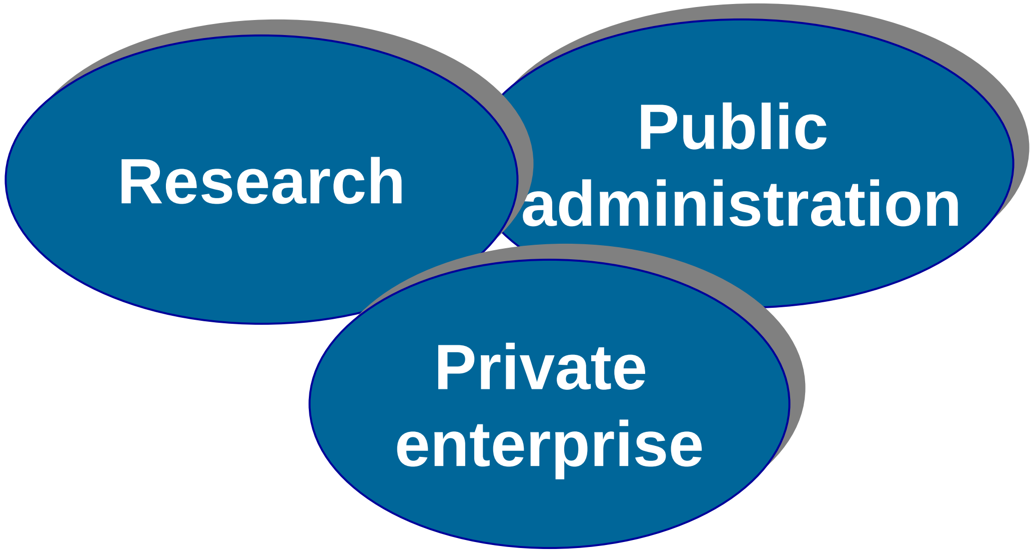
The Myth of Regional Innovation?
Source: Sagentia

Mapping of regions and clusters in England



LocoMotive

Interaction for economic success



But do we really understand one another?
Do we really want to understand one another?

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Hamburg Innovation GmbH

LOCOMOTIVE

"Dissemination of knowledge concerning current R&D localisation motives of large regionally important private sector organisations"

FP6 Regions of Knowledge

1.1.2006 -30.9.2007

LocoMotive

Where and why are big companies expanding their R&D activities and what can we do to make it happen here?

Hamburg	TuTech Innovation
Toulouse	Pôle Universitaire Européen
Oxford	Oxford Science Enterprise
Øresund and Barcelona	Interlace Invent
Helsinki	Culminatum
Prague	Tech Centre Academy Sciences CR
Budapest	CEU Consulting
Rotterdam	Erasmus University Business School

www.locomotive-project.org

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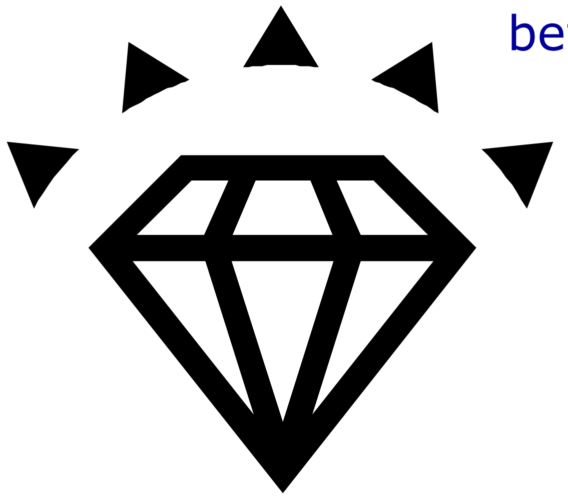
Facets of LOCOMOTIVE

Tactical relationship building

Comparison with latest research findings

Networking and mutual support between partners

Position statements from R&D managers "the mood of industry"



Influencing policies of companies and regional actors

LOCOMOTIVE activities

- A methodological framework (standard interview questionnaire)
- interviews with key R&D managers
- Regional roundtable discussions involving regional policy makers, CTOs and researchers
- Dissemination and discussion (recommendations)

LOCOMOTIVE some of the issues

- How strong is the commitment to R&D in the region (risk of losing a facility)
- How could universities/TT offices improve services to industry?
- Are there differences between foreign and domestic companies?
- What makes the region attractive for R&D location?
- Do regional policies have any impact at all?

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Managing the links – global trends and regional policies in R&D Location

Furthering the dialogue ....

Conference Hamburg 5 June 2007

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Hamburg Innovation GmbH

LocoMotive

Conference agenda – day 1

Research and innovation in Europe: threats and opportunities

Can Europe compete as a research location? Some views from industry

Advancing the role of universities as partners for innovation

What can regions do to attract researchers and research investment?

The dialogue continues …
Volkerkünde Museum

LocoMotive

Conference agenda – day 2

Creation of regional brands to support research clusters.

New approaches to inward investment promotion in Europe, North America and Asia.

From policy to action: EU initiatives

Our conclusions

The dialogue continues …
Take it home

Enjoy the conference

Make new friends …

Promoting R&D investment in the Czech Republic

CZECHINVEST
Investment and Business Development Agency

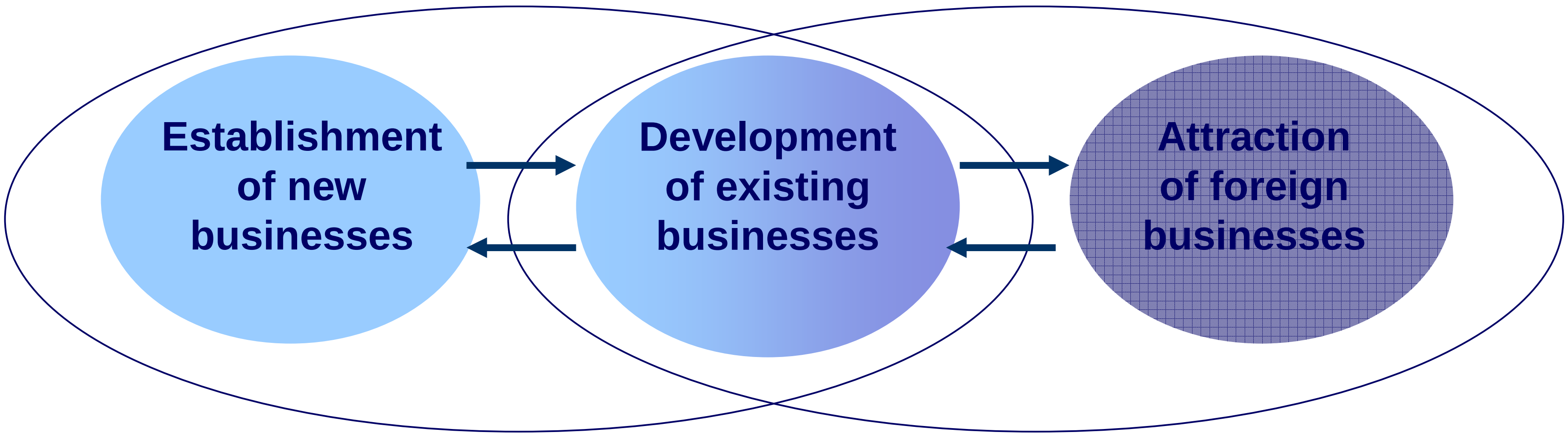
Attracting inward investment in a new member state

Ministry of Industry and Trade

CzechInvest's activities
Development since 1993

CZECHINVEST

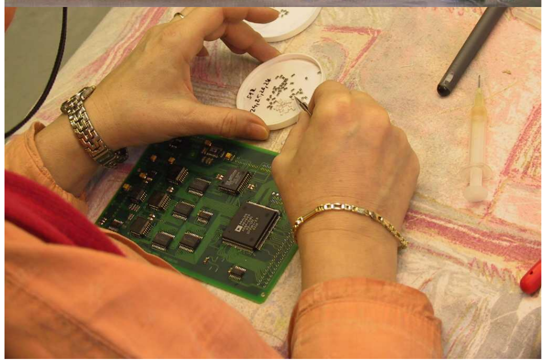
1993	1998	2003	2005
Promotion of foreign investment	**Development of business infrastructure**	**Support of entrepreneurial activities**	**Support of technological development**



Sectors activelly promoted by CzechInvest for FDI

CZECHINVEST

- Automotive (cars and components)
- Aerospace
- Electronics and microelectronics
- High tech engineering
- Biotechnology, pharmaceuticals and medical devices
- Software development and IT services
- Shared services centres (HR, accounting, finance), regional HQs
- Repair centres of high-tech products



CzechInvest: investment projects

CZECHINVEST

Successfully completed projects: 771

No. of jobs created or safeguarded: 154,000

Investment commitments mediated: US$ 18 bn

Proven track record: foreign investors in the CR

- 41% of employees in industry
- 59% of industrial production
- 68% of industrial exports

- 700+ German companies
- 400+ US companies
- 168 Japanese companies
- 20 Taiwanese companies
- 12 Korean companies

Strategic decision in 2000

Target selected non-mfg activities

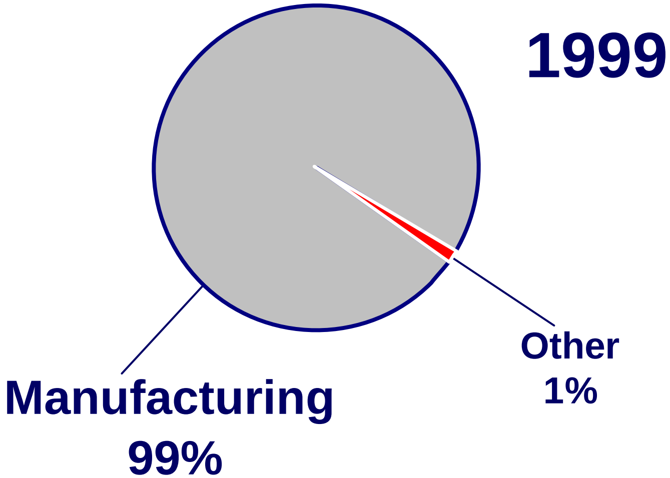
-- Centres for research and development

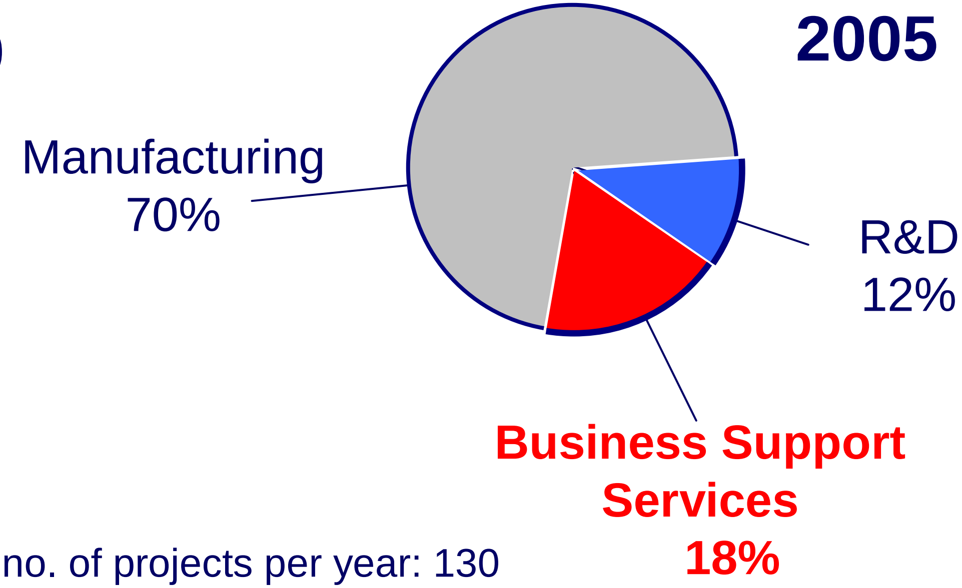
-- Centres for industrial design

-- Software development centres, IT expert solution centres

-- High-tech repair centres

-- Shared services centres, customer contact centres

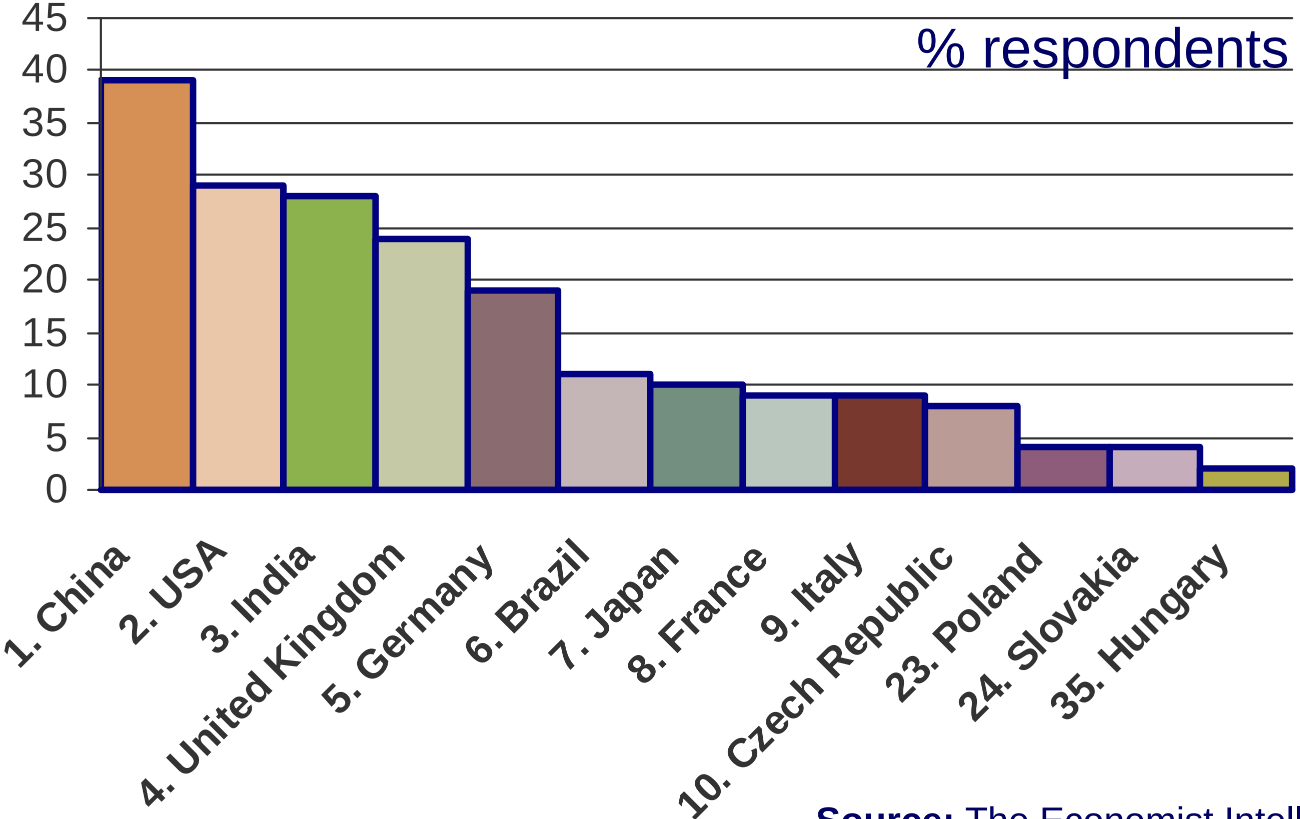




Average no. of projects per year: 130

CR in the top 10 most attractive countries for R&D

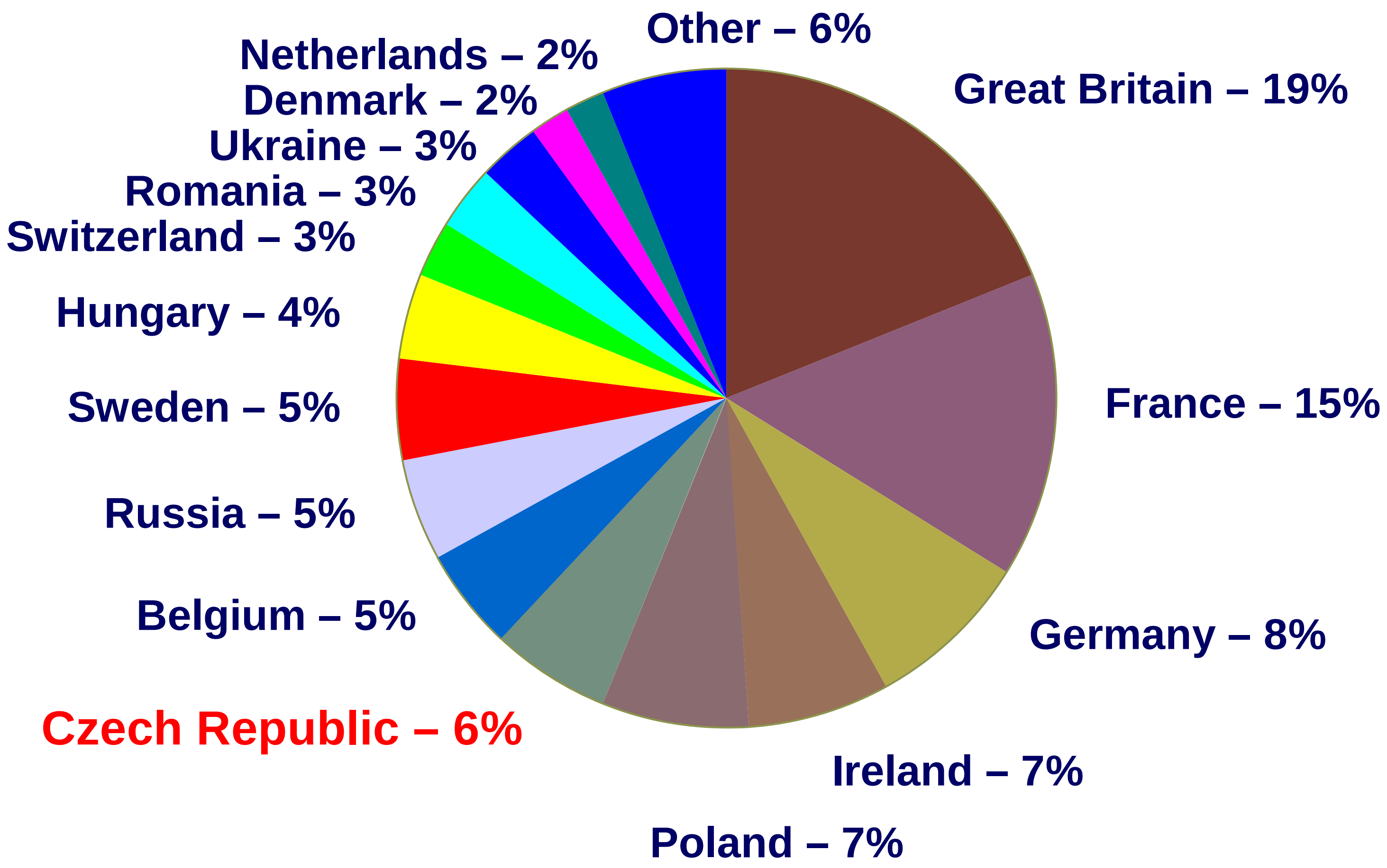
In which of the following countries does your company plan to spend the most on R&D in the next three years? Please choose the top three countries.



Source: The Economist Intelligence Unit, 2004

New foreign R&D investment projects, Europe, 1-6/2005

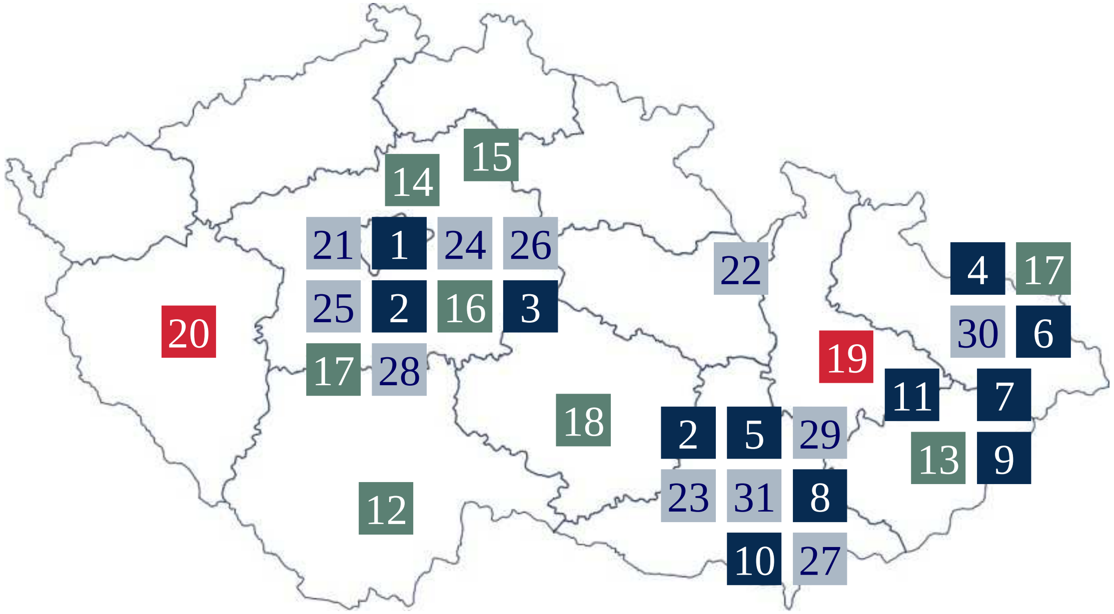
CZECHINVEST



Source: IBM – Plant Location International, October 2005

Selected R&D and Technology centers

CZECHINVEST

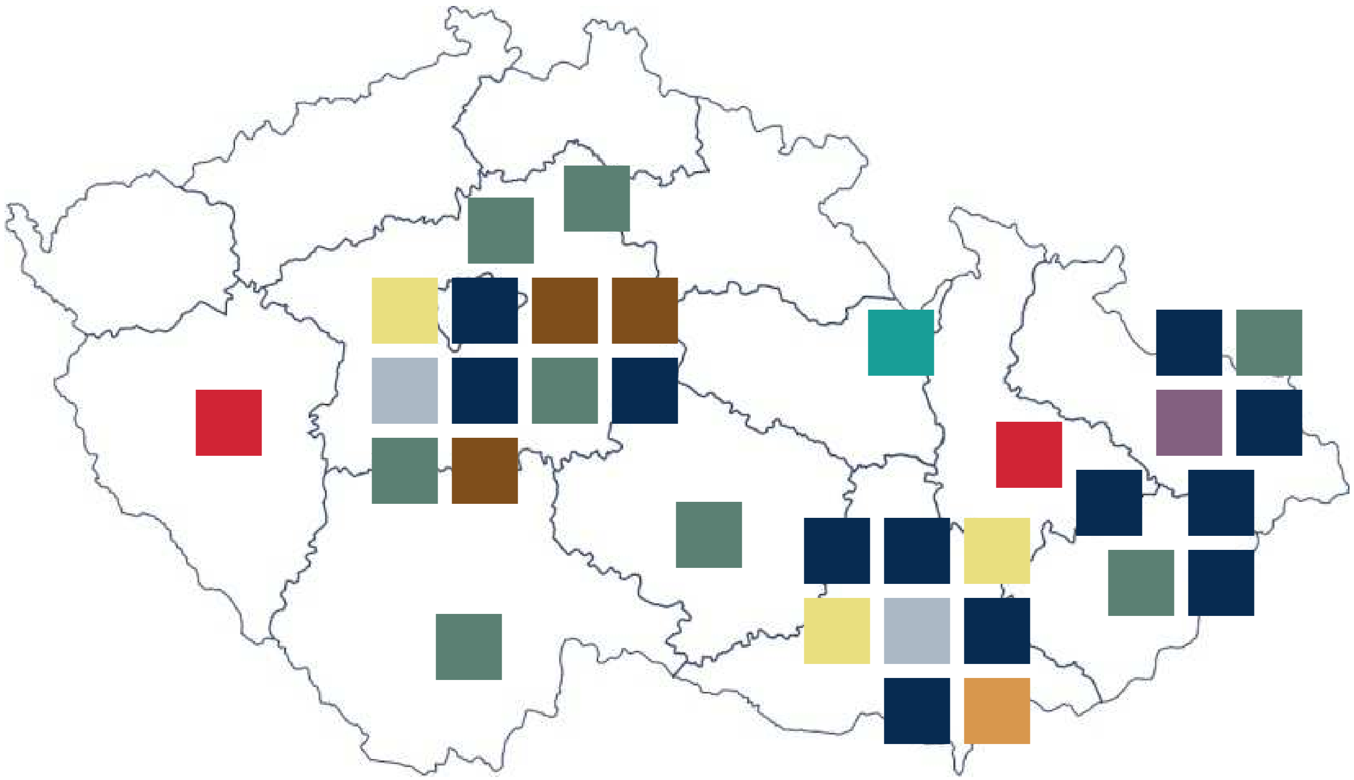


- USA
- Germany
- Japan
- Other

1 Ingersoll-Rand
2 Honeywell
3 Rockwell Automation
4 Roper Industries
5 AMI Semiconductor
6 Hayes Lemmerz
7 Freescale Semiconductor
8 FEI
9 ON Semiconductor
10 Tyco Safety Systems
11 Visteon
12 Robert Bosch
13 Siemens Automotive
14 Volkswagen
15 Siemens VDO
16 Mercedes-Benz
17 Siemens Kolejová vozidla
18 Bosch Diesel
19 Olympus
20 Matsushita/Panasonic
21 Ricardo
22 Rieter
23 Delong Instruments
24 Valeo
25 UniControls
26 Latecoere
27 IMI-Norgren
28 ST Microelectronic
29 Tescan
30 Bang&Olufsen
31 Flextronics

Selected R&D and Technology centers

CZECHINVEST



- USA
- GB
- Japan
- France
- Denmark
- Singapore
- Germany
- Switzerland
- Czech Republic

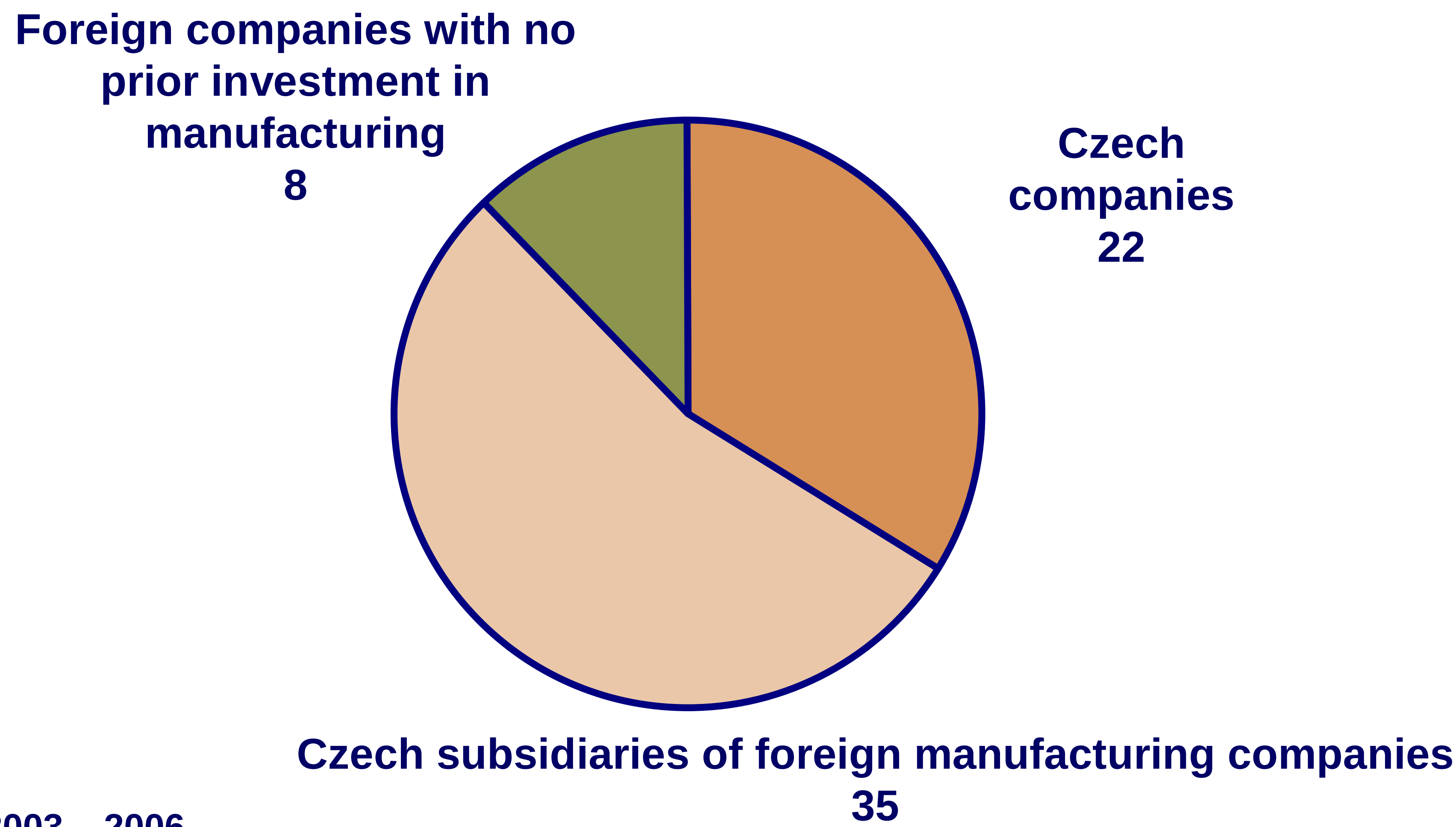
Foreign investment in R&D: modes of entry

CZECHINVEST

- Privatisation of a manufacturing company with an R&D centre (e.g. Volkswagen – Skoda Auto, Siemens)
- Privatisation of an R&D centre (e.g. IngersollRand)
- Greenfield investment following previous investment into manufacturing (e.g. Valeo, Bang & Olufsen, Bosch)
- Greenfield investment built in cooperation with a university (Honeywell, Rockwell Automation)
- Greenfield investment with no previous acitivities in CZ (Ricardo, AMI Semiconductor, Roper Industries)

Technology centres established with our support

CZECHINVEST

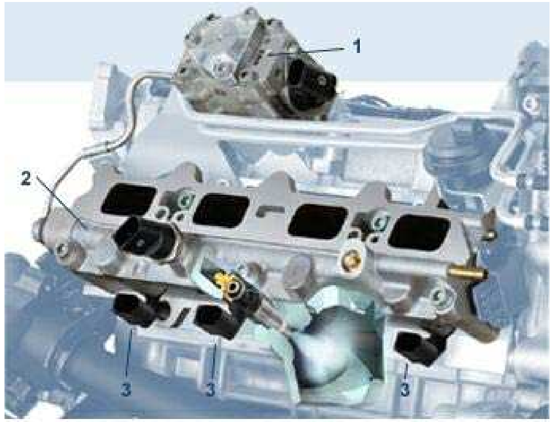


2003 – 2006

BOSCH

CZECHINVEST

Global centre for the development and manufacture of fuel injection systems for diesel engines

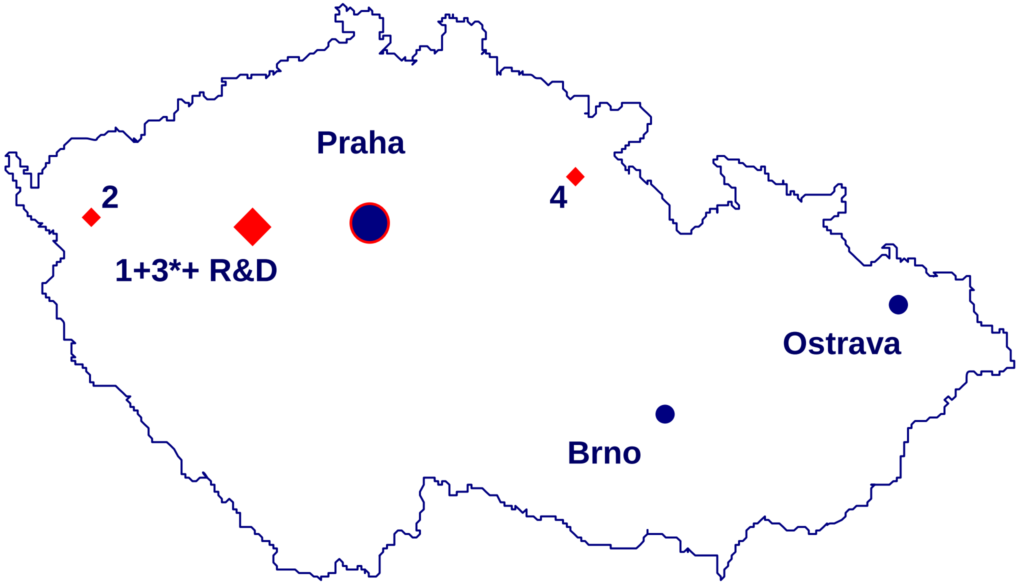


- Mfg activities in CZ since 1991
- 2 locations – C. Budejovice and Jihlava
- More than 8,000 emplyees in manufacturing
- Currently over 200 R&D engineers
- Cooperation with 3 technical universities

Five Matsushita investments in the Czech Republic

CZECHINVEST

- **Panasonic AVC networks Czech – tv sets 1996-97**
- **Panasonic electric works communication relays – 1998**
- **Panasonic AVC networks Czech – expansion – 1999 - 2000**
- **Panasonic mobile & automotive systems – 2000**
- **Panasonic AVC networks Czech – technology center - 2003**



Panasonic

Total investment:
USD 500 million

No. of employees:
over 7,000

Rockwell Automation

CZECHINVEST

Rockwell Automation: development laboratory in Prague

-- In the Czech Republic since 1993

-- Cooperation with Czech Technical University

-- Cooperation with University of Western Bohemia

Rockwell Automation

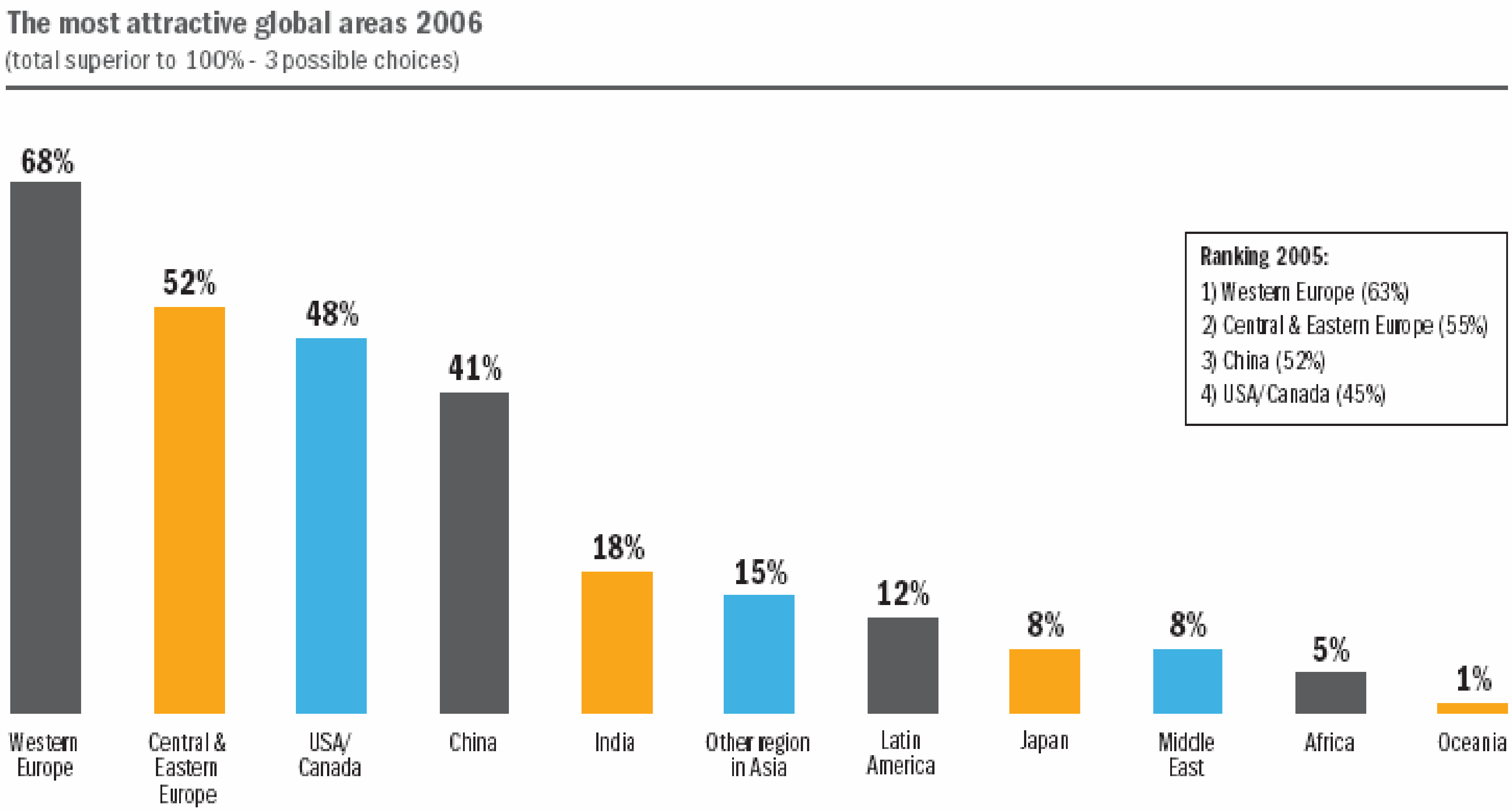
-- One of 5 independent development labs of RA in the world

-- 20+ development engineers

-- Development of software for industrial machinery

European Attractiveness Survey, 2006

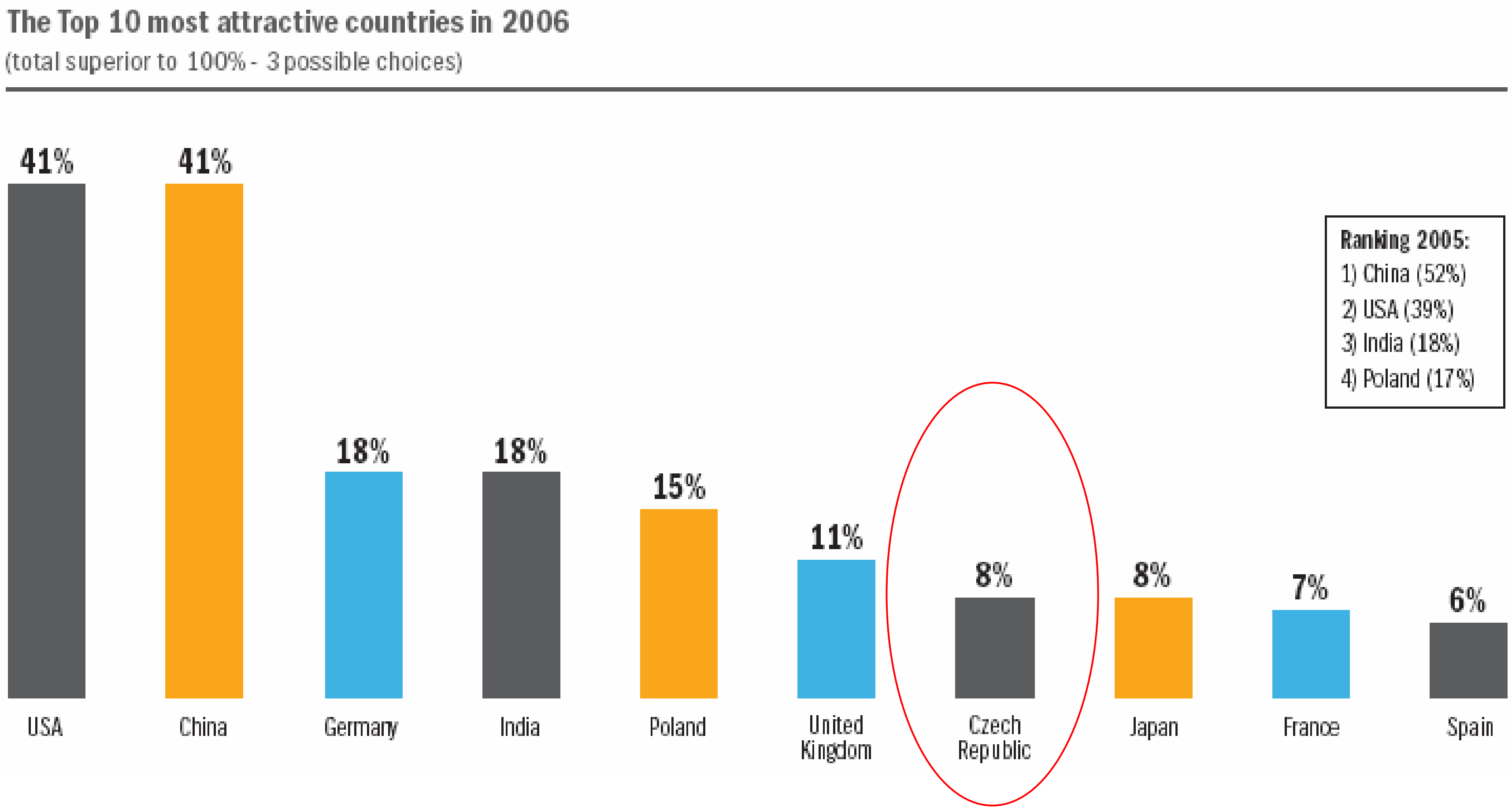
CZECHINVEST



Source: Ernst & Young, 2006

European Attractiveness Survey, 2006

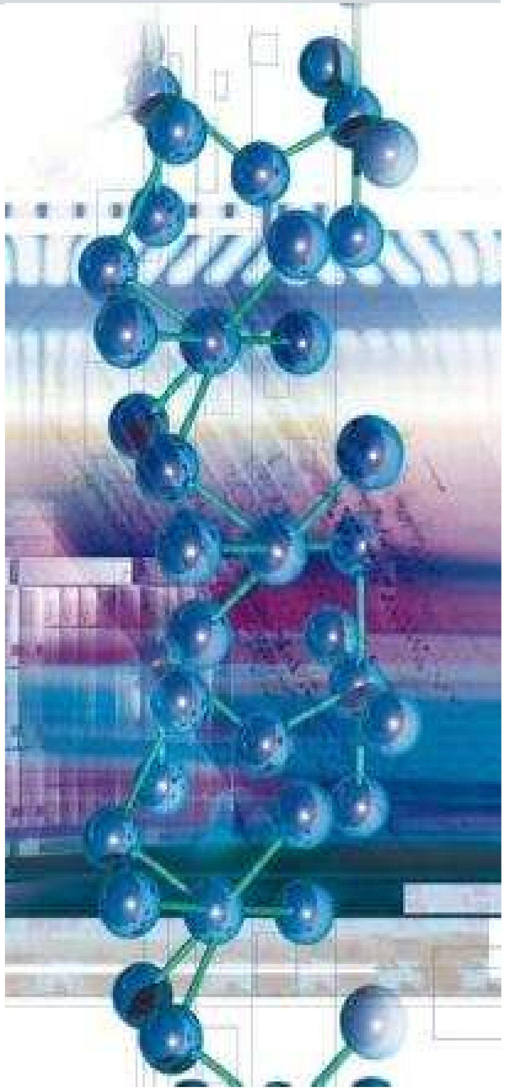
CZECHINVEST



Source: Ernst & Young, 2006

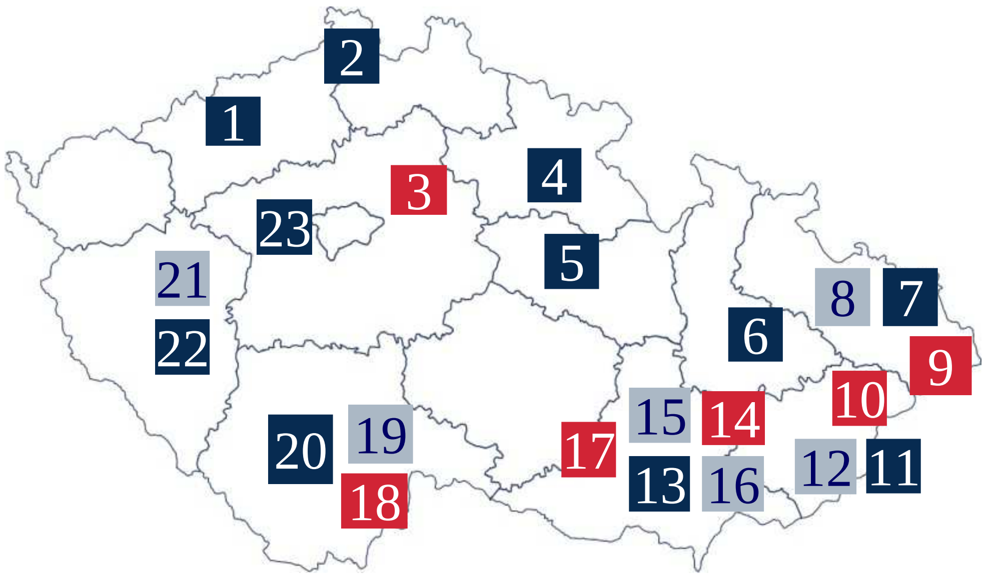
Attracting inward investment in R&D

- Active promotion of the country
  - Inventive image-building
  - Active direct marketing
- Good project management
  - Quick provision of relevant information
  - Good domestic contacts
  - Good project management
- Developed infrastructure
  - Suitable real estate options
  - Suitable environment
  - Suitable financial instruments



Science parks, innovation centres and incubators in the CR

CZECHINVEST

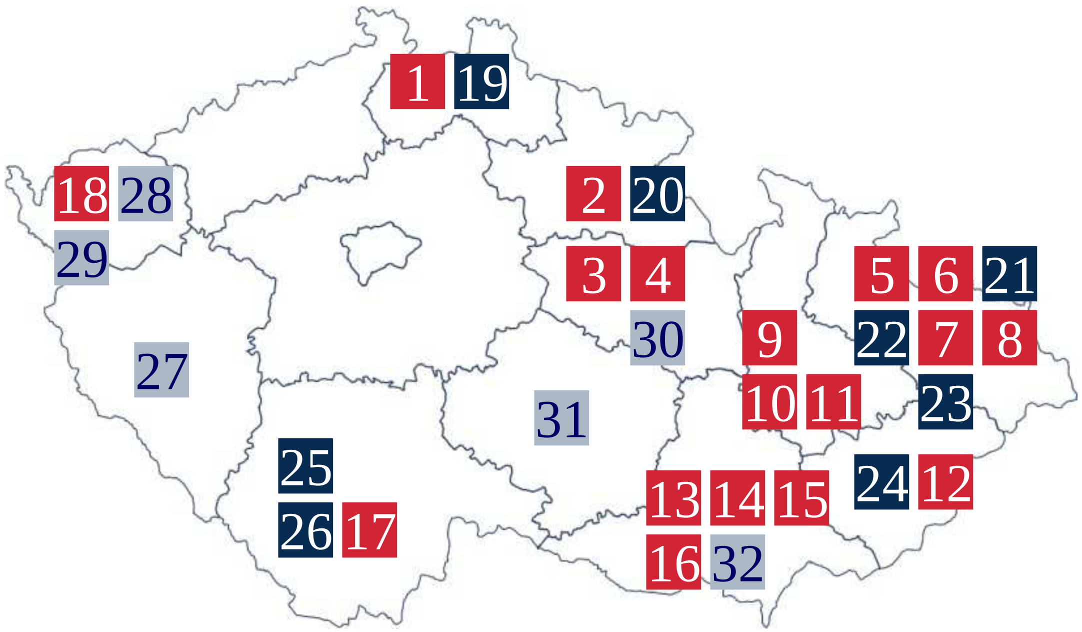


- Science and technology parks
- Innovation and technology transfer centres
- Incubators

1 Science and Technology Park in Březno
2 Science and Technology Park in Rumburk
18 University Centre and Incubator in Nové Hrady
4 Technology Centre Hradec Králové
6 Science and Technology Park in Olomouc
7 Science and Technology Park in Ostrava
20 Science and Technology Park in Č. Budějovice

8 BIC Ostrava
9 STEEL IT, Třinec
10 Business Incubator in Vsetín
11 Science and Technology Park in Zlín
12 Technology Innovation centre in Zlín
13 Science and Technology Park in Brno
14 INBIT Biotechnological Incubator
15 South-Moravian Innovation centre
16 BIC Brno
17 Technology Incubator VUT Brno
3 Business Incubator in Nymburk
19 Innovation centre in Třeboň
5 TechnoPark Pardubice
21 BIC Plzeň
22 Science and Technology Park in Plzeň
23 Science and Technology Park in Řež

Cluster initiatives in CR



- Established clusters – phase II
- Established clusters
- Cluster mapping ended

1 Technical textiles
2 Packaging technology
3 Technical plastics
4 Nanotechnology
5 Wood processing
6 Renewable energy
7 Automotive
8 Engineering

9 Automotive
10 Nanotechnology
11 ICT
12 Plastic
13 Aircraft
14 Biotechnology
15 Bioinformatics
16 Furniture

17 Construction materials
18 Musical instruments
19 Glass
20 Stone processing
21 ICT
22 Chemical industry
23 Construction
24 Shoemaking
25 Water treatment tech.
26 Renewable energy
27 Mechatronics
28 Tableware
29 Wood processing
30 Electronics
31 Wood processing
32 Wine-making

Financial support of research and innovation

CZECHINVEST

- R&D projects – national budget
- Technology centres – national budget
- R&D centres and parks – EU structural funds
- Innovation projects – EU structural funds
- R&D/innovation environment – EU structural funds

EU Structural Funds in 2007-2013

CZECHINVEST

Operation programme	Responsible body	Amount allocated, EUR billion
Enterprise and Innovation	Ministry of Industry and Trade	3.041
Research and Development for Innovation	Ministry of Education	2.070
Education for Competitiveness	Ministry of Education	1.815
Human Resources and Employment	Ministry of Labour	1.811
The Environment	Ministry of the Environment	4.917
Transportation	Ministry of Transport	5.759
Regional programmes	Regional councils	4.659
Integrated operational programme	Ministry for Regional Development	1.553
Supranational Cooperation	Ministry for Regional Development	0.037
Transborder Cooperation	Ministry for Regional Development	0.351
Prague – Adaptability	Regional Council	0.121
Prague – Competitiveness	Regional Council	0.295

Support of entrepreneurial activities and innovation

CZECHINVEST

OP Enterprise and Innovation

-- the introduction of innovation, technologies, products; cooperation of the industrial sector with R&D; quality of the business infrastructure

OP Research and Development for Innovation

-- R&D capacities, capacities for cooperation between the public and private sector

OP Education for Competitiveness

-- infrastructure for education, educational reform programmes, etc.

Applicants

Companies, associations/ clusters

Non-profit research organisations, e.g. universities

Schools/universities, non-profit educational organisations

OP Enterprise and Innovation: areas of support related to R&D

CZECHINVEST

Priority	Area of support	Programme	%
1. Establishment of companies	1.1 Support for beginning entrepreneurs	START	0.6
	1.2 Use of new financial instruments		2.0
2. Development of companies	2.1Banking instruments for the support of SMEs	PROGRES	2.6
		GUARANTEE	5.0
	2.2 Support for new production technologies and ICT in companies	DEVELOPMENT	3.0
		ICT and Business-Support Services	7.0
		ICT in Companies	4.2
3. Efficient energy	3.1 Energy conservation and renewable sources of energy	ECO-ENERGY	4.0
4. Innovation	**4.1 Increased innovation efficiency of companies**	**INNOVATION**	**14.0**
	4.2 Capacities for industrial R&D	**POTENTIAL**	**8.4**
5. Business and innovation environment	**5.1 Cooperation platforms**	**COOPERATION**	**5.3**
		PROSPERITY	**12.0**
	5.2 Infrastructure for human resources development	TRAINING CENTRES	5.0
	5.3 Business infrastructure	**REAL ESTATE**	**16.1**
6. Business-development services	**6.1 Support for consulting services**	**CONSULTING**	**5.0**
	6.2 Support for marketing services	MARKETING	2.9

MediPark

-- Project of Masaryk University in Brno

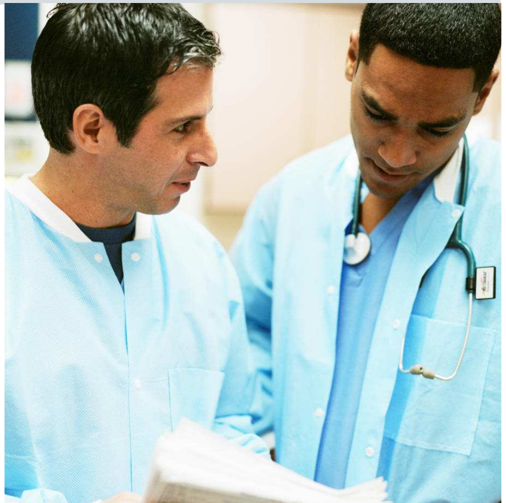
-- 15 ha – incubators, spin-off center, transfer of technology

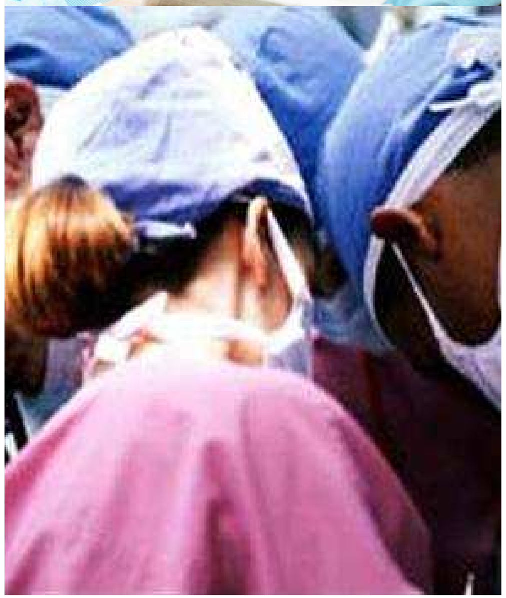
-- Focused on medicine, biology and chemistry

-- Local and foreign SMEs

Medical R&D Centre for the 21st Century

CZECHINVEST





International Clinical Research Centre

-- the world's first international centre in the field of medical research

-- strategic project of the Czech Republic

-- collaboration with Mayo Clinic (USA)

Four basic elements:

-- next-generation science and research base

-- top-quality public healthcare facility

-- international education centre

-- technology park

Thank you for your attention

www.czechinvest.org
info@czechinvest.org

CZECHINVEST
Investment and Business Development Agency

Ministry of Industry and Trade

CzechInvest, the Investment and Business Development Agency, is an agency of the Ministry of Industry & Trade of the Czech Republic

Eingebettetes geschütztes Dokument

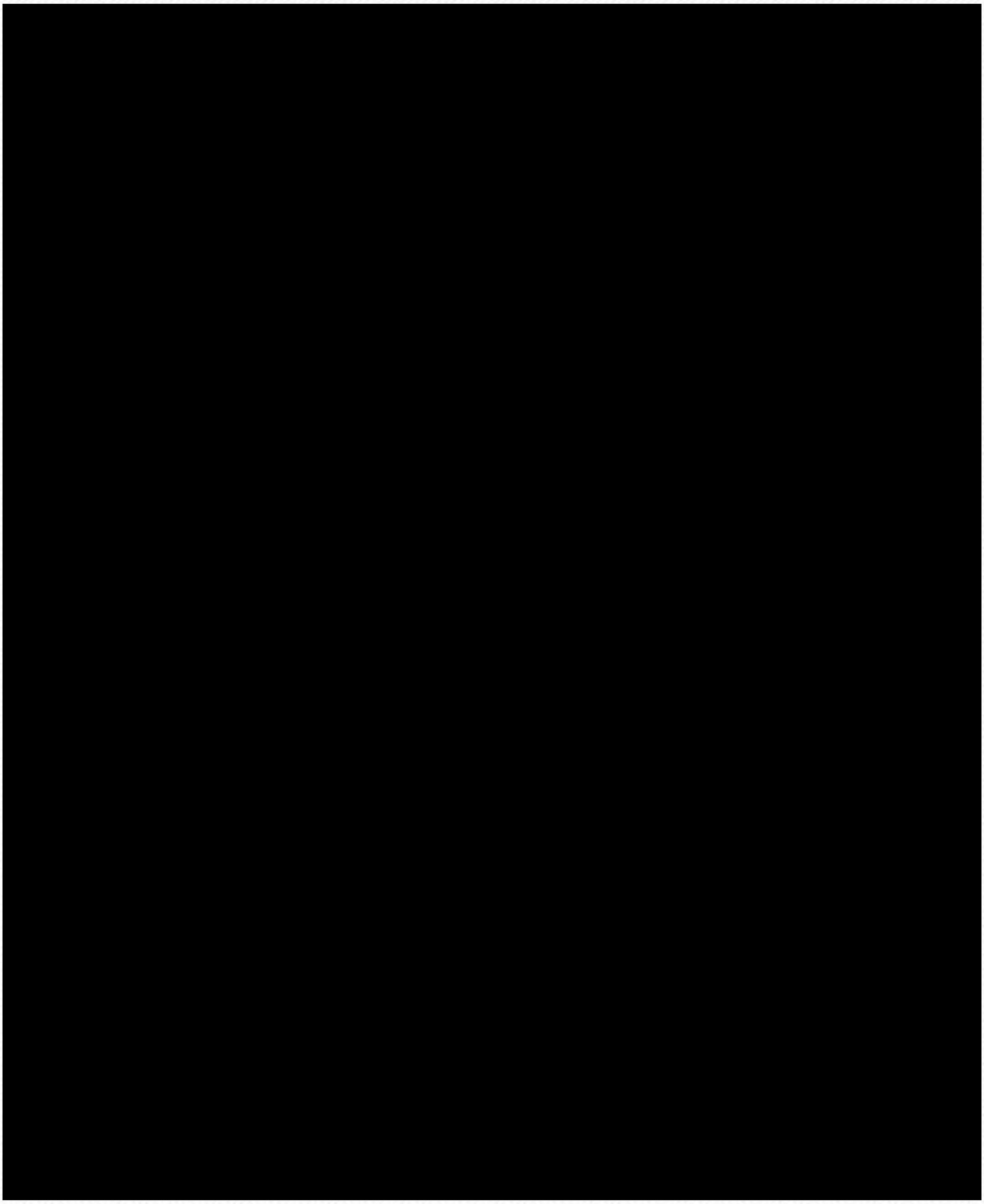
Die Datei *http://locomotive.tutech.eu/cms/Content/download/14_LOCOMOTIVE_Haselmayer_070606.pdf* ist ein geschütztes Dokument, das in dieses Dokument eingebettet wurde. Doppelklicken Sie auf die Reißzwecke zur Anzeige.

Establishing a reputation as a region for innovation: practical experiences?

Managing the links – Global Trends and Regional Policies in R&D Location

6 June 2007

Mr. Tatu Laurila, CEO
Greater Helsinki Promotion
Tatu.laurila@inhelsinki.com



Outline

Global challenges of innovation driven economy

Case: Innovative Helsinki?

Promotinal point of view – how to make difference?

Role of Greater Helsinki Promotion Ltd

Stages of national (or regional) competitiveness challenge innovation policies

PROGRESS

REGRESS

Resource driven → **Investment driven** → **Innovation driven** → **Wealth driven**

Resource driven
- Inexpensive basic resources
- little production of investment articles
- Technology import
- Few links to end users

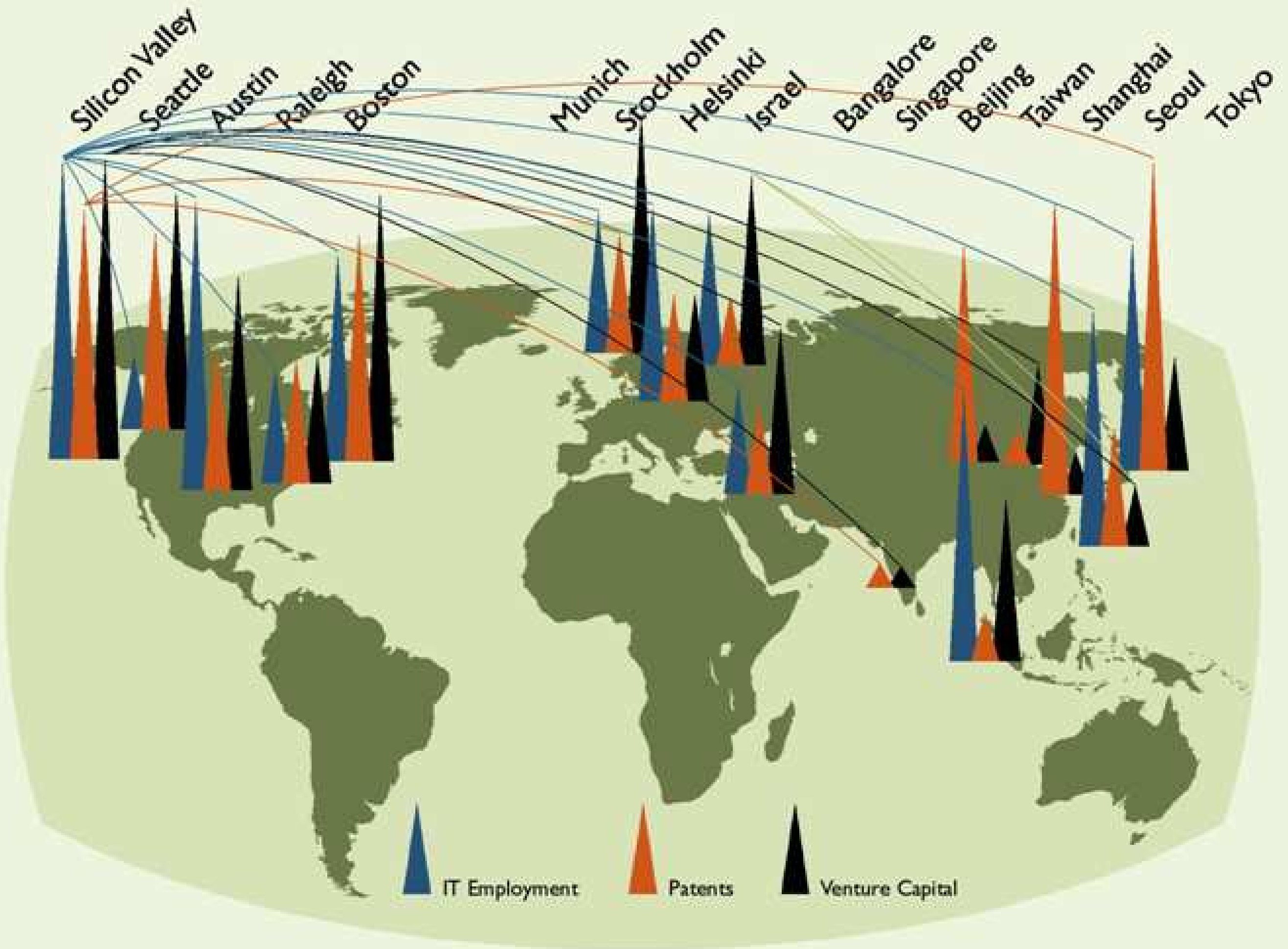
Investment driven
- Ability & willingness to invest aggresively
- Application of best technology
- Economies of scale
- ’Bulk’ end products
- B-to-B market

Innovation driven
- Significant domestic R&D
- Active competition
- Human capital basis of competitiveness
- Differentiated products
- Wide contents of services

Wealth driven
- Exploitation of present wealth in expense of future
- Little motivation for change, entrepreneurship or innovation

Adapted from: Porter (1991).

GLOBAL LINKAGES



Source: Joint Venture SILICON VALLEY NETWORK

Measurement of Helsinki's perception

- A broad survey was carried out to determine the image of Helsinki and its position in relation to competitors. The survey also aimed to determine what issues corporate leaders find significant when studying prospects for establishing operations in an overseas competence center.
- A total of 180 corporate leaders were interviewed by telephone. Respondents were from China, Hong Kong, India, Singapore, USA, Germany, Great Britain, Russia, the Netherlands and Sweden.
- Also, 131 representatives of foreign corporations already established in Finland were interviewed.

Future markets

Return on investment

Location

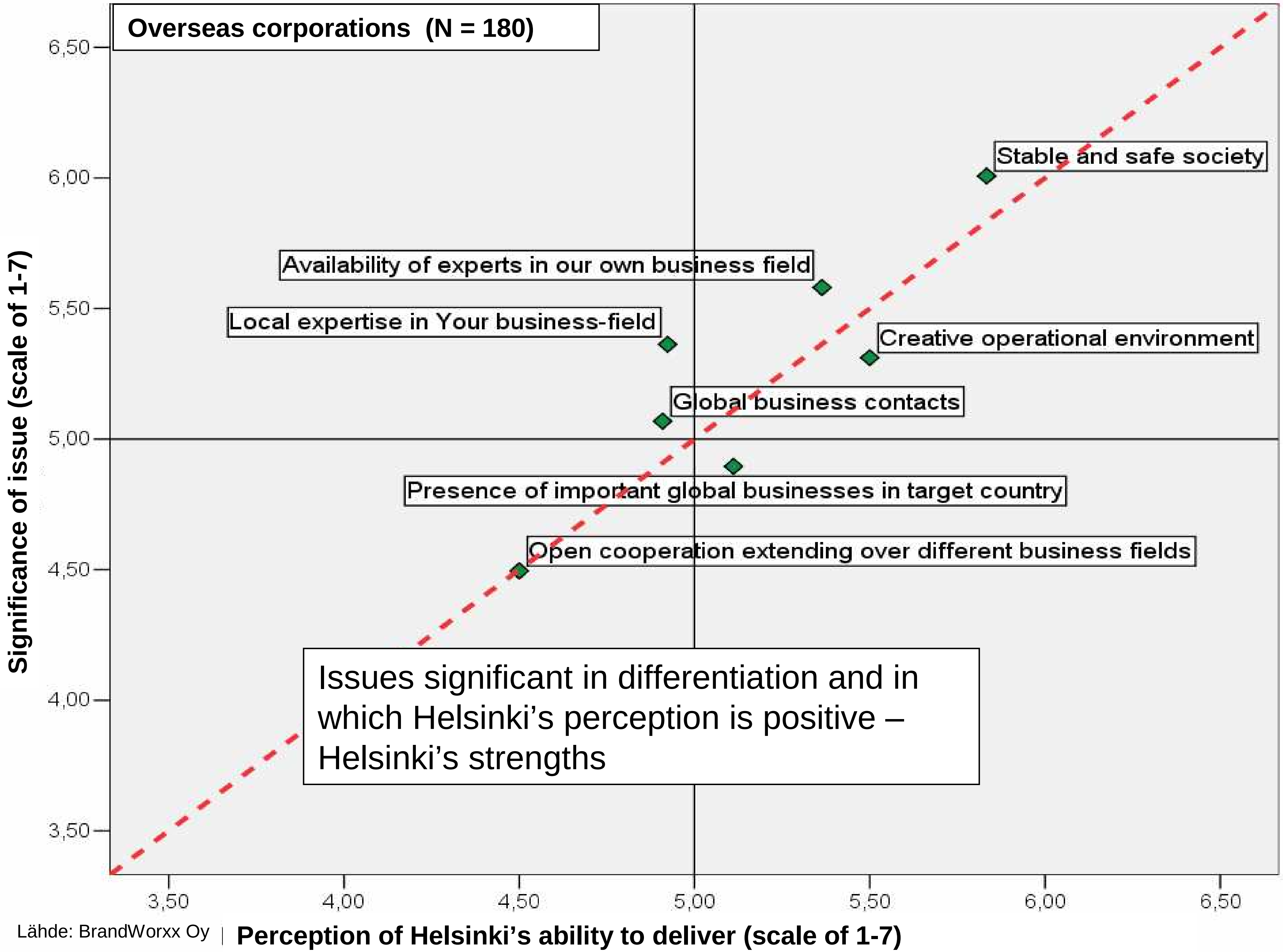
Success

Future markets

Return on investment

Location

Success



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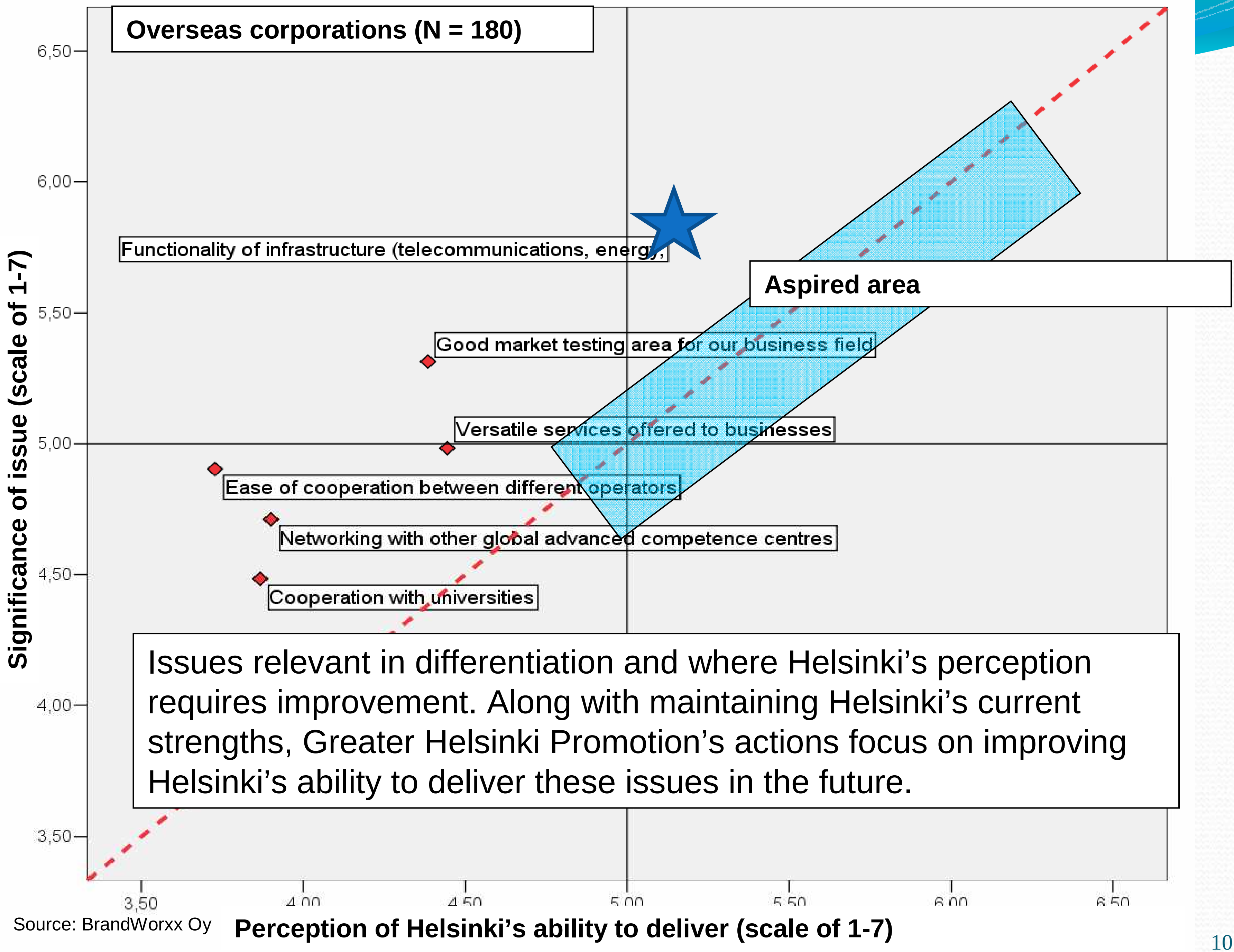

Source: BrandWorxx Oy

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Role of Greater Helsinki Promotion Ltd

The Vision for Helsinki Region

The vision for Helsinki Region

*The Helsinki Metropolitan Area is **a dynamic world-class centre for business and innovation**. Its high-quality services, arts and science, creativity and adaptability promote the prosperity of its citizens and bring benefits to all of Finland. The Metropolitan Area is being developed as a unified region close to nature where it is good to live, learn, work and do business.*

Helsinki Metropolitan Area Advisory Board,
16 November 2004

Innovation Strategy | HELSINKI METROPOLITAN AREA

A four-pillar Innovation Strategy:

I. Improving the international appeal of research and expertise

II. Reinforcing knowledge-based clusters and creating common development platforms

III. Reform and innovations in public services

IV. Support for innovative activities

Outline

Global challenges of innovation driven economy

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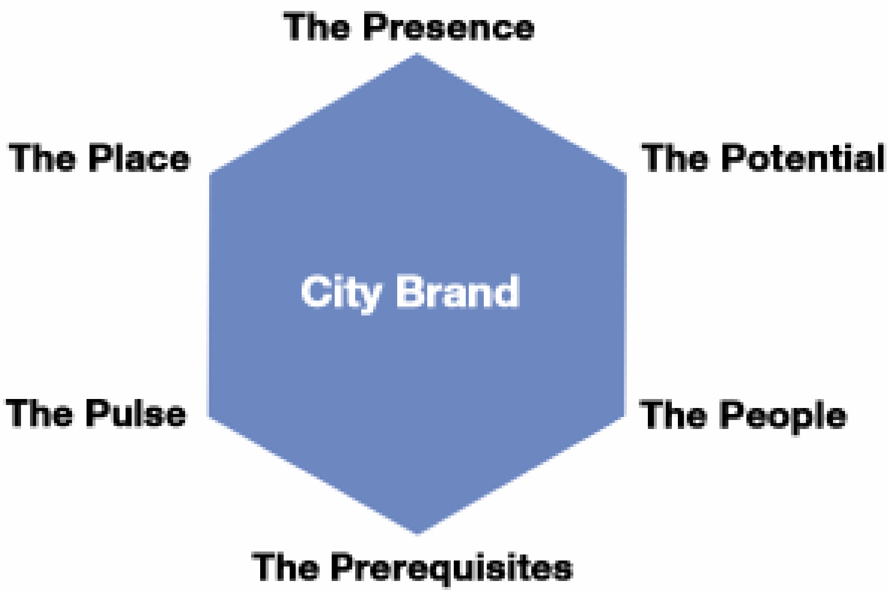
Cities as brands



Source: Anholt City Brand Index –
second edition 2006

1 Sydney
2 London
3 Paris
4 Rome
5 New York
6 Washington DC
7 San Francisco
8 Melbourne
9 Barcelona
10 Geneva
11 Amsterdam
12 Madrid
13 Montreal
14 Toronto
15 Los Angeles
16 Vancouver
17 Berlin
18 Brussels
19 Milan
20 Copenhagen
21 Munich
22 Tokyo
23 Boston
24 Las Vegas
25 Seattle
26 Stockholm
27 Chicago
28 Atlanta
29 Dublin
30 Edinburgh
31 Philadelphia
32 Oslo
33 Lisbon
34 Prague
35 Singapore
36 Helsinki
37 Hong Kong
38 Dallas
39 New Orleans
40 St Petersburg
41 Rio de Janeiro
42 Buenos Aires
43 Beijing
44 Seoul
45 Reykjavik
46 Budapest
47 Shanghai
48 Moscow
49 Johannesburg
50 Mexico City
51 Warsaw
52 Havana
53 Jerusalem
54 Bangkok
55 Cairo
56 Dubrovnik
57 Mumbai
58 Manila
59 Lagos
60 Nairobi

Markets & clients of GHP operations

International People

Students to study in our schools and universities.

Professionals to work in our firms and share knowledge and contacts.

Families to buy our goods and services and become a part of the community.

International Companies

Companies to employ our workers and develop their potential.

Corporations to buy our supplies, goods and services.

Firms to partner and grow with our companies.

International Capital

Funding for our entrepreneurs, start-ups and young companies.

Capital into our stock market, increasing the value of our firms.

Money into our municipalities and for our public works projects.

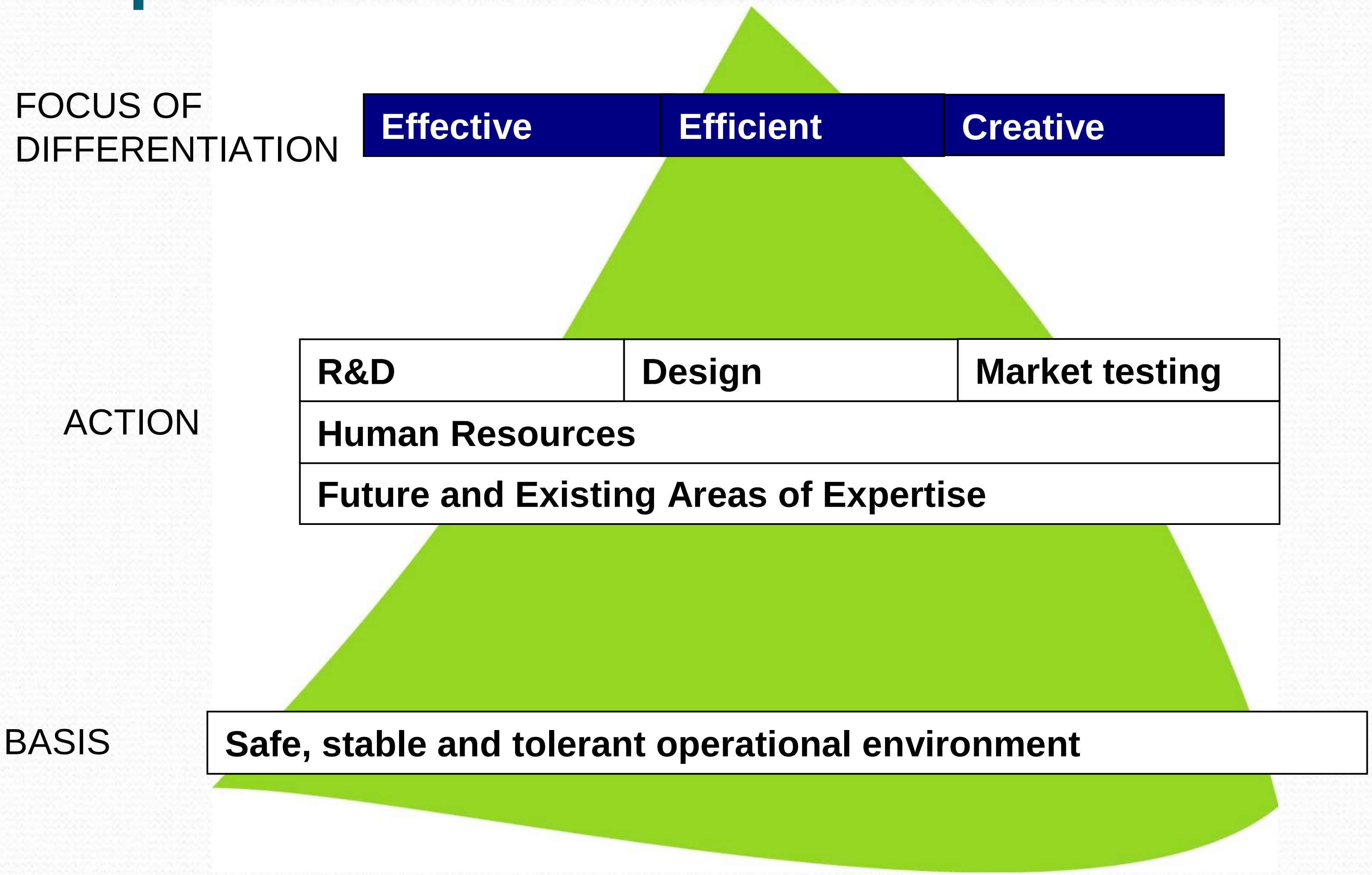
International Events

Business seminars in our niche areas of current and future strengths.

Industry-specific conferences, trade fairs and networking events.

One-off public events that increase awareness and quality of life.

Differentiation & value proposition of Helsinki



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Global challenges of innovation driven economy

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Role of Greater Helsinki Promotion Ltd

Organization – in general

- Greater Helsinki Promotion was founded in 4/2006 as an international (business) promotion agency for the Helsinki region.
- Owned by:

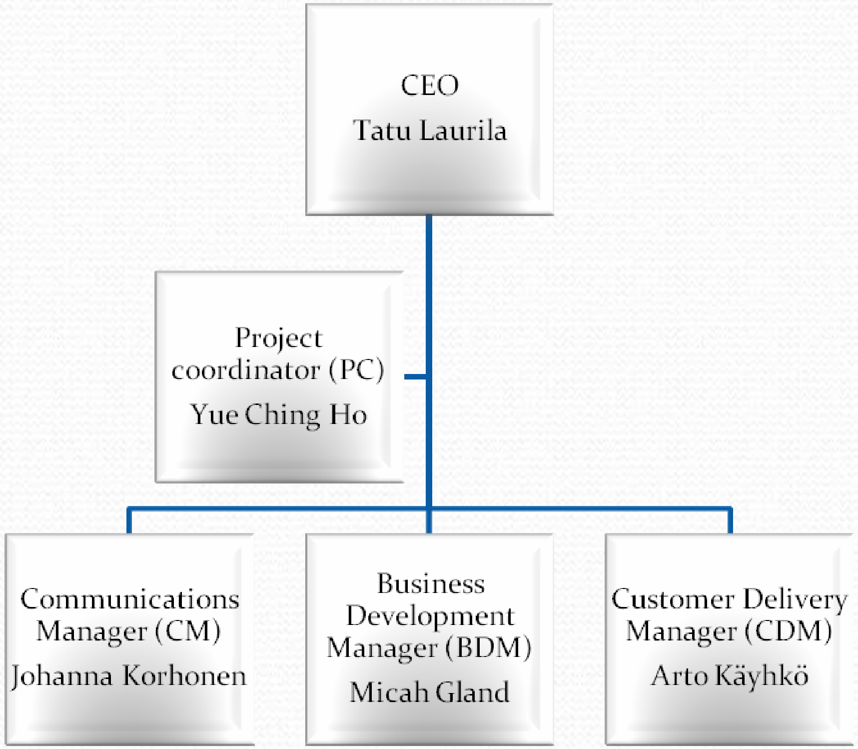
City of Helsinki · ESPOO ESBO · Vantaa · KAUNIAINEN GRANKULLA · Uudenmaan liitto Nylands förbund

- Yearly funding grom owners: 3.5 million euros (until 2009).
- Contact info:

Address	Mechelininkatu 1 a – 00180 Helsinki - Finland
Tel.	+358 9 562 6677
Fax.	+358 9 562 6688
Internet	http://www.inhelsinki.com
E-mail	firstname.lastname@inhelsinki.com

Organization – the team

Organizational chart



Roles and responsibilities

- CEO
  - overall leadership & management; stakeholder contact
- Project coordinator
  - administration; customer support; project coordination
- Communications manager
  - marketing communications strategy and coordination
- Business Development Manager
  - partner community building, service concept
- Customer Delivery Manager
  - KAM (Key Account Manager) network contact, main customer contact

Core processes

Marketing Communications

- Community, GHP visual outlook by end of August
- Promotional Activity, ongoing cases but targets tbd
- Events (goals and plans tbd asap) June

Community Building

- Partnering (goals and plans tbd asap) June – August
- Enablement (planned on-road with partners) September – December

Customer Delivery

- Packaging & Offer building together with Partnering, June - August
- Stakeholder and Landing processes developed according the feedback the processes gain from previous processes. September - December

Finland is a land of R&D&I

Prospects for Europe

Summative Conclusions : Understanding the Implications of LocoMotive for the EU

Helen Lawton Smith
Oxfordshire Economic Observatory & Birkbeck, University of London

LocoMotive Final Conference
6th June 2007

LocoMotive

Why Locomotive?

- Understanding & achieving a vision for a more innovative Europe (Dearing, 2006)
- Realising success of national initiatives across Europe (e.g. Finland)
- EU Lisbon agenda, 2001: “Improve competitiveness in the knowledge economy”
- Barcelona, 2002: “EU Target 3% GDP investment in R&D, two thirds from private sector”
- Movement beyond research-oriented supply-side measures – integration with market demand

The European Dimension

- Changing worldwide distribution of R&D – Globalisation, Mergers & Aquisitions
- Competition from India, Russia and China – and the USA
- Paradigm shift at European level - An innovation-friendly market? (Aho 2006)
- Maintenance of supportive environment for MNC R&D?
- Diversity across European regions (old and new Europe) - Regional diversity

Key Policy Issues

From the results a policy can be addressed through a number of key issues:

- **Taxes**
- **Education**
- **Funding**
- **Governance Quality**

Locating R&D

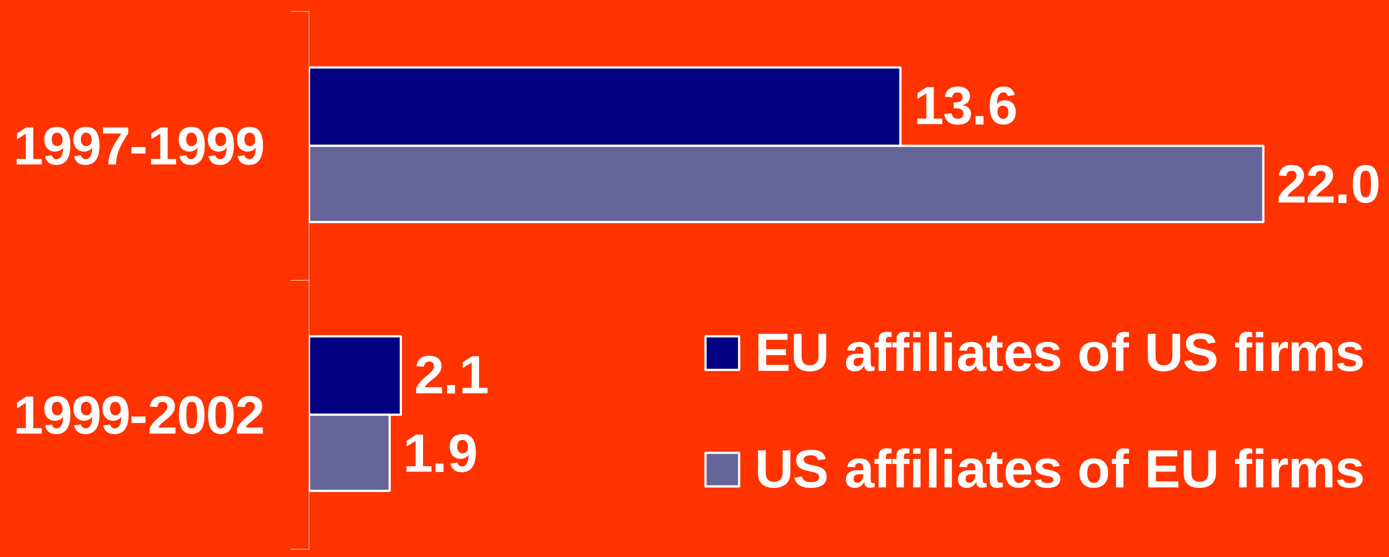
- European Landscape vs. Scales of Practice

Local → Regional → National → European

- Pan-European issues such as:
  - ✓ Functional linkages
  - ✓ Public regulations
  - ✓ Skills shortages
  - ✓ Global competition
- Reorientation of universities in the KBE - cooperation among MNEs, public sector and universities

Attracting Mobile R&D:

America rather than Europe…



R&D expenditure of foreign affiliates, Average annual growth (in % from € PPS)

So What...?

- What can be done directly and indirectly to improve the overall ecosystem which will boost the attractiveness of the location, its empowerment and what are the risks?

"Constructed regional advantage"

- **Context specific initiatives:**

Enterprises - Science base - Labour market

Networking - Governance

The Science Base

- Facilitating knowledge and technology transfer
- Promote industry-industry <u>and</u> university-industry interaction within regions
- Developing formal and informal mechanisms and intermediaries

Science parks & Incubators

Labour Markets & Education

- Need for education and training to meet the needs of industry
- Investment in high school science teachers and technicians
- Blended learning culture
- Sectorally specialised education, training and development programmes – including CPD

India	350,000
China	207,000
Japan	103,000
US	76,000
UK	24,000

Number of engineering graduates per year

Embedding & Networking

Embedding in the region...

- Need to raise R&D intensity of SME to collaborate effectively with MNCs
- Support inter-industry cooperation between MNCs & SMEs and with research institutes and governments

Networking in the region…

- Networked SMEs are likely to be more successful than non-networked SMEs
- Networked SMEs are more innovative
- Networks act as ‘open gates’

Governance

"Strong regional institutions with capacity to develop sophisticated science and innovation policies, a focus for economic strategy on knowledge-based industry and a location with ambitions as a centre for technology and knowledge-based systems"

(Charles, 2006)

- Implications and significance of cluster policy?
- Local and regional visions for the future?

Final conclusions

- Large R&D intensive MNCs highly significant to regional economies in Europe
- Labour markets are one of the most critical factors – Notion of ‘Ecosystems’
- Challenges for policy makers - coherent vision and need for harmonisation in Europe

Prospects for Europe

Summative Conclusions : Understanding the Implications of LocoMotive for the EU

Helen Lawton Smith
Oxfordshire Economic Observatory & Birkbeck, University of London

LocoMotive Final Conference
6th June 2007

LocoMotive

Innovation Systems and Culture in Oxford University

Mark Mawhinney
General Manager, Isis Enterprise

Oxford University is very old

- Teaching in Oxford since 1096
- Developed rapidly from 1197
  - Henry II banned English students from University of Paris
  - An early example of restriction of trade
- Oxford University has always welcomed overseas students
  - Emo of Friesland 1197

- Alternative History
  - Students came to Oxford from Paris to avoid the traffic
  - later some went from Oxford to Cambridge
  - for the same reason
  - in which case it was all a waste of time

www.cam.ac.uk
"in 1209 scholars taking refuge from hostile townsmen in Oxford migrated to Cambridge and settled there."

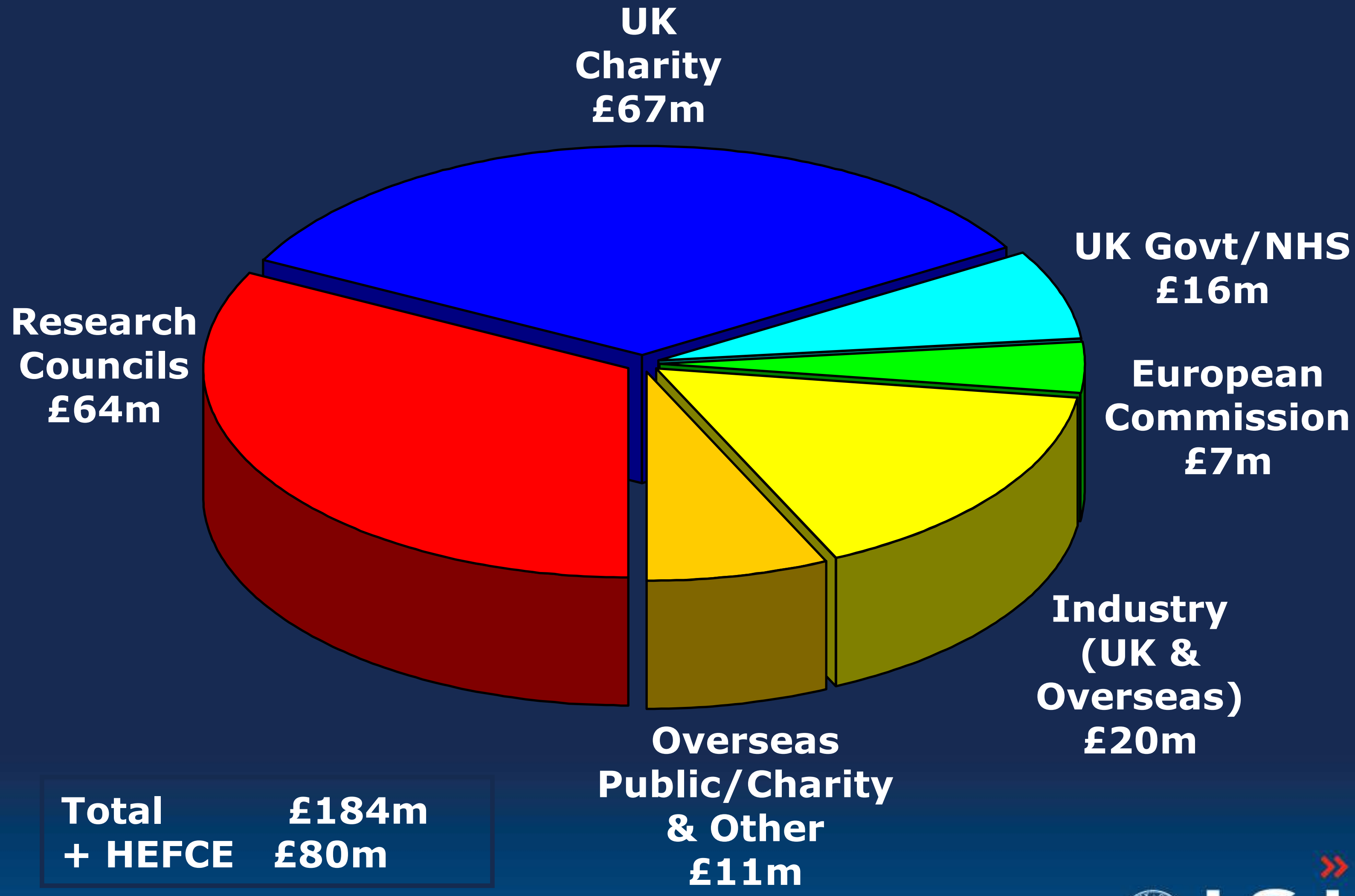
ISIS INNOVATION

Research at Oxford

- 3,700 researchers
- 5,000 graduate students
- Most Powerful UK Research University
  - Research Fortnight
- Most Innovative UK University
  - Cross Atlantic Capital Competition
- Research Spend
  - £264 million (2004/2005)

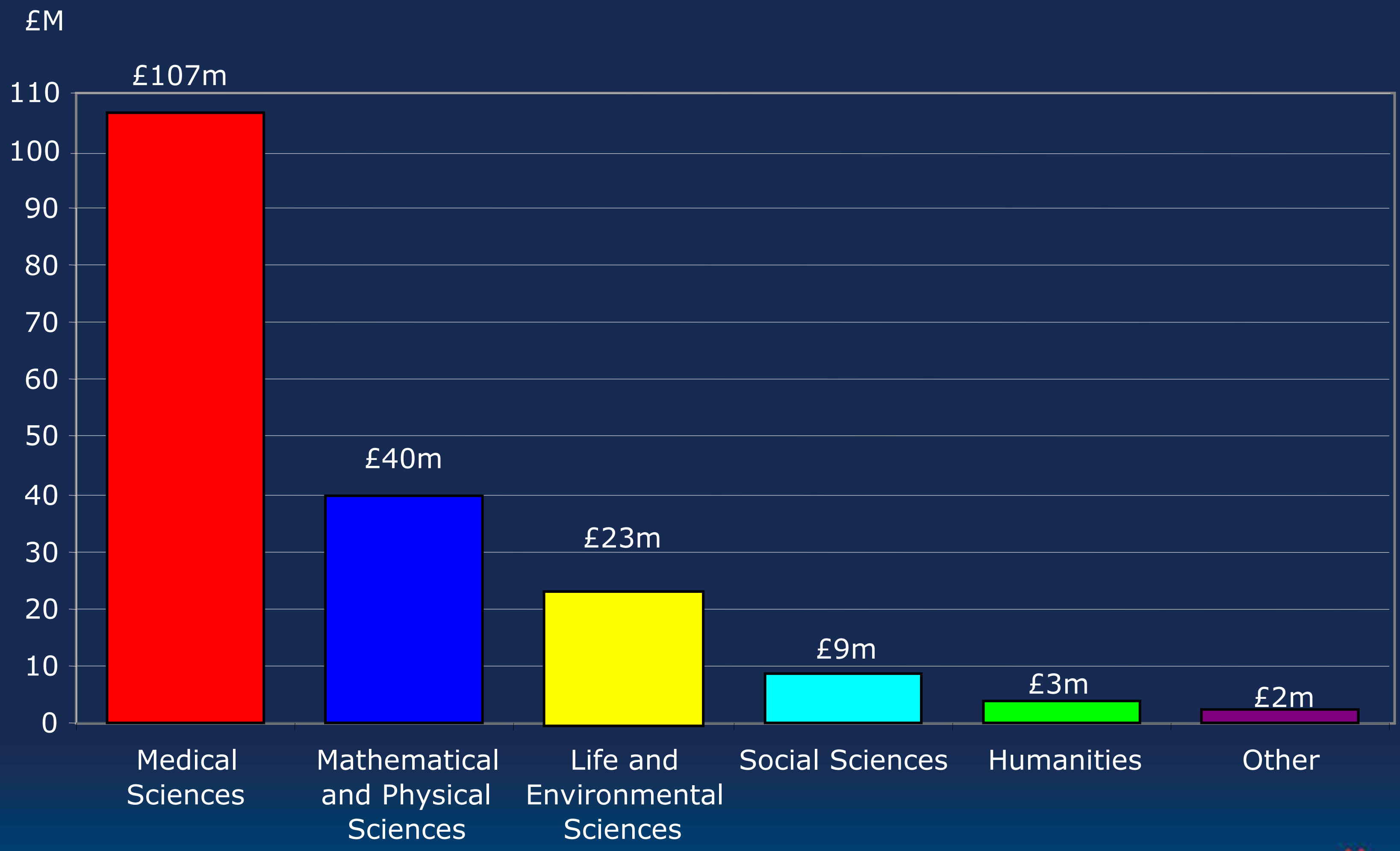
ISIS INNOVATION

Research Funding 2004-2005
£264 million [1993 £83m]



Total	£184m
+ HEFCE	£80m

External research income by Academic Division 2004-2005



Total £184 million

ISIS INNOVATION

What is a University?

- A great University is defined by great academics
  - Great researchers
  - Great thinkers
  - Great teachers
- Not
  - Great administrators
  - Great technology transferors
  - Or even great leaders
- Although list two helps recruit and retain list one

ISIS INNOVATION

What is a University for?

- Principle products - Teaching and Research
  - There are few alternative sources of either of these
- Valuable by-product – commercialisable inventions
  - There are many other sources of commercialisable inventions
- It is an error to design a production plant to maximise the output of the by-product
- Technology transfer comes at the end of the research
  - The value then extracted must be maximised but not at the expense of the prime mission

- Ignoring this could turn some great universities into “not-so-great” contract research companies

ISIS INNOVATION

Technology Transfer

- Technology transfer is about stimulating communication between two very different cultures (academia & industry)
- The two cultures will not spontaneously understand one other
  - Although there has always been the occasional multi linguist!
- Therefore intermediaries are required
  - at least to start with
- It only works if the intermediaries have a ***real*** understanding of both cultures
- There is not a single recipe that always works
  - National legal framework is a major influence
  - But there are some underlying principles

The Challenge

Commerce

- Driven by external needs
- Clear goals with shareholder commitments
- Commercial confidentiality

Researcher

- Self directed
- Next step defined by yesterday's results
- Free exchange of ideas

- "Academics never deliver"
- "Industry is out to cheat us"

- So we can expect it will be challenging to build a mutually trusting relationship

Reporting Structure (partial)

UNIVERSITY COUNCIL

Intellectual Property Advisory Group

Four Academic Divisions

Social Sciences Division
Anthropology
Archaeology
Area Studies
Development Studies
Economics
Educational Studies
Environment
Internet Institute
Law
Saïd Business School
Politics
Social Policy and Social Work
Sociology

Humanities Division
Chinese Studies
Classics
Comparative Philology
Ruskin School of Drawing
English Language & Literature
History
Medieval & Modern Languages
Modern Middle Eastern Studies
Music
Oriental Studies
Philosophy
Theology

Medical Science Division
Biochemistry
Clinical Medicine
Physiological Sciences
Psychology

Maths & Physical Science Division
Chemistry
Computer Science Earth Sciences
Engineering Science
Materials
Mathematics
Physics
Plant Sciences
Statistics
Zoology

Administration

Regional Liaison

Science Enterprise Centre

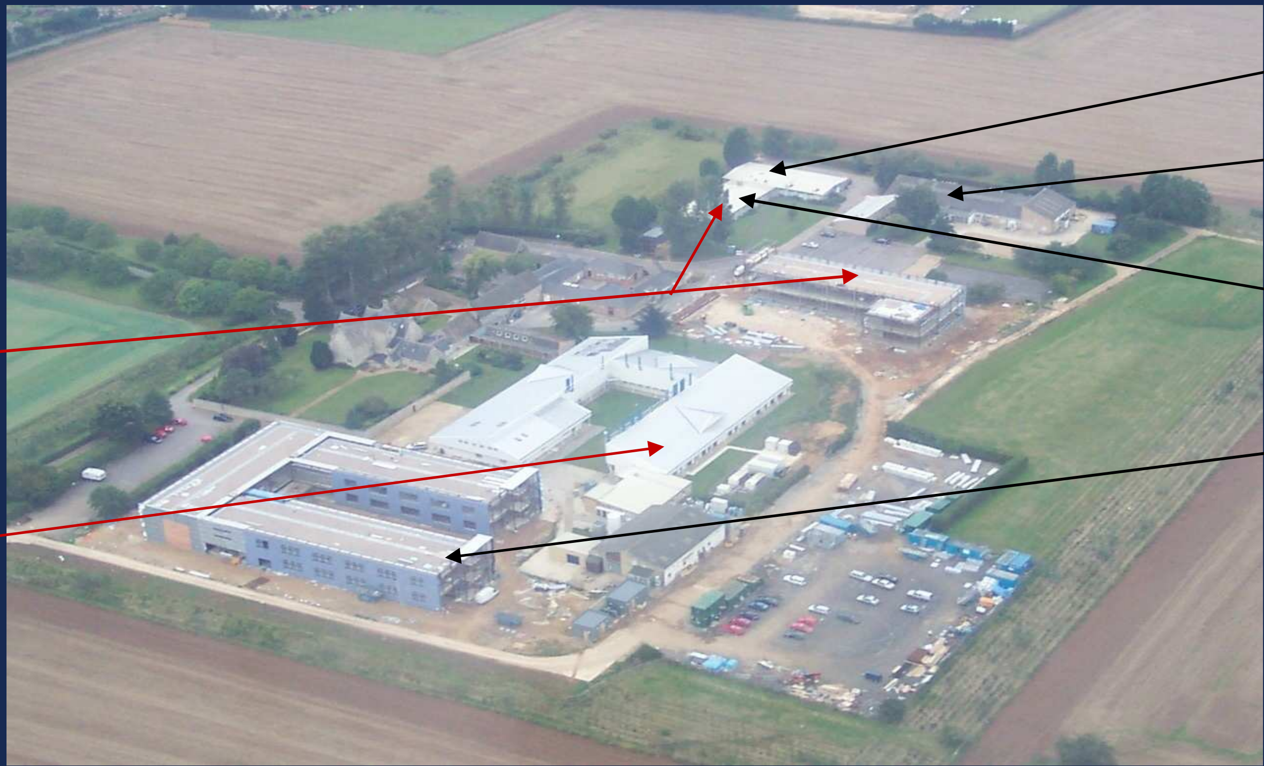
Research Services

Isis Innovation Limited

Begbroke Science Park

ISIS INNOVATION

Begbroke Science & Business Park



- Owned & operated by Oxford University
- University research labs
- Business Incubator & premises for new companies
- Central meeting room and café

ISIS INNOVATION

Intellectual Property Policy
October 2000

- University claims ownership of all employees' and students' IP rights resulting from University research activities
- The university assists those researchers ***who wish to*** commercialise their research
  - by patenting, licences, spinout companies & consultancy
- Researchers share the benefits
  - Royalty shares from licences
  - Equity in spinout companies
  - Income from personal consultancy

ISIS INNOVATION

Isis Innovation

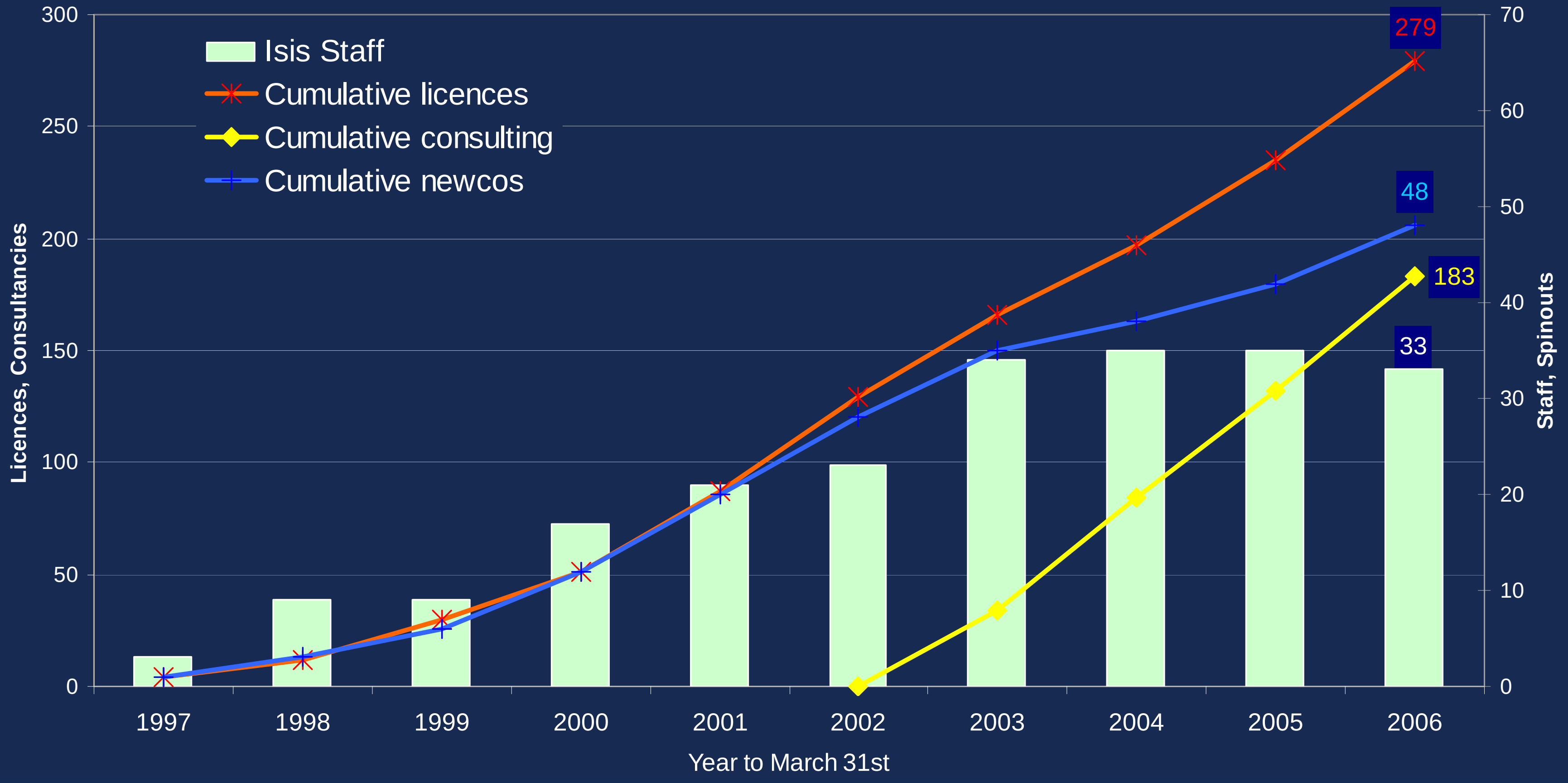
> A company owned by the University of Oxford
> To help researchers commercialise the results of their research

Activities

Patenting	50 p.a.
Licensing of intellectual property	30 p.a.
Consulting and service contracts	50 p.a.
Formation of new companies	8 p.a.

ISIS INNOVATION

Isis staff, spinouts, licences & consultancies



Isis Innovation People

Administration (12)	Physical Science Group (9)	Life Science Group (9)	Business Innovation & Consulting (6)
Deputy Chairman Dr Tim Cook **Managing Director** Tom Hockaday **Portfolio Manager** James Mallinson **Lawyer** Stephen Brett Emma Wheatley **Office Manager** Jenny Bailey **Marketing** Cynthia Warmington **Accounts** Gemma Allnutt **Facilities** Jane Tarry **Reception** Gillian Hicks **Isis Enterprise** Dr Mark Mawhinney Dr Sarah Macnaughton	**Head of Group** Dr David Baghurst **Project Managers** Dr David Churchman Dr David Eastham Dr Jamie Ferguson Dr Mairi Gibbs Terry Pollard Dr Roger Welch Dr Tony Lewis **Administrator** tba	**Head of Group** Linda Naylor **Project Managers** Dr Fiona Begg Dr Dina Chen Dr Colin Story Dr Adam Stoten Dr Suzy Wood Dr Sarah Deakin tba **Administrator** Anna Pickvance	**Head of Group** Catherine Quinn **Project Managers** Andrew Goff Dr Rick Inwood Gill Rowe Dr Elen Wade-Martins **Administrator** Kerry Antcliffe

ISIS INNOVATION

Isis Philosophy

- We support researchers ***who wish to*** transfer technology
- The researcher's interests are key
- Our most critical asset is researcher confidence
- We generate researcher enthusiasm by
  - Internal marketing
  - University IP policy
  - Employing high quality staff experienced in both research and industry

A source of New Companies

> Between 1959 and 1997 £1billion of public companies were built by managers and investors on Oxford University technology

ISIS INNOVATION

Oxford Spin-outs Pre 1998

		Capital	Equity	Main Business
1959	Oxford Instruments	£100m	-	Scientific Instruments
1977	Oxford Lasers		-	Lasers
1988	Oxford GlycoSciences	£102m*	Yes	Glycobiology
1989	Oxford Molecular	£53m*	Yes	Drug design
1992	Oxford Asymmetry	£316m*	Yes	Chemistry
1994	PowderJect	£542m*	Yes	Drug delivery
1996	Oxford BioMedica	£137m	Yes	Gene Therapy
1997	Oxagen		Yes	Genetics
1997	Oxford Gene Technology		Yes	Gene chips
Total		£1,250m		

(Quoted valuations at 3/10/2006 or at sale of company*)

ISIS INNOVATION

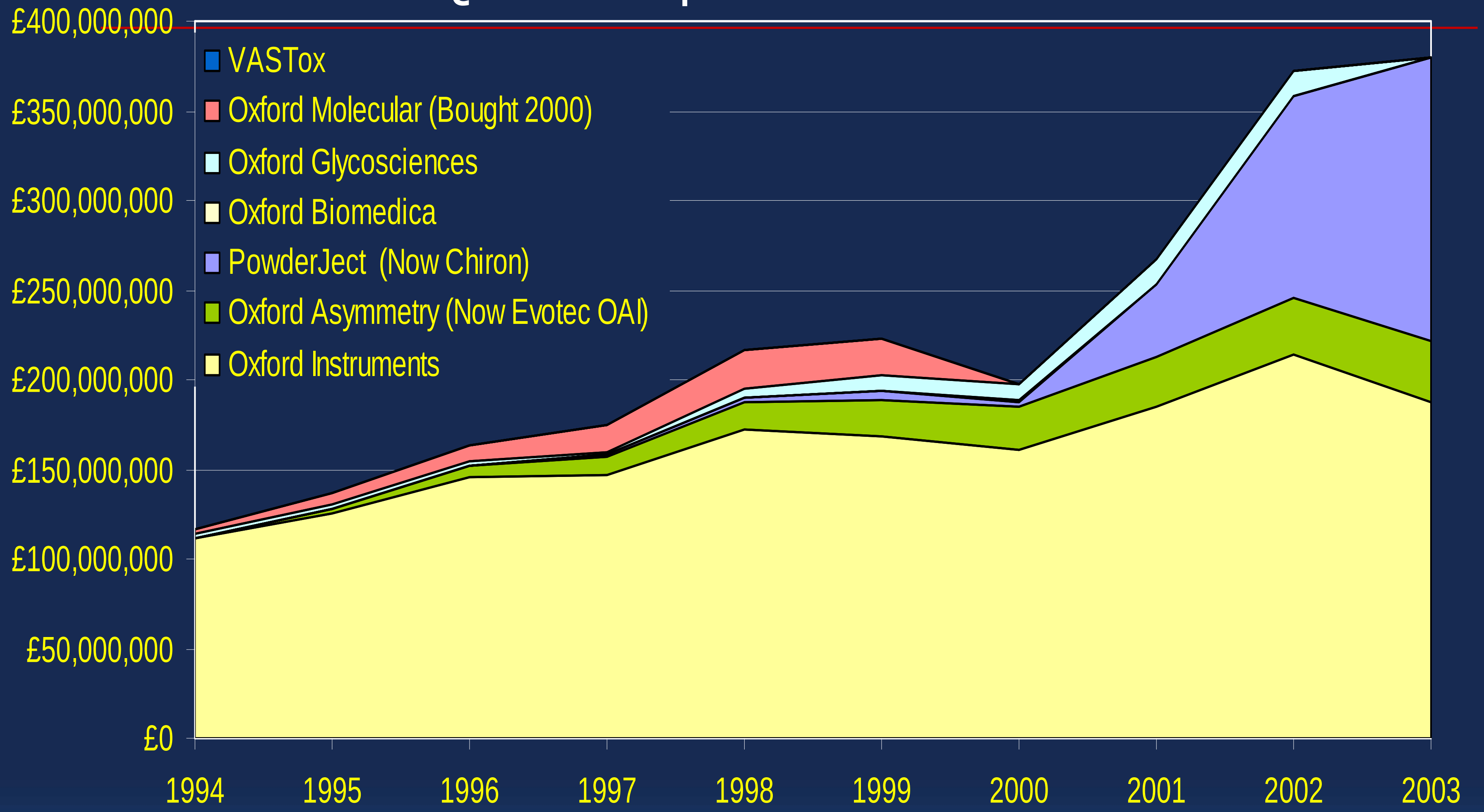
Oxford Spin-outs Post 1998

1998	Feb	**Opsys**	Displays
	Mar	**Synaptica**	Neurodegenerative diseases
	Jun	**Prolysis**	Antibiotics
	No	**Celoxica**	IT
	Nov	**Sense Therapeutic**	Pharmaceuticals
1999	Mar	**Avidex Pharmaceuticals**	Pharmaceuticals
	Jun	**Oxxon Pharmaccines**	Pharmaceuticals
	Jun	**Dash Technologies**	IT
	Aug	**Oxonica**	Nanotechnology
	Aug	**Abington Sensors**	Sensors
	Dec	**Oxford Medical Imaging**	Image analysis
2000	Jan	**Third Phase**	Clinical trials management
	Apr	**Mindweavers**	Sensory development
	May	**Oxford BioSignals**	Vigilance monitoring
	Aug	**Oxford BioSensors**	Biosensors
	Dec	**TolerRX**	Immunology
	Dec	**OXIVA**	Medical software
	Dec	**PharmaDM**	Drug design
2001	Mar	**OxLoc**	GPS/GSM tracking
	Mar	**Oxford Bee Company**	Pollination
	Apr	**Oxford Ancestors**	Genealogy
	Apr	**Novarc**	Press tooling
	May	**Oxford ArchDigital**	Digital archaeology
	Nov	**NaturalMotion**	Neural networks
	Dec	**Inhibox**	Drug searching
2002	Jan	**Pharminox**	Cancer Drugs
	Feb	**Minervation**	Health Information
	Mar	**Spinox**	Artificial silk
	May	**Zyentia**	Protein Structures
	Aug	**Oxitec**	Insect pest control
	Oct	**Oxford Immunotec**	TB Diagnostics
	Nov	**ORRA**	Risk Analysis
	Nov	**Glycoform**	Cancer drug dev't
	Nov	**BioAnalab**	Pharma Testing
2003	Feb	**VASTOx**	Pharma screening
	Jun	**ReOx**	Drug discovery
	Jul	**Riotech**	Hepatitis drug dev.
	Aug	**OCSI**	Social inclusion
2004	Jun	**Oxford Medical Diagnostics**	Breath Analysis
	Jun	**G-Nostics**	Anti-smoking test
	Nov	**Surface Therapeutics**	Drug development
	Dec	**EKB Technology**	Bioprocess Eng'ring
2005	May	**Oxford Nanolabs**	Biosensors
	Jun	**Oxford RF Sensors**	Industrial Sensors
	Sep	**Oxbridge Pulsars**	Radar/Comms
	Nov	**Celleron**	Drug discovery
	Dec	**Oxford Catalysts**	Hydrogen from liquids
2006	Mar	**TdeltaS**	Metabolism
	Apr	**Oxford Medistress**	Stress diagnosis
	Jun	**Particle Terapeutics**	Drug delivery
	Jly	**Aurox**	Microscopy
	Sep	**Oxford Advance Surfaces**	Polymers

External investment £282m
£30m Seed/Business Angels &
£252 million Institutional/Venture Capital

ISIS INNOVATION

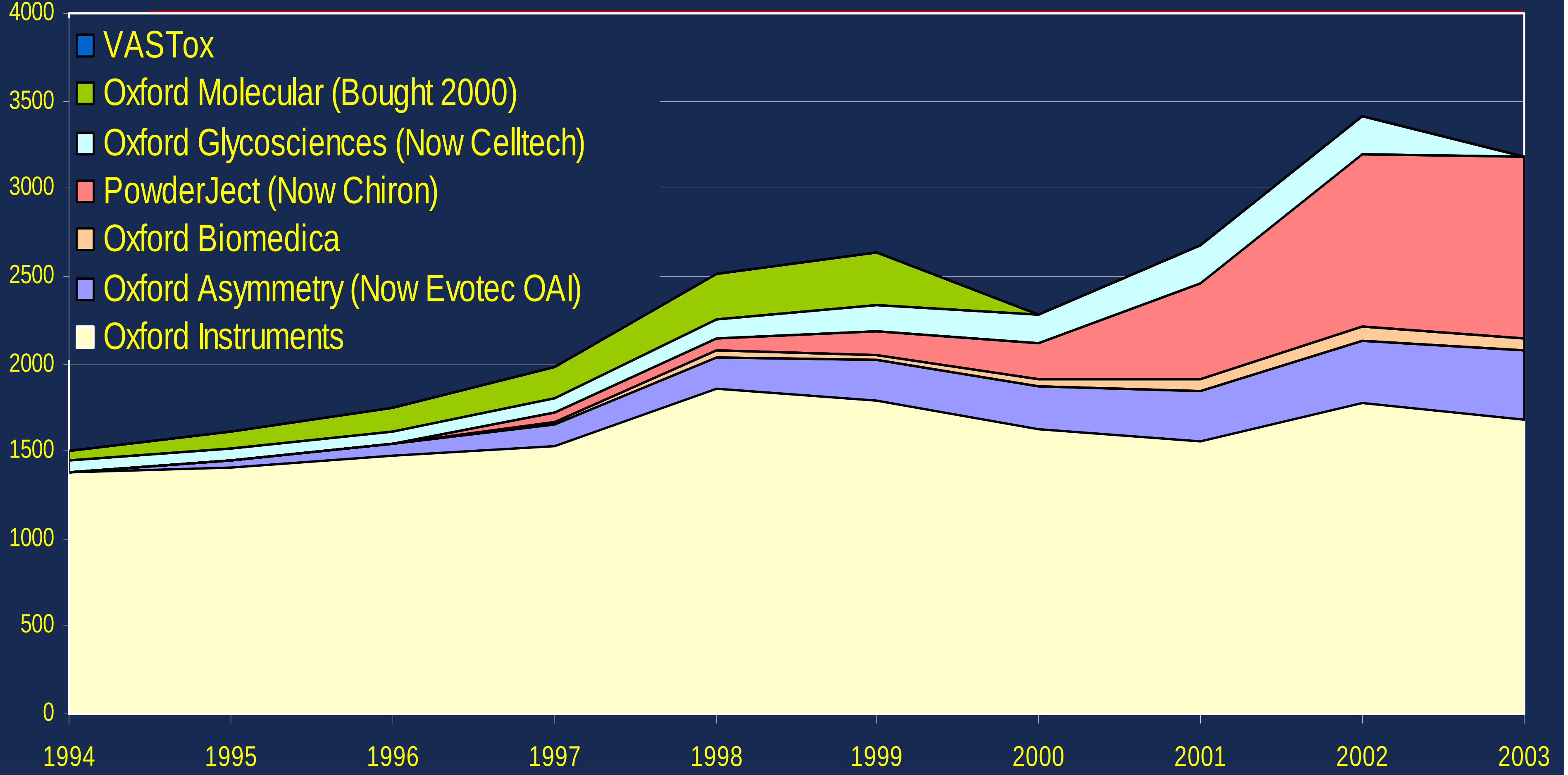
Turnover of Quoted Spinouts



Data Oxford Economic Observatory 2004

ISIS INNOVATION

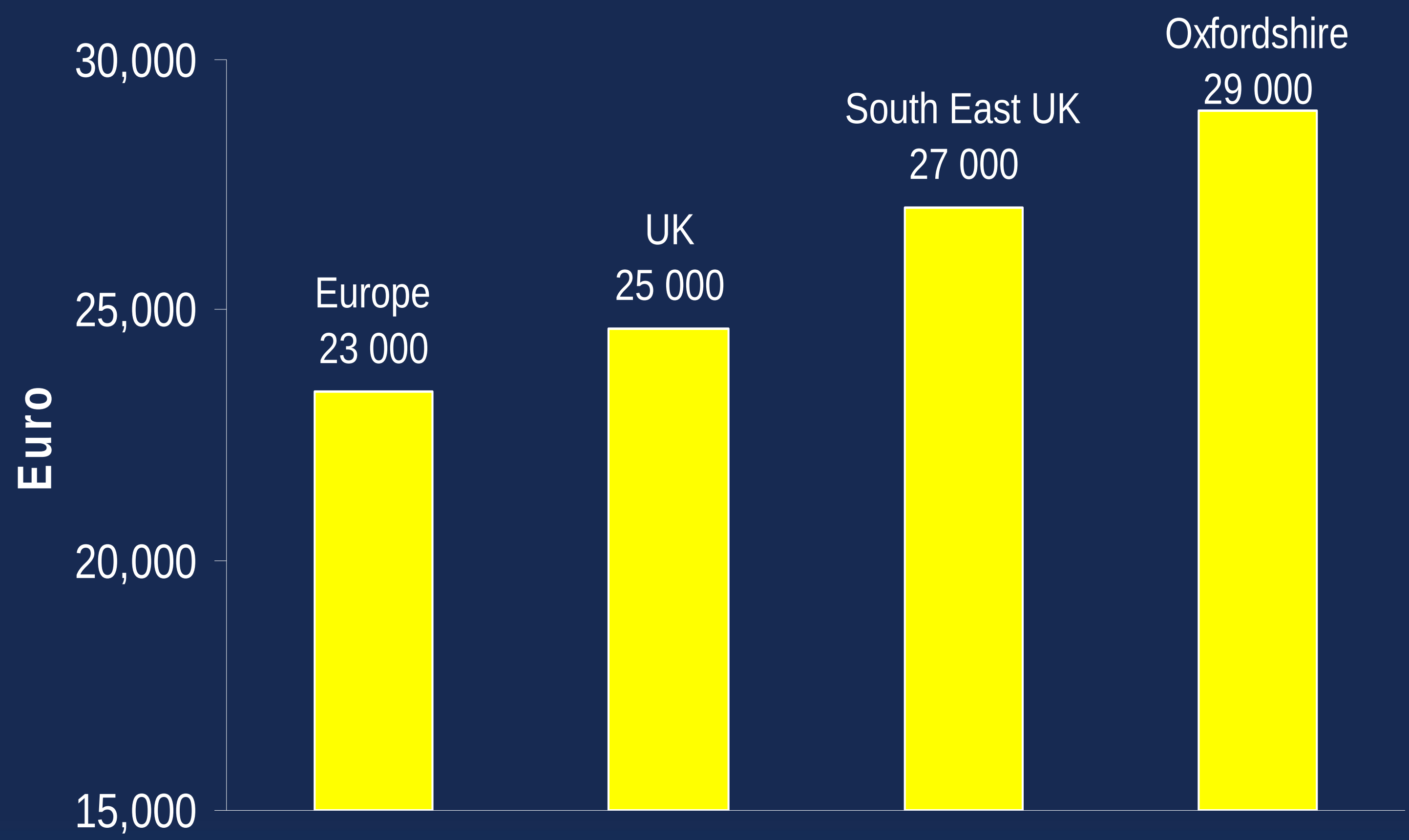
Jobs Created by Quoted Spinouts



Data Oxford Economic Observatory 2004

ISIS INNOVATION

Gross Value Added per head



Data Oxford Economic Observatory 2001

ISIS INNOVATION

Culture Change

Entrepreneurial culture of researchers

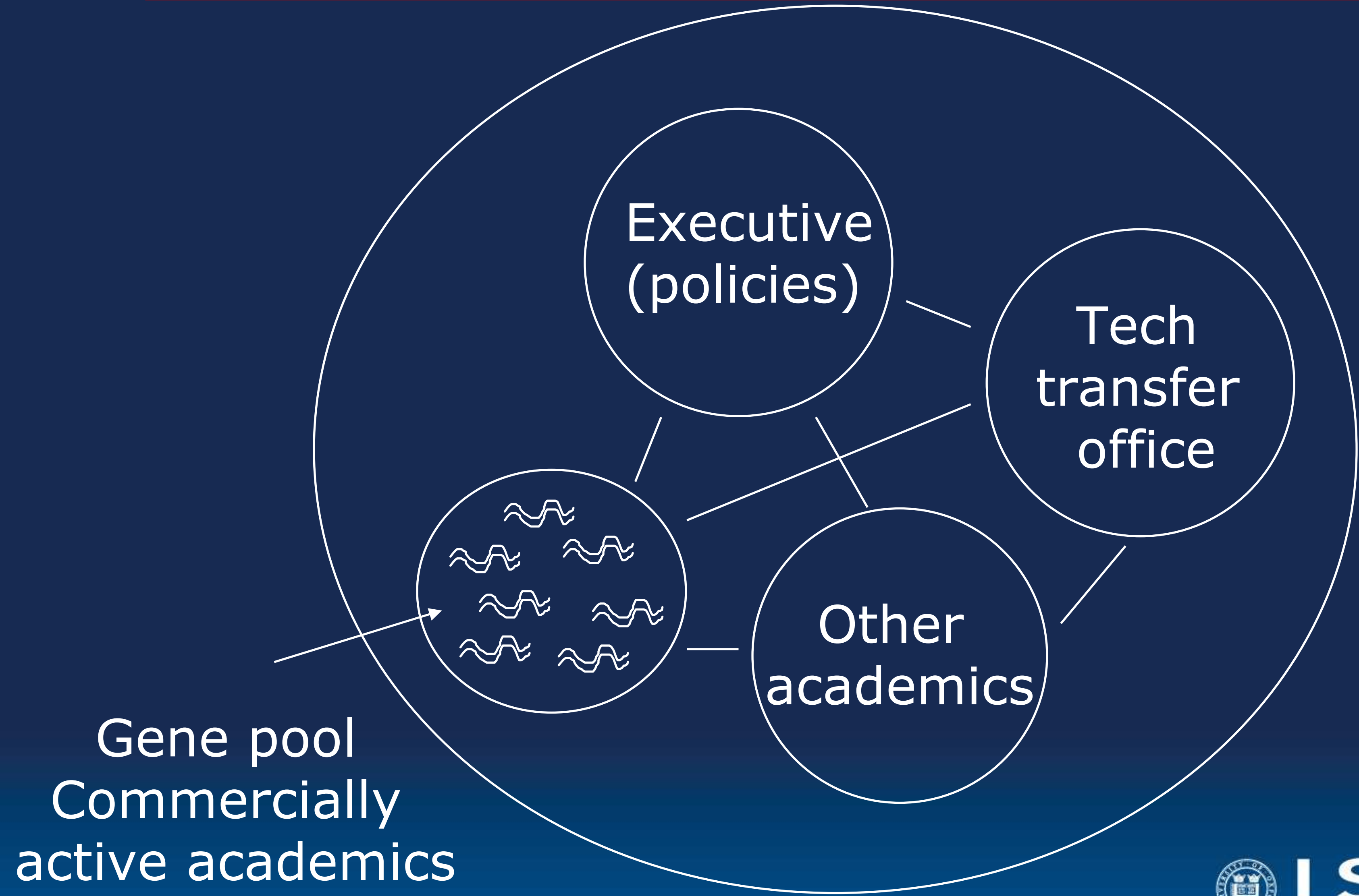
University technology transfer resource

Local professional environment

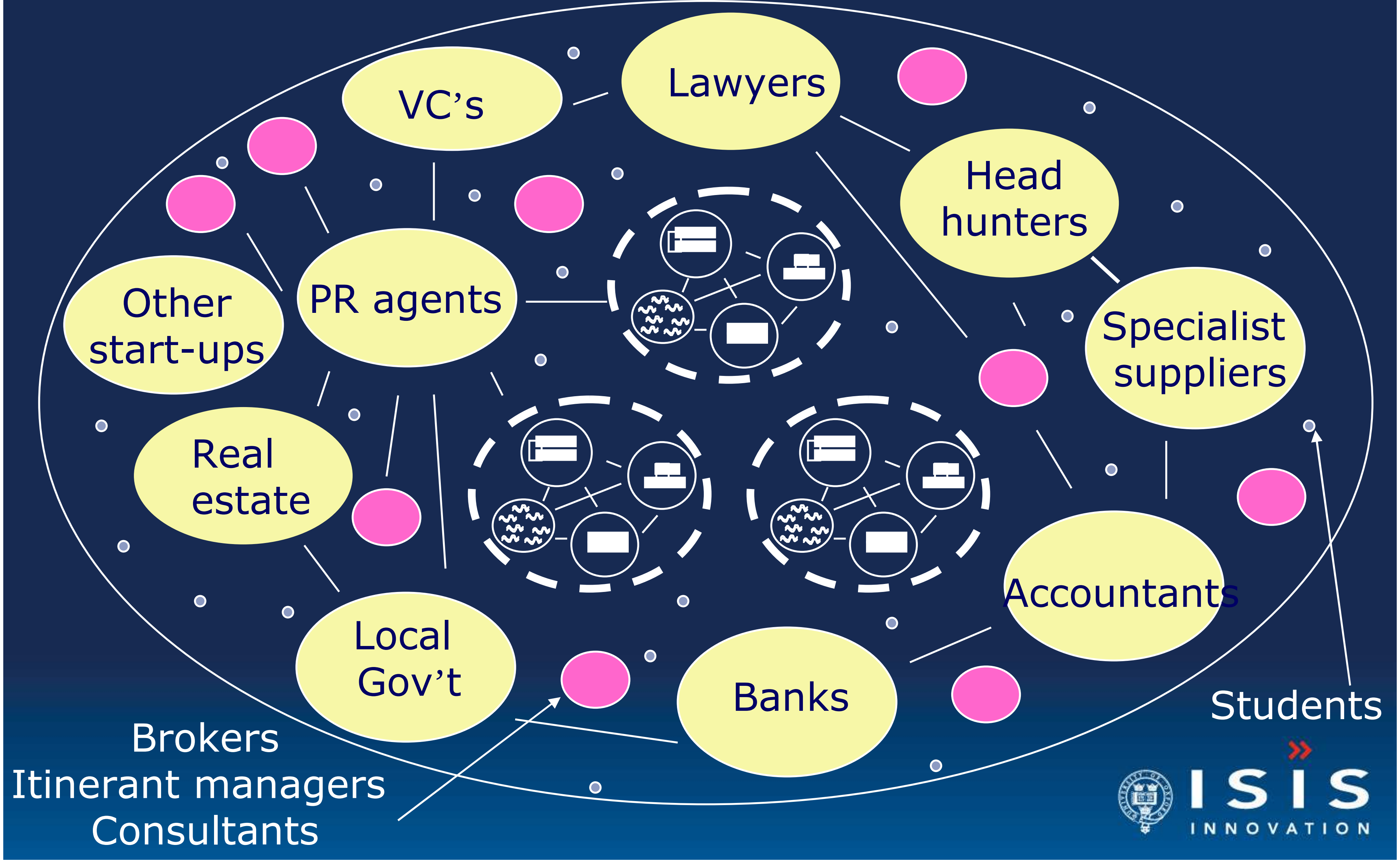
> All three must proceed together but the University must lead the change because..

1. The ideas are in the University
   - If University provides TT resource, change will happen faster
     Oxford pre-Isis 1 spin-out every 4 years, post Isis 8 per year
2. If the University doesn't lead, the University may not receive its share of the benefits

The University



Sub-culture in a barter economy

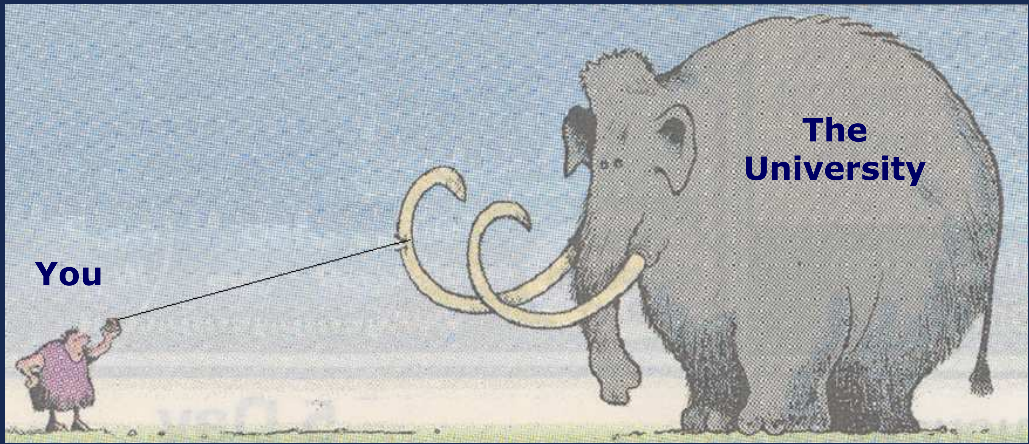


Conclusions

- Universities impact local economies in many ways
  - Attracting people
  - Educating people
  - Generating new knowledge
  - Commercialising via
    - Consultancy
    - Licences
    - Spinouts
- Oxford University has developed systems for all the above
- City & University can both benefit from closer collaboration

ISIS INNOVATION

Managing your relationship with a university



Like leading an elephant with a thin rubber band

- Walk along with the elephant
  - > In whichever direction it chooses to go
  - > Until it gets used to you
- Start to pull gently on your rubber band
- If you pull too hard or too suddenly
  - > You will break your rubber band and
  - > Have no further influence over the elephant

ISIS INNOVATION

But

- Don't think you will ever have complete control

Cartoon by Stoney, Ravette Publishing +44 1403 711443 Tony Lopez (Copyright)

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Supporting Regional Innovation in Toronto

Jen Nelles
University of Toronto - ISRN
Munk Centre for International Studies

Locomotive Final Conference
5-6 June, 2007
Hamburg, Germany

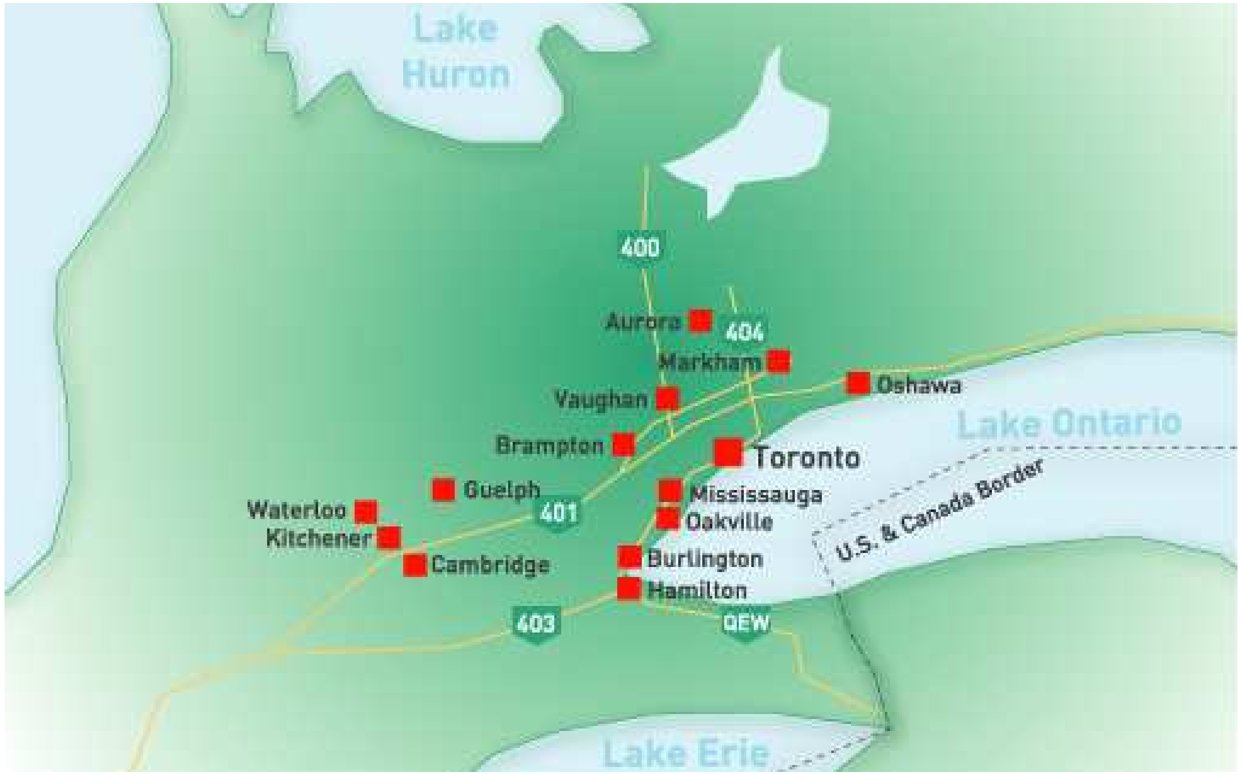
Innovation Systems Research Network

ISRN

Innovation Systems Research Network

ISRN

The Toronto Region



Innovation Systems Research Network

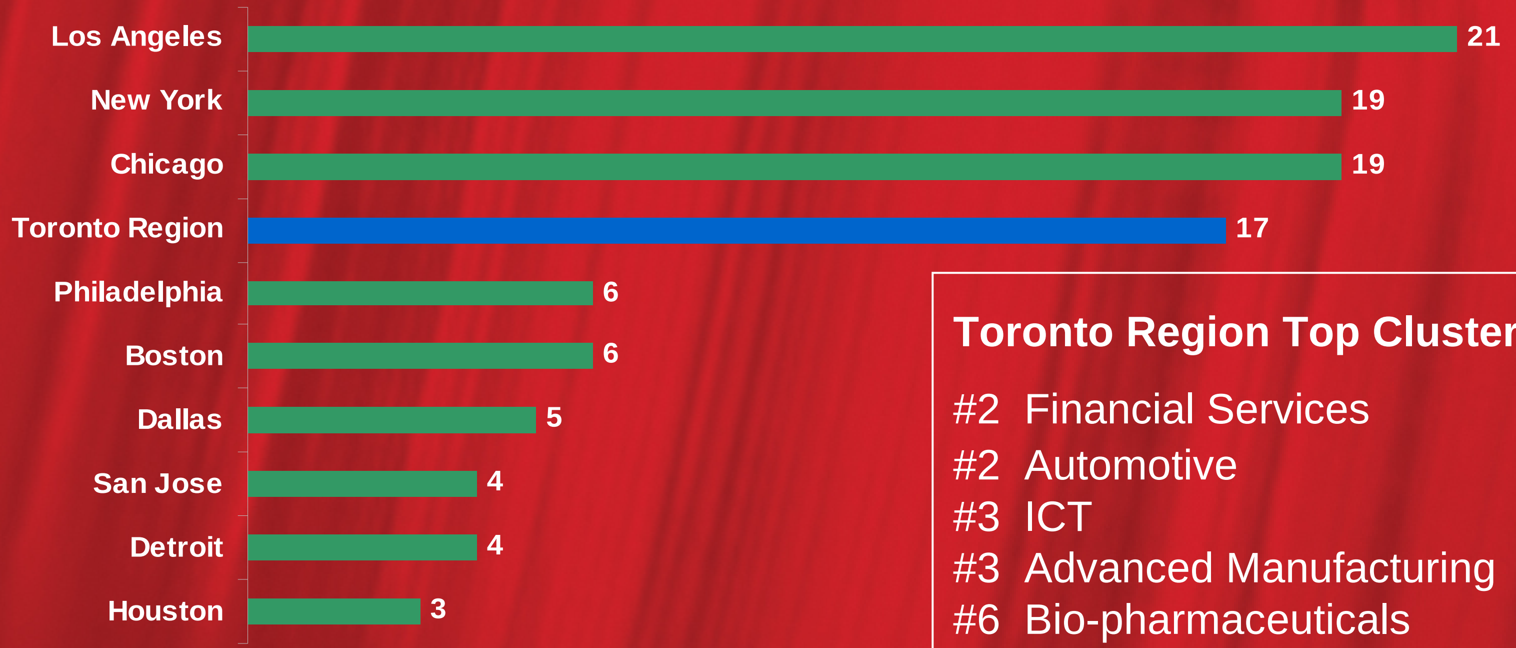
A Vibrant and Innovative Region

- **7.2 million people (5th largest in North America)**
- **$323b GDP**
- **35% of all R&D in Canada**
- **$6b private and public sector R&D**
- **Over 5,000 major ICT, Bio Life Sciences and Advanced Manufacturing companies**
- **Over 33% of Canada's most highly cited scientists (52 star scientists)**
- **USTPO Patent Applications (2005): 1,615**
- **16 Major Public Research Institutions**
- **101 Venture Deals totaling $328 million US (2005)**

TORONTO REGION
ACCELERATE INNOVATION.

Hub of Leading Clusters

Number of key strategic clusters in which the region ranks in the Top 5 in North America



Toronto Region Top Clusters

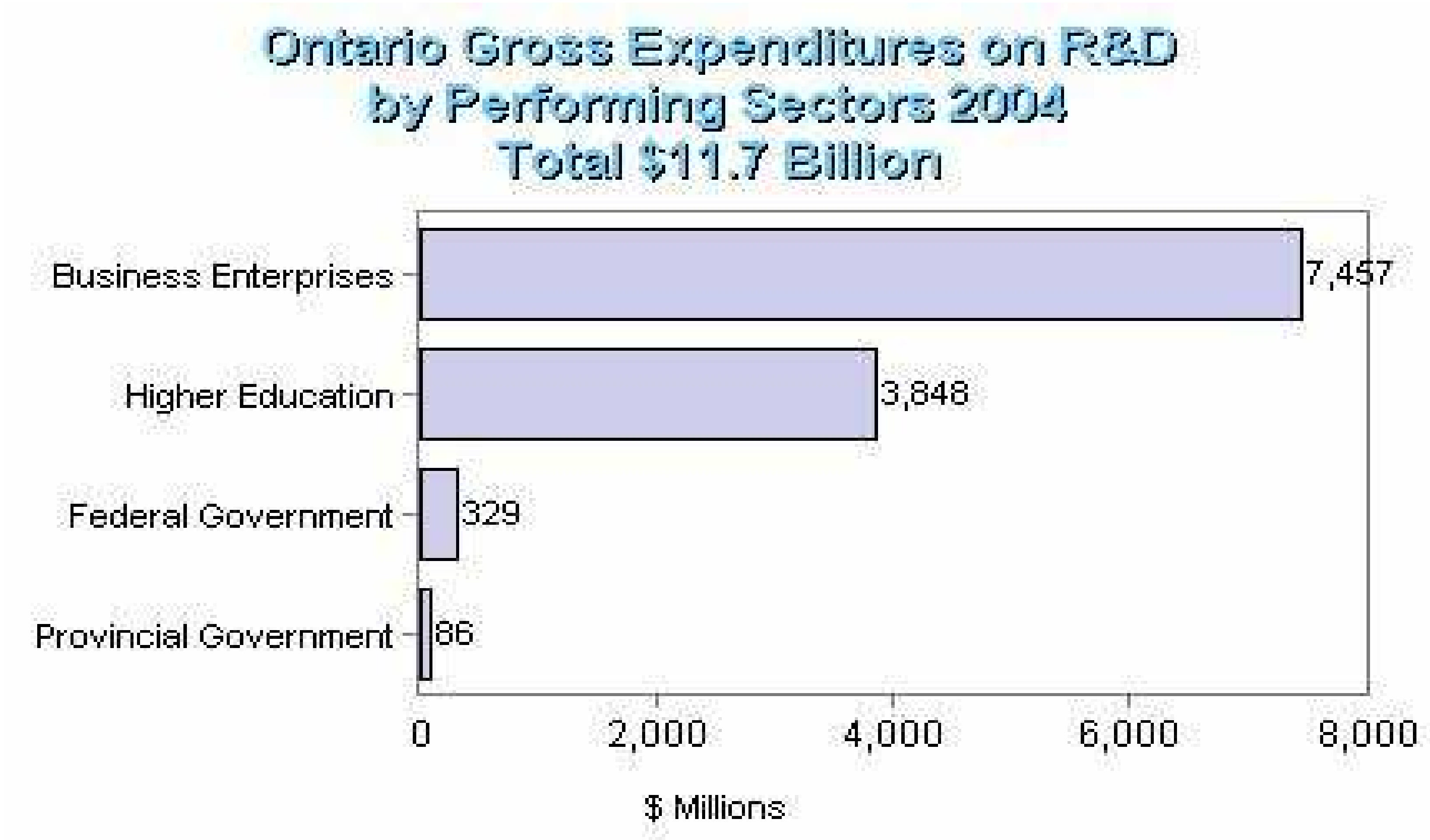
#2 Financial Services
#2 Automotive
#3 ICT
#3 Advanced Manufacturing
#6 Bio-pharmaceuticals

Source: Harvard University, ISC, ICP 2004

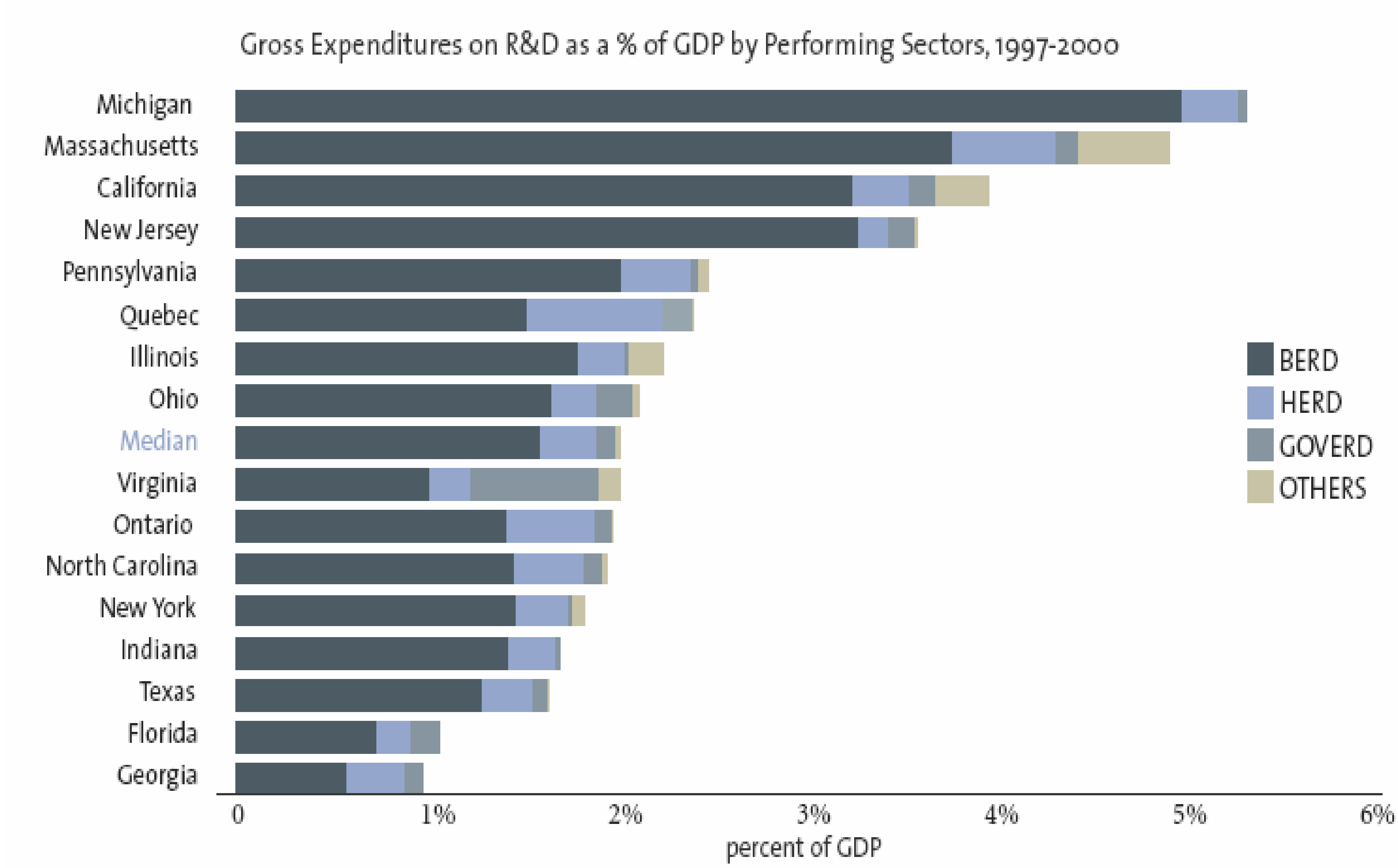
Magnet for Innovative Companies

TORONTO REGION
ACCELERATE INNOVATION.

ABB
ALCATEL
CELESTICA
HUSKY
Pratt & Whitney Canada
A United Technologies Company
Alias
AMD
CGI
IBM
LEXUS
RIM
APOTEX
ERICSSON
MDS
Science advancing health
Microsoft
sanofi pasteur
The vaccines business of sanofi-aventis Group
AstraZeneca
imagination at work
SIEMENS
ATI
GENNUM
MAGNA
TOYOTA
Autodesk
GM
NOKIA
Connecting People
NORTEL NETWORKS
Bell
Google
OPEN TEXT
CORPORATION
BIOVAIL
gsk GlaxoSmithKline
hp
invent
Pfizer
XEROX



Source: Statistics Canada, Science Statistics
September 2006



Source: Statistics Canada - Science, Innovation and Electronic Information Division; National Science Foundation

Innovation Systems Research Network

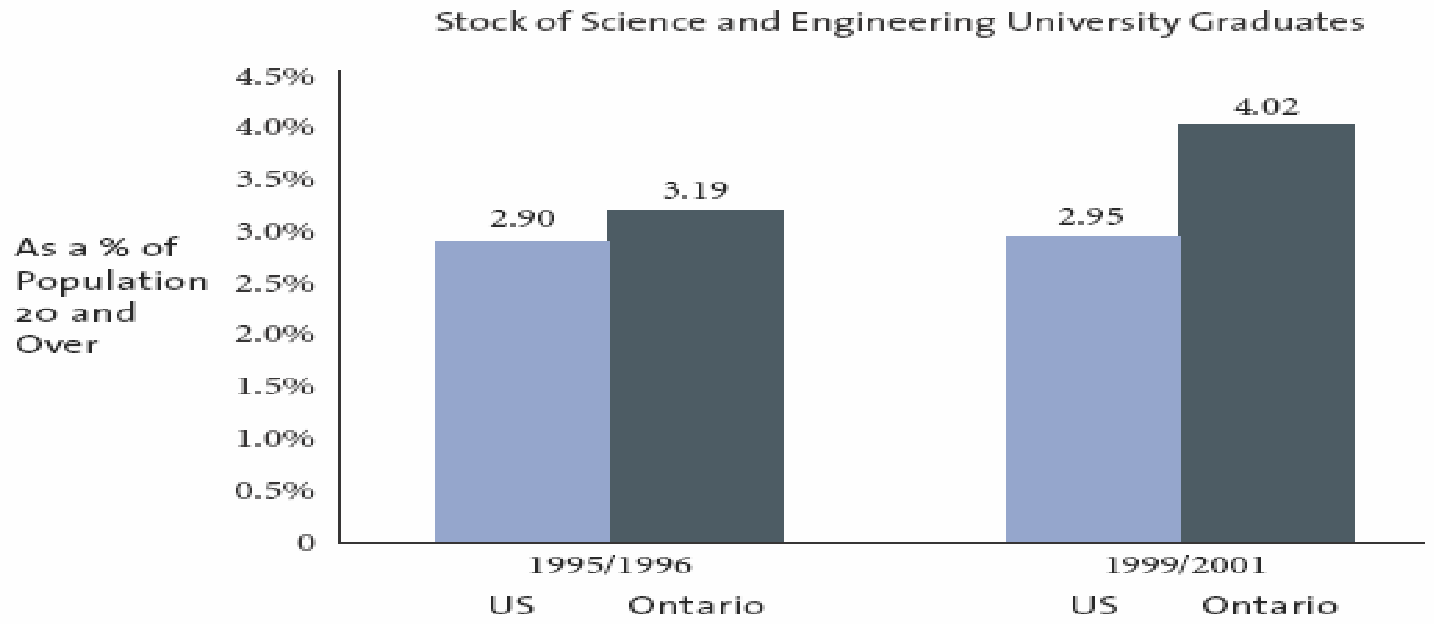
Canada's Top 100 Corporate R&D Spenders 2006

Rank			R&D Expenditures			Revenue	Research Intensity	
2005	2004	Company	FY2005 $000	FY2004 $000	% Change 2004-2005	FY2005 $000	R&D as % of Revenue**	Industry
1	1	Nortel Networks Corporation*	$2,248,730	$2,549,639	-11.8	$12,749,667	17.6	Comm/telecom equipment
2	2	Bell Canada	$1,740,000	$1,451,000	19.9	$17,250,000	10.1	Telecommunications services
3	3	Magna International Inc.*	$823,888	$689,795	19.4	$27,637,808	3.0	Automotive
4	4	Pratt & Whitney Canada Corp. (fs)	$472,000	$465,000	1.5	$2,700,000	17.5	Aerospace
5	5	ATI Technologies Inc.*	$451,372	$389,063	16.0	$2,692,792	16.8	Computer equipment
6	6	IBM Canada Ltd. (fs)	$343,000	$334,000	2.7	$5,500,000	6.2	Software and computer services
7	7	Alcan Inc.*	$275,033	$311,059	-11.6	$24,619,712	1.1	Mining and metals
8	13	Atomic Energy of Canada Limited	$264,092	$215,879	22.3	$286,567	92.2	Energy/oil and gas
9	9	Bombardier Inc.*	$212,030	$192,622	10.1	$17,842,022	1.2	Aerospace
10	8	Ericsson Canada Inc. (fs)	$201,000	$235,000	-14.5	$610,000	33.0	Comm/telecom equipment
11	10	Alcatel Canada Inc. (fs)	$194,000	$190,000	2.1	nd		Comm/telecom equipment
12	11	Apotex Inc.	$183,141	$172,363	6.3	$1,000,000	18.3	Pharmaceuticals/biotechnology
13	12	Pfizer Canada Inc. (fs)	$178,730	$157,883	13.2	$2,162,707	8.3	Pharmaceuticals/biotechnology
14	14	GlaxoSmithKline Inc. (fs)	$135,535	$140,317	-3.4	$975,125	13.9	Pharmaceuticals/biotechnology
15	18	Cognos Incorporated*	$128,354	$118,692	8.1	$1,000,213	12.8	Software and computer services
16	38	TELUS Corporation	$125,000	$56,700	120.5	$8,142,700	1.5	Telecommunications services
17	30	Research In Motion Limited*	$122,590	$84,210	45.6	$1,636,202	7.5	Comm/telecom equipment
18	19	Merck Frosst Canada Ltd. (fs)	$117,019	$117,673	-0.6	$606,897	19.3	Pharmaceuticals/biotechnology
19	80	Suncor Energy Inc.	$108,000	$95,000	13.7	$11,084,000	1.0	Energy/oil and gas
20	26	Biovail Corporation*	$107,692	$94,359	14.1	$1,133,495	9.5	Pharmaceuticals/biotechnology

Strengths of the Toronto Region

- Quality of the Labour Force
- Excellent Knowledge and Research Infrastructure
- Competitive Costs
- Advanced Producer Services
- Generous Government Support

Highly Educated Workforce

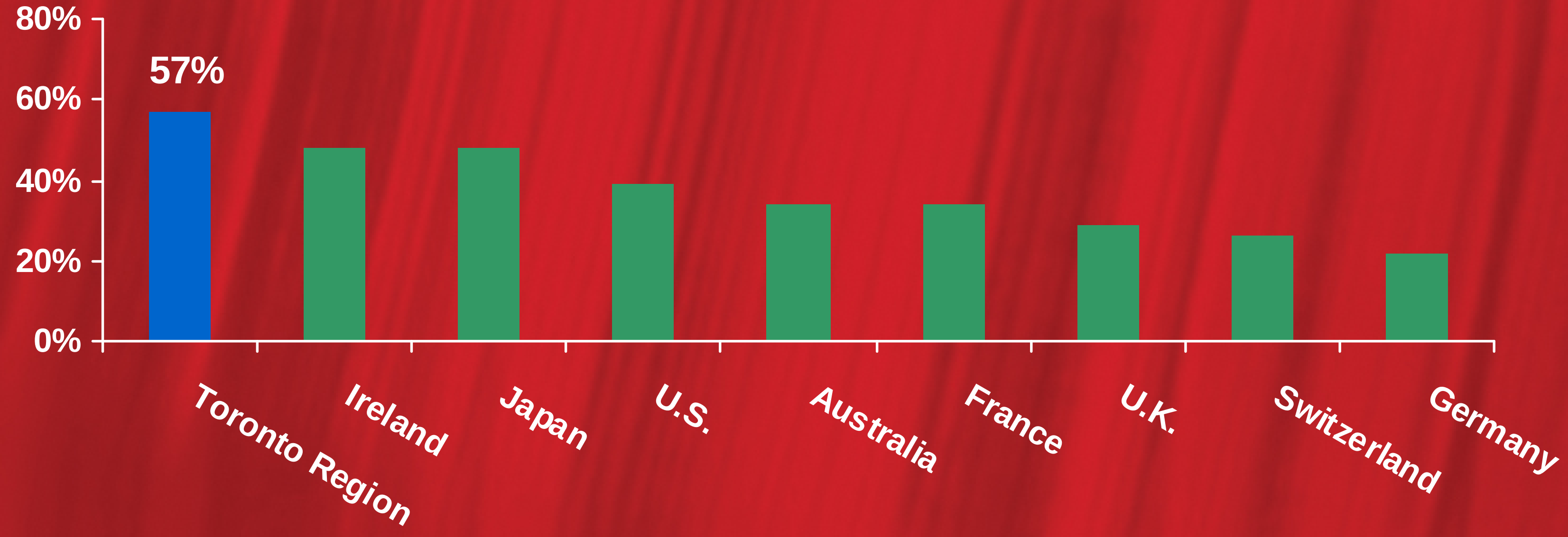


Source: Statistics Canada; Canism II; National Science Foundation

TORONTO REGION
ACCELERATE INNOVATION.

Best Educated Workforce in the World

Percentage of Workers with Post-Secondary Education (25 to 64 years of age)



Source: Statistics Canada and OECD, 2003

Toronto Region Research Alliance

World Class Research and Education Infrastructure

- **9 Universities**
- **11 Academic Hospitals**
- **8 Institutes of Technology and Colleges**
- **Over 300 Research Institutes**
- **240,000 Students**
- **70,000 Graduating Students per Year**
- **10,000 Faculty Members**

Advanced Research Collaborations – Specialized Institutions

- Canadian Institute for Advanced Research
- Guelph Molecular Super Centre
- MaRS Discovery District
- Ontario Centres of Excellence
- Ontario Institute for Cancer Research
- Perimeter Institute for Theoretical Physics
- Sheridan Science and Technology Park

TORONTO REGION
ACCELERATE INNOVATION.

Lower Corporate Income Taxes (% of income)

Source: Federation of Tax Administrators and Ministry of Finance, MEDT, 2005

Low Operating Costs for Research and Development

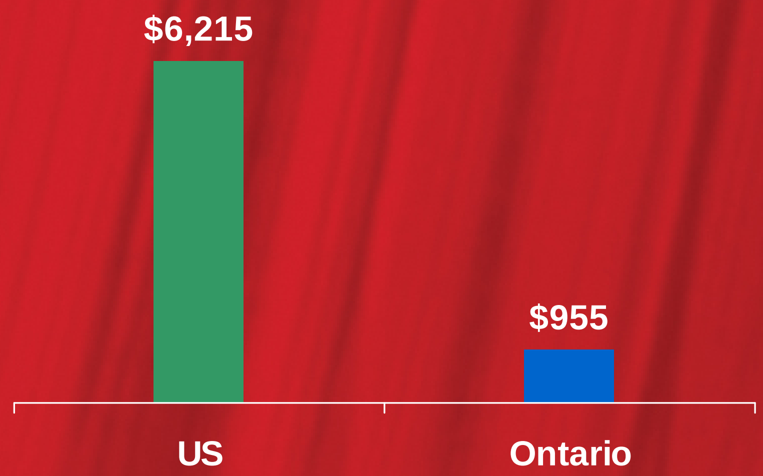
Source: KPMG Competitive Alternatives, 2006

TORONTO REGION
ACCELERATE INNOVATION.

Major Savings on Employee Health Care Costs

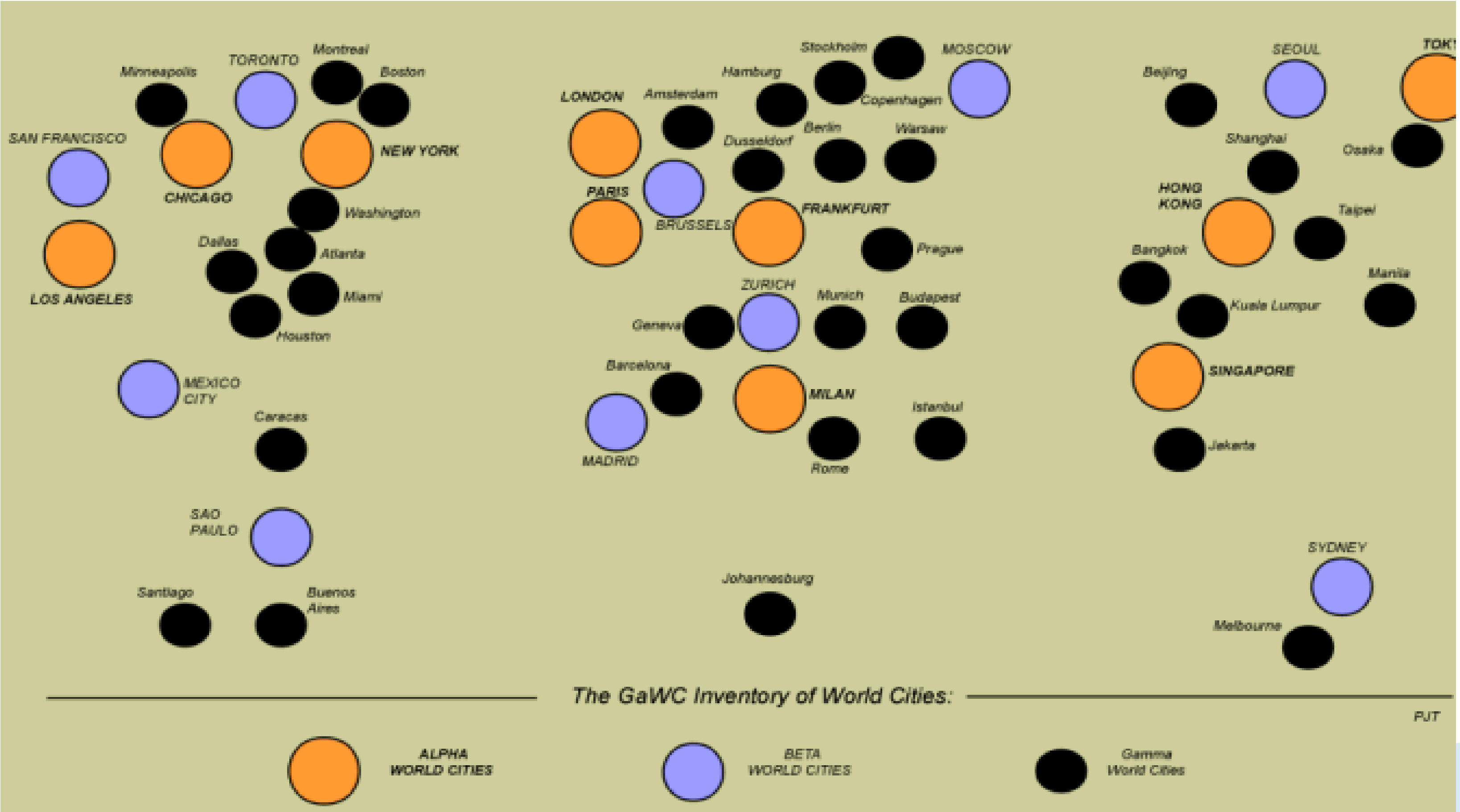
- **85% lower than in the US per employee**
- **75% covered by Government of Canada**
- **US system relies more on private funding**
- **Cost gap expected to widen**

Health Care Costs per Employee (USD)



Source: Mercer, Statistics Canada, Watson Wyatt 2004

Toronto Ranks High Globally on Advanced Producer Services



Canadian Support

- Scientific Research & Experimental Development (SR&ED) Tax Credit
- Federal Industrial Research Assistance Program (IRAP)
- Federal Sustainable Development Technology Canada
- Federal Technology Partnerships Canada
- Canadian Institutes for Health Research (CIHR)
- Canada Foundation for Innovation (CFI)

Provincial Support

- Grants and loans
  - Ontario Advanced Manufacturing Investment Strategy (AMIS)
  - Ontario Market Readiness Program
  - Ontario Innovation Tax Credit (OITC)

- Other Support
  - Regional Innovation Networks
  - Ontario Centres of Excellence
  - Industry Liaison Initiatives by Universities, Institutes of Technology and Colleges, and Hospitals

Recent Initiatives - Ontario

Early Researcher Awards
Health Technology Exchange (HTX)
Innovation Demonstration Fund
International Strategic Opportunities Program
Ontario Research Commercialization Program
Ontario Research Fund
Premier's Catalyst/Discovery Award

Challenges

- Retaining and Growing R&D Performing Firms
- Hollowing Out?
- Commercialization Gap
- Lower VC Investment and Return

Hollowing Out?

Exhibit B Of Canada's 33 global leaders in 1985, only 16 remain

33 Global Leaders in 1985

Abitibi-Price	Harlequin	Northern Telecom
Alcan	*Hiram Walker*	*Scott's Hospitality*
AMCA	HBC fur auction (now North American Fur Auctions)	*Seagram Co.*
Asbestos Corporation Ltd.	*Inco*	SNC*
Atco Ltd.	*Laidlaw*	Teck-Cominco
Bombardier	Lavalin*	Tembec
Canada Malting	*Lumonics*	*Thomson Travel*
CCL Industries	McCain	Timminco
Falconbridge	Mitel	Trimac
Finning International	*Moore Corporation Ltd.*	*Trizec*
Geac Computers	*National Business Systems*	*Unican Security Systems*

16 *departures* and 1 merger (*): loss of 17 gobal leaders since 1985

Source: Institute for Competitiveness & Prosperity analysis.

Creating World Leaders

Exhibit C **Canada has created 56 new global leaders since 1985**

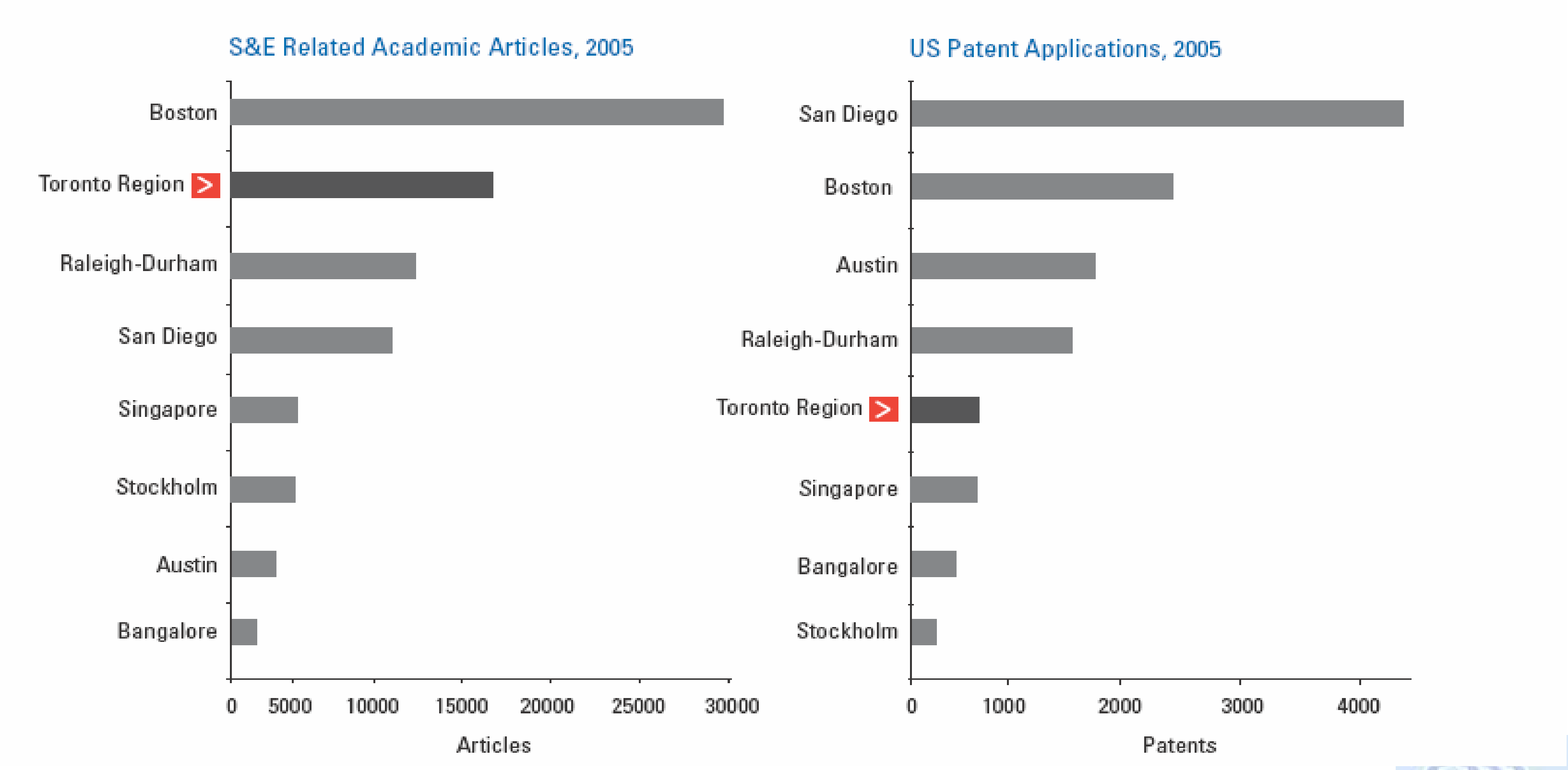
72 Global Leaders Currently (*since 1985*)

Abitibi Consolidated	***Cinram***	***Megellan Aerospace***	***Ritchie Bros. Auctioneers***
Agrium	***CN Rail***	***Magna***	***Scotia Mocatta***
Alcan	***Connors Bros.***	***Major Drilling***	***Shawcor Ltd.***
Ashton-Potter	***Coolbrands***	***Manulife Financial***	***Sierra Wireless***
Atco Ltd.	***Cott***	***Marsulex***	SNC-Lavalin
ATS	***Couche-Tard***	McCain's	***Spectra Premium Industries***
Axcan Pharma	***Dalsa***	***MDS***	***SunGro Horticulture***
Barrick Gold	Finning International	***Methanex***	***TD Waterhouse/Ameritrade***
Bombardier	***Fording***	Mitel	Teck-Cominco
CAE	***Four Seasons****	N. American Fur Auction	Tembec
Cemeco	***Gildan***	Northern Telecom	***Thomson Corp.***
Canam Steel	Harlequin	***NOVA Chemicals***	Timminco
Canfor	***Husky Injection Molding***	***Open Text***	***TLC Vision***
CCL Industries	***Imax***	***Pantheon***	***Tree Island Industries***
Celestica	***Jim Pattison Group***	***Peerless Clothing***	Trimac
CHC Helicopter	***Linamar***	***Potash Corp.***	***Westcast Industries***
Chemtrade Logistics	***Maax***	***Quebecor World***	***Weston Foods***
CGI	***MacDonald Dettwiler***	***Research in Motion***	***Zarlink***

*Four Seasons will become foreign owned in 2007.
Source: Institute for Competitiveness & Prosperity analysis.

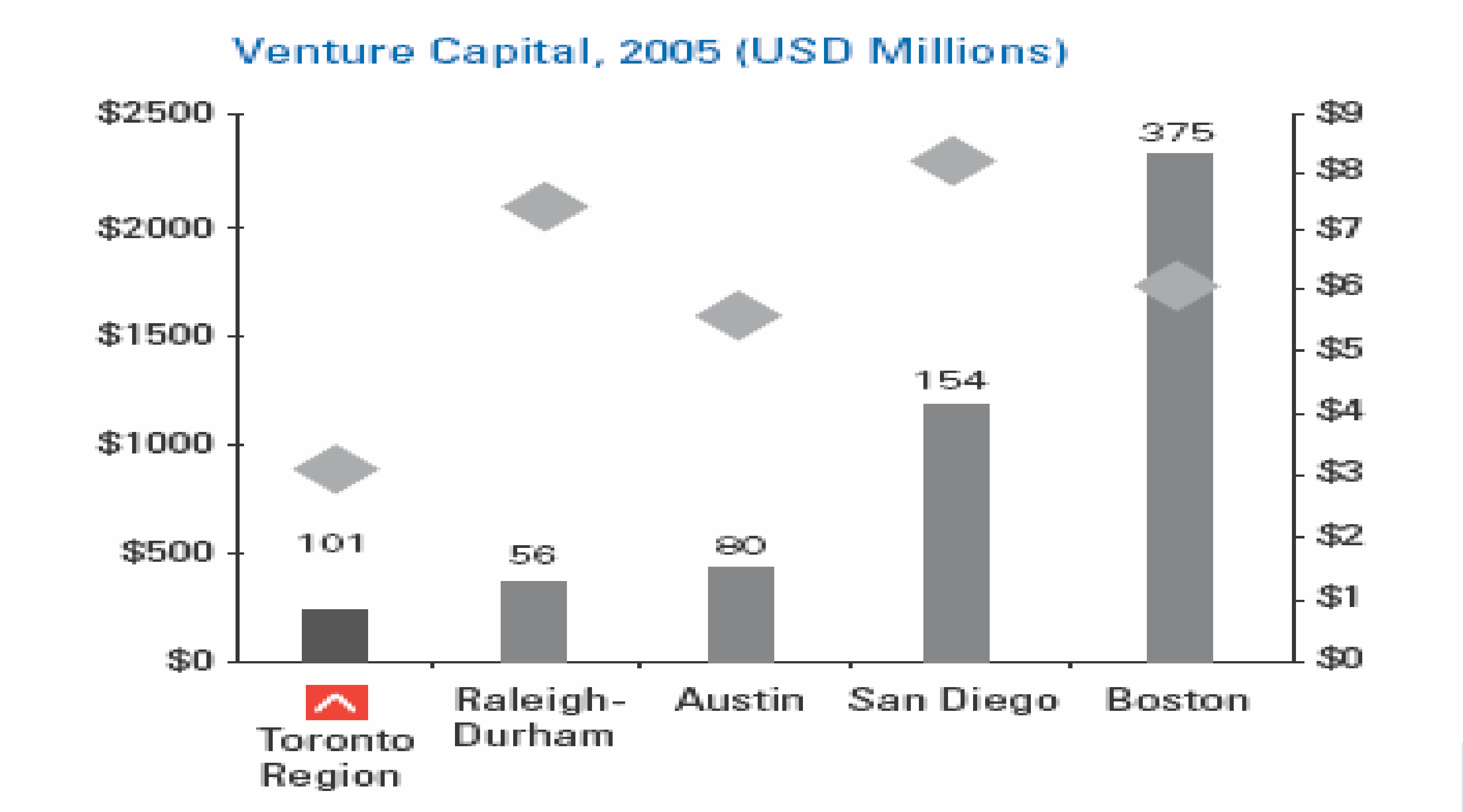
* Ian Austen, "Canada Wonders Why It's the Bought and Not the Buyer," *The New York Times*, October 24, 2006.

Commercialization Gap



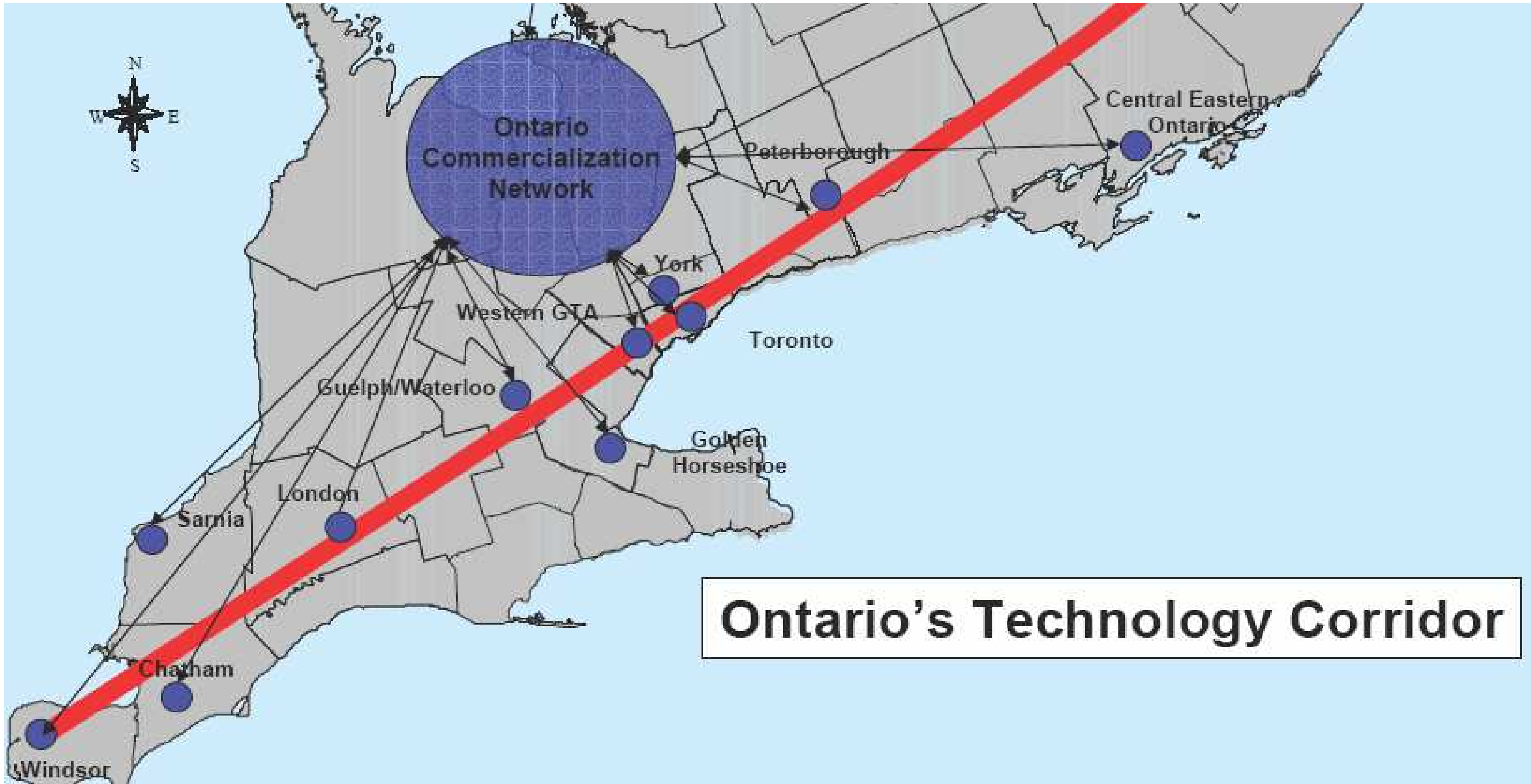
Innovation Systems Research Network

Lower VC Investment

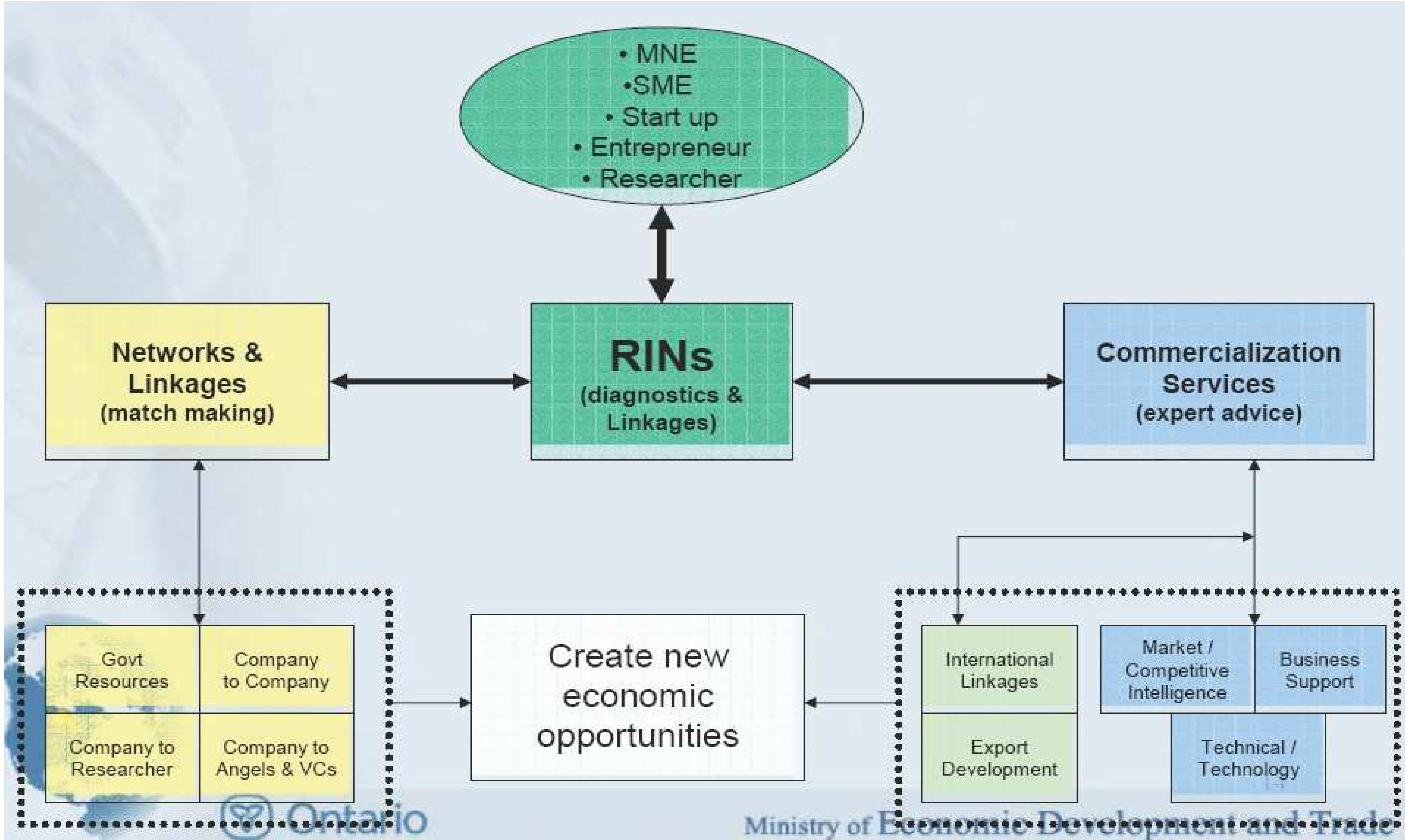


Innovation Systems Research Network

Solutions? – Regional Innovation Networks as Tools of Engagement



RIN Structures

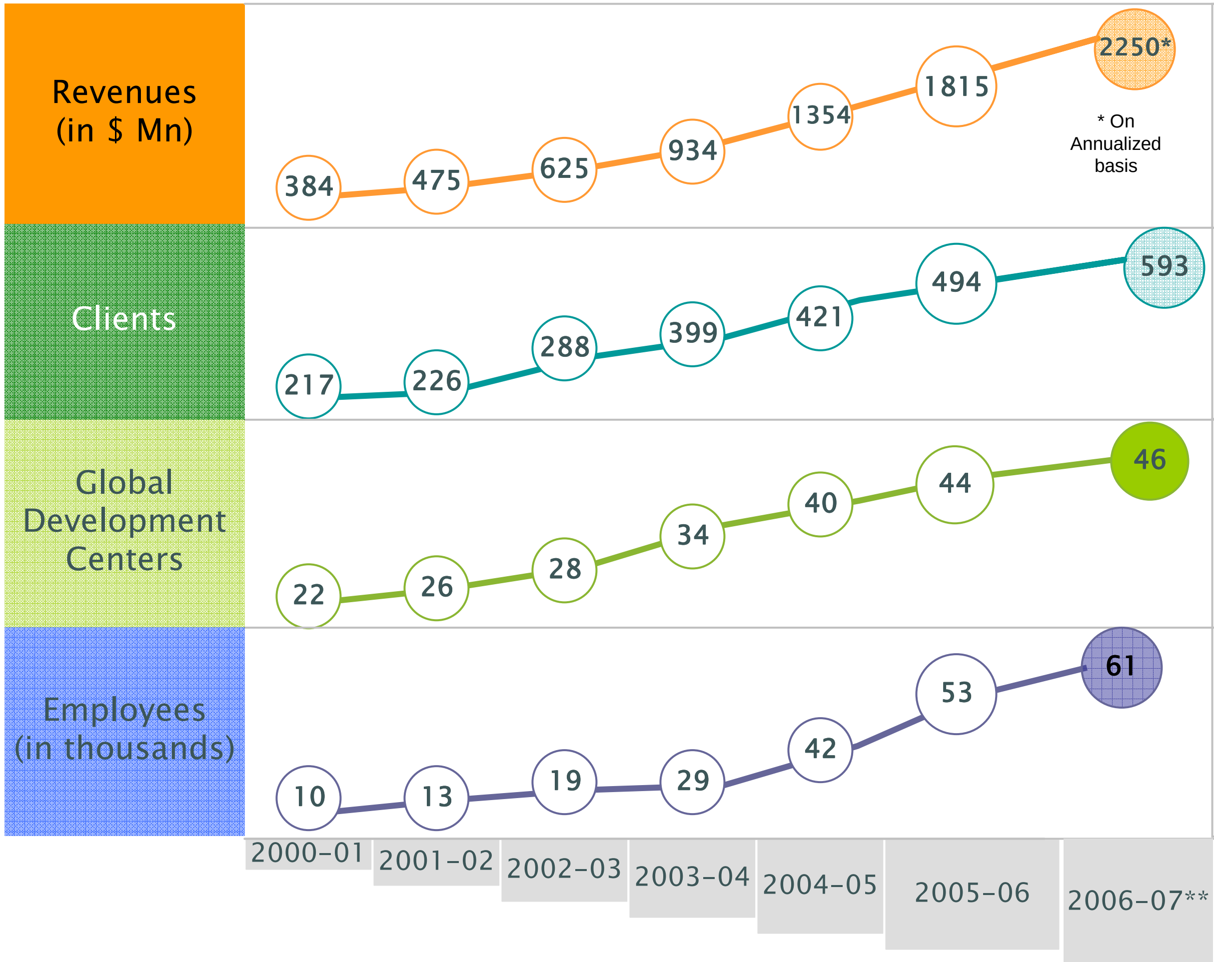


Innovation Systems Research Network

Logomotive final conference
Hamburg

Risto Niva, VP

No. 1 Provider Of Integrated Business, Technology and Process Solutions on a Global Delivery Platform *



Sustained Growth

CAGR of 36% in last 5 years

- Part of NYSE's TMT (Technology-Media-Telecom) Index, NSE Nifty Index and BSE Sensex
- Revenue: $640.5 mill for Q3 06-07

Partner to Industry Leaders

- 163 global 500 clients
- 157 clients among Forbes 2000
- **592 active clients as on Dec 31 '06**

Global Footprint

- Listed on NYSE
- 53 countries
- ~11,600 employees onsite across geos
- 24 near shore development centers

Diverse Talent Pool

- 40 nationalities
- 2120 domain consultants
- More than 66,000 employees as of Dec 31 '06

Wipro tops **Most Admired Knowledge Enterprise (MAKE)** Asia ranking 4th time in a row - 2006

Fin Tech 100 ranked Wipro in top 25 enterprise companies in Financial services industry - 2006

Winner of the "ASTD Best " award 2006 by American Society for Training & Development (ASTD) 3 times in a row

Wipro named **"IT Outsourcing Service Provider of the year"** at the third Annual **NOA Awards** - UK (2006)

Global Delivery Footprint

Europe

- 11 Development centers
- 3 Year CAGR 44%
- Employee Strength 4000+

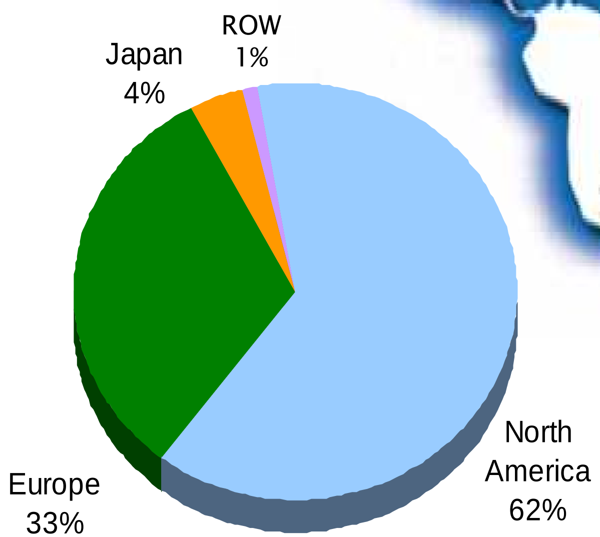
North America

- 5 Development Centers
- 3 year CAGR 40%
- Employee Strength 4200+

48 Development / Delivery centers

Asia-Pacific

- 7 Development centers
- 3 Year CAGR 23%
- Employee Strength 300+



INDIA

- 25 Development Centers
- Employee Strength:28,000+

Wipro in Europe

Country	Manpower 01.02.07 Total
Austria	71
Belgium	67
Czech Republic	
Denmark	40
Finland	464
France	173
Germany	288
Greece	
Hungary	23
Ireland	61
Italy	21
Kenya	
Netherlands	83
Norway	9
Poland	
Portugal	225
Romania	
South Africa	
Spain	10
Sweden	67
Switzerland	168
Tunisia	
Turkey	
UK	2257
Total	**4027**

- Finland is the largest base of employees in Europe
- Apart from the Technology business, there are additional 200 people from Hydrauto

Revenues, Reach & Presence in Europe

- Fastest growing and high focus market for Wipro
  - Over $650 Mn in revenues
  - Over $100 Mn of investments (total acquisitions prices)
  - Three out of 8 acquisitions are European based (past 1 year)
- Contributes ~31% to overall Wipro revenues
- Successful three way 'go-to-market' strategy
  - Vertical
  - Horizontal / Service line
  - Geo
- 150+ active clients (across industries)
- 15+ Development centres in strategic locations across Europe
- Widest geographical presence
  - 22 offices in over 12 countries
- Culturally diverse workforce of over 4000 people onsite

Acquisition strategy

- Three out of the eight acquisitions European based
- First offshore outsourcing company to pursue strategic acquisition to build complementary capabilities.
  - NewLogic in Wireless Communications – Austria
  - Enabler in Oracle based retail solutions – Portugal
  - Saraware in Design and Engineering services for Telecom companies Finland
- Tri-fold objective
  - To add niche skill sets to current portfolio
  - To increase geographical footprint
  - To add locals to the global workforce

Why in Europe

- We need to be close to customer
- Local customers, local employees
- To be global you need to be local also
- Our growth target by the end 2010 is 120-130 000 employees, there has to be also people all over world
- Typically 20-30% of work done near customer and rest in India

Thank you