Education in the Knowledge Triangle

DG Education and Culture Framework Contract 02/10 - Lot 1

Final report

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Executive summary

An exploration of education in the knowledge triangle

This report brings together 12 case studies of higher education institutions across the European Higher Education Area and explores the different types of practices they employ to engage across education, business and research – with a particular focus on education.

The case studies are both illustrative and serve an analytical purpose. Each one tells its own story but when pulled together they also provide a number of insights into the different type of approaches universities take to address some of the priorities for action and specific challenges that are faced by the Higher Education sector.

Priorities for action and specific challenges

The analysis of the case studies presented is based upon the priorities set out in the Council Conclusions on developing the role of education in a fully functioning knowledge triangle (2009/C 302/03).

- Developing more coherence between policies in the field of education, research and education
- Accelerating pedagogic reform
- Partnership between universities and business and other relevant stakeholders
- Measures to develop an innovation culture in universities
- Creating incentives for universities to develop transferable knowledge
- New approaches to quality assessment
- Developing the EIT\textsuperscript{1} as a model for the future

In the Council Conclusions each priority is accompanied by suggestions of specific areas for engagement for universities, which have been drawn out and examined in more detail in the case studies.

Selection of case studies

The 12 case studies were selected from across the European Higher Education Area with the aim of highlighting different types of approaches, different geographical, regional and local priorities and different types of institutions.

- Aalto University (Aalto), Finland – a student-centred approach to education
- Aarhus University (Aarhus), Denmark – a ‘quadruple-helix’ university
- Chalmers University of Technology (Chalmers), Sweden – Collaboration across disciplinary boundaries
- École Polytechnique Fédérale de Lausanne (EPFL), Switzerland – open innovation in education
- Université Joseph Fourier, Grenoble (UJF), France – embedding in the region
- Karlsruhe Institute of Technology (KIT), Germany – working across the disciplines – House of Competence
- Mondragon University (MU), Spain – the Mendeberri educational model
- Umea University (Umea), Sweden, the knowledge triangle in the governance model
- University of the Arts London (UAL), UK, Flexible innovative teaching models in the creative arts
- University of Trento (Trento), Italy, the knowledge triangle in regional innovation
- University College London (UCL), UK, a comprehensive university with a focus on future grand challenges
- Zürcher Hochschule der Künste (ZHdK), Switzerland, transdisciplinarity in the Arts

\textsuperscript{1} The European Institute for Innovation and Technology
Analysis of success, enabling factors and potential for transferability

The case studies provide a rich basis for understanding how the different operating environments of universities affect the level and quality of engagement across the education, research and business environments. Different types of success factors have been identified across the cases, categorised as follows:

- Central support structures: governance and strategies
- The focus on internal and external stakeholder engagement
- Approaches taken to educational activities
- Approaches taken to internationalisation
- Approaches taken to internal development

Overall success is particularly linked to the central support structures and the management and strategic development which supports the linking of education, research and business. Another key success factor is ensuring that the strategy becomes operational, facilitating the creation of an environment in which the different types of stakeholders can work together.

The key enabling factors, as well as the challenges and barriers, mostly relate to the national and regional context and the framework conditions that affect institutions.

The transferability of the approaches identified in case studies is also dependent on the operating environment of an institution, its national and regional environment and its governance and structure. Some of the universities studied have already developed active strategies to transfer elements of their models. The broad approach of universities like Aarhus, Chalmers, Karlsruhe Institute of Technology and Umea appears to be transferable both nationally and internationally. Other universities in the selection of case studies have some activities which could be transferable, but are more dependent on the necessary framework conditions.

Lessons learnt and recommendations

This rich collection of information from 12 very different case studies brings together a number of potential ideas and lessons for universities and policy makers on how better to integrate the knowledge triangle with education activities.

Embedding the entrepreneurial culture throughout the higher education institution

The entrepreneurial culture should be embedded throughout institutions, among staff, students and with partners/other stakeholders.

Involving students as co creators of knowledge and as part of the innovation system

There is a fundamental shift in the position of students in many institutions from an end product or consumer to an integral part of the development of knowledge and opportunities. Students already look for all kinds of additional opportunities to enhance their academic achievements and they increasingly value opportunities for internships, project based activities, creating their own relationships with stakeholders and exposure to new learning environments.

Creating rich learning environments for talent development

Many of the case studies are taking novel approaches to teaching and learning and embedding them across curricula. The new learning environments also need diverse teachers from industry and research.

Quality assurance and recognition of new skills development

It is increasingly important to find new ways of recognising the wider variety of skills that are being accumulated in these rich knowledge triangle environments.
Taking an interdisciplinary approach

Universities with developed approaches to the knowledge triangle have a strong emphasis on interdisciplinarity and on breaking down traditional academic silos.

Developing academic talent

Academics need to have professional development opportunities to further develop their own talent and to allow them access to new ideas for teaching, learning and business interaction.

Internationalisation as a way of improving institutional practice

Internationalisation provides two significant ways for improving the knowledge triangle, first through international partnerships with both universities and business, and secondly through using these partnerships to learn about other approaches and improve their own institutional capabilities and practices.

Implementation of flexible management models

There is an emergence of matrix organisational models. These types of models help to combine more traditional education and research activities with emerging cross disciplinary approaches.

Transforming working environments - widening access

The working environment plays a key role in making relationships work. In some cases, this is through co-location of stakeholders and in others universities have developed physical spaces outside of the university infrastructure to help facilitate the relationships.

Embedding evaluation and monitoring of the impact of knowledge triangle related activities in the university strategy

Evaluation and monitoring is crucial to the understanding of the impacts of knowledge triangle related activities in universities.

Smart specialisation as a focus for knowledge triangle activities

Universities can tap into the resources and talent of a region and specialise their knowledge triangle activities.

Taking the longer term vision for change at the institutional level

Initiatives and activities often build on years of other experiences and activities, learning and adapting by doing.

Incentives and funding structures

If universities want to develop relationships and create transferable knowledge it is essential to have the right incentive and funding structures in place.

Engaging with the national policy environment across the areas of research, education, enterprise and innovation

Cross ministerial contact can be complex and a recommendation to policy makers would be to try and overcome this barrier by helping universities to have access to all the necessary policy support across ministries involved in education research, enterprise and innovation.
1 Introduction to the study

This is the final report for the study on the ‘Education in the Knowledge Triangle’, for DG Education and Culture. This report brings together 12 case studies of higher education institutions across the European Higher Education Area and explores the different types of practices they employ to engage across education, business and research – with a particular focus on education.

1.1 Objective and scope of the study

The concept of the knowledge triangle has been widely discussed and refined at European level. It provides a way of understanding and promoting the role that the effective interaction between education, research and innovation can play for society and business as well as higher education and research. Although a strong concept, the practical implementation of the knowledge triangle in the every day practices of universities and their partners is not well documented outside of European projects, especially not from the perspective of education and how the activities feed into research and innovation.

This study, focusing on the integration of education in the knowledge triangle, was commissioned to collect examples of good practice from across Europe. The final report brings together 12 case studies from across the European Higher Education Area. The case studies serve both an illustrative and analytical purpose in exploring the role of education in the knowledge triangle. Illustrative, in that they showcase good practice examples of initiatives and activities that are undertaken; analytical in that they are used to explore trends in approaches, success factors, barriers and enabling factors which encountered by universities and their partners.

Given the heterogeneous Higher Education landscape that exists in Europe, each case is different. In spite of these differences, it is clear that common threads can be extracted from the cases. The case studies look both at individual activities and initiatives, and at the implications for the institutions i.e. governance related aspects, the initial results of the activities, the integration into the regional or sectoral economy and the potential for transferability of successful schemes.

The cases might also to provide a basis for conclusions and recommendations for policy, support and programme-related lessons and with regard to implementation - aspects of evaluation and feedback mechanisms.

Box 1 Objective and scope of the study

This study aims to explore how the integration of the three sides of the knowledge triangle takes place at different higher education institutions (HEI) in Europe, with a special focus on the educational aspect. The case studies reflect on a range of issues, including:

- How the integration happens effectively, helping both companies and Higher Education Institutions through the flow of knowledge?
- How and why do universities work with companies and what are the key motivations and drivers for collaboration? How can this process be supported?
- What are the main forms of interaction? Do organisations interact through a facilitator or through direct contacts?
- What different feedback mechanisms are in place and how do they affect the work of the different organisations?

1.2 The methodology of the study

The Terms of Reference for this study set out three key work activities:

1. Preparation of a set of case studies of good practice
2. Discussion of lessons learned with an expert panel / at a validation workshop
3. Preparation of a report with guidance for how lessons learned could inform EU educational initiatives
Based on the discussions with the European Commission during the kick-off meeting, the inception report of the current study listed 26 Higher Education Institutions identified as potential good practice case studies. The selection of the case studies took into account a range of factors with the main objective of selecting higher education institutions that through the case study approach would demonstrate the broad diversity of collaborative activities carried out at different higher education institutions in Europe.

A final 12 in-depth institutional level case studies were carried out through desk research, interviews with representatives of the higher education institutes, and in those cases when access was granted also with external partners. In total over 30 in-depth interviews were carried out covering the 12 case studies. The individual case studies are appended to this report.

Box 2 Case studies for Education in the Knowledge Triangle

- **Aalto University** (Aalto), Finland – a student centred approach to education
- **Aarhus University** (Aarhus), Denmark – a ‘quadruple-helix’ university
- **Chalmers University of Technology** (Chalmers), Sweden – Collaboration across disciplinary boundaries
- **École Polytechnique Fédérale de Lausanne** (EPFL), Switzerland – open innovation in education
- **Université Joseph Fourier**, Grenoble (UJF), France – embedding in the region
- **Karlsruhe Institute of Technology** (KIT), Germany – working across the disciplines – House of Competence
- **Mondragon University** (MU), Spain – the Mendeberrri educational model
- **Umea University** (Umea), Sweden, the knowledge triangle in the governance model
- **University of the Arts London** (UAL), UK, Flexible innovative teaching models in the creative arts
- **University of Trento** (Trento), Italy, the knowledge triangle in regional innovation
- **University College London** (UCL), UK, a comprehensive university with a focus on future grand challenges
- **Zürcher Hochschule der Künste** (ZHdK), Switzerland, transdisciplinarity in the Arts

The case studies give a particular narrow perspective on each institution covered. They focus on specific areas of good practice, especially those which involve relationships with regional businesses or are embedded in the regional environment. The point is to highlight and reflect the approaches so the case studies can be used as a basis of analysis and further discussion, both with the Commission services and with experts, HE and business representatives.

This final report will be presented at a validation workshop in Brussels in November 2012. The workshop is organised by the European Commission, with Technopolis providing contact details for some invitees, the input paper, in the form of the current report and agenda for discussion. The study team will lead the workshop and report back on the workshop findings. The date of the validation workshop and the list of participants were finalised in October 2012

The invited participants represent the case study stakeholders as well as the wider community of actors in this area (including the European Institute of Innovation and Technology KICs). The workshop will aim at validating the findings of this report and at producing further policy recommendations.

1.3 Structure of the report

The remaining part of the report comprises six chapters and an appendix with the case studies:

- Chapter 3: Describes The knowledge triangle in the policy environment
- Chapter 4: Introduces the Selection of case studies and framework for analysis
- Chapter 5: Contains a Analysis of the overall strategic approaches to integrating education in the knowledge triangle
- Chapter 6: Includes a Analysis of the success and enabling factors, barriers and potential for transferability
- Chapter 7: Gives Lessons learnt and recommendations
2 The knowledge triangle – concepts, policy and practice

2.1 The definition of the knowledge triangle

“The concept of the knowledge triangle relates to the need for improving the impact of investments in the three forms of activity – education, research and innovation – by systemic and continuous interaction”.

Conclusions of the Council and of the Representatives of the Governments of the Member States, meeting within the Council, of 26 November 2009 on developing the role of education in a fully-functioning knowledge triangle (2009/C 302/03)

Figure 1 Knowledge triangle

The knowledge triangle provides a way of understanding and promoting the role that the strong interaction between education, research and innovation can play for society and business as well as for higher education and research. The first word to highlight is interaction. It is the flow of knowledge between the concepts and the interaction between the actors which epitomises what is behind the knowledge triangle. It particularly highlights the non-linear nature of knowledge creation and the multiple input and feedback loops that exist between the actors in the knowledge triangle system.

There are no poor relations in the knowledge triangle. As a model it is flexible and fluid with all sides of the triangle having a key role in the creation of new knowledge, ideas and innovation. From the perspective of European higher education institutions creating knowledge, sharing knowledge, developing skills, curriculum development, embedding new ideas in markets and contributing to new relationships are some of the important aspects.

2.2 The knowledge triangle in the policy environment

“..fully integrating the knowledge triangle requires more joined-up policy-making and cooperation between the fields of education, research and innovation at both European and Member State level”

Conclusions of the Council and of the Representatives of the Governments of the Member States, meeting within the Council, of 26 November 2009 on developing the role of education in a fully-functioning knowledge triangle (2009/C 302/03)

The knowledge triangle is a central concept on the European innovation, research and education policy landscape and is at the core of the next generation of policies and programmes.
As the IPTS 2009 report\(^2\) “Connecting the Dots. How to Strengthen the EU Knowledge Economy” highlights “The knowledge triangle is extremely convenient for policy purposes because it provides a simple but effective representation.”

This interaction of education, research and innovation has been stressed by the European Council at every summit since 2006. The concept sits in a unique and privileged position between the European Higher Education Area and the European Research Area and is highlighted in all main Commission policies relating to education, research and innovation:

**Europe 2020:** The knowledge triangle is an important concept in the Europe 2020 Strategy, both to exit the crisis and to prepare the EU for the future. The strategy is defined by 7 flagship initiatives focused in the areas that need most attention at the EU, national and regional level. Among the seven EU 2020 flagship initiatives, the Innovation Union, launched in October 2010, sets out for the first time a comprehensive strategy to strengthen every link in the innovation chain, from “blue sky” research to the market itself. The crucial role of universities and their global networks is also clearly stated in the EU 2020 flagship initiatives.

**Education and Training 2020:** A strategic objective of Education 2020 is enhancing creativity and innovation, including entrepreneurship, at all levels of education and training – through the promotion of the acquisition of transversal competences by all citizens and ensuring the functioning of the knowledge triangle (education-research-innovation). Partnerships between enterprises and educational institutions as well as broader learning communities with civil society and other stakeholders are also a priority.

**The European Institution of Innovation and Technology:** The European Institute of Innovation and Technology (EIT) can be seen as a flagship project for the links between education, research and innovation, as the three activities are integrated in its design.

**The European Research Area:** A central objective of the ERA is to establish the fifth freedom, the freedom of movement of knowledge. Some initiatives are developing a common understanding between various actors of research and innovation (large firms, SMEs, universities, public research centres, etc.) to help them to cooperate across the EU. For example the initiative on knowledge transfer and intellectual property, or the European Technology Platforms, which bring people from all over Europe together in specific technology areas. Other programmes like CIP (or the new programme COSME) support SMEs in innovation activities. There are also large-scale activities pooling resources such as the joint technology initiatives. Horizon 2020 will play a key role in creating even more synergies and relationships across the knowledge triangle actors but including the EIT and CIP as part of its core activity.

### 2.3 From policy to practice

“for education to fulfil its role in the knowledge triangle, research and innovation objectives and outcomes need to feed back into education, with teaching and learning underpinned by a strong research base, and with teaching and learning environments developed and improved through greater incorporation of creative thinking and innovative attitudes and approaches”

Conclusions of the Council and of the Representatives of the Governments of the Member States, meeting within the Council, of 26 November 2009 on developing the role of education in a fully-functioning knowledge triangle (2009/C 302/03)

Despite the emphasis on the knowledge triangle, most of the actual activity in the Member States to date has been associated with technology transfer, enterprise development and the necessary conditions for the translation of research into production, thus focusing on the research/industry link. There has also been an increasing level of interest in entrepreneurship, but again through the medium of technology transfer, looking at spin-offs, start-ups and potentially student enterprises.

However, as underlined in the Council conclusions, there is a need for these research and innovation objectives to feed back into education, with teaching and learning environments developed and improved through greater incorporation of creative thinking and innovative attitudes and approaches.

\(^2\) “Connecting the Dots. How to Strengthen the EU Knowledge Economy” Technical Note JRC55672 12/09
This also includes a need for traditional academic culture to be complemented by awareness of its key role in delivering a more highly skilled, enterprising and flexible workforce. This includes a need for training of teachers and lecturers as well as adjustments to both the curriculum and teaching methods.

The concentration on technology transfer issues also means that the role of social sciences and humanities has not been given the same attention or recognition. Despite the interlinked nature of the relationships in the triangle, there is a concentration on the diffusion of knowledge rather than a bidirectional flow.

Educational institutions hold a pivotal role through their relationships with both research and business. They are also unique in their links to the wider community, both in education with links to schools and lifelong learning actions, and more broadly with individuals and community groups. Education is also crucial in developing the capacity of individuals and organisations to absorb and use the new knowledge created.

However, there are still challenges to be faced. There remains a lack of innovation and entrepreneurial culture in many areas of higher education and research, and the research and higher education system is relatively fragmented, which means that excellence that exists is not always shared or profited from. Resources - both state and private investments - are stretched, at a time when higher education institutions are being required to change in line with the European modernisation agenda to develop new models and new missions. Meanwhile a range of societal challenges are also developing – not least the changing demographic profile, with implications for, for example, healthcare and Higher Education Institution recruitment patterns. Then there are the broader issues of climate change and the environment.

The European Commission is already championing the education dimension of the knowledge triangle. Since 2008, the European Commission's annual University-Business Forum has also brought higher education institutions, companies, business associations, intermediaries and public authorities together. It has provided them with a space in which to interact in an effort to modernise higher education so that it might meet the real-world needs of the European job-market.

The updated 2011 Modernisation Agenda for Higher Education, which includes “supporting growth and jobs” in its title, continues to highlight the central role which the EIT plays in strengthening the higher education systems throughout Europe. The European Commission is also further encouraging the support and interaction between higher education and business through the ‘Knowledge Alliances’ pilot actions to develop structured partnerships to create results-driven cooperative ventures between universities and companies. In particular, the Knowledge Alliances initiative recognises the need for a two-way process, with higher education and business joining forces to design innovative, sustainable ways of increasing human capital. The first three alliances are in the areas of ‘the European film and audiovisual sector’, ‘the type of educational programmes required by industry and manufacturing’ and ‘how to best foster an entrepreneurial spirit through new approaches to education’. The alliances include both higher educational and industrial partners, and the first round of the pilot scheme has a funding envelope of €1million for the period 2011-13. The second call was approved for 2012 and new projects will come on stream later in the year.

2.4 The state of university business cooperation in Europe

One very important catalyst of the knowledge triangle is the relationship between Higher Education Institutions and businesses. The European Commission funded a study on the state of university business cooperation in Europe in 2010 which provided one of the first overviews of the types of university business cooperation and their relative importance to the institutions.

The study identified eight ways in which Higher Education Institutions and business cooperate:

1. Collaboration in research and development (R&D)
2. Mobility of academics
3. Mobility of students


http://ec.europa.eu/education/higher-education/business-case_en.htm
4. Commercialisation of R&D Findings
5. Curriculum development and delivery
6. Lifelong learning (LLL)
7. Entrepreneurship
8. Governance

An important finding of the study is that cooperation between Higher Education Institutions and business in Europe is still in the early stages of development. The study found that European University Business Cooperation (UBC) is influenced by a large number of factors including the perception of benefits coming from UBC as well as barriers to and drivers of UBC. Moreover, situational factors such as age, gender, years at the HEI, years in business, type of HEI and country also influence the extent of UBC undertaken. Despite this complexity, by focusing on the appropriate strategies, structures and approaches, operational activities and framework conditions, cooperation can be increased.

2.5 Highlighting the role of the EIT

“The European Institute of Innovation and Technology (EIT), being the first EU-level initiative to focus on coherent interactions between all actors of the knowledge triangle, should be developed as an example of good practice for Member States, higher education and research institutions and the business sector with regard to integrating all three sides of the triangle.”

Source: Conclusions of the Council and of the Representatives of the Governments of the Member States, meeting within the Council, of 26 November 2009 on developing the role of education in a fully-functioning knowledge triangle (2009/C 302/03)

The EIT is a particularly important instrument to highlight, as it is a real example of action at the European level – joining up the policy making process and creating a network of knowledge triangle actors. The EIT is a flagship institute with respect to its emphasis on the knowledge triangle. Established in March 2008 as a body of the European Union, its mission is “to increase European sustainable growth and competitiveness by reinforcing the innovation capacity of the EU”. The EIT is implemented through a distributed network of Knowledge and Innovation Communities (KICs). The KICs gather together close-knit partnerships of European education, research and business entities – the knowledge triangle – and also involve public authorities in these partnerships. This is the first time such a group of actors have been brought together across countries and disciplines to work towards common goals.

The KICs operate by networking the partners that carry out specific activities in the three focus areas of Innovation/Research, Education and Business Creation and by building a pipeline of projects through a bottom-up approach.

For example
- For ‘education’ European Masters and PhD programmes and programmes for professional development have been established;
- For ‘innovation’ innovation support projects are being co-funded; and
- For ‘entrepreneurship’ support services for business development are being facilitated.

The main aim of the KIC is to provide a platform where ideas, skills, business models from a wide range of partners with a common thematic focus can be translated effectively into innovations. The KICs also work through physical sites, called Co-location Centres, in which the partners can meet to work together on shared innovation challenges. Thus, the EIT aspires to all of the expected impacts of a working knowledge triangle: to scale-up the concentration of knowledge and skills, to share ideas and resources, to create and sustain businesses and to trigger the entrepreneurial spirit.

The first three KICs were designated in December 2009 and started work in 2010. They are:
- KIC InnoEnergy - sustainable energy;
- EIT ICT Labs - future information and communication society; and
Climate-KIC - climate change mitigation and adaptation.

It is ambitious in the scale and the scope of the partnerships but can also serve as a test bed for how to reduce barriers between partners in the knowledge triangle and to establish the incentives and measures which can be used to stimulate synergistic interactions.

Success is to be measured through positive social and economic impact for Europe, new business creation in existing industries and SMEs, creation of new businesses and jobs and the education and delivery of a new generation of entrepreneurs.

2.6 Priorities for action and associated challenges in developing education in the knowledge triangle

The Council Conclusions on developing the role of education in a fully functioning knowledge triangle (2009/C 302/03) highlighted throughout this report sets out a series of priorities for action, including:

- Developing more coherence between policies in the field of education, research and innovation
- Accelerating pedagogical reform
- Partnership between universities and business and other relevant stakeholders
- Measures to develop an innovation culture in universities
- Creating incentives for universities to develop transferable knowledge
- New approaches to quality assessment
- Developing the EIT as a model for the future

These priorities suggest specific areas which have been pulled out to be examined in more detail in these case studies, thus looking at the extent to which curriculum changes have been introduced together with increased use of interactive and enquiry based learning, the nature of the partnerships established, and steps taken to establish an innovation culture. These issues at the institution level need to be set within a context of the incentives (policy, financial, fiscal or demand led) for the development of transferable knowledge, developments in the coordination of policies in education, research and innovation at the national and regional level.

The Council conclusions also identified a specific set of challenges for the education sector in the knowledge triangle.

- The need to bridge the gap between education and research and innovation, where Higher Education Institutions have a unique pivotal role. At present, however, even though most institutions interact with the other elements of the knowledge triangle, they often do so in a fragmented way – contacts with industry being undertaken by careers services, technology transfer offices of varying roles, by alumni services and fundraising functions and through individual professors
- A need for a more innovative and entrepreneurial culture in the university sector has been identified, covering all aspects from pedagogical methodologies to the encouragement of student business and spinouts from research activities, start-ups and incubators. This has implications for many dimensions of HEI activity and governance, and is the subject of a separate study
- A need to improve communication and mobility between teaching and research and business and the wider economy has been identified so that knowledge flows can be optimised, with people as the vector of transmission. At present barriers of various natures exist to these types of mobility – both cultural and practical. They raise issues of career structures and accreditation, recognition of qualifications and asymmetric barriers to entry
- A need for further reform of governance and financing structures for greater autonomy and accountability to facilitate more diversified revenue streams and more effective collaboration with the business world. This is needed to give universities the flexibility to operate within this linked and entrepreneurial environment. Barriers include legal
frameworks – limiting the powers of universities in fields as diverse as Intellectual Property and staff contracts

A further challenge, highlighted earlier, is the need for education to raise its profile within the debate on the knowledge triangle, which until now has been dominated by the research/innovation dimension.
3 Selection of case studies and framework for analysis

This section of the report explores the rationale for choosing the final 12 case studies for the study and presents the analytical framework, which is used to bring all of the case studies together. The framework for analysis uses the priorities and challenges set out in the Conclusions of the Council and of the Representatives of the Governments of the Member States, meeting within the Council, of 26 November 2009 on developing the role of education in a fully-functioning knowledge triangle (2009/C 302/03) as a reference.

3.1 Selection of the case studies

The 12 case studies were selected at the level of individual institutions taking into account a number of factors, including:

- **The focus of the initiative** – whether this reflects something that is policy or legislation driven or is the result of decisions taken by the institution itself, thus the extent to which it is top down or bottom up. This affects the nature of the activity – whether it is largely reactive or whether it is a proactive step, which may mean it has to take an innovative approach to potential barriers, both internal and external

- **The degree of integration in the local economy** – whether the activity relates to the institution itself or is part of a wider local or regional activity, and the level of external support this entails, level of partnership with other education/research bodies. This includes a selection which are participants in the EIT KIC co-location centres

- **The driver behind the approach** – whether it is as a result of pressure, need or initiatives from industry, whether education is the main driver, or the extent to which research/technology transfer is the main driver of the triangle for that institution

- **Diversity in the approach** of integrating the knowledge triangle in the institution’s activities - While in principle the cases are looking for examples that integrate all three aspects of the triangle, it is clear from the literature that the degree to which this is explicit varies widely. The cases therefore examine the different ways this is represented in strategies and activities

- **Geographical diversity** - to reflect the different framework conditions in which the institutions operate, covering their legal status, funding, and governance status

- **Type of the institution** – where consideration was given to the status of the HEI (public vs. private institutions), the scientific coverage (comprehensive vs. specific focus such as technology, arts and humanities, business), the research intensity of the HEI, furthermore the size (enabling a view on the importance of critical mass versus flexibility) and the age of the HEI (including institutions the subject of recent mergers and reorganisations)

The objective of the selection was to cover as wide a range of types of Higher Education Institutions as possible, which led to the selection of the above-described universities. Figure 2 provides an overview of these universities, including the key factors and main reasons for inclusion in the study.
## Figure 2 The university case studies – factors and reasons for inclusion

<table>
<thead>
<tr>
<th>Name of the HEI (acronym used in the study)</th>
<th>Country</th>
<th>Size of the HEI</th>
<th>Year of establishment</th>
<th>Public vs. private</th>
<th>Coverage</th>
<th>Reasons for inclusion</th>
</tr>
</thead>
</table>
| Aalto University (Aalto)                   | FI      | 17,000 students | 2010 (merger)         | Public foundation | Broad    | - Specific research collaboration with Nokia  
- Centre of research of nanotechnology and one of largest microscopy clusters in Europe  
- Aalto Centre for Entrepreneurship  
- Aalto Venture Garage, a co-working space and seed accelerator  
- In the process of creating the university the university law of Finland was rewritten for the university to be allowed to collect endowments  
- ICT Labs KIC co-location centre |
| Aarhus University (Aarhus)                 | DK      | 43,600 students | 1928                  | Public            | Broad    | - New structure putting knowledge transfer as one of four priority pillars  
- Health faculty cooperation with Skejby University Hospital as the best Danish hospital and with a strong research profile  
- Aarhus was awarded the title of ‘Denmark’s Entrepreneurial University’  
- The university has established a dedicated Centre for Entrepreneurship and Innovation |
| Chalmers University of Technology (Chalmers) | SE      | 11,000 students | 1829                  | Private foundation | Technology | - Partnerships with major Swedish industries such as Ericsson, Volvo and SKF  
- Collaboration between the Department of Computer Science and Engineering at Chalmers and ICVR at ETH Zurich is being established  
- Masters curriculum closely linked to research and industry needs  
- Programme of “Initiative Seminars” for people representing research, innovation and society |
| École Polytechnique Fédérale de Lausanne (EPFL) | CH      | 8,500 students | 1869                  | Public            | Technology | - Institute of technology, with specific focus on engineering, basic sciences, ICT, Life science, Construction & Architecture and Environment  
- Ongoing reforms in the bachelor curricula (including interfaculty teaching and multidisciplinary projects, teaching on global issues, etc)  
- Member of the Eurotech networks  
- Centre for Research and Support of Training and its technologies (CRAFT) to implement initiatives, support academics and contribute to the quality of teaching  
- Elaborated evaluation and accreditation processes |
| Karlsruhe Institute of Technology (KIT)     | DE      | 20,000 students | 2009 (merger)         | Public            | Technology | - Founded in 2009 by a merger combining teaching and research institutions  
- Claims to be operating along the three strategic fields of action of research, teaching, and innovation  
- Change in legislation at the Land level to increase KIT autonomy  
- Involved in Competence networks  
- KIC associated partner |
| Mondragon University (MU)                   | ES      | 4,000 students | 1997                  | Private           | Broad    | - University originating from three educational cooperatives set up in 1997  
- Close and permanent relationship with the working world, especially the Mondragon Corporation  
- Students can combine their studies with part-time work  
- Corporations sit on the university boards  
- Established a new Educational Model called the Mendeberri Project |
### Umea University (Umea)
- **Country**: SE
- **Size of the HEI**: 16,000 students
- **Year of establishment**: 1965
- **Public vs. private**: Public
- **Coverage**: Broad
- **Reasons for inclusion**:
  - One of largest providers of distance education courses in the Nordic countries
  - Established many interdisciplinary schools
  - The board represents both community and business interests
  - University management structured according to the points of the KT

### Université Joseph Fourier, Grenoble (UJF)
- **Country**: FR
- **Size of the HEI**: 15,400 students
- **Year of establishment**: 1811
- **Public vs. private**: Public
- **Coverage**: Technology and medical
- **Reasons for inclusion**:
  - Participates in pôles de compétitivité
  - Open recruitment means they need curriculum for stars and for more “fragile” students, providing experiential learning and LLL
  - KIC InnoEnergy co-location centre

### University of the Arts London (UAL)
- **Country**: UK
- **Size of the HEI**: 28,000 students
- **Year of establishment**: 1886, but in its current format 2004
- **Public vs. private**: Public
- **Coverage**: Arts
- **Reasons for inclusion**:
  - Collegiate university
  - Strategy depends on becoming fully engaged with the creative and cultural sectors, embedding both staff and students in networks and alliances that expand academic horizons and diversity of sources of income
  - Focus on further education, executive education and continuing professional development for the creative and cultural sectors
  - Specialise in delivering widening participation activities within schools and colleges
  - Ambition to increase the involvement of strategic partners in developing and delivering curriculum and research

### University of Trento (Trento)
- **Country**: IT
- **Size of the HEI**: 15,000 students
- **Year of establishment**: 1962
- **Public vs. private**: Public
- **Coverage**: Broad
- **Reasons for inclusion**:
  - Founded as an enterprising university
  - Has a specific impact agenda not only focused on economic impact
  - Diverse range of innovative enterprise activities
  - Institutional structure reflects knowledge triangle
  - 250 staff per annum pass through entrepreneurship training
  - Recognition and delivery of CPD is part of their impact/interaction strategy, e.g. dental school
  - Encouraging impact from enterprises in Arts and Humanities

### University College London (UCL)
- **Country**: UK
- **Size of the HEI**: 24,000 students
- **Year of establishment**: 1826
- **Public vs. private**: Public
- **Coverage**: Broad
- **Reasons for inclusion**:
  - Focus on the development of strategic international alliances
  - Italian seat of the Italian-German University, an institution that deals with coordination for advanced training and research between Italian and German universities
  - University of Trento and Microsoft Research operate "The Centre for Computational and Systems Biology"
  - Participant in ICT Labs KIC

### Zürcher Hochschule der Künste (ZHdK)
- **Country**: CH
- **Size of the HEI**: 2,500 students
- **Year of establishment**: 2007 (merger)
- **Public vs. private**: Public
- **Coverage**: Arts
- **Reasons for inclusion**:
  - Offers degree programmes and further education courses in education, design, film, art & media, dance, theatre, and music, interrelating teaching and research in addition to professional education
  - Promoting innovation in society is a core concern of the ZHdK
  - The university runs seven research centres
3.2 Brief overview of the case studies

This section provides a brief overview of the 12 completed case studies on the selected higher education institutions, explaining the context in which they operate and highlighting the most prominent features of the approaches they choose to implement.

Aalto University

Aalto University is spearheading higher education reform in Finland. Created by the merger of several institutions in Greater Helsinki, the university takes advantage of its dynamic economic environment to engage global enterprises and local start-ups in all aspects of the Aalto vision of working towards a better world through top-quality research, interdisciplinary collaboration, pioneering education, surpassing traditional boundaries, and enabling renewal.

Aalto takes a student-centred approach to education, supporting interdisciplinary collaboration with experiments in teaching and learning methods. Central to this approach is the project/problem based learning model pioneered elsewhere but adapted here in the imaginative establishment of thematic multidisciplinary ‘Factories’, in which students and staff collaborate with professionals from industry.

Aarhus University

Aarhus University is in the forefront of higher education reform in Denmark. Following mergers with numerous specialist institutes and universities over the last five years the university now has operations in more than 20 locations all over Denmark, with the activities in the city of Aarhus remaining the most comprehensive. In 2009, Aarhus was awarded the title of ‘Denmark’s Entrepreneurial University’ and aspires to be a national and international beacon for entrepreneurship education by ensuring that students have the competence to apply their academic knowledge to create value for society.

Aarhus describes itself as emerging from the Humboldtian tradition into a modern ‘quadruple-helix’ university, adding talent development and knowledge exchange to the basics of research and education. Against this background, the university has established a dedicated Centre for Entrepreneurship and Innovation, to house a multiplicity of collaborative activity. In the same vein, there is a separate Student Incubator, inviting students to pursue ideas of innovation in whatever academic domain.

Chalmers University of Technology

Chalmers University of Technology is a private university governed by a foundation, based in Gothenburg. With its background as a 19th century industrial school, Chalmers has a long tradition of involvement with industry, both in education and research, and now in innovation entrepreneurship. Chalmers also has the distinction of having produced some 40 per cent of Sweden’s graduate engineers and architects.

As a dedicated university of technology, Chalmers has a single faculty, with 17 departments. In recent years the departments have been reorganised into ‘Areas of Advance’ with the intention of better integrating education, research and innovation - the knowledge triangle - in the activities of the university. The eight Areas of Advance are seen as a focus for collaboration across disciplinary boundaries and with external actors, offering platforms for interdisciplinary research and networks that add to the basic research performed within departments.

École Polytechnique Fédérale de Lausanne (EPFL)

The École Polytechnique Fédérale de Lausanne (EPFL) is a Swiss Institute of Technology. Over the past ten years EPFL has shifted from a civil engineering institute to a broader technology-focused institution EPFL’s support for university-business cooperation dates back to 1986 when it launched its first industrial liaison programme. Since then, and particularly in the last 10 years, EPFL has developed its innovation and technology transfer activities through a variety of instruments including a technology transfer office, a programme for the creation of start-ups, a strategic collaboration programme and transdisciplinary programmes and centres. The technology transfer activities are systemic in EPFL, and the Polytechnique embraces a model of open innovation which has attracted significant multinationals to locate their R&D centres in the associated Science park.
Open innovation extends its reach into education, through linking students into the enterprises that work alongside the Polytechnique. At the heart of all education, research and innovation activities is the technological purpose of the Institute. The approach to teaching includes making use of the interdisciplinary centres of excellence and supporting academic staff with personal development programmes. The quality assurance process at EPFL represents a significant development towards the integration of the knowledge triangle and covers all aspects of education, research and technology transfer.

**University Joseph Fourier Grenoble**

Université Joseph Fourier Grenoble (UJF) is a public university in France, traditionally specialising in the scientific, technology and medical fields, with the later addition of social sciences and humanities. UJF, since 2009 part of the unified PRES-Grenoble University, is spread across 20 locations in the Grenoble metropolitan area and the wider Rhône-Alpes Region.

UJF leads the ‘thematic pole’ International Software and Smart Systems Cluster (Pilsi). Pilsi is organised around three dimensions - basic research, applied research and training – and when fully developed, it will bring together more than 1,900 people. Beyond its wide variety of industrial collaborations, UJF is distinguished in the education field by its pioneering ENEPS (École Nationale de l’Enseignement Professionnel Supérieur) which enables access to higher education to students from vocational secondary education, who normally would not qualify. The success of the initiative and the low drop-out rate encouraged academic and industry stakeholders to consolidate and expand the initiative. ENEPS has been selected in 2012 by the ‘Investments of the Future’ programme, which was launched by the French government to foster innovation capacities.

**Karlsruhe Institute of Technology**

Karlsruhe Institute of Technology (KIT) is one of the most prominent scientific institutions in Germany, established by the merger of a university and a national research centre in 2009. KIT, located in the dynamic Baden-Württemberg region of Germany, brought together the resources of a university with those of a large-scale research centre in natural sciences and engineering, with the aspiration to excel in the areas of research, innovation and teaching and to eventually join the ranks of the top universities in the world.

On the education side, one of KIT’s pioneering initiatives is the ‘House of Competence’ (HoC), an interface between the humanities and social sciences and natural sciences and engineering which has established itself as particularly attractive to students. In particular, HoC acts as a platform for centralised coordination of courses offering the transversal and job-related skills now required as a complement and extension of subject-related studies and required in the labour market. A further initiative is the Student Enterprise Club, providing an opportunity for students to present their business ideas to an international network of students, start-up founders, investors, and experienced entrepreneurs for advice and review.

**Mondragon University**

Mondragón University (MU) is located in the Basque Country, in Spain, with its main campus in the small town of Mondragón itself, in Gipuzkoa Province. MU is a private, not-for-profit, cooperative university, part of the world’s largest worker cooperative and possibly the most successful example of worker-owned enterprise. The university was created in 1997 as a cooperative, with the merger of three existing educational institutions. Its unique status sets the university in the context of hundreds of companies under the aegis of the Mondragon Cooperative Corporation.

While Mondragon’s approach to education was already rooted in the actual needs of cooperative enterprises, the combined influence of the Bologna process and the growing awareness of the need to develop further transversal (or ‘professional’) competencies among Mondragon students fostered the introduction of an innovative education model: the Mendeberri model. This model incorporates project-based, problem-based and case study-based learning, leading to a decrease in the number of traditional courses and an increase of the work carried out in small groups supervised by tutors. The Mendeberri model was an important overhaul for the MU, in the sense that it implies a new understanding of the concept of education, where students are pro-active agents of their own education.
Umeå University

Umeå University, one of two public universities in the city, was founded in 1965 as the fifth university in Sweden. Umeå University cooperates with more than 600 international universities throughout the world, and has an extensive collaboration with many other Swedish universities. Umeå collaborates with industry, both within the region and internationally. The university operates in specific conditions, where the region is very dependent on the university, meaning that the municipality of Umeå is an important partner, as are the smaller municipalities in the region.

Umeå University has a focused strategy with reference to the knowledge triangle, and there is a strong view of the importance of collaboration with external partners. In the last few years a formal structure has been built up for better coordination between the different aspects of the knowledge triangle. Three Deputy Vice-Chancellors are now in place, one responsible for research, one responsible for education and one responsible for external relations and innovation. There is a strategic council for each area and the whole system is integrated within the different faculty managements. This kind of structured way of working is seen as fundamental to being able to develop a strong competence in research, education and innovation.

University of Trento

The University of Trento, a public university founded in 1962, has locations in both Trento and Rovereto, in Italy’s Autonomous Province of Trentino. The university grew from its roots as a higher university institute of social sciences with the gradual addition of faculties over the 1970s and 1980s. The last faculty, of cognitive sciences, was added in 2004. The University of Trento is active in commercial collaborations in a region highly dependent upon service industries, yet with a considerably higher than average investment in R&D.

In this economic setting, the university/municipality initiative Trento RISE combines the public/private dimensions of the knowledge triangle serving the system for regional innovation. Trento RISE, an EIT ICT Labs partner, seeks to create an increasingly integrated system of research and higher education based on the principles of excellence and quality, creating added value for both components. The local government provides a framework for action with its planning, coordinating and investment capacity. Private enterprises and research institutions experiment on new products and services, while citizens are included to enable user-driven open innovation.

University of the Arts London

University of the Arts London (UAL) is a collegiate university comprising six constituent colleges, brought together in 1989. Central Saint Martins College of Art and Design (CSM) delivers added value to its clients in the form of design solutions to business problems concerning new product innovation, communication, marketing, branding and corporate identity. The College’s student-oriented approach includes promoting creative and flexible projects and innovative teaching, developing well-designed spaces and buildings for interaction and networking, and embracing risk-taking culture.

The University also applies a strong business oriented approach, with a main underlying rationale to generate an operating surplus. In this sense, CSM is run similar to an enterprise, catering most of its resources to education and fulfilling student demands. This approach is a direct consequence of UK government policy in which students pay substantial fees for undergraduate and postgraduate education.

University College London

University College London (UCL) is a comprehensive university in the heart of London. A key strategic driver for UCL is to have a socio-economic impact through “education, scholarship, research, discovery and collaboration”. Knowledge transfer is not seen as a third activity but on the same level as teaching and research. Knowledge transfer is also not limited to commercialisation of research but also includes public and community engagement as well as public policy engagement.

UCL launched “UCL Grand Challenges” in 2007 as concentrations of cross-disciplinary and cross-thematic specialist expertise across UCL, including wider partners. The Grand Challenges are used as a way to coordinate the institutional responses to the societal agenda around four key global challenges: Global Health, Sustainable Cities, Intercultural Interaction and Human Wellbeing. It works on the premise that global issues can rarely be addressed though single research advances and dialogue and cooperation is needed.
In education, UCL has developed a key skills scheme which is a framework of skills for student’s to develop which will help them in both their professional and personal life. Through the recognition of not only core skills but also transversal skills, UCL has a system in place, which gives a comprehensive picture of student’s achievement in all areas throughout their academic career. This includes, prizes, voluntary work, clubs and societies for example.

**Zurich University of the Arts**

Zurich University of the Arts (ZHdK) is one of Europe’s largest universities of the arts. There is ongoing university reform and in 2010, a new structure for research management was created. The university now has a cross cutting and all encompassing research conference which is formed of the directors of the research institutes, research managers and researchers. ZHdK has particular links with the creative industries and there has been a growing cluster of such companies in the location surrounding the university.

As part of the merger activities of the university, transdisciplinarity in the arts is a major focus for research and teaching. This is reflected in the new organisational structures and also in offers such as Master of Arts in transdisciplinary studies.

**3.3 The analytical framework for the study**

As highlighted, the 12 selected case studies serve both an illustrative and analytical purpose on the role of education in the knowledge triangle. They are illustrative, as they seek to showcase good practice examples of initiatives and activities that are undertaken by different higher education institutions and their external partners. However, at the same time they serve as a basis for an overall analysis to explore success and enabling factors, barriers that had to be overcome and the potential for transferability of successful schemes. The cases also seek to provide a basis for conclusions and recommendations for policy, support and programme-related lessons and with regard to implementation - aspects of evaluation and feedback mechanisms.

An analytical framework is used in the study to help demonstrate and highlight the diversity of activities carried out at the different higher education institutions. The framework builds on the priority actions as identified in the Council conclusions⁵:

- Developing more coherence between policies in the field of education, research and innovation
- Accelerating pedagogical reform
- Partnership between universities and business and other relevant stakeholders
- Measures to develop an innovation culture in universities
- Creating incentives for universities to develop transferable knowledge
- New approaches to quality assessment
- Developing the EIT as a model for the future

These priorities suggest specific challenge areas for education that can be examined in more detail through the analysis of the case studies, and - as set out in the inception report – they are grouped into seven specific challenge areas:

- **Teaching** – focuses on novel delivery methods of teaching in evidence at different levels in the institutions, such as the creation of new learning environments, incorporation of entrepreneurship education in the teaching activities, examples of informal and creative learning, innovative approaches and collaborative structures put in place to advance the teaching methods or developing coherent programmes across multiple institutions

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⁵ Conclusions of the Council and of the Representatives of the Governments of the Member States, meeting within the Council, of 26 November 2009 on developing the role of education in a fully-functioning knowledge triangle (2009/C 302/03)
Education in the knowledge triangle

- **Outreach** – covers the Higher Education Institution activities in terms of engaging with their surroundings from different perspectives. This includes strategic level decisions driving the Higher Education Institutions to embrace and actively contribute to the local and regional environment, developing relations with businesses, educational and training institutions and other social and economic partners (e.g. science and innovation parks), mobilising students contribute to local and regional communities or the articulation of the Higher Education Institution’s activities around the societal grand challenges.

- **Mobility** - comprises not only international mobility but social and inter-sectoral mobility. It covers students, HEI staff (teaching staff and researchers) and external partners. Different forms of mobility might be built on long-term collaborations for example between higher education institutions establishing joint and double degree programmes or promoting academic mobility or between Higher Education Institutions and businesses / other external stakeholders through interdisciplinary and collaborative structures. There are also prerequisites of effective mobility that needs to be tackled such as the recognition of qualifications between academia and industry or the accreditation of work placements.

- **Curriculum development** – explores the implementation of innovative content development solutions such as inter- and multidisciplinary curricula, embedding the development of transferability skills in the curricula, focusing on employability records, engaging businesses and research organisations in devising the content of the curricula, enabling the students to undertake personalised and individualised degree programmes or in the case of the EIT Knowledge and Innovation Communities (KICs) developing educational programmes in line with the needs of the different KICs.

- **Quality systems** – covers not only the quality assessment of education, but incorporates many other aspects such as the training and support systems for staff, the impact measurements of the quality assessment system, performance evaluation criteria established or the feedback mechanism put in place.

- **Links** – these cover the links created between the internal and external stakeholders of the Higher Education Institutions through new channels applied and two-way communication. At the same time there is an increased focus on internal activities, creation of networks across the HEI, bringing together different types of stakeholders to interact and create linkages between education, research and innovation e.g. through engaging researchers in teaching.

- **Governance** – embraces strategy level issues, such as the adoption of a goal oriented holistic action plan; expressing the Higher Education Institution’s vision and mission through statements embedding the three sides of the knowledge triangle. Implementation-related issues such as putting dedicated personnel in place for integration of the knowledge triangle and for fostering entrepreneurial, creative and innovative culture at the Higher Education Institutions; involving external partners in the management of the university; creating support structures or emphasising the need for leadership competences in the management. Governance also covers funding-related issues including reward / incentive systems or the diversification of funding streams.

The case studies were analysed along these priority and challenge areas and the results of the analysis are presented in two matrices in chapter 4.
4 Analysis of the overall strategic approaches to integrating education in the knowledge triangle

4.1 Development paths of the universities in relation to integrating the knowledge triangle

The development paths of the universities, in respect of the ways and methods they integrate different aspects of the knowledge triangle in their operation, vary substantially. The diverse implementation methods are highly dependent on the national and regional context, the legislation regarding the higher education sector in the different countries including funding aspects, or on the format in which they function (i.e. public vs. private institutions). There are, however, some key elements that can be regarded as important ingredients in an institution’s approach in embracing the knowledge triangle. These include the different emphasis in the mission and vision statements of the higher education institutions; the development of the infrastructure including the strategies, support structures and procedures in place in addition to the methods implementation.

This chapter first describes through a selection of mission and vision statements the different manifestations and interpretations by the institutions of the knowledge triangle. Furthermore, it presents the various support infrastructures established. A detailed analysis on all the different methods of implementation follows, portraying the key initiatives and placing them in the wider analytical framework.

In most cases, the references to the knowledge triangle in mission and vision statements are implicit rather than explicit, although all of the elements are there. Aarhus, Chalmers and Umeå are examples where there is a much stronger reference to the actual knowledge triangle, reflecting its more official status in national strategy as well as within the institutions. It is not that the other institutions do not have equal commitment; it is just not defined clearly as a single concept.

Box 3 Mission and vision statements

Aalto University – Mission and objectives
Aalto University “aims to be an internationally acclaimed, multidisciplinary university where research and education are promoted hand-in-hand”
Source: Aalto University, Annual Board Report and Financial Statements, 2011

Aarhus University - Mission, vision and values
The mission of the University of Aarhus is to develop knowledge, welfare and culture through research and research-based education, knowledge dissemination and external advice.
The vision of the University of Aarhus is to belong to the elite of universities and to contribute to the development of national and global welfare.
The values of the University of Aarhus are based on the ethical ideals of freedom and independence that are described in the Magna Charta of the European Universities. Staff and students at the University of Aarhus work enquiringly and critically, in open and dynamic interaction with the surrounding world.

Chalmers University of Technology - Areas of Advance
The mission of the Areas of Advance is ‘to create a unique integration of the knowledge triangle; research, innovation and education by including a new dimension to the existing organisation. Through this strategic instrument we are able to concentrate, visualize and advance our scientific excellence by bridging gaps and accelerating the interplay between academia, industry and society, as well as within our own environment at Chalmers’
Source: Chalmers University of Technology Roadmap of Scientific Excellence

Karlsruhe Institute of Technology
Addressing the knowledge triangle of research, education, and innovation is an explicit goal of the institute. This is reflected in KIT’s five ‘visions’ which orient the activities at the institute:
Attracting the best minds from all over the world
Becoming the leading European centre of energy research
Playing a role in nanosciences that will be visible worldwide
Being a leading innovation partner of industry
Setting yardsticks in teaching and promotion of young scientists.
Focusing on the development paths of institutions, as defined above, it is clear that each takes an approach or model to suit their own individual purposes. When combined with the institution's support structure and procedures – all institutions are attempting to maximise the results and impacts of their efforts.

Aalto for example has restructured premises and built new facilities to foster interdisciplinarity and interactions, implemented transversal initiatives and structures outside the existing university's structures and fostered improvements through international cooperation by learning from external examples they consider transferable to them (e.g. Venture programme with Stanford Technology Ventures Programme (STVP) in the US Silicon valley). Zurich University of the Arts has also restructured with a greater focus on transdisciplinarity, including in its educational course offers.

EPFL supports university business cooperation through an open innovation model and supporting programmes and initiatives. As well as its own internal activities to support cooperation, it works with the Science Park PSE (located on campus) - which became an “innovation square” in 2010. The Science Park hosts a number of multi national’s R&D centres.

The University of Joseph Fourier Grenoble puts its main focus on engaging with several collaborative structures for university-business collaborations (e.g. competitiveness clusters), while also carrying out campus-based projects bringing together higher education, research and innovation actors around key areas of interest for local actors (GIANT campus6). In addition, UJF also exploits the increasing integration of the resources of local and regional Higher Education Institutions to support reforms initiated at the national level. This has been particularly successful in the areas of entrepreneurship and the development of apprenticeships.

Umeå University’s approach is reflected directly in its organisational set up. It has three deputy vice-chancellors in place, responsible for education, research, external relations and innovation in addition to active strategic councils for each area. Exploitation of the results generated by the university is assisted by a holding company structure that is owned by the university.

Mondragon provides a specific case, being embedded in a cooperative structure, where collaborative networks are built around the university, including its internal stakeholders. In the case of Mondragon, companies and technology centres are working together on a joint agenda, which is reinforced by a specific education model (the Mendeberri model) for the integration of ‘professional’ skills in the curricula. The university’s business-orientated approach to education enables tailoring the curricula and contributes to the adaptation of the training of future workforce to the needs of local companies.

4.2 Analysis of approaches to priorities and challenges and examples from the case studies

The study team developed two matrices (see Figure 3 and Figure 4) to showcase the variety of activities carried out at the different Higher Education Institutions and with their partners. The first

6 http://www.giant-grenoble.org/en/about-giant
matrix (Figure 3) contains the seven priorities and the seven specific challenges for the higher education sector (derived from the Council Conclusions) paired with activities that are being carried out to address these areas within the institutions. The overview table is not comprehensive, but it highlights a wide variety of initiatives and factors, that could address the different issues and challenges.

The second matrix (Figure 4) contains over 100 illustrative examples of specific activities or approaches drawn from the case studies. The matrix should be read in conjunction with the actual case studies, as the table only contains references to the chapters of case studies. All case studies are appended to this report.

It is also important to note that not all of the examples given correspond neatly to addressing one particular priority or challenge. The matrix with the examples from the case studies highlights many overarching initiatives which can realistically address a number of priorities for action and educational challenges. The inclusion of an example at a given point in the matrix indicates a more dominant feature of the initiative or activity. Some examples of these overarching initiatives include the Aalto Factories, the Areas of Advance at Chalmers or Schneider Electric’s relations with the Université Joseph Fourier.

Box 4 Examples of overarching approaches from the case studies

**Aalto Factories**

Not only are researchers, students and business enterprises actively working together, but there is also an integration of the research, innovation and education dimension inside the Factories. The Factories lead research and innovation projects involving students, companies and researchers and they benefit from dedicated technologies and facilities. Additional events (such as workshops and conferences) are regularly hosted. Some study programmes and courses are also directly offered in partnership with the Factories (e.g. the interdisciplinary International Design Business Management master study programme).

As in the whole approach of the university, the education dimension was a key driver behind the creation of the Factories, with the objective to develop an orientation of innovation and creativity in mindsets and attitudes among students. At the same time, the new knowledge produced at the Factories is transferred to the courses taught at the university.

**Schneider Electric’s collaboration with the Université Joseph Fourier**

In Grenoble, Schneider collaborates actively with higher education institutions, research institutes (e.g. CNRS, National Institute for Research in Computer Science and Control) and other local industry partners. Examples of collaboration range from education, R&D and social-centred initiatives and include:

- Collaborative research projects
- Participation in the Board of the Minalogic competitiveness cluster, participation in University Boards (at the UJF, at the National Polytechnic Institute of Grenoble)
- Participation in the GIANT Campus and in the KIC InnoEnergy
- Hosting doctoral projects carried out through industrial PhDs, internships, and offers work experience for students in dual study systems
- Sponsoring students at the Vocational Higher Education School’ (ENEPS)
- Managing a programme designed to support the professional integration of young people from disadvantaged areas

Furthermore, the BipBop programme, which is part of the social responsibility agenda of Schneider Electric, is relevant here in two respects: first, it is a potential area for future collaboration between the Université Joseph Fourier and Schneider Electric; second, the programme is based on three pillars (i.e. business, research and training activities), which are close - even if different due to the underlying societal and development missions entailed - to the three dimensions of the knowledge triangle.

**Chalmers University of Technology: Areas of Advance**

Chalmers has organised its 17 departments in so-called ‘Areas of Advance’ with the intention of better integrating education, research and innovation - the knowledge triangle - in the activities of the university. The Areas of Advance are seen as a focus for collaboration across disciplinary boundaries and with external actors. The main task of the Areas of Advance is to integrate education, research and innovation, and to shape programmes stimulated by the Areas of Advance themselves. The integration of education and research already has a long tradition at Chalmers, but courses that are inspired by the Areas of Advance necessarily put special emphasis on innovation. The Areas of Advance are intended to serve as meeting places for teachers and students from various programmes to formulate relevant problems and address them in project-based courses, preferably with the support of industry and public sector employees. The mark of courses inspired by the Areas of Advance should be that students and teachers with different competencies work on a common occupationally-relevant problem. The idea is to draw inspiration for problem formulation both locally and from more distant parts of the world, preferably in interaction with industry.
<table>
<thead>
<tr>
<th>Challenges</th>
<th>Teaching (Delivery methods)</th>
<th>Outreach</th>
<th>Mobility</th>
<th>Curriculum development (Content)</th>
<th>Quality systems</th>
<th>Links (Internal)</th>
<th>Governance</th>
</tr>
</thead>
</table>
| Developing more coherence between policies in the field of education, research and innovation | - Industrial and commercial techniques incorporated to curriculum development  
- Shift from traditional methods to enquiry-based or technology-based learning  
- Support adapted to the needs of different students | - Alignment of the institution’s strategies with external partners  
- Creation of one entry point to the HEI, e.g. integration of career and TTO services | - Joint and double degree programmes between institutions based on formal agreements | - Dismantling silos and accomplishing in-depth collaborative working structure | - Internal communication methods between education and research  
- Integration of communication across the whole institution  
- Creation of networks crossing the HEI | - Diversification of funding streams  
- Goal oriented, holistic action plan  
- Vision and mission statements embedding the three sides of the KT  
- Dedicated personnel for integrating the KT | |
| Accelerating pedagogical reform (What is done?) | - Increased focus on lifelong learning | - Bringing together students and businesses to create interdisciplinary culture  
- External student environment influences future pedagogy  
- International competition for attracting the best students  
- Social mobility as a mission of universities | - Inter- and multidisciplinary curricula development  
- Encouraging innovative initiatives from teaching staff  
- Development of new grading systems for students (based on new skills)  
- Training and support system for teaching staff | - Engagement of researchers in teaching  
- Creative space to foster informal meetings and collaboration (‘meetings around the coffee machine’) | - Dedicated HEI management fosters interdisciplinary, inter-sectoral and intercultural communities within the HEI  
- Creation of new structures independent from the university’s faculties (to go over traditional disciplinary boundaries) | |
| Partnership between universities and business and other relevant stakeholders | - Relations with businesses as employers or buyers of research  
- Interaction with schools for the promotion of research career  
- Enhanced partnership with social partners and training institutions  
- Students’ engagement in volunteering activities and other universities’ initiatives  
- Open innovation paradigm | - Student mobility including internships, sandwich years, placements  
- Development of incentives to increase staff mobility  
- Staff exchange programmes  
- Bringing industry on campus or in collaborative structures (possible relocation) | - Incorporating transferable skills in CD  
- Involvement of businesses, research organisations and other stakeholders in curriculum accreditation  
- Involvement of businesses, research organisations and other stakeholders in curriculum accreditation | - Communication methods between HEI and external partners (incl. business, alumni, potential students)  
- Bringing the actors together to thrive interactions between students, researchers and industry | - Involvement of external partners in the management of the HEI  
- Support structures and enablers of innovation in place  
- Cooperative management | |
| Measures to develop an innovation culture in universities (How is it done?) | - Establishment of a more dynamic and interactive learning environment (creative spaces)  
- Emphasis on informal learning and creativity  
- Use of research outcomes  
- Entrepreneurship education forms integral part of teaching activities | - Provision of incubator facilities, SME mentoring and advisory services  
- Establishment of / cooperation with science and innovation parks | - Recognition of mobility between academia and businesses  
- Promotion of international academic mobility with the aim to acquire new skills that can be applied in businesses  
- Enabling ‘internal move’ between disciplines  
- Possibility to build individualised curriculum | - Impact measurements of quality assessment  
- Development of two-way communication and moving towards new channels  
- Incentive system for teaching for researchers  
- Incentives for staff to engage in projects with innovation dimension  
- Support for student led innovative initiatives  
- Campus development (co-location of activities) | - Advanced leadership and managerial competences  
- Dedicated HEI leadership to promote innovation culture  
- Funding arrangements and incentive structures to advance cultural change | |
## Education in the knowledge triangle

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Teaching (Delivery methods)</th>
<th>Outreach</th>
<th>Mobility</th>
<th>Curriculum development (Content)</th>
<th>Quality systems</th>
<th>Links (Internal)</th>
<th>Governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating incentives for universities to develop transferable knowledge</td>
<td>- Using the curriculum to transfer knowledge</td>
<td>- Interaction with wider stakeholders / regional economy and community</td>
<td>- Real life and real case approach bridges research to innovation and societal impact</td>
<td>- Integrating knowledge transfer in university’s evaluation criteria</td>
<td>- Foster bottom-up, user-centred thinking to create linkages with society and disseminate and implement innovation</td>
<td>- Reward system in place to foster knowledge transfer activities through structural changes</td>
<td>- Specific strategies for knowledge creation, development and transfer</td>
</tr>
<tr>
<td>New approaches to quality assessment</td>
<td>- Feedback mechanism built in to teaching activities</td>
<td>- New activities need new evaluation methods also to motivate learners</td>
<td>- Recognition of qualifications and experience in academia and business</td>
<td>- Involvement of businesses and other stakeholders in accreditation / recognition</td>
<td>- Innovative approaches to quality assessment with feedback system put in place</td>
<td>- Incorporation of knowledge triangle criteria for assessing the activities of the institution</td>
<td>- Reward system in place to foster knowledge transfer activities through structural changes</td>
</tr>
<tr>
<td>Developing the EIT as a model for the future</td>
<td>- Coherent programme development across multiple institutions</td>
<td>- Involvement of partner institutions in the delivery of programmes</td>
<td>- New educational programmes in line with the needs of the KICs</td>
<td>- EIT label</td>
<td>- Alumni development for the transfer of knowledge</td>
<td>- Governance based on joint contribution and commitment</td>
<td>- Reward system in place to foster knowledge transfer activities through structural changes</td>
</tr>
</tbody>
</table>
## Education in the Knowledge Triangle

**Figure 4** Examples from the case studies addressing the priorities for action and the specific challenges for the education sector

<table>
<thead>
<tr>
<th>Priorities / Challenges</th>
<th>Teaching</th>
<th>Outreach</th>
<th>Mobility</th>
<th>Curriculum development</th>
<th>Quality systems</th>
<th>Links</th>
<th>Governance</th>
</tr>
</thead>
</table>
### Priorities / Challenges

<table>
<thead>
<tr>
<th>Measures to develop an innovation culture in universities</th>
</tr>
</thead>
<tbody>
<tr>
<td>- KIT: Entrepreneurship education</td>
</tr>
<tr>
<td>- Aalto: Centre for Entrepreneurship</td>
</tr>
<tr>
<td>- UJF: Entrepreneurship studies</td>
</tr>
<tr>
<td>- Chalmers: School of Entrepreneurship</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Creating incentives for universities to develop transferable knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Mondragon: Cooperation culture ('cooperative' culture)</td>
</tr>
<tr>
<td>- Umea: Plants Science Centre</td>
</tr>
<tr>
<td>- UJF: Technology transfer (FiRAils, GRAVIT and GRAIN)</td>
</tr>
<tr>
<td>- UAL: Sponsored projects</td>
</tr>
<tr>
<td>- UCL: Grand Challenges</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>New approaches to quality assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- UCL: Academic led quality management system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Developing the EIT as a model for the future</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Trento: Training Camps</td>
</tr>
<tr>
<td>- UJF: InnoEnergy KIC co-location centre in Grenoble affecting both HEI and local businesses</td>
</tr>
<tr>
<td>- Trento: ICT Labs- co-location centre, Doctoral Training Centre</td>
</tr>
</tbody>
</table>

### Teaching

<table>
<thead>
<tr>
<th>Teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Umea: Incubators in biotech and creative industries</td>
</tr>
<tr>
<td>- Chalmers: Innovation Office West, Chalmers Invest / Innovation, Science parks</td>
</tr>
<tr>
<td>- Aarhus: AU centre for Entrepreneurship and Innovation</td>
</tr>
<tr>
<td>- UJF: Integrated internships</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Mondragon: promotion of international mobility since 1972</td>
</tr>
<tr>
<td>- Umea: International office</td>
</tr>
<tr>
<td>- UJF: Integrated internships</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Curriculum development</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Aalto: Mobility and flexibility (reform of BA’s programmes to promote transversal skills, flexibility between degrees)</td>
</tr>
<tr>
<td>- Umea: Holding companies</td>
</tr>
<tr>
<td>- UJF: University-business links – national reforms</td>
</tr>
</tbody>
</table>

### Quality systems

<table>
<thead>
<tr>
<th>Quality systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Aalto: on Tracks / on Waves</td>
</tr>
<tr>
<td>- Chalmers: Campus- a meeting point</td>
</tr>
<tr>
<td>- Aalto: Aalto Tenure Track</td>
</tr>
</tbody>
</table>

### Links

<table>
<thead>
<tr>
<th>Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Umea: Building for meetings – Arts Campus</td>
</tr>
<tr>
<td>- Aarhus: Student Incubator</td>
</tr>
<tr>
<td>- UCL: Knowledge Transfer</td>
</tr>
</tbody>
</table>

### Governance

<table>
<thead>
<tr>
<th>Governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Aarhus: Centre for Entrepreneurship</td>
</tr>
<tr>
<td>- UCL: Business oriented management</td>
</tr>
<tr>
<td>- ZHdK: Cross-cutting theme of cultural entrepreneurship</td>
</tr>
<tr>
<td>- Aalto: Aalto Tenure Track</td>
</tr>
<tr>
<td>- UCL: Embedding knowledge transfer across all schools – Knowledge Transfer and Enterprise Boards</td>
</tr>
</tbody>
</table>

### New approaches to quality assessment

<table>
<thead>
<tr>
<th>New approaches to quality assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- KIT: Teaching quality index EPFL: involvement of private sector in faculty evaluations in the CRAFT QA process</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chalmers: Constant monitoring and frequent evaluations to assess advancements and refine methods applied by the Areas of Advance</th>
</tr>
</thead>
<tbody>
<tr>
<td>- KIT: InnoEnergy KIC co-location centre</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aalto: Aalto Tenure Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>- KIT: InnoEnergy KIC co-location centre</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aarhus: Talent development – members of staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>- UCL: Embedding knowledge transfer across all schools – Knowledge Transfer and Enterprise Boards</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aalto Tenure Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>- KIT: InnoEnergy KIC co-location centre</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aalto: Aalto Tenure Track</th>
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<tbody>
<tr>
<td>- KIT: InnoEnergy KIC co-location centre</td>
</tr>
</tbody>
</table>
5 Analysis of the success and enabling factors, barriers and potential for transferability

The case studies provide a rich basis for analysis on the different factors affecting the operation and initiatives of the universities. The following chapter provide analysis and detailed descriptions on the key success and enabling factors, and challenges for the individual Higher Education Institutions, which is followed by an overview highlighting the factors affecting all universities and exploring issues of transferability.

5.1 Overview analysis of the key success, enabling factors and challenges

Three tables follow which bring together the identified key success factors, enabling factors and challenges affecting the higher education institutions in pursuing their strategies to bring together education, research and business from the perspective of education.

The types of success factors fall under the following categories:

- Central support structures: governance and strategies
- The focus on internal and external stakeholder engagement
- Approaches taken to educational activities
- Approaches taken to internationalisation
- Approaches taken to internal development

The types of key enabling factors can be categorised as follows:

- National / regional context
- Governance and strategies
- Organisational structure incl. funding
- Stakeholder engagement
- Internationalisation

The types of challenges and barriers faced are very similar to the enabling factors as follows:

- National / regional context
- Organisational structure incl. funding
- Education
- Stakeholder engagement
- Internationalisation

It is difficult to draw patterns and therefore conclusions in relation to the types of factors affecting success in relation to 12 case studies. However, the following tables already illustrate the particular importance of the management and the strategy of the universities in supporting new types of collaboration. Additionally, they highlight the importance of employing mechanisms which support these strategies on the ground, in particular in relation to facilitating access to stakeholders. The overview tables are followed by more detailed descriptions of all of these factors from the perspective of each individual case study.
## Education in the Knowledge Triangle

### Figure 5: Key Success Factors

<table>
<thead>
<tr>
<th>Major Categories</th>
<th>Key Success Factors</th>
<th>Aalto</th>
<th>Aarhus</th>
<th>Chalmers</th>
<th>EPFL</th>
<th>UJF</th>
<th>KIT</th>
<th>Mondragon</th>
<th>Umea</th>
<th>Trento</th>
<th>UAL</th>
<th>UCL</th>
<th>ZHdK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Central support structures: governance and strategies</strong></td>
<td>Transformation of the university is supported by the management / strategies</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Development of a new university structures</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td></td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>High degree of specialisation of the university - smart regional specialisation model</td>
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<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Enabling bottom-up approach to generate new initiatives</td>
<td>X</td>
<td></td>
<td>X</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Strong focus on entrepreneurship culture (with dedicated structures in place)</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Focus on internal and external stakeholder engagement</strong></td>
<td>Open innovation model</td>
<td></td>
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<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Both internal and external stakeholders foster participatory approach and engagement</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Active collaboration and strategic partnerships with external stakeholders (based on trust and reputation, incl. formal commitments)</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>Support systems in place to facilitate interactions</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>Responsive attitude to industrial needs, shared research agenda between the stakeholders and curriculum development based on industrial needs</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td><strong>Education</strong></td>
<td>Interdisciplinary model in education and / or research</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Focus on transversal competences and practical skills</td>
<td>X</td>
<td></td>
<td>X</td>
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<td></td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Flexible and innovative educational model enabling to permeate structures and degrees</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>Emphasis on informal learning</td>
<td>X</td>
<td></td>
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<td></td>
<td>X</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Broad range of initiatives support entrepreneurship education and training</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Internationalisation</strong></td>
<td>Strong focus on international linkages and international nature of the university</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Internal development</strong></td>
<td>Continuous strive for improvement through monitoring, quality assurance, benchmarking</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>New career models, HR development (for both research and education staff), talent development</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
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</tr>
</tbody>
</table>
### Figure 6 Key enabling factors

<table>
<thead>
<tr>
<th>Major categories</th>
<th>Key enabling factors</th>
<th>Aalto</th>
<th>Aarhus</th>
<th>Chalmers</th>
<th>EPFL</th>
<th>UJF</th>
<th>KIT</th>
<th>Mondragon</th>
<th>Umea</th>
<th>Trento</th>
<th>UAL</th>
<th>UCL</th>
<th>Zhdk</th>
</tr>
</thead>
<tbody>
<tr>
<td>National / regional context</td>
<td>National / regional context and environment promote new activities, embedded approach to KT</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Governance and strategies</td>
<td>Support structures and strategy in place to develop and transform the university (involvement of broad range of internal stakeholders)</td>
<td>X</td>
<td></td>
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<td></td>
<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>Organisational structure incl. funding</td>
<td>Financial and organisational autonomy, funding available for innovative ideas</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
<td>X</td>
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<tr>
<td></td>
<td>Flexibility fostering short project-based collaboration and emergence of new partnerships</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Possibility to create dedicated, physical space to foster implementation of initiatives and interactions</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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</tr>
<tr>
<td>Stakeholder engagement</td>
<td>Existing strategic partnerships with external partners (public and private actors) on which to build</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>Internationalisation</td>
<td>Continuously expanding university with broad international network</td>
<td></td>
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<td>X</td>
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</tbody>
</table>

### Figure 7 Main challenges, barriers

<table>
<thead>
<tr>
<th>Major categories</th>
<th>Main challenges, barriers</th>
<th>Aalto</th>
<th>Aarhus</th>
<th>Chalmers</th>
<th>EPFL</th>
<th>UJF</th>
<th>KIT</th>
<th>Mondragon</th>
<th>Umea</th>
<th>Trento</th>
<th>UAL</th>
<th>UCL</th>
<th>Zhdk</th>
</tr>
</thead>
<tbody>
<tr>
<td>National / regional context</td>
<td>External stakeholders’ views prevent integration of the KT activities</td>
<td>X</td>
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<tr>
<td></td>
<td>National policy context, system prevents advancement in cooperation and collaboration across the KT aspects</td>
<td></td>
<td>X</td>
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</tr>
<tr>
<td>Organisational structure incl. funding</td>
<td>Adoption of a common operating model after merger of HEIs, research organisations</td>
<td>X</td>
<td></td>
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<td>X</td>
<td></td>
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<tr>
<td></td>
<td>Fast pacing transformation of the university represents a major challenge at all level</td>
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<td></td>
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<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>Cultural change internally i.e. adoption to new roles and attitude by students, teachers and researchers</td>
<td>X</td>
<td>X</td>
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<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td></td>
<td>Base funding does not provide funding for additional, development activities / no sustainable core funding, shrinking core</td>
<td></td>
<td></td>
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<td>X</td>
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</tbody>
</table>
### Major categories

<table>
<thead>
<tr>
<th>Main challenges, barriers</th>
<th>Aalto</th>
<th>Aarhus</th>
<th>Chalmers</th>
<th>EPFL</th>
<th>UJF</th>
<th>KIT</th>
<th>Mondragon</th>
<th>Umea</th>
<th>Trento</th>
<th>UAL</th>
<th>UCL</th>
<th>ZHdK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Funding</strong></td>
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<tr>
<td>Highly resource intensive model due to need for coordination and constant interactions</td>
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<tr>
<td><strong>Education</strong></td>
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<td></td>
<td>X</td>
</tr>
<tr>
<td>New challenges to education in ways students are thought and have to learn</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<td>X</td>
</tr>
<tr>
<td><strong>Stakeholder engagement</strong></td>
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<td>X</td>
</tr>
<tr>
<td>Engaging new partners and developing long-term collaboration with industry and other external partners</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
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<td>X</td>
</tr>
<tr>
<td>Lack of coordination of the initiatives and partnerships (informal communication) might affect the development dimensions</td>
<td></td>
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<td>X</td>
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<tr>
<td><strong>Internationalisation</strong></td>
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<td></td>
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<td>X</td>
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<tr>
<td>International orientation and expansion, students</td>
<td>X</td>
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</tbody>
</table>

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**Note:** The table above represents the major categories and their associated main challenges, barriers, and their implementation across different institutions.
### 5.2 Key success, enabling factors and challenges: Aalto University

#### Key success factors

- The attitudes of companies, academics and students are a critical success factor in the participative approach developed in the education and cooperation activities.
- Reputation, trust and an educational interest from companies are central to all partnerships. Trust is also crucial when dealing with problems such as confidentiality issues.
- New career models (as tenure track and lecturer career systems) and HR developments were introduced to equip professors and researchers with the skills necessary to guide and lead students in their new role.
- The interdisciplinary model of the university combined with strong entrepreneurship culture among students and staff.
- Significance of the university’s international linkages, which help develop new initiatives (e.g. partnership between the Aalto Centre for Entrepreneurship and Stanford Technology Ventures Program) or transfer Aalto’s innovative experiments (e.g. diffusion of the Design Factory approach in China, Chile and Australia).
- The consideration given to informal learning and transversal competences in the education of students.
- A bottom-up approach in which innovative R&D/education projects and collaborations can be initiated by students, academic staff and external partners. This places the emphasis on creativity at all levels and is coupled with the active involvement of faculty staff in initiating and implementing innovative education initiatives.

#### Enabling factors

- Flexibility is crucial for short project-based cooperation and it represents a motivating factor for companies choosing partners. In the approach applied by the Aalto Factories companies are free to decide to submit projects or to participate in specific projects proposed by the Factory.
- Independence from university structures: The Design Factory’s approach is based on complex three-way interactions between education, innovation and research activities that require lateral thinking. These interactions can be best developed and promoted in an interactive dedicated space. In this respect, Aalto Factories’ independence from any pre-existing university structures with a dedicated physical space available is a critical requirement for their successful management and operations.
- Balancing freedom and accountability: The flexibility of Aalto’s management model, balanced by accountability and responsibility: for example, the Aalto Design Factory is subject to an Annual Report and the decision for financial support is reviewed every year by the university’s governance.

#### Barriers, challenges

- A key challenge in the education reforms following the merger of universities has been the adoption of a common operating model, which enhances interdisciplinary collaboration.
- The Aalto model is challenging in that it promotes new roles for teachers, students and industry. Students are encouraged to take up an active role in their own learning and education and are considered both as participants of the research and innovation process and members of the university community. From mere knowledge providers, teachers become enablers and co-creators in charge of supporting students in the learning of new ideas and knowledge. Likewise, companies have to learn how to interact with students and to develop a common language and culture. Not only are students granted great responsibility but they are also held accountable for their attitudes and results.
- There is a risk that their success depends on how the Factory ideas and models are adapted and used in Aalto Schools, departments and degree programmes.
5.3 Key success, enabling factors and challenges: Aarhus University

<table>
<thead>
<tr>
<th>Key success factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ The transformation of the university was a top level priority for the university's management and board</td>
</tr>
<tr>
<td>■ Interdisciplinary collaboration has become a central part of the university culture in this transformation and in Research, Aarhus is developing interdisciplinary centres</td>
</tr>
<tr>
<td>■ The university has created a more flexible inner education market, making it easier to exchange and develop degree programmes, courses and teaching activities cutting across the main academic areas, departments and centres.</td>
</tr>
<tr>
<td>■ Talent development: Aarhus University is now able to offer talented researchers the best possible conditions in future for interdisciplinary research and collaboration with leading researchers in relevant fields.</td>
</tr>
<tr>
<td>■ Knowledge exchange: Aarhus University is taking flexible action and responding to specific needs from external parties regarding knowledge and solutions within specific interdisciplinary themes.</td>
</tr>
<tr>
<td>■ The AU Centre for Entrepreneurship &amp; Innovation - has been established and has helped to support the process towards the entrepreneurial university</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Barriers, challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Aarhus University Development Contract 2012–2014 based on seven goals and describes the level of ambition for Aarhus University in the coming years. The goals are based on the following indicators and this drives success:</td>
<td></td>
</tr>
<tr>
<td>■ Student satisfaction of their studies</td>
<td></td>
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<tr>
<td>■ Unemployment figures for the Master's degree graduates from Aarhus University</td>
<td></td>
</tr>
<tr>
<td>■ Coherence between university and secondary schools</td>
<td></td>
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<tr>
<td>■ Recruitment of undergraduate students from other universities and educational institutions</td>
<td></td>
</tr>
<tr>
<td>■ ECTS credits earned by students at AU sums University admitted to full-time study at a Danish university</td>
<td></td>
</tr>
<tr>
<td>■ Completion time for students at the undergraduate and graduate</td>
<td></td>
</tr>
<tr>
<td>■ The scope of economic cooperation between Aarhus University and the wider community, for example businesses</td>
<td></td>
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<tr>
<td>■ The economic scope of continuing education</td>
<td></td>
</tr>
<tr>
<td>■ Aarhus University's research impact in the international research</td>
<td></td>
</tr>
<tr>
<td>■ External international funding</td>
<td></td>
</tr>
<tr>
<td>■ Doctorate holders</td>
<td></td>
</tr>
<tr>
<td>■ Unemployment figures</td>
<td></td>
</tr>
<tr>
<td>■ Funding of interdisciplinary centres at Aarhus University</td>
<td></td>
</tr>
<tr>
<td>The pace of change at the university can be a challenge. Aarhus has been through a comprehensive transformation which has involved both a major management focus – i.e. a top-down approach - and a bottom-up approach based on individual researchers and the academic environments at the university.</td>
<td></td>
</tr>
<tr>
<td>Until now, the university has placed great emphasis on an academic development process that has constituted a framework for synergy between the academic environments and institutions. In future, work is continuing with a full implementation of the university’s strategy.</td>
<td></td>
</tr>
<tr>
<td>Funding may be an issue as many of the transformations could not be funding from base funding from the government.</td>
<td></td>
</tr>
<tr>
<td>Cultural changes: Aarhus has gone from being a very traditional university to quite revolutionary. The transformation has required a culture change internally at the university's institutes and is an area where work is continuing</td>
<td></td>
</tr>
</tbody>
</table>
5.4 Key success, enabling factors and challenges: Chalmers University of Technology

### Key success factors

- As a result of a review of the university’s activity, Chalmers organised its 17 departments in so-called ‘Areas of Advance’ some 5 years ago. The intention was to achieve better integration of education, research and innovation - the knowledge triangle - in the activities of the university. This new dimension creates a virtual matrix organisation and enables a powerful way to work with an operational bottom-up process combined with a strategic top-down approach.

- Chalmers developed a strong innovation support system facilitating interactions, exploitation of ideas, development opportunities within the university, collaborations with external partners and utilisation of the results in the society.

- Extensive campus developments with the main objective to create physical space for the promotion of greater interaction between academia, industry and the community.

- The university regards entrepreneurship education as top priority, and devised different approaches to foster students to become entrepreneurs through educational (e.g. Chalmers School of Entrepreneurship), training and research activities, with special focus on collaboration with industry.

- Collaboration, strategic and project based, with external partners is of a high importance and truly embedded in the institution’s strategy and activities with focus on all different types of external stakeholders both nationally and internationally.

- Constant monitoring and frequent evaluations, including international evaluation to assess advancements and refine methods applied by the Areas of Advance.

### Enabling factors

<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Barriers, challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chalmers can build on and develop new initiatives based on its longstanding strategic cooperation agreements with the industrial sector, including the most important Swedish multinationals such as Ericsson or Volvo</td>
<td>The Areas of Advance that have become most successful are those with a history of collaboration between different partners and areas. Where this has not been a case it is important for the university to create a situation of confidence in relations with external partners.</td>
</tr>
<tr>
<td>Collaboration between the university, industry and local governments to foster infrastructural developments and joint projects such as the development of science parks</td>
<td>Cross-ministerial contacts for the universities do not yet exist in Sweden. The University’s main contact and natural connections are with the Ministry of Education and Research, but the knowledge triangle demands contact with other ministries as well, creating a gap that will need to be addressed.</td>
</tr>
<tr>
<td></td>
<td>One possibly discouraging factor regarding the better integration of education in the knowledge triangle is the signals that are given by the Swedish research funds. It is perceived that for a researcher with a long track record of teaching and pedagogical qualities it is harder to obtain funds than if one’s career had been devoted purely to research.</td>
</tr>
</tbody>
</table>
5.5 **Key success, enabling factors and challenges: Ecole Polytechnique Fédérale de Lausanne (EPFL)**

<table>
<thead>
<tr>
<th><strong>Key success factors</strong></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>EPFL’s status under national, rather than regional, government, specifies in statute three distinct missions aligning directly with the knowledge triangle</td>
<td></td>
</tr>
<tr>
<td>EPFL’s focus on technology and practical orientation is in line with the strong tradition of apprenticeship in the Swiss education system, enabling strong linkages between the three elements of the knowledge triangle. At the same time, integration of science and technology with the humanities is promoted</td>
<td></td>
</tr>
<tr>
<td>The university's open innovation model, now taking shape in the recently-launched Innovation Square, has paved the way for close relationships with the business community. Also, EPFL’s research excellence is evidenced by its high position in international rankings</td>
<td></td>
</tr>
<tr>
<td>EPFL promotes a culture of experimentation, engaging students in research and innovation activities from the beginning of their studies, and supporting the development of good practice throughout the curriculum</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Enabling factors</strong></th>
<th><strong>Barriers, challenges</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The EPFL approach to change is exemplified by the Competencies programme, piloted in mechanical engineering with a view to wider application following iterative testing. Similarly, the Teaching Bridge initiative in interdisciplinarity has been constructed on the basis of success in preceding projects</td>
<td>The scale, pace and nature of pedagogical and technological change at EPFL, with the associated impact on curriculum design and content, inevitably presents challenges to teaching staff, though support is available through CRAFT</td>
</tr>
<tr>
<td>Quality assurance is central to the EPFL approach, involving stakeholders (including businesses) in the evaluation of faculty activity. The CRAFT project pioneers the use of technology in supporting teaching quality and learner feedback</td>
<td>Equally, the cultural challenge of engendering the entrepreneurial mindset, particularly amongst students, needs to be addressed by further encouraging the link between learning and innovation</td>
</tr>
<tr>
<td>EPFL’s expansion into the Middle East, and its ambitious association with the international Coursera online teaching/learning platform both present opportunities and risks with regard to internationalisation of EPFL’s activities</td>
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5.6 Key success, enabling factors and challenges: University Joseph Fourier

<table>
<thead>
<tr>
<th>Key success factors</th>
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<tbody>
<tr>
<td>Long-term partnerships with collaboration spread across a wide range of areas (research, innovation, education, social responsibility)</td>
</tr>
<tr>
<td>Collaborative structures and initiatives developed jointly by local research and innovation stakeholders</td>
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<tr>
<td>Bottom-up and flexible approach to cooperation within individual university and industry</td>
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<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Barriers, challenges</th>
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<tbody>
<tr>
<td>National higher education reforms in several areas (entrepreneurship, business-enterprise cooperation, dual study system, vocational education, etc), which are supported at the regional policy level</td>
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<tr>
<td>The Grenoble metropolitan area is a dynamic research and innovation environment, host to many and varied renowned research institutes and high-tech industry, which have a long history of cooperation</td>
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<tr>
<td>Strong sense of belonging to the same locality, with very integrated local partnerships between research, innovation and higher education actors</td>
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</tr>
<tr>
<td>Eagerness of local industry actors to work with university and their leading role in several partnerships and collaborative initiatives</td>
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</tr>
<tr>
<td>Segmentation of universities regionally and locally in France; this has been partially addressed through various national reforms, one of which is the PRES, the Research and Higher Education Clusters, that was created with a view to bringing together higher education and research institutions at the local level and to initiate joint initiatives and pool resources together</td>
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<tr>
<td>Open recruitment process at French universities, which means that universities welcome students coming from highly heterogeneous social and education backgrounds: one key challenge for the UJF is therefore to ensure that the mechanisms in place are tailored to all needs. The system needs to ensure a balance between education schemes that are tailored for the best students (e.g. internships in research labs for the best bachelor students, specific research training for bachelor and master students), together with education schemes that support the inclusion and retention of people who are experiencing difficulties</td>
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<tr>
<td>The rather bottom-up approach to partnerships has led to a profusion of collaborative structures and initiatives, which can lead to a certain lack of visibility for enterprises, as well as a lack of coordination between the different dimensions of the knowledge triangle at the level of individual initiatives, even if initiatives in one dimension can lead to further initiatives in the other dimensions</td>
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</table>
5.7 Key success, enabling factors and challenges: Karlsruhe Institute of Technology

<table>
<thead>
<tr>
<th>Key success factors</th>
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<tbody>
<tr>
<td>Continuous strive for improvements in teaching quality, including the introduction of system, course evaluations with a teaching quality index and course evaluation scheme; and improvements in structural and framework conditions to facilitate the contribution of business partners also in the teaching activities</td>
</tr>
<tr>
<td>Support structures put in place immediately after the merger of the two institutes to reinforce key areas (e.g. professorship for scientists or HOC) competences and to exploit joint initiatives</td>
</tr>
<tr>
<td>Establishment of dedicated structures, the House of Competence (HOC) to facilitate the integration of research scientists in the domain of lecturing. It focuses on developing ‘Study cultures under large-scale research conditions’ furthermore, the centre is devoted to the acquisition of key competences in developing and delivering lectures and courses</td>
</tr>
<tr>
<td>Teaching and promoting young scientists, which involves the assignment of mentors and involvement of young scientists in teaching functions from early stages</td>
</tr>
<tr>
<td>Education at KIT combines conceptual and theoretical concepts with illustrative and case-driven teaching and therefore links education to business and research. Innovative new teaching strategies and the diverse faculties with long experience in research, education and industry ensure the development of new curricula</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Barriers, challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merger of the two institutes combining the strengths of the predecessors in the fields of education and research</td>
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<tr>
<td>Traditionally strong cooperation between the public and private sectors that creates a profound basis on which institutes can build and develop its activities</td>
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</tr>
<tr>
<td>Strong national (Länder) support system with highly developed research infrastructure and intermediary system in place to facilitate interaction between the actors of the research and education system and maximise the potential for collaboration. However, the support system goes together with significant requirements for strong achievement and solid performance</td>
<td></td>
</tr>
<tr>
<td>Need for high level of adaptation in culture and attitude: For historical reasons, the innovation culture of the university and that of the research centre were very different. The research centre was organised as a centralised facility and served a single research orientation, cooperating very closely with industry in the fields covered. Innovation was aligned to its research programmes. The university, on the other hand, had a decentralised focus on research. Many projects were carried out and innovation was the individual focus of the various faculties. The current goal is to combine the two innovation cultures, keeping the best attributes of each.</td>
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</tr>
<tr>
<td>The innovative methods applied by KIT challenge the students as well. They have a prominent role to play in customising their own degrees, getting engaged in the extra curricular activities run by KIT and through the action-learning approach they are brought face to face with real-life challenges</td>
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</table>
5.8 Key success, enabling factors and challenges: Mondragon University

<table>
<thead>
<tr>
<th>Key success factors</th>
<th>Enabling factors</th>
<th>Barriers, challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>The institute’s strategy acknowledges the place of students / education in the innovation ecosystem</td>
<td>The local Mondragon context that offers a unique, dynamic ecosystem for innovation, served by a long history of interactions</td>
<td>Cultural transformation needed to adapt the reform in the ways students are taught and have to learn, including the need for academic staff to train themselves to adjust to their new role and the new curricula</td>
</tr>
<tr>
<td>Active collaboration and trust between the partners, who belong to the Mondragon Cooperative and share the same culture, coupled with strong knowledge transfer culture (i.e. the ‘cooperative’ culture) among the partner organisations and with bottom-up and flexible approach to cooperation</td>
<td>High level of autonomy for the university, due to its financial independence from the rest of the Mondragon Cooperative</td>
<td>No sustainable core funding for the University, which requires almost 50 per cent of the university’s income to be gained from tuition fees for example for the year of 2010-11</td>
</tr>
<tr>
<td>Shared strategic agenda and alignment of education strategy to the needs of local businesses and mechanisms put in place to strengthen collaboration through formal commitment of the partners (e.g. through joint technology roadmap, which formalises and validates common objectives, priority lines and future needs)</td>
<td>Flexibility, granted by the common cooperative management model, that allows for the emergence of new research lines, research projects and collaborations</td>
<td>Highly resource intensive model due to the need for coordination and the constant exchange of information between the partners. The cost is however more limited within the Mondragon model, due to the strong links between the partners</td>
</tr>
<tr>
<td>High degree of specialisation of the university, with focus on very specific niches of expertise, smart regional specialisation model</td>
<td>Business-orientated and entrepreneurship culture among the partners</td>
<td>Due to its dynamism and the integration of local actors, the Mondragon innovative ecosystem presents the risk of evolving in a closed eco-system where the links with local industry is outweighed compared to international links and international openness for students. However, this is not the case at Mondragon University, which has started funding and promoting international student exchanges already since 1972, well before creation of the Erasmus programme</td>
</tr>
</tbody>
</table>
5.9 Key success, enabling factors and challenges: Umeå University

<table>
<thead>
<tr>
<th>Key success factors</th>
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<tbody>
<tr>
<td>There is a clear strategy in place with strong support from the central and faculty management to foster the university’s activities in all three sides of the knowledge triangle. The university regards education as the key driver of knowledge triangle, but they keep working on trying to bridge the gaps between education, research and innovation</td>
</tr>
<tr>
<td>Creation of alliances with Higher Education Institutions and other external partners</td>
</tr>
<tr>
<td>Learning from other experiences is regarded very valuable, and the university does benchmark its performance both nationally and internationally</td>
</tr>
<tr>
<td>There is a continuous development in curricula development. The university aims to ensure that research outcomes and the latest industrial/commercial techniques are used to inform and develop the curriculum content. Research also feeds back into education by having a high number of researchers as teachers as well as building on the specific research competences of the university which also result in new educational programmes. Furthermore, the university works with professors and lecturers from industry in order to get direct access to the latest information in that specific industry.</td>
</tr>
<tr>
<td>It is important that the whole management is involved (also the faculty management) and that the links between the three aspects are understood. The university created strategic councils that are working with all three aspects of the knowledge triangle also have the task to find indicators on how the co-operation with the surrounding society is functioning and what the partners receive from the collaboration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Barriers, challenges</th>
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<tbody>
<tr>
<td>Continuously expanding university with broad national and international connections, including 600 international universities</td>
<td></td>
</tr>
<tr>
<td>The contacts between the research community and the corporate sector have improved and strengthened by the establishment of holding companies associated with the university and therefore provides a sound bases and opportunities for knowledge and technology transfer</td>
<td></td>
</tr>
<tr>
<td>Development of university’s environment with the aim to facilitate meetings between internal and external stakeholders. For example, the Arts Campus functions as a venue for education, research and professional activities within the fields of architecture, design, art and digital culture – a creative environment which can be quite unique in Sweden, Europe and even worldwide</td>
<td></td>
</tr>
<tr>
<td>The university operates in specific conditions, where the region is very dependent on the university, meaning that the municipality of Umeå is an important partner, as are the smaller municipalities in the region.</td>
<td></td>
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<tr>
<td>Strong external push towards graduate employability, therefore humanities loose attention and resources, which might lead to the surrounding society missing out on important perspectives that humanities can bring to society</td>
<td></td>
</tr>
<tr>
<td>The surrounding society itself represents a barrier to a smooth integration of the different aspects of the knowledge triangle. There is an ongoing public debate in Sweden, debating whether high quality research and collaboration between industry and the university can be compatible at all</td>
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5.10 Key success, enabling factors and challenges: University of Trento

<table>
<thead>
<tr>
<th>Key success factors</th>
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<tbody>
<tr>
<td>Analysing and focusing in on a few key thematic areas to compete in an international environment</td>
</tr>
<tr>
<td>Finding international support and promoting internationalisation generally</td>
</tr>
<tr>
<td>The University of Trento through the Trento ICT Labs co-location centre uses local strengths to develop an internationally-oriented education programme</td>
</tr>
<tr>
<td>The University successfully incorporating users and the public in the innovation processes</td>
</tr>
<tr>
<td>Innovative initiatives are put in place to assist getting access to the resources of the university and the local areas such as the Portal for Innovation which is aimed at providing centralised knowledge management facilities</td>
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<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Barriers, challenges</th>
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<tbody>
<tr>
<td>The university can capitalise on a range of regional and national initiatives to support technological innovation in the region, including the development of Science and Technology Parks, Business Innovation Centres, and Integrated Centres for Entrepreneurship Development and incubators</td>
<td></td>
</tr>
<tr>
<td>Strong commitment of the partners to secure the place and contribution of education in the knowledge triangle as illustrated by the Trento RISE initiative</td>
<td></td>
</tr>
<tr>
<td>The engagement with the EIT means quality assurance and monitoring procedures put in place and it also represents European level design of the educational initiatives of ICT Labs at the Trento co-location centre, which is a reassuring factor for businesses and stakeholders</td>
<td></td>
</tr>
<tr>
<td>A potential barrier to the success of the EIT-related education initiatives might be due to the students who do not complete their degrees as their involvement in a start-up or project can lead to drop-out from the educational programmes</td>
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</tbody>
</table>
5.11 Key success, enabling factors and challenges: University of the Arts London, Central Saint Martins College of Art and Design (CSM)

### Key success factors

- The individual colleges set their own strategies. CSM focuses its specific strategies on fostering innovation and at the same time it continues developing a range of initiatives to foster links between students and businesses.
- CSM runs student-oriented initiatives and understands that students are the main assets of the institution. These initiatives are also strongly supported by the senior management. The main rationale behind is to generate a surplus by focusing on projects that engage students.
- The CSM brief is clear and much more straightforward than at other universities - to develop collaborations, enhance the brand, etc. Decisions are also straightforward; the staff prioritise opportunities that bring in the most money while also benefiting the students.
- Reputation of the university, that it educates students who have innovative and creative ideas and are not embedded within a well-established and risk-averse system of thought; and the quality and innovativeness of CSM’s deliverables are very high.
- When approaching potential clients, CSM takes a very direct approach having appointed dynamic business focused managers. CSM negotiates the contracts with its external partners and reportedly, external partners expect the unexpected when they approach CSM.
- Encouraging students from a range of backgrounds through short courses brings money and diversity amongst the student population.
- Developing sophisticated communications with industry encourages business links with students. This includes teaching students to have a professional attitude and value their intellectual property.
- Promoting creative and flexible projects and innovative teaching.

<table>
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<tr>
<th>Enabling factors</th>
<th>Barriers, challenges</th>
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<tbody>
<tr>
<td>UAL operates as a collegiate university comprising six constituent colleges. UAL runs only the technical support functions. The decision to dismantle the centralised offices in favour of a decentralised approach has been widely regarded successful for the governance of enterprise.</td>
<td>CSM is run similar to an enterprise, catering most of its resources to education and fulfilling student demands because that is where the surplus is generated. This approach is a direct consequence of UK government policy in which students pay substantial fees for undergraduate and postgraduate education. The university expects to get no government assistance for teaching by 2015, nowadays 51% of its income stems from tuition fees.</td>
</tr>
<tr>
<td>In the UK, government cuts in higher education mean that universities will have to focus more and more on the bottom line, therefore universities pay particular attention to their students. For the same reasons, CSM has a highly business oriented attitude, with the main goal to generate a surplus while benefitting the College’s academic mission.</td>
<td>The main barriers that CSM has managed to overcome are the expectation of clients. CSM actively negotiates contracts so that they are broad and allow for a range of deliverables.</td>
</tr>
<tr>
<td>The location in central London allot many resources to the University, while other universities do not necessarily have access to the local cosmopolitan resources that London offers.</td>
<td>There are some concerns that bringing in students to the UK may be difficult due to rising fees for university education. Furthermore, international students are not able to obtain a visa to work within the UK after their education and that might lead for the university that they will not be able to fulfil the demand from the national economy for arts graduates.</td>
</tr>
<tr>
<td>CSM being located in central London also had to face a major barrier in terms of physical space. The College simply was not big enough. The university has made attempts to remedy this with the development of an award-winning building in central London, which turned into a success after all, providing many spaces for collaboration and spontaneous meeting and forming informal contacts.</td>
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</table>
### Key success, enabling factors and challenges: University College London

<table>
<thead>
<tr>
<th>Key success factors</th>
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<tbody>
<tr>
<td>UCL as a very strong coordinated and simplified governance structure and overarching strategies covering all aspects teaching, learning, research and internationalisation</td>
</tr>
<tr>
<td>The UCL grand challenges as a central focus for networking, research (from blue sky to near market), policy and practice</td>
</tr>
<tr>
<td>The international nature of UCL plays to its strengths and marks it out as a University which is educating global citizens</td>
</tr>
<tr>
<td>The recognition of transversal skills and extra curricular activities as a core part of the student experience</td>
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<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Barriers, challenges</th>
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<tbody>
<tr>
<td>The focus of UCL on economic and social impacts underpins all its engagement activities</td>
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</tr>
<tr>
<td>UCL governance structure – through the centrally managed department for Enterprise Operations, internal and external bodies can all connect with enterprise opportunities and knowledge transfer</td>
<td></td>
</tr>
<tr>
<td>The institutional learning and teaching strategy which encompasses new methods and pedagogies, multi disciplinary, internationalisation, transversal skills, innovative learning environments</td>
<td></td>
</tr>
<tr>
<td>UCL has professional training development for all academic staff to support their development in new pedagogy and technology enhanced learning approaches. This is part of the wider Teaching and Learning Strategy</td>
<td></td>
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<tr>
<td>There are significant challenges for the Higher Education Sector in the UK including the new fee regime and a tightening up on international students</td>
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</tr>
<tr>
<td>The international student issue is also compounded by increased competition from other educational institutions in the UK and abroad. The UK is particularly vulnerable with new immigration policy formulation meaning it becomes more complex to maintain certain levels of overseas students</td>
<td></td>
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<tr>
<td>There is still less prominence given to enterprise activities in the Social sciences, humanities and the arts</td>
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<tr>
<td>There is a need to increase the availability of space and infrastructure for students to further support the goals of increased interdisciplinary teaching, learning and research.</td>
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</table>
5.13 Key success, enabling factors and challenges: Zurich University of the Arts (ZHdK)

<table>
<thead>
<tr>
<th>Key success factors</th>
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</thead>
<tbody>
<tr>
<td>■ The strategy for the Knowledge Triangle is explicit at ZHdK: This extends to include the regional and national actors in the governance system, although a top down initiative it has driven the structural changes necessary and set the agenda for the future.</td>
</tr>
<tr>
<td>■ Co-location with the cultural and creative sectors: ZHdK has well established links to cultural institutions and the cultural and creative industries that are actively embedded the process of informing research and teaching.</td>
</tr>
<tr>
<td>■ The transdisciplinary approach to education including a new Master’s programme</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enabling factors</th>
<th>Barriers, challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>■ Cultural entrepreneurship as a cross cutting theme throughout the University. This does not directly intervene with the education and research portfolios but it follows a philosophy of promoting a new dimension in the scope of the university’s provision and activities.</td>
<td></td>
</tr>
<tr>
<td>■ Dedicated structures to support cross cutting, transdisciplinary and transversal skills acquisition</td>
<td></td>
</tr>
<tr>
<td>■ New funding streams for innovative ideas and projects</td>
<td></td>
</tr>
<tr>
<td>■ The teaching and research staff play a decisive role in bringing their market experience into the university environment</td>
<td></td>
</tr>
<tr>
<td>■ Informal communication at ZHdK is a concern. They are moving to a new campus which will hopefully overcome some the issues through new infrastructure and build space</td>
<td></td>
</tr>
<tr>
<td>■ There are still changes in relation to university autonomy in Switzerland and the new university act will help to bring further substantial improvements</td>
<td></td>
</tr>
</tbody>
</table>

5.14 Overview of the different approaches applied by the various Higher Education Institutions

The different factors influencing the activities and operations of the higher education institutions highlight many interesting approaches, and a number of key defining factors that affect the transferability of successful examples can be summarised as presented in Figure 8. Among others the national and regional context and the university's structure - either due to recent mergers or restructuring processes - are the key aspects to consider when considering the transferability of the different schemes.

5.14.1 Regional and national context (SMART specialisation)

Strong focus on ICT – University of Trento, Italy

Since 2007, the Autonomous Province of Trento has promoted ‘Trentino as a Lab’ (TasLab), an adaptation of the ‘living lab’ approach to regional innovation. It is an ICT innovation network that brings together research centres, enterprises and the government of Trentino with citizens for concurrent research and co-creation. The living lab operates under the principles of user-driven, open innovation. The TasLab promotes projects by analysing the area and market to find potential solutions and collaborations.

The region Trentino is very attentive to innovation, specifically in ICT. There are three main protagonists. First, there is the Trentino system of higher education and research with over 800 researchers (out of 2000 total in the Trentino region) working in the ICT sector. There are 12 public research centres and the university hosts internationally renowned research institutes. Second, there is a group of 960 ICT companies, employing 4500 professionals; and finally, there is the local government, which has supported this focus on innovation in ICT-enabled services through a number of legislative acts, including horizontal measures to support the establishment of a knowledge society as well as vertical interventions to stimulate sustainable growth and industrial competitiveness.

The University of Trento is part of the living lab initiative of the Province of Trentino, an initiative providing a guiding framework for research and innovation in ICT. The university has capitalised on
this infrastructure by establishing a co-location centre for a Knowledge and Innovation Community (KIC).

A specific initiative is Trento RISE, an open innovation governance model that includes the University, several public and private research centres, such as the Bruno Kessler Foundation, the FIAT Research Centre, Microsoft, and a regional branch of the National Research Council (CNR). With Trento RISE the knowledge Triangle is explicitly addressed with the regional government acting as a driver.

**Baden-Württemberg, Germany – Karlsruhe Institute of Technology**

The research infrastructure in Baden-Württemberg consists of 70 institutions of higher education. Additionally, there are many research organisations, including 12 of the 85 internationally renowned Max Planck Institutes and 14 of the 60 institutes of the Fraunhofer-Gesellschaft. The private sector cooperates closely with the research-oriented universities and institutes in the region. It invests in research and teaching, this includes financing over 70 endowed professorships at the universities in the region.

The vast number of research institutes are connected through a range of intermediaries. Research networks and clusters stimulate interdisciplinary research and joint projects. Comprehensive networks of transfer centres, such as the technology transfer offices at the universities, play an important role in developing relationships and opportunities. Other intermediaries include organisations dedicated to research marketing, transferring technology to SMEs, non-profit organisations devoted to business assistance, and a range of technology and sector specific institutions.

**Grenoble’s network of collaboration, France – University of Joseph Fourier**

In spite of the fact that Grenoble is only an average-sized city, the Grenoble metropolitan area is a dynamic research and innovation environment, host to many and varied renowned research institutes, for example: the Centre for Atomic Energy (CEA); the National Centre for Scientific Research (CNRS); the National institute for Health and Medical research (INSERM); and the European Molecular Biology Laboratory (EMBL). It has the largest concentration in R&D jobs in France after Paris (23,400) and it has established itself as one of the leading European centres in terms of high-tech industries in the fields of bio- and nanotechnologies in particular.

Bringing research, education and innovation partners together has been on the agenda of the local partners since 2006, with the central idea to promote integration over the traditional segmentation of the French university system. The GIANT Campus (Grenoble Innovation for Advanced New Technologies Campus) launched in 2008, was initiated by UJF, together with the Grenoble Management School, Grenoble National Institute of Polytechnic, CEA, CNRS, EMBL, ESRF, and the ILL. Local authorities and agencies as well as businesses are also involved as partners (including Schneider Electric, bioMérieux, Siemens, STMicroelectronics, SEM MINATEC Entreprises, etc). Three regional competitiveness clusters are also taking part in the initiative. Essentially, GIANT is an infrastructure project, which brings together research, innovation and education activities around three areas of high societal relevance: communication technologies, renewable energies and environmental issues, and bioscience and healthcare. It is conceived as a space for experimentation, which fosters cross-disciplinary collaboration and offers opportunities for formal and more informal interactions. Once finished, the campus will represent a complex of premises and facilities, spread over 250ha.

**Zurich University of the Arts supporting regional cultural entrepreneurship**

Zurich University of the Arts, although a small institution overall is particularly well embedded into the region. The Department for Cultural Analysis works with and carries out research with the creative and cultural industries in the region and across Switzerland as a whole. The work helps understand the relevant labour markets, the development of sectors and feeds back into the institutional strategy. Zurich also uses the knowledge acquired to embed new teaching on cultural entrepreneurship within the curriculum and ensure that new enterprise developments are considered to be a clear option for students. Some of the teaching modules delivered to support this include transversal themes and competence development, entrepreneurship education.

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7 Grenoble-Isère Economic Development Agency (2012), Key figures Grenoble-Isère, 2012
5.14.2 Potential for transferability of the different approaches

Based on the key success and enabling factors identified and the national and regional context considered, the following table shows a summary on the potential of transferability of the different approaches chosen by the various universities studied.

Figure 8 Defining factors in the transferability of approaches applied by the universities

<table>
<thead>
<tr>
<th>University</th>
<th>National / regional environment</th>
<th>University structure</th>
<th>Potential for transferability</th>
</tr>
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<tbody>
<tr>
<td>Aalto</td>
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<td>H</td>
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<tr>
<td>Aarhus</td>
<td>H</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>Chalmers</td>
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<td>L</td>
<td>H</td>
</tr>
<tr>
<td>EPFL</td>
<td>H</td>
<td>L</td>
<td>H</td>
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<tr>
<td>UJF</td>
<td>H</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>KIT</td>
<td>M</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>Mondragon</td>
<td>L</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Trento</td>
<td>L</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Umea</td>
<td>L</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>UAL</td>
<td>H</td>
<td>M</td>
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</tr>
<tr>
<td>UCL</td>
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<td>L</td>
<td>L</td>
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<tr>
<td>ZHdK</td>
<td>H</td>
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<td>M</td>
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</table>

Some universities have already developed active strategies to transfer elements of their models. For example Aalto University is a spearhead project of the Finnish university reform. Other mergers between regional universities and strategic alliances with polytechnics may follow. The Aalto approach is therefore likely to inform and inspire – at least to some extent – other academic institutions in Finland. More specifically the Aalto Factory model has attracted a lot of interest from different higher education institutions across the globe. A Factory was set up in the Tongji University in Shanghai (China), based on the example of the Aalto Design Factory. The so-called Aalto-Tongji Design Factory (ATDF) is a physical place bringing people and activities together on the Tongji University Jiading Campus. ATDF enables the testing of the transferability of the Factory concept in a radically different culture. Likewise, the Swinburne University of Technology in Melbourne (Australia) has established a 'Living Lab' on product development.

Even though Mondragon University is very specific, due to the particularity of the regional context and its cooperative status, some of its elements are nonetheless transferable. The university has also already set up a company to transfer their model to other universities abroad. For example, Mondragon University has helped the Panamericana University in Bogota (Colombia) to adopt the Mendeberri teaching model and the Mondragon strategy for liaising with companies and knowledge transfer.

In case of Chalmers, its participation in international networks such as CESAR and collaboration with foreign HEIs affect both Chalmers and the partners, and provide many possibilities to transfer successful initiatives. The approach applied by Chalmers is successful due to the dedication of the university, top-management, staff and students and the external partners. Transforming the university does not happen without difficulties, and there are still barriers to overcome, but Chalmers’ commitment towards integrating all activities of the knowledge triangle is a good example on how to address these challenges and overcome boundaries set by national systems.
KIT's teaching quality index, where students are asked to evaluate whether their courses meet their individual learning needs has also attracted attention from abroad. So far, 15 other universities are interested in adopting the evaluation method, among them universities in Brazil and Vietnam.

Aarhus University, undergoing the most significant organisational change in its history, applies a comprehensive set of indicators to foster the achievements of the objectives and assess the university's performance, out of which some might be also interesting for other organisations. The main indicators include: student satisfaction with their studies; unemployment figures for the Master degree graduates from Aarhus University; coherence between university and secondary schools; recruitment of undergraduate students from other universities and educational institutions; ECTS credits earned by students at AU sums University admitted to full-time study at a Danish university; completion time for students at the undergraduate and graduate levels; the scope of economic cooperation between Aarhus University and the wider community, for example businesses; the economic scope of continuing education; Aarhus University's research impact in the international research; external international funding; doctorate holders unemployment figures and the funding of interdisciplinary centres at Aarhus University.

Some of the initiatives carried out at the University Joseph Fourier present interesting features which could be replicated in other contexts. In particular, the ‘Research and Innovation’ postgraduate programme could be transferred to other higher education institutions as a way to enhance students’ integration in the job market and enterprises’ access to research and innovation skills. Likewise, ENEPS is a valuable initiative that could be copied in the longer run by other French universities. It shows the benefits resulting from the diversification of the student public, both for businesses, which can access to more vocational profiles and for the students themselves, who are offered new pathways to university education.

Several of the features of the Umeå University’s approach may lend themselves to transfer and application elsewhere: in governance and management, for example, the conscious allocation of knowledge triangle constituents as responsibilities at deputy vice-chancellor level is a significant endorsement of the whole strategy. Second, the major industrial involvement in the operation of the university but particularly in the Industrial Doctoral School and the Institute of Design, may offer other HEIs practical models of collaboration for mutual benefit.

When considering the transferability of the Trento approach, it has to be noted, that a key characteristic for transferability of the success of the Trento region is the small size. With fewer actors, networking is easier, there is greater financial and administrative reliability, and programmes can be delivered at a faster rate. Decisions are easier to make with fewer stakeholders involved in negotiations. The Province of Trentino has used its small size and autonomy to deliver a large programme to enhance its innovative potential.

As part of the University of the Arts in London, much of CSM’s success lies in its location, the sector in which it operates, and the students that are enrolled. The location in central London allots many resources to the University. Other universities do not necessarily have access to the local cosmopolitan resources that London offers. The sector actively seeks younger students for contract work as they are perceived to have fresh ideas. Once again, this is not transferable to many sectors, because especially in science and technology, businesses prefer students with higher education. Finally, the students are attracted to the location and brand that CSM offers. Although other universities are working on brand development, CSM is widely regarded as one of the best. Developing a brand that is widely noted to be one of the best requires a long track record amongst other factors. However, the innovative teaching methods, risk-taking culture, and focus on students and their education are effective. When the curriculum is flexible, collaboration with the outside world is fruitful and is more likely to be absorbed into the teaching curriculum at the university.

University College London has a strong central vision. This central vision drives forward the university in its pursuit for engagement and collaboration, not only limited to knowledge transfer and innovation-enterprise but extending to public engagement, outreach and policy making. This is an ambitious approach and can be held up as a very good example of vision leading into practice. The transferability of this approach is complicated. Other universities can broadly take this approach but cannot use the same vision and values as these differ greatly depending on history, culture and governance models. Elements can be transferred including the empowerment of academic staff through developing new initiatives and implementing parts of the strategy of the institution. Another
interesting areas for potential transferability it the recognition of transversal skills and extra curricular activity as a core part of the student experience. UCL gives student’s responsibility for their own learning environment and the development of skills through the key skills system.

Essential aspects of Zurich University of the Arts are transferable in terms of the structures that have been put in place to bring together the disciplines, and also the partnerships formed with the regional cultural and creative industries. However the approach is defined by the region and its location. It is also very dependent on the wider Swiss governance system. Contextually, Switzerland has a strong cultural industry and a well established international reputation for design.

In terms of overall approach, Ecole Polytechnique Fédérale de Lausanne can offer a good example in its incremental and iterative way of approaching change. Pilot actions, such as the Competencies programme, exemplify a risk-limiting method of testing new ideas, while giving teaching and learning participants an opportunity through feedback to influence the final outcome. A further transferable aspect is the early exposure of students to concepts of experimentation and innovation, laying the groundwork for a continued emphasis on the link between learning and application, and on the nature and value of the learning/research/innovation dynamic.

While the EPFL type of Quality Assurance system may be already familiar to other universities, the distinctive benefits of the CRAFT initiative could be of interest to institutions looking for ways to engage and support teaching staff in the management of change and the implementation of new methods of curriculum planning and development and teaching and learning methods. CRAFT may be of special interest due to its novel use of technology in assessment and support systems.
6 Lessons learnt and recommendations

A rich collection of information from 12 very different case studies makes it very complex to produce common lessons learnt and recommendations. The following collection is extracted from the case studies and brings together areas where universities may consider focusing efforts for the purpose of improving education, research and business linkages, and where policy makers and funders can help make the conditions more conducive to knowledge triangle strategies and activities.

**Embedding the entrepreneurial culture throughout the higher education institution**

The entrepreneurial culture should be embedded throughout institutions, among staff, students and with partners/other stakeholders. This involves changing many of the ways in which a university tackles its teaching, research and other third mission activities, putting partnership at the heart of approach. In some cases this is a centralised approach (through a dedicated organisational unit such as Aarhus, Chalmers), in other cases the approaches taken are decentralised. Both approaches can be powerful. This is an over-arching recommendation which can be implemented in many ways. The subsequent recommendations for universities should all, in part, lead to increasing the entrepreneurial culture.

**Involving students as co creators of knowledge and as part of the innovation system**

There is a fundamental shift in the position of students in many institutions from an end product or consumer to an integral part of the development of knowledge and opportunities. Students already look for all kinds of additional opportunities to enhance their academic achievements and they increasingly value opportunities for internships, project based activities, creating their own relationships with stakeholders and exposure to new learning environments. Universities and business alike can benefit from these relationships. Exemplar in this is the Aalto University “Aalto Factories” as already highlighted. In EPFL students are involved in teaching activities and in Mondragon education is considered to be part of the local innovation strategy. This could extend beyond the student to the wider public (Trento).

**Creating rich learning environments for talent development**

Many of the case studies are taking novel approaches to teaching and learning and embedding them across curricula. This is not just about entrepreneurship but talent development in general. The role of the student in being part of creating these environments is increasingly important, especially in action learning. These new learning environments are equally important in those universities which are now providing vocational education and lifelong learning opportunities for business and the wider public. Those outside of the formal education system often respond better to collaborative learning environments and ideas development delivered through informal teaching and learning mechanisms.

The rich learning environments also need diverse types of teachers. Institutions are engaging more industrial partners to deliver courses or course modules. In addition, researchers are given more teaching time in order to ensure transfer of knowledge from current research into the curricula. All of these elements together are crucial in developing the transversal competencies which graduates need for creating companies, gaining access to the labour market or working in research.

**Quality assurance and recognition of new skills development**

Students are both changing the relationships they have while at university, and also changing the way they learn. Therefore it is important to find new ways of recognising the wider variety of skills that are being accumulated in these rich knowledge triangle environments. The case studies highlight a number of examples of the recognition of transversal skills and extra curricula activities (UCL and the key skills system for example). There are also examples of the co development of learning outcomes with industry (Trento).
Taking an interdisciplinary approach

Universities with developed approaches to the knowledge triangle have a strong emphasis on interdisciplinarity and on breaking down traditional academic silos. The approaches take place at many levels, including interdisciplinary research centres, interdisciplinary courses and modules and it is also embedded in the management structure in some universities. Interdisciplinarity is mentioned in most of the case studies as being part of its success.

Developing academic talent

Academic staff are faced with a number of new roles and responsibilities as universities changing their vision and strategies to include more aspects of working across the knowledge triangle. As well as incentives to engage in new activities, academics also need to have professional development opportunities to further develop their own talent and to allow them access to new ideas for teaching, learning and business interaction. Academics are a key mechanism for ensuring joint working and sharing of good practice happens across faculties and structures. In UCL, the knowledge transfer champions and the teaching fellows are examples of encouraging academic support and investment in their own career development.

Internationalisation as a way of improving institutional practice

There are many reasons for universities to have a strong internationalisation agenda. There are also specific ways in which internationalisation can affect knowledge triangle related activities. In the global operating environment linkages between education, research and business extend beyond regional and national borders. Internationalisation provides two strong ways for improving the knowledge triangle, first through international partnerships with both universities and business, and secondly through using these partnerships to learn about other approaches and improve their own institutional capabilities and practices.

Implementation of flexible management models

Universities are changing the way in which they manage their assets (research, education, students, relationships as well as IP). There is an emergence of matrix organisational models. These types of models help to combine more traditional education and research activities with cross disciplinary approaches. Matrix management models are particularly adept at allowing knowledge flow across all of the parts of the organisation from bottom to top and from side to side. The matrix management model is one which has been implemented across the KICs specifically to allow such flows of knowledge to occur.

There are also new management models being used for specific programmes or entities such as the Aalto factory which has employed a system of annual planning and reporting. Shortened management planning allows universities to align their planning more easily to external business cycles and gives increasing flexibility and responsiveness to the external environment.

Transforming working environments - widening access

Many of the institutions in the case studies have developed close long term relationships with local research and industry partners and work with them across the education and research agendas. The working environment also plays a key role in making these relationships work. In some cases, this is through co-location of stakeholders and in others universities have developed physical spaces outside of the university infrastructure to help facilitate the relationships. Well designed spaces and buildings for interaction and networking are a common feature in this collection of case studies.

Embedding evaluation and monitoring of the impact of knowledge triangle related activities in the university strategy

It is always difficult to understand the relationship between activity and impact if there are no measurements being made. Evaluation and monitoring of university business interaction is still quite scarce external to technology transfer. In these case studies Chalmers have recently evaluated their “Areas of Advance” in which there was a specific focus on the impacts of the integration of education in the knowledge triangle. EFPL have evaluated the
quality of research, innovation and education activities and assessed the extent of the links between them.

**Smart specialisation as a focus for knowledge triangle activities**

In order to be successful, it is important to look at the assets of a university and surrounding area and exploit them fully. Smart specialisation implies concentrating resources on a few key priorities based on a region's economic potential rather than spreading efforts and investments too thinly. In the smart specialisation strategies encouraged under the Structural Funds, universities are highlighted as a key critical asset of the regional innovation system. Universities can turn this around for their own benefit as by tapping into the resources and talent of a region and specialising their knowledge triangle activities there is more chance of having a significant impact.

**Taking the longer term vision for change at the institutional level**

Many of the case studies highlight how changes in the way the institution works in relation to the knowledge triangle are often incremental and take time. Although there are some cases of major institutional reform, the initiatives and activities often build on years of other experiences and activities, learning and adapting by doing. Universities can capitalise on the lessons learnt from existing activities and set about implementing incremental change towards a long-term vision of the knowledge triangle as a part of the institutional culture.

**Incentives and funding structures**

It is not possible to recommend particular incentives or funding structures, which encourage knowledge triangle, related activities. There are too many national, regional and local specificities. However if universities want to develop relationships and create transferable knowledge it is essential to have the right incentive and funding structures in place. It is especially important to consider incentives for academics that are too often bound by professional development incentives, which relate to their research agendas and ignore education, business relations and other third mission activities. Competitive research funds in particular might be encouraged to look at all three sides of the knowledge triangle and treat them more equally.

**Engaging with the national policy environment across the areas of research, education, enterprise and innovation**

Universities are working in a much wider environment when tackling education, research and business. In countries where universities are closely linked to their ministries, the new agendas often means that they need to be able to work with more than one Ministry if they are to be able to fulfill all of their missions to equal success. Cross ministerial contact can be complex and a recommendation to policy makers would be to try and overcome this barrier by helping universities to have access to all the necessary policy support.
Annex 1  Case studies
1 Aalto University

1.1 Introduction

1.1.1 An autonomous University formed by a merger of three Universities

The establishment in 2010 of Aalto University was the most significant recent event of the Finnish university reforms. Aalto is a foundation-based university resulting from the merger of Helsinki University of Technology, Helsinki School of Economics and the University of Art and Design, Helsinki.

Aalto University exemplifies the move in Finland towards a more autonomous and less fragmented university system. The Universities Act 2009 granted Finnish universities more independence in their legal status and established foundation-based universities, prompting the expansion of the private funding base through endowments and business activities.

The Aalto model is based on a very long tradition of cooperation between the merged institutions and business enterprises, with the advantage of Helsinki as a key European innovation hub. At the national level, sustained public-private partnerships have been supported particularly since 2006 through the Strategic Centres for Science, Technology and Innovation (SHOK) programme. SHOKs are not-for-profit limited companies that carry out pre-commercial research around virtual cooperation between universities, research institutes and companies.

Located in Greater Helsinki, Aalto University benefits from the dynamics of one of the most innovative regions in Europe, with significant opportunities for cooperation at a regional level. After the merger, the university consisted of several campuses, but following extensive consultation, including online discussion and workshops with external partners, most of the activities were combined on the main campus in Otaniemi Espoo, with a continued presence in Töölö Helsinki.

1.1.2 A comprehensive university fostering multidisciplinary research and education

Aalto University is a large institution, with a comprehensive and multidisciplinary focus. In 2010 it consisted of 16,057 students and 3,459 postgraduates, with 4,684 FTE staff (of whom 339 were professors). The university is structured around six Schools: the School of Arts, Design and Architecture, the School of Business, the School of Chemical Technology, the School of Electrical Engineering, the School of Engineering, and the School of Science.

Aalto has a strong research focus mainly on computer science and modelling, materials research, design, ICT and media. Every teacher and scientist is engaged both in teaching and research activities. Research excellence is a key driver for the work done at the University.

According to its strategy, Aalto University “aims to be an internationally acclaimed, multidisciplinary university where research and education are promoted hand-in-hand”\(^8\). The university performs particularly well with regard to research quality criteria and has attracted several grants from the Finnish Academy of Finland (e.g. grants from 2012-2017 Centres of Excellence programme) as well as international distinction (e.g. European Research Council's grants).

\(^8\) Aalto University, Annual Board Report and Financial Statements, 2011.
Excellence in education is also a core principle. Bachelor students are selected via an entrance exam and the grades obtained in the nationwide matriculation examination. Most of the Master degree programmes are in English and the university has a strategy of attracting international students.

### 1.1.3 Participative management model

The executive bodies at university level are the University’s Board, the president, the Deans of six Schools and the University Academic Affairs Committee. All the board members are external to the university and are either high-level academics or business experts. The university has three vice presidents in fields that are close to the three dimensions of the knowledge triangle: education, research and knowledge networks.

![Organogram of Aalto University](source: Website of the Aalto University)

The university follows a flexible management model, served by the financial and organisational autonomy of the university. The governance is flat and democratic, with key external partners being consulted on the future of the university (e.g. through their participation in the Presidents’ Circle). Additionally, the academic staff and students are encouraged to submit ideas for innovative courses or innovative study projects and to enhance the standards of the university’s activities.

The small size of the country encourages close linkages, as the majority of managers at large Finnish Companies are alumni of one of Aalto’s Schools. The university’s management includes professors...
who have worked in the private sector, and industry has a long tradition of taking part in the courses offered by the university. Also, external stakeholders are involved in the University’s Board (the Chair of the Board is the President and CEO of KONE Corporation) and participate in the Presidents’ Circle that brings together alumni, donors, business top managers and entrepreneurs. Since its establishment as a foundation in 2010, the university has been able to raise funds from private donors, who also often engage in strategic partnerships with the university. By the end of 2011 about €200m was donated to the University from Finnish industries and other financiers.

1.2 Innovative teaching and learning: a student-centred approach to education

Aalto University has undergone a range of education-related reforms since its creation in 2010. These attest a new approach to education, in which students and learning activities are placed at the centre of research and innovation process. Most of them are focused on how to foster creativity among students and to create value from interdisciplinarity.

1.2.1 Interdisciplinarity

The creation of Aalto University depended on a willingness to increase interactions between disciplines in the fields of art, design, technology and business. Curricula, teaching methods and the operation of study programmes are being reformed through several “pedagogical experiments” in order to support interdisciplinary collaboration.

For example, open Aalto courses (e.g. courses organised by one or more Aalto Schools and open to all students regardless their field of study) have been developed and are piloted outside the normal core curricula. The originality of these courses consists in the fact that they have been developed bottom-up by academic staff and submitted through calls for new pedagogical ideas. The selected ideas are offered extra financial resources which support the setting up and development of innovative teaching proposals.

The university also proposes three cross-disciplinary Master degree programmes that involve interdisciplinary teams, in the fields of International Design Business Management, Creative Sustainability and Strategic Management.

**International Design Business Management**

International Design Business Management (IDBM) is a multidisciplinary two-year Master degree programme offered by the Aalto University School of Business, School of Art and Design, and School of Science. The launch of the minor study programme in 1995 was prompted by the needs of the design industry. IDBM is a selective programme, with about 30 to 45 students attending the programme annually.

The Master degree programme (since 2010) offers advanced competence in multi- and cross-disciplinary, global, design and intensive business development, responding to such challenges in the business world that require systemic and integrative thinking, multi- and cross-disciplinary approaches, flexible practices and the ability to operate under uncertain conditions. Learning takes place at both the individual level and in the social environment created by projects and group work, with projects conducted with business partners. The IDBM programme is strongly linked to the Design, Service and Media Factories.

A central objective is to educate top-level developers of global business who operate in design- and technology-intensive environments. The programme combines in-depth competence in the field of specialisation in design/technology/business with multi- and cross-disciplinary competence. An international perspective forms a central part of the programme’s content and all teaching is delivered in English.


1.2.2 A student-centred approach

Aalto University’s learning model is based on a project- and problem-based methodology, and is aimed at the acquisition of transversal professional skills. A general pattern is that much learning takes place beyond the classroom. In several curricula (Master programmes, minor study courses, etc), teams of 2-5 students work on business cases for one year, under business and academic
supervision. Students thus benefit from a wide exposure to the real world, having to solve concrete issues faced by industry and society.

ICT is a central part of the ongoing education reforms, with aims to integrate formal and informal learning. Virtual interactions (between professors and students and between students) are used to facilitate the implementation of innovative teaching and learning, and more particularly group work. At the moment, the focus is put on the effective use of common learning environments and tools across the Aalto Schools and the introduction of communal websites (e.g. blogs, wikies and other social media forums), whose contents are open and can be edited cooperatively by students and professors.

Student-led initiatives are also strongly encouraged and supported: interesting examples are “Aalto on Tracks” (2010) and “Aalto on Waves” (2011) projects, which have created inspiring practices to organise courses and collaborative learning.

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<th>Aalto on Tracks</th>
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<td>Aalto on Tracks took around 100 Aalto University students and several professors in a private train from Helsinki to Shanghai World Exposition in China in May 2010. The project was entirely organised by Aalto students and sponsored by foundations and companies. The rationale behind the trip was to stimulate students’ interest and offer innovative, unusual ways of learning. During the one-week stay in Shanghai, students attended workshops, lectures, and various events (e.g. company and university workshops). An Internet connection to the train was arranged, so that other students could follow the conferences and other events. Source: <a href="http://aaltoontracks.com/">http://aaltoontracks.com/</a></td>
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<td>Aalto on Waves, which finished in April 2012, was a student-driven innovation project where people from Aalto travelled by ship to Brazil. During the journey, they created a social impact through learning and collaborating on real challenges. Source: <a href="http://www.aaltoonwaves.com/">http://www.aaltoonwaves.com/</a></td>
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All in all, by incorporating creativity in its education model, Aalto University encourages students to develop critical, independent thinking. Students are actively engaged in their own development and in the development of the university. This is considered as a real added value in their careers, given that international companies are constantly in search of new ways of tackling technological and societal challenges. Advantages are twofold: students are prompted to adopt a more practical approach to their studies by working together on concrete issues with experienced researchers and technicians, while businesses benefit from fresh perspectives on their challenges and solutions. Cooperation therefore creates opportunities for both students and companies, leading for example to first contact that could result in future recruitment.

1.2.3 **Mobility and flexibility**

The extensive reform of Bachelor programmes is part of the wider education reform at Aalto University, with the aim to promote flexible pathways between degrees and transversal skills requirements. Programmes are being combined and integrated, resulting in fewer degree programmes with wider scope. Starting from the university year 2013, students will no longer apply to narrow study paths but instead to wider degree programmes within which they can choose areas of specialisation. Alternative and elective modules, to be chosen from different fields of study, enable students to develop their own interdisciplinary pathways. The aim is to foster the mobility of students and academic staff and enhance the interactions between schools and departments.

Internationalisation is also an integral part of Aalto’s strategy and degree programme reform. Students and staff are expected to acquire and demonstrate the skills and mindset that are needed to work in an internationally-orientated environment. Incoming and outgoing mobility is promoted at all levels. Double and joint Master degrees are on offer and most of the Master programmes are provided in English.

1.2.4 **Advancement of entrepreneurship culture**

The Aalto Centre for Entrepreneurship (ACE) offers entrepreneurship education to students and is responsible for activities related to technology transfer and commercialisation, intellectual property management and start-up companies. ACE hosts the Venture Garage, an independent structure
which helps develop business concepts and start-up projects developed by students, researchers and other entrepreneurs. In 2011 ACE launched an extensive partnership with Stanford Technology Ventures Program (STVP) in the US Silicon valley, with the aim to create new know-how and research regarding innovations, ventures and workplaces. The programme consists of courses and workshops for Aalto University’s entrepreneurial researchers, students as well as other personnel at Stanford University and throughout Silicon Valley. Aalto University is the first official European partner of STVP and the objective is to help build Aalto University into one of the leading entrepreneurship universities in Europe. On the Finnish side, the programme is strongly supported by the Finnish Funding Agency for Technology and Innovation (TEKES).

The university also offers minor studies and courses in entrepreneurship as part of its study programmes. In addition the university is host to the Aalto Entrepreneurship Society (Aaltoes, http://aaltoes.com/), an independent, privately funded student and post-graduate led community initiative, which was founded in 2009. The university’s aim is to encourage the creation of start-ups and it has had a significant effect in terms of spreading the entrepreneurship culture at the university. An example of activity is the “Summer of Start-up”, a 10-week summer programme targeted at students and researchers from all over the world with early-stage business ideas.

1.3 Overview of specific education initiatives: The Aalto Factories

As mentioned previously, the recent education reforms at Aalto University are primarily targeted at a reduction in the number of Bachelor degree programmes and the elaboration of interdisciplinary, innovative courses. Infrastructure is also a key component of these reforms, with various attempts to develop creative platforms, learning spaces and environments that foster the interactions between industrial innovation, research and education activities. The Aalto Factories are a good illustration of such reforms tackling the university’s structures. Three Factories have been set up in fields in which the Aalto University schools have already actively cooperated: the Design Factory, the Media Factory and the Service Factory.

The Factories are the realisation of the Aalto University’s philosophy at its best. They follow the ‘open innovation’ paradigm and are based on the idea that innovation and creative ideas often occur during informal exchange of information. Basically, the idea is to move from a cooperation model based on formal meetings and deliveries to a co-creation approach based on spontaneous and informal meetings. The design of the Factories around creative spaces that adapt to the needs of individuals is a key element in fostering these informal ‘talks around the coffee machine’ (at least for the Media and Design factories, which are hosted in dedicated buildings).

Not only are researchers, students and business enterprises actively working together, but there is also an integration of the research, innovation and education dimension inside the Factories. The Factories lead research and innovation projects involving students, companies and researchers who benefit from dedicated technologies and facilities. Additional events (such as workshops and conferences) are regularly hosted. Some study programmes and courses are also directly offered in partnership with the Factories (e.g. the interdisciplinary International Design Business Management Master study programme). As in the whole approach of the university, the education dimension has been a key driver behind the creation of the Factories, with the objective to develop an orientation of innovation and creativity in mindsets and attitudes among students. At the same time, the new knowledge produced at the Factories is transferred to the courses taught at the university.

1.3.1 The Aalto Design Factory

The Design Factory – active in the field of product design - is the pioneer of the three Factories and is the best developed model. It started with an experimental lab project supporting prototyping and the testing of new ideas between the Helsinki University of Technology and eight Finnish and international companies. The creation of Aalto University was then seen as the opportunity to extend and adjust the concept to a large-scale open university, and the Design Factory was launched in 2008 as the first Aalto Factory. It is hosted in a bespoke 3,500 square metre building. Some of the events carried out involve first-year students, but Master students are the main participants in the projects carried out in the Factory (often the students develop their final study projects at the Factory).

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The Design Factory has a staff of 26, to support the projects carried out and the interaction between students and business, while a management team of four people run the Factory. The hierarchy is minimal and the Factory’s structure is much flatter than the usual university structures.

Figure 11 Organisation of the Aalto Design Factory


The Design Factory is open 7 days a week, 24 hours a day. Openness and flexibility are key to the Factory concept and again, this is a way to encourage creativity and trust among the participants. Like the two other Factories, the Design Factory is a cross-university unit open to students from all six Aalto Schools, and interdisciplinarity is the basis of any activity. The university provides funding for, and monitoring of the Factory. Industrial partners also contribute to the annual funding and to the costs of the projects in which they are involved.

Students, researchers and companies are encouraged to adopt a collective, problem-solving approach. Between 30 and 50 companies, including international groups as well as start-ups, take an active part and some of them have office space at the Factory. All sectors are involved, though most partners come from manufacturing industry (e.g. KONE, Zeta Design). Unlike more traditional partnerships (such as competence centres and research contracts), companies do not look to create new products when working with students. They are rather driven by potential innovative ideas and concepts that can arise for their future development. Not only do enterprises benefit from students’ input, but also the Factory’s innovative set-up is a key driver for their participation. Working at the Factories encourages their R&D staff to think ‘out of the box’, as they are confronted by a non-hierarchical open innovation environment different from their traditional roles inside a structured corporation environment.

1.4 Main challenges and success factors in the approach applied by Aalto University

1.4.1 Merger and common operating models, collaborative infrastructures

As noted in the introductory paragraphs, Aalto is the result of a merger between three universities with long tradition in terms of their own teaching, research and innovation activities. A key challenge in the education reforms following the merger has been the adoption of a common operating model, which enhances interdisciplinary collaboration. Aalto’s approach to education comes alongside a rethinking
of the university’s infrastructure and buildings with a view to fostering more intensive cooperation, interaction between fields, and creativity. In this respect, the Factory approach indicates the importance of initiatives developed outside the pre-existing structures. New structures help to spread innovativeness and common approaches, and to move forward from the pre-existing fragmented education/cooperation traditions.

Physical space for co-location is also key to the Aalto Design Factory’s concept. The Factory’s approach is based on complex three-way interactions between education, innovation and research activities that require lateral thinking. These interactions can be best developed and promoted in an interactive dedicated space, i.e. outside existing departmental structures. In this respect, Aalto Factories’ independence from any pre-existing university structures is a critical requirement for their successful management and operations. However, there is a risk that their success depends on how the Factory ideas and models are adapted and used in Aalto Schools, departments and degree programmes.

Restructuring and new premises are being developed to support the creation of the university and to support the education reforms. New premises are currently being built for the School of Arts, Design and Architecture. The Library will be renovated and restructured in the form of a learning centre in order to provide better support between different disciplines and fields, while all Bachelor students will be brought together in a new Bachelor Degree Education Centre.

1.4.2 Culture and accountability

The attitudes of companies, academics and students are a critical success factor in the participative approach developed in the education and cooperation activities. Reputation, trust and an educational interest from companies are central to all partnerships. Trust is also crucial when dealing with problems such as confidentiality issues.

The Aalto model is challenging in that it promotes new roles for teachers, students and industry. Students are encouraged to take up an active role in their own learning and education and are considered both as participants of the research and innovation process and members of the university community. From mere knowledge providers, teachers become enablers and co-creators in charge of supporting students in the learning of new ideas and knowledge. Likewise, companies have to learn how to interact with students and to develop a common language and culture. The process has not always been smooth and the Factories’ approach has raised several concerns over the extent to which students can be trusted and can be reasonably involved in research and innovation activities. However, so far the results seen at the Factories are encouraging. Not only are students granted great responsibility but they are also held accountable for their attitudes and results. The model seems to be very motivating for students, who are said to spend large hours of their non-course time working at the Factories. New career models (as tenure track and lecturer career systems) and HR developments are aimed at equipping professors and researchers with the skills necessary to guide and lead students in their new role.
**Aalto Tenure Track**

Tenure track is the core academic career system of Aalto University. Aalto tenure track offers a well-supported career path aimed at the professorial level for successful academics. Tenure track is based on the principle of commitment from university and individual to an academic career; it has clearly defined expectations, incentives, and assistance in personal development. The core principles are as follows:

- **Clear and transparent rules and processes** – Clear and transparent criteria and processes for entry, support, evaluation, and promotion to reduce personal ambiguity over career advancement
- **Compensation of success** – Adequate salary and compensation to motivate people to work towards Aalto’s vision and objectives
- **Equal opportunity to succeed** – People do not compete against one another in the tenure track. Therefore, personal motivation and cooperation will flourish
- **Ensuring world-class tenure track support** – Aalto aims to create world-class tenure track support, which ensures continuous professional development, and knowledge dissemination within the organisation. To that end, Aalto has in place a mentoring system, research support, pedagogical and leadership development programmes, as well as sabbatical and junior leave

The Aalto tenure track structure consists of three basic levels. The tenure track levels are:

- Assistant Professor, (1st and 2nd term); non-tenured
- Associate Professor; tenured/non-tenured
- Full Professor; tenured

In addition, the Aalto tenure track includes an additional level of Aalto Distinguished Professor (tenured), which is reserved for Full Professors with exceptional academic merit.


### 1.4.3 Project-based cooperation

As in any kind of cooperation, companies face problems of time and resources to engage in education-centred partnerships. Flexibility is therefore crucial and short project-based cooperation, such as that carried out at the Aalto Factories, is a motivating factor for companies, which are free to decide to submit projects or to participate in specific projects proposed by the Factory. This enables companies to adopt a pro-active approach and to focus resources and time on the projects that are of specific interest for their own development. The existence of a physical co-creation platform is also key to ensure longer-term interaction and cooperation.

### 1.5 Future developments and transferability

Aalto University is a spearhead project of the Finnish university reform. Other mergers between regional universities and strategic alliances with polytechnics may follow. The Aalto approach is therefore likely to inform and inspire – at least to some extent – other academic institutions in Finland.

The Design Factory is currently being reviewed and the Design Factory 2.0 will open in October 2012. Space management is the main focus of forthcoming changes, with focus on internal mobility, flexibility and increased communication between the Factories’ participants. The main purpose is to make the many and varied activities carried out at the Factory more visible to everyone. For example, the sharing of workstations is being tried, in order to allow use by everyone and to foster cooperation between different teams.10

Internationalisation is also part of the Factories’ development process, as the Factory model has attracted a lot of interest from different higher education institutions across the globe. A Factory was set up in the Tongji University in Shanghai (China), based on the example of the Aalto Design Factory. The so-called Aalto-Tongji Design Factory (ATDF) is a physical place bringing people and activities together on the Tongji University Jiading Campus. ATDF enables the testing of the transferability of the Factory concept in a radically different culture. Likewise, the Swinburne University of Technology in Melbourne (Australia) has established a ‘Living Lab’ on product development. The Living Lab, inspired by the Aalto Factories, is a teaching unit on product development actively connected with the daily activities of partner companies. Aalto Design factory has supported the set-up of these Factories, either by providing help and support or by co-creating with the local partner. The Finnish, Chinese and

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Australian Design Factories now form a global network for exchange of experience. A fourth Factory will be launched in the Pontificia Universidad Católica de Chile in autumn 2012.

AppCampus is another upcoming initiative of note. Launched in May 2012 by Aalto University, AppCampus is a three-year mobile application development programme funded by Microsoft and Nokia (which will jointly invest up to €18m). It funds proposals from students and entrepreneurs willing to develop mobile app start-up companies. The programme is very innovative in the sense that investment in early-stage concepts is an exception in the ICT sector. Additionally, it promotes entrepreneurship among students as well as innovation-driven education activities. Aalto University was chosen as programme leader due to its reputation as a hotbed of new start-up companies and the Finnish expertise in mobile telephony. The Aalto University Centre for Entrepreneurship (ACE) is in charge of managing the programme, providing premises, coaching services, and access to both academic and business networks for budding app developers.

Last but not least, Helsinki is part of the European Institute of Innovation and Technology (EIT) ICT Labs co-location centre. The EIT ICT Labs Master School will open in September 2012 and will offer a Master degree programme dedicated to engineering with a fully standardised minor in Innovation and Entrepreneurship. The Master will be offered at the co-location centres' participating universities, which include Aalto. This is an important step forward within the Finnish context, where engineering and ICT education have not historically included a strong tradition of entrepreneurship.

1.6 Lessons learnt

The Aalto University approach fosters a direct involvement of students in innovation and research activities as well as direct interactions between research, education and innovation. The Aalto Factories have been created in the form of creative, interdisciplinary platforms where students, industry and researchers meet and develop projects together through formal and informal interactions.

Key to this approach is:

- The interdisciplinary model of the university
- Strong entrepreneurship culture among students and staff
- Significance of the university’s international linkages, which help develop new initiatives (e.g. partnership between the Aalto Center for Entrepreneurship and Stanford Technology Ventures Program) or transfer Aalto’s innovative experiments (e.g. diffusion of the Design Factory approach in China, Chile and Australia)
- The availability of a dedicated physical space outside the normal business or university infrastructure: this contributes to transforming traditional roles and working environments (yet the Aalto Factories are attached to the university and their success may ultimately be evaluated based on the adoption of factory ideas and models by Schools and departments)
- The consideration given to informal learning and transversal competences in the education of students
- A bottom-up approach in which innovative R&D/education projects and collaborations can be initiated by students, academic staff and external partners This places the emphasis on creativity at all levels and is coupled with the active involvement of faculty staff in initiating and implementing innovative education initiatives
- The flexibility of Aalto’s management model, balanced by accountability and responsibility: for example, the Aalto Design Factory is subject to an Annual Report and the decision for financial support is reviewed every year by the university’s governance

11 Website of the appcampus programme: http://www.appcampus.fi/
12 Website of the EIT ICT Lab Master school: http://eitictlabs.masterschool.eu/
1.7 Contacts, references

1.7.1 List of interviewees

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Martti Raevaara</td>
<td>Vice President of Academic Affairs (Education)</td>
<td>Aalto University</td>
</tr>
<tr>
<td>Prof. Hannu Seristö</td>
<td>Vice President of Knowledge Networks</td>
<td>Aalto University</td>
</tr>
<tr>
<td>Prof. Kalevi Ekman</td>
<td>Director of Aalto Design Factory, Professor of Machine Design at Aalto University School of Science and Technology</td>
<td>Aalto University, Aalto Design Factory</td>
</tr>
<tr>
<td>Dr. Anne Stenros</td>
<td>Design Director</td>
<td>KONE Corporation</td>
</tr>
</tbody>
</table>

1.7.2 References

- Aalto University, Aalto’s year 2010 in Review, 2011
- Aalto University, Annual Board Report and Financial Statements, 2011
- Aalto Media Factory, Highlights of the academic year 2010-2011
2 Aarhus University

2.1 Introduction

2.1.1 About Aarhus University

Aarhus University was awarded the title of ‘Denmark’s Entrepreneurial University’ in 2009 (the prize has not been awarded since). With more than 11,000 employees and 40,000 students enrolled in more than 200 degree programmes, and an annual budget of more than €800 million, Aarhus University is both a traditional and a modern European university.

Aarhus University is currently undergoing major reforms aimed at strengthening the university’s efforts to help society address the grand challenges of our time. The university aspires to be a national beacon for entrepreneurship education and one of the internationally leading universities for the development of entrepreneurship education, and thus ensure that the candidates have competences in applying their academic knowledge to create value for society. Furthermore, Aarhus University wants to be known nationally for its active collaboration with the business world in the creation of more knowledge-based progress and innovation in order to increase economic growth in Denmark, and to be known internationally for developing best practice within knowledge collaboration.

Aarhus University was established in 1928 as a small private initiative. It has since grown to become a leading public research university with international reach covering the entire research spectrum. The university is dedicated to four strategic core activities: research, talent development, knowledge exchange, and education in all fields – from the humanities to business and social sciences, and from science and technology to medicine. Aarhus University is organised in twenty-six academic departments. Research at Aarhus University is organised in traditional departments under the four faculties and in interdisciplinary research centres. In addition, Aarhus University researchers engage in research collaboration under the auspices of Knowledge Management Centres with external partners such as government organisations, private enterprises, NGOs and Aarhus University’s wide range of international partner universities.

Figure 12 Aarhus University locations in Denmark

In 2006 and 2007, Aarhus University merged with the Herning Institute of Business Administration and Technology, the National Environmental Research Institute, the Danish Institute of Agricultural Sciences, the Aarhus School of Business and the Danish University of Education. In 2012, Aarhus University merged with Aarhus School of Engineering: this has added diversity to the university in the form of new subjects, tasks, staff, students, structure and geographical locations.

Today, Aarhus University has operations in more than 20 locations all over Denmark, with the activities in the city of Aarhus being by far the most comprehensive. The main campus is located in...
Aarhus and, over the years, close and productive collaboration has developed between the city and its educational institutions – a collaboration that is also supported by the regional authorities. Aarhus ranks as one of Europe’s best cities in which to study, and the city emphasises the importance of its educational institutions, especially the University.

The University of Aarhus operates within a regulatory framework laid down in the Danish University Act complemented by a development contract between the University and the Danish Ministry of Science, Innovation and Higher Education.

This contract defines a number of strategic objectives for the university’s four core areas – research, education, communication of research results and knowledge sharing – and for its collaboration with society at large. Among other things, the development contract states that the university wants to strengthen its formal collaboration with both private and public institutions and to make an important contribution to the development of society.

**Figure 13 Key figures, students (1), 2003-2010**

<table>
<thead>
<tr>
<th></th>
<th>Humanities (2)</th>
<th>Health Sciences</th>
<th>Social Sciences (3)</th>
<th>Science</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor</td>
<td>5,799</td>
<td>1,516</td>
<td>6,573</td>
<td>2,576</td>
<td>16,464</td>
</tr>
<tr>
<td>Master</td>
<td>7,825</td>
<td>1,518</td>
<td>4,729</td>
<td>1,548</td>
<td>15,620</td>
</tr>
<tr>
<td>PhD</td>
<td>348</td>
<td>570</td>
<td>212</td>
<td>692</td>
<td>1,822</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>220</td>
<td>-</td>
<td>-</td>
<td>220</td>
</tr>
<tr>
<td>Full-time, total</td>
<td>13,972</td>
<td>3,824</td>
<td>11,514</td>
<td>4,816</td>
<td>34,126</td>
</tr>
<tr>
<td>Part-time (4)</td>
<td>1,023</td>
<td>118</td>
<td>2,405</td>
<td>362</td>
<td>3,908</td>
</tr>
<tr>
<td>Student total</td>
<td>14,995</td>
<td>3,942</td>
<td>13,919</td>
<td>5,178</td>
<td>38,034</td>
</tr>
</tbody>
</table>

Source: Aarhus University. 1) Converts to full-time students; 2) Including Art at Business and Social Sciences; 3) Excluding Arts at Business and Social Sciences; 4) Part-time Master etc.

**Figure 14 Key figures, staff and research, 2003-2010**

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total full-time staff</td>
<td>5,754</td>
<td>5,905</td>
<td>5,887</td>
<td>5,895</td>
<td>6,216</td>
<td>6,568</td>
<td>6,876</td>
<td>7,192</td>
</tr>
<tr>
<td>No. of PhD degrees</td>
<td>192</td>
<td>209</td>
<td>209</td>
<td>227</td>
<td>245</td>
<td>257</td>
<td>260</td>
<td>329</td>
</tr>
<tr>
<td>No. of Doctorates</td>
<td>20</td>
<td>18</td>
<td>23</td>
<td>16</td>
<td>16</td>
<td>8</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>No. of publications</td>
<td>9,138</td>
<td>8,701</td>
<td>10,601</td>
<td>10,061</td>
<td>11,331</td>
<td>11,731</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Aarhus University

**Figure 15 Budget 2006-2012 (EUR million, about 70% state funded)**

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget</td>
<td>392</td>
<td>643</td>
<td>693</td>
<td>733</td>
<td>761</td>
<td>803</td>
<td>826</td>
</tr>
</tbody>
</table>

Source: Aarhus University

**Figure 16 Research Funds subject to competition, EUR million**

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research councils and public foundations</td>
<td>116</td>
<td>121</td>
</tr>
<tr>
<td>EU framework programmes</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Danish and foreign foundations and companies</td>
<td>54</td>
<td>63</td>
</tr>
<tr>
<td>Competitive research funding, total</td>
<td>182</td>
<td>197</td>
</tr>
</tbody>
</table>

Source: Aarhus University
2.1.2 Top ranking university

Aarhus University’s research is widely acknowledged within the international research community. During the last decade, the university has consolidated its position as one of the world’s top-ranked universities with a very high research impact and several research areas belonging to the world elite. Aarhus University has produced two Nobel Prize Laureates in the past fifteen years and is currently ranked in the worldwide top 100 by leading university rankings as shown below.

Figure 17 Aarhus University’s rank

<table>
<thead>
<tr>
<th>Name of index</th>
<th>Rank of Aarhus University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leiden</td>
<td>51 (2011)*</td>
</tr>
<tr>
<td>QS World University Ranking</td>
<td>79 (2011)</td>
</tr>
<tr>
<td>ARWU – Shanghai</td>
<td>86 (2011)</td>
</tr>
<tr>
<td>HEEACT – Taiwan</td>
<td>96 (2011)</td>
</tr>
<tr>
<td>Times Higher Education World University Ranking</td>
<td>125 (2011)</td>
</tr>
</tbody>
</table>

*among the 100 largest universities in the world. Source: Aarhus University

2.2 Drivers of the education model

2.2.1 Aarhus University in transition - a more coherent university

According to Aarhus University, new times mean new demands from the world around universities, and Aarhus University intends to adapt to these. The mission of the University of Aarhus is to develop knowledge, welfare and culture through research and research-based education, knowledge dissemination and external advice. This mission implies that Aarhus University has a great focus on solving great global challenges such as the climate, energy, security, health and economy via interdisciplinary solutions created on a platform of excellent core competences.

Mission, vision and values

The mission of the University of Aarhus is to develop knowledge, welfare and culture through research and research-based education, knowledge dissemination and external advice.

The vision of the University of Aarhus is to belong to the elite of universities and to contribute to the development of national and global welfare.

The values of the University of Aarhus are based on the ethical ideals of freedom and independence that are described in the Magna Charta of the European Universities. Staff and students at the University of Aarhus work enquiringly and critically, in open and dynamic interaction with the surrounding world.

Source: Aarhus University, Strategy 2008-2012 Quality and diversity

Charged with these statements Aarhus University is undergoing the most significant organisational change in its history. The aim is to create a university that combines in-depth professional competence with interdisciplinary collaboration, in close and flexible interaction with the surrounding community.

Since the university reform in Denmark accompanying the mergers in 2007 at Aarhus University, the university has striven to create a coherent institution. Aarhus University, like many other European universities, comes from the Humboldtian tradition, combining research and education at the highest level. Aarhus University has developed this tradition, and its leadership considers identification and development of research talents and exchange of knowledge as absolute core responsibilities. In this sense, Aarhus University describes itself as a modern ‘quadruple helix’-university that aims to be able to provide flexible and customised contributions to the society, extending its activities to all sections of society and cutting across the university’s four core activities:

- Excellent research
- Focused talent development
- Inspiring consultancy and knowledge transfer
- World-class education and knowledge dissemination
Education in the knowledge triangle

Figure 18 The development of the quadruple helix

Source: Aarhus University, Rector Lauritz B. Holm-Nielsen, presentation February, 2011

Based on the identification of these four core areas of activity, Aarhus University has developed a strategy and implemented an organisational change. The strategy document, ‘Strategy 2008–2012 – Quality and Diversity’ has been a significant response to the extensive fusion in 2007. At the same time, the strategy has been an important framework for organisational change at the Aarhus University. The organisational changes implied internal mergers to create fewer units in order to diminish internal barriers and offer a better framework for interdisciplinary initiatives.

Figure 19 New management structure for Aarhus University

Source: Aarhus University, Rector Lauritz B. Holm-Nielsen: presentation February, 2011
The change consists of four overall dimensions, all of which are intended to strengthen the university's academic development and quality: interdisciplinary centres and forums, organisation, management, and finance and administration:

- **Academic organisation:** a unified university with fewer internal boundaries. From nine to four main academic areas, from 55 to 26 departments
- **Governance:** management with appointed leaders and joint responsibility for the entire university. From ten management units to a senior leadership team with cross-cutting responsibility for strategic management and quality assurance
- **Administration and finance:** a single university with an integrated administration. A common financial model, standardised quality service for the whole university; from three to one (two) levels of administration – front office and back office philosophy
- **Academic checks and balances:** one academic council per faculty (main academic area), and 4 AU Fora, one for each core activity: research, talent development, knowledge exchange and education

### 2.3 The university of entrepreneurship

As mentioned before, Aarhus University has been designated Denmark’s University of entrepreneurship, though it has an untraditional focus on entrepreneurship. Where most universities are focused on business development and development of business plans, Aarhus University puts focus on individual students and developing their human resources and capacity to acquire an innovative and value creating set of mind.

The following characterises the university's work on entrepreneurship:

- Aarhus University has a strategy for entrepreneurship, which is closely linked with the university's overall strategy
- Entrepreneurship is a high priority in the university's top management
- The university has established a special unit, the **Centre for Entrepreneurship**, which on a research basis contributes to drive and develop the university's activities and strategy for entrepreneurship
- All the students at the university have the opportunity to participate in entrepreneurship activities and courses. This applies at the graduate level and postgraduate level

#### 2.3.1 Independent critical thinking

Teaching and learning at Aarhus University is mainly structured around lectures, seminars, practical exercises and group work. Students are expected to actively participate in academic discussions during class. Collaboration is an integral part of studying at Aarhus University, so students are highly encouraged to join or create a study group as soon as the semester begins. In some cases, students may be automatically assigned a study group.

The University is ‘top-heavy’ in the sense that the majority of students are post-graduate students enrolled in Master's and PhD programmes. In all the degree programmes, research and education are closely linked to ensure depth, quality, and content that reflect the latest scientific developments.

Aarhus University is the only Danish university to have been awarded the ECTS label (European Credit Transfer System) by the European Commission. Moreover, Aarhus University has been FAFSA certified (Free Application for Federal Student Aid) by the US Department of Education.

#### 2.3.2 Talent development

One of Aarhus University’s focus areas is talent development, an activity considered so important that it is singled out as one of the four core activities in the Aarhus University strategy. As the development and nurturing of research talent is part of that core activity the university is committed to the provision of opportunities for an ever-increasing number of highly-qualified, early career researchers.

More than 60 per cent of students are enrolled at postgraduate level, and the university consistently focuses on recruiting talented international students and early career researchers. Moreover, the university is well on its way to doubling enrolments on its doctoral programmes and to fulfilling its aim of 2,000 PhD students in 2012. Developing research talent and recruiting early career researchers
ensures the universities a base of highly qualified researchers. At the same time it ensures that businesses are able to move up the value chain and provides society at large with the skills necessary to tackle global issues.

Figure 20 Number of PhD students 2008-2010

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newly enrolled PhD Students</td>
<td>481</td>
<td>475</td>
<td>574</td>
</tr>
<tr>
<td>Enrolled PhD students:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arts</td>
<td>265</td>
<td>294</td>
<td>337</td>
</tr>
<tr>
<td>Science and Technology</td>
<td>491</td>
<td>604</td>
<td>692</td>
</tr>
<tr>
<td>Health</td>
<td>473</td>
<td>504</td>
<td>570</td>
</tr>
<tr>
<td>Business and social Sciences</td>
<td>201</td>
<td>208</td>
<td>223</td>
</tr>
<tr>
<td>PhD students, total</td>
<td>1,430</td>
<td>1,610</td>
<td>1,822</td>
</tr>
</tbody>
</table>

Source: Aarhus University

### 2.3.3 New interdisciplinary research centres

A characteristic of Aarhus University is the significant effort made to develop interdisciplinary research programmes. Aarhus University continuously strives to combine research in new ways. In connection with the reform of Aarhus University, a number of interdisciplinary research centres are being established, which are all involved in at least two and preferably three of the university’s four core activities: research, talent development, knowledge exchange and education. These centres will also comprise activities within two or more of the main academic areas.

Aarhus University believes that research deeply rooted in traditional disciplines is a prerequisite for successful interdisciplinary collaboration. Committed focus on interdisciplinarity which is firmly rooted in basic research has led to new and groundbreaking insights in areas such as sustainability, psychology, economics, the neurosciences, nanoscience and energy research.

The interdisciplinary centres at Aarhus University have:

- An interdisciplinary approach exploiting potential synergies across the university’s main academic areas
- A project portfolio covering at least two – and preferably three – of the university’s core areas: research, talent development, knowledge exchange and education
- An aim of research excellence
- The possibility of attracting considerable external funding
- A considerable volume on a par with departments (and potential to develop into a department)
- A head who is an outstanding researcher and possesses the necessary managerial qualifications

**Examples: MINDLab and iNano**

One example is the MINDLab which is funded by a grant of €16million by the Danish Ministry of Science, Technology and Innovation. In MINDLab, neuroscientists, psychologists, anthropologists, biologists, and statisticians work alongside scholars from business science, religious science, music and many other fields in an effort to understand the brain, its order/disorder and its development through physical and social interactions. By placing different fields of inquiry in close collaboration, creating structured information systems, making state-of-the-art equipment available and in other ways facilitating multidisciplinary knowledge sharing, MINDLab has produced ground-breaking new insights.

Another example is the Interdisciplinary Nanoscience Centre (iNano), which was established in 2002 by a small seed grant of €500,000 bringing some of the universities young minds together. iNano has since then undergone radical development. The aim of iNano is to foster interdisciplinary research within the fields of nanoscience and nanotechnology, and actively promote synergistic
interactions that overcome traditional scientific boundaries. In essence, iNano provides an interdisciplinary framework in which expertise in physics, chemistry, molecular biology, engineering, and medicine is combined to create cutting-edge science of international stature. In 2012, iNano will move into a brand new 10,000m² building.

2.3.4 Innovation and collaboration with industrial partners

Aarhus University collaborates closely with many industrial partners. This provides access to professional expertise developed outside the academic world and opens up new possibilities for research funding. By collaborating with Aarhus University, industrial partners gain access to high-capacity research environments, state-of-the-art laboratories as well as talented young researchers and students.

AU Centre for Entrepreneurship & Innovation is considered to be a leading centre for knowledge collaboration with SMEs. It not only facilitates the collaboration process but the centre also experiments with new methods for bringing research based knowledge into the working practice of public organisation and private businesses.

The Technology Transfer Office at Aarhus University serves to increase the scope of technology transfer and research-based innovation between the university and the business community. The Technology Transfer Office assists in contract development, patentable inventions and files for protection of intellectual property rights. It coordinates the further development and marketing of technologies, negotiates licence agreements and administrates active patents and agreements. The office maintains a strategic partnership with the MedTech Innovation Centre (MTI C) creating one of Europe's strongest innovation environments by combining legal and commercial competencies.

If a company wishes to collaborate with Aarhus University, but does not have a specific research collaboration in mind, there is a number of other options that the Business Liaison Office facilitates. Examples of such collaboration include:

- Participation in after-work meetings where a university staff member presents a specific subject
- Networks where researchers and companies share knowledge
- Companies hosting PhD students as part of the Industrial PhD Initiative
- Identification of researchers for collaboration within a field of interest of a specific company
- Companies hosting students in internships or collaborating with students on the students’ projects
- Customised continuing education courses for staff in companies

2.3.5 International collaboration

International collaboration is an integrated part of all activities at Aarhus University. Aarhus University has a long-standing tradition of partnering with some of the world’s best research institutions and university networks. The university has seen a considerable rise in the level of international mobility among staff and students. Aarhus University strongly supports mobility and is committed to contribute to increasing the mobility of staff and students. The number of international students and young researchers at Aarhus University has grown significantly. In 2005 international students made up 6 per cent of the student body; by 2009, 13 per cent of the student body was international. In the same period, the proportion of international PhD students at AU more than doubled and today one in every five PhD students is international.

Figure 21 International students and exchange students

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>International students in complete degree programmes</td>
<td>2,917</td>
<td>3,188</td>
</tr>
<tr>
<td>Total, including incoming exchange students</td>
<td>4,000</td>
<td>4,443</td>
</tr>
<tr>
<td>Exchange students, incoming</td>
<td>1,083</td>
<td>1,255</td>
</tr>
</tbody>
</table>
2.4 Overview of specific education initiatives

2.4.1 AU Centre for Entrepreneurship & Innovation (AU CEI)

For Aarhus University it is important that students acquire entrepreneurial skills during their study and leave the university with the tools necessary to create their own business. The university has pioneered the 'Entrepreneurial University' and created a Centre for Entrepreneurship & Innovation and an incubator service where students can develop and implement their business plans. Several years ago, the County of Aarhus took the initiative to offer courses in entrepreneurship to university students. AU CEI was subsequently established as an interdisciplinary initiative between Aarhus University, the County of Aarhus and the Municipality of Aarhus.

Today AU CEI constitutes a knowledge centre that services all the academic fields of the university, with a function to build bridges between the theoretical research and its application in society. AU CEI is also a competence centre for entrepreneurship teaching at Aarhus University. One of the centre’s main focuses is that the students acquire the ability to act as well as value-adding competences by applying their academic knowledge. The centre is both a service unit and a development unit for the academic fields at Aarhus University. It is able to assist in the development of activities that can strengthen the university’s collaboration with public and private companies, trade associations, organisations etc. Furthermore, AU Centre for Entrepreneurship and Innovation manages a number of externally financed projects, whose common denominator is to support knowledge collaboration between research and businesses.

2.4.2 Student Incubator

The Student Incubator at Aarhus University aims to assist in the establishment of innovative and viable businesses, and is open to all students in bachelor’s or master’s degree programmes in Aarhus who would like to pursue entrepreneurship based in their own academic field. The idea is to create a dynamic environment, which through creativity, interdisciplinarity and drive will frame radical innovation. At the same time Aarhus University wants to show that entrepreneurship is about value creation, and that innovative opportunities exist in all fields. Studies show that entrepreneurs working in teams and networks accomplish more than entrepreneurs working alone. Generally speaking, the Student Incubator works on strengthening the students’ enterprise activity, enabling them to create value to themselves and society. Students get free access to and help with: starting own business; developing a business idea; identifying partners, sponsors, and clients; access to a work place in a professional office environment; and access to coaching and consultancy.

2.4.3 Talent development - members of staff

At most universities, PhD students are considered the oldest – at Aarhus University, the PhD students are among the youngest members of staff. Young researchers thus enjoy highly attractive conditions: they participate in staff meetings, earn an attractive salary and are entitled to pensions and parental and other benefits. Young researchers at Aarhus University enjoy supervised research training that
enables them to perform high-quality research. In addition to state-of-the-art facilities and laboratories, a research-based approach to all activities, dynamic study environments and a strong tradition of interdisciplinary research make Aarhus University an attractive place to launch a research career.

2.4.4 Pioneering flexible PhD programmes

Aarhus University is developing flexible PhD frameworks, allowing young researchers to embark on a research career once they are ready to do so. Traditional European PhD programmes after Master’s level are combined with attractive five and four-year PhD programmes that can be accessed either one year into the Master’s programme (the 4+4 model) or immediately after the Bachelor’s degree (the 3+5 model). These flexible models and the fact that all programmes are delivered in English have led to a significant rise in the number of PhD students at Aarhus University and have enabled the university to recruit top talents from Denmark and abroad. Today, international students account for one in five PhD students at Aarhus University. Established researchers at Aarhus University have a particular responsibility for sharing knowledge and experience with the next generation of researchers. Young researchers benefit from participating in strong academic networks, and Aarhus University is committed to providing them with global competencies through mobility and collaboration with international colleagues.

2.4.5 Internationalisation of science and education

To strengthen the international profile of the university, Aarhus University launched an internationalisation strategy 2009-2013. Aarhus University’s internationalisation strategy sets goals for the international activities of the university until 2013 and identifies the main objectives which these activities are intended to further. International involvement is anchored in the activities of the university’s nine main academic areas, while the university’s common administrative system plays a coordinating role, guaranteeing the effectiveness and visibility of concrete initiatives as well as the optimal utilisation of resources. Ultimately, the university’s goal is to create the best possible environment for welcoming international students and guest researchers and for helping to make them – and in many instances their families – an integrated part of the community.

Aarhus University wishes to strengthen its position as a leading and attractive international university by recruiting the best scholars and students from Denmark and abroad. This is partly done through the graduate schools and through the International Centre, a professional unit which caters for the growing number of international scholars and students in and outside Aarhus University. The International Centre is housed in the Dale T. Mortensen Building, named after the 2010 Northwestern University’s Nobel Laureate in Economic Sciences. The building is also home to the university’s PhD House and the IC Dormitory. The building, which also hosts the cozy Dale’s Café, serves as a meeting place for PhD students and a venue for international activities at the university.

From application to departure

At Aarhus University, international scholars and students are fully serviced from the time they apply to when they leave Aarhus University. The International Centre offers a full range of services to make the transition to Aarhus University as smooth as possible. The International Centre has three support units – staff mobility, student mobility and housing services. The centre assists students and researchers from abroad in all practical matters, including accommodation, visas, residence and work permits, childcare etc. Once arrived, the staff and student mobility units arrange social events and information sessions.

Aarhus University welcomes strategic partnerships and alliances at all levels. The university’s researchers participate in numerous international networks, personal alliances and research partnerships based on mutual interests and trust. As part of the Erasmus programme, Aarhus University engages in student exchange with partner universities in Europe, and collaborates closely with other Nordic countries as part of the Nordplus programme for student exchange. In addition, Aarhus University has exchange agreements with a large selected group of universities overseas.

Aarhus University participates in networks and activities that provide access to strong academic environments in other parts of the world covering geographical areas that are expected to develop into key knowledge regions. Notable among the institutional networks is the Coimbra Group of European Universities. Founded in 1985 and formally constituted by Charter in 1987, the Coimbra Group is an association of long-established European multidisciplinary universities of high international standard.
Other strategic alliances are the Utrecht Network, Euroscience, the Nordic University Association (NUS), the Southern African-Nordic Centre (SANORD), the Nordic Centre at Fudan University in China and the Nordic Centre in India (NCI). In collaboration with other Danish universities, Aarhus University is taking part in the establishment of the Sino-Danish Centre (SDC) for Education and Research at the Graduate University of the Chinese Academy of Sciences in Beijing.

2.5 Key success and enabling factors in the approach applied by AU

Nationally, the universities in Denmark have in the task of fulfilling the government's ambitious goals within the area of research and education. The Danish government has a target of 60 per cent of all young people completing a programme of higher education and 25 per cent of all young people completing a long-cycle programme of higher education. These goals are directly in line with the Aarhus University's own objectives. The University has in recent years increased inclusion of students significantly and simultaneously lowered the dropout rate in education.

The new strategy at Aarhus University put emphasis on the following goals:

- **Education**: the creation of a more flexible inner education market, making it easier to exchange and develop degree programmes, courses and teaching activities cutting across the main academic areas, departments and centres. This will make it correspondingly easier for students to combine their basic studies with perspectives from other fields. Ultimately, society will be able to welcome graduates who understand how to think and behave in an interdisciplinary way, with a sound basis in their core competences.

- **Talent development**: Aarhus University will be able to offer talented researchers the best possible conditions in future for interdisciplinary research and collaboration with leading researchers in relevant fields. The result will be a new generation of researchers born into an interdisciplinary way of thinking, based on their own excellent core competences.

- **Research**: In the area of research, Aarhus University will invest in more interdisciplinary centres from now on. These will combine knowledge from different fields, composed according to the needs of society or in response to a specific scientific issue that cannot be resolved on the basis of a narrowly defined academic perspective.

- **Knowledge exchange**: Aarhus University will take actions that will enable the university to take flexible action and respond to specific needs from external parties regarding knowledge and solutions within specific interdisciplinary themes. Aarhus University will to an even greater extent share its knowledge with public authorities, private companies, politicians and the general public to raise the level of knowledge and to qualify the basis for decision-making in all sectors of society.

Aarhus University Development Contract 2012–2014 has now been signed by the Chairman of the Board and the Danish Ministry of Science, Innovation and Higher Education. The Development Contract is based on seven goals and describes the level of ambition for Aarhus University in the coming years. The development contract for the three year period has to be seen in the light of the strategy plan of the university that describes the overall priorities and focus areas of Aarhus University, and the financial framework that is expected to apply to Aarhus University during the contract period. The goals in the development contract are covering areas such as quality of education, greater consistency in the education system, faster study completion, increased capacity for innovation, quality in research, talent and contribution to global solutions to global challenges. The goals are based on the following indicators:

- Student satisfaction of their studies
- Unemployment figures for the Master's degree graduates from Aarhus University
- Coherence between university and secondary schools
- Recruitment of undergraduate students from other universities and educational institutions
- ECTS credits earned by students at AU sums University admitted to full-time study at a Danish university
- Completion time for students at the undergraduate and graduate
Education in the knowledge triangle

• The scope of economic cooperation between Aarhus University and the wider community, for example businesses
• The economic scope of continuing education
• Aarhus University's research impact in the international research
• External international funding
• Doctorate holders Unemployment figures
• Funding of interdisciplinary centres at Aarhus University

2.6 Main barriers and potential solutions

The organisational change towards a quadruple helix university and to being Denmark's university of entrepreneurship is the most comprehensive transformation in the history of the university. This transition has involved both a major management focus – i.e. a top-down approach – and a bottom-up approach based on individual researchers and the academic environments at the university. The transition process has been through several steps and will continue. Until now, the university has placed great emphasis on an academic development process that has constituted a framework for synergy between the academic environments and institutions. In future, work is continuing with a full implementation of the university's strategy.

Figure 23 Timeline for organisational change

Source: Aarhus University, Presentation March 2012 by Rector Lauritz B. Holm-Nielsen

A major challenge in the transformation process has been that many of the strategy's core elements cannot be funded by the university's base funding from the Danish Ministry of Science, Innovation and Higher Education. This base funding has primarily funded the daily operations at the university and has not been directed at development of new activities such as knowledge collaboration with industry, work on entrepreneurship and interdisciplinary collaboration.

Additionally, there have been cultural challenges to get an original traditional university like Aarhus University to transform. The transformation has required a culture change internally at the university's institutes and is an area where work is continuing.

Several factors have helped to break down barriers in connection with the university's transformation. First of all, the process has from the very beginning been a top-level priority by the university's management and board. Secondly, the changes were supported by a comprehensive organisational change where interdisciplinary collaboration has been done as part of university culture. Thirdly, an independent organisation - the AU Centre for Entrepreneurship & Innovation - has been established and has helped to support the process towards the entrepreneurial university.

2.7 Lessons learnt and recommendations

2.7.1 Lessons learnt:

• Aarhus University is using the concept of “strengthening the knowledge triangle” as a way to raise its profile as a leading European research university
Education in the knowledge triangle

- National environment, such as pressure from the Danish Government to fulfil national goals as well as the explicit strategy of the University itself drive the University and its leadership to carry out comprehensive organisational changes, including administrative as well as academic integration, and to put an increased focus on the development of academic talent
- Matrix organisational models provide a way to combine more traditional education and research activities with new emerging cross disciplinary approaches. In this case research and education are organised in four academic faculties structured along traditional academic departments but also interdisciplinary and inter-departmental research centres
- A mechanism for strengthening creative and innovative culture within a university is to create a dedicated organisational unit, such as the establishment of the AU Centre for Entrepreneurship and Innovation shows
- Aarhus University believes that research deeply rooted in traditional disciplines is a prerequisite for successful interdisciplinary collaboration. Against this background, talent development is one of the four priority pillars in the strategy, which is implemented by flexible PhD programmes for example

2.7.2 Recommendations:

- To achieve successful implementation of the strategy, it is important to have a dedicated management and to involve the whole organisation in the processes. This means involvement not just at the level of the central management of the university, but also management at the lower levels, such as the management of faculties, research centres and departments
- If universities are to develop transferable knowledge, it is essential to have the right incentive and funding structures to put in place both at national and regional level. This is valid for core funding as well as dedicated research funding through competitive mechanisms e.g. research councils

2.7.3 Transferability of the approach:

- Several features of the Aarhus University approach may be transferred and applied elsewhere as follows:
  - Establishment of a Centre for Entrepreneurship and Innovation dedicated to development an innovation culture at the university
  - Creation of flexible PhD and talent programmes in which young scientists and students are trained from early in their study career to become leading scientists and scholars
  - Creation of a strategy for internationalisation in order to open up education and research towards globalisation
  - A strong focus on excellent research and interdisciplinary centres

2.8 Contacts, references

2.8.1 List of interviewees

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<tr>
<th>Name</th>
<th>Position</th>
<th>Organisation</th>
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<tr>
<td>Flemming K. Fink</td>
<td>Centre Director</td>
<td>AU Centre for Entrepreneurship &amp; Innovation</td>
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</table>

2.8.2 References

- Development contract 2012-2014 – Aarhus University. www.au.dk
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Strategy 2008-2012 – Quality and Diversity, Aarhus University 2008

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3.1 Introduction

Chalmers University of Technology dates back to a charitable donation in the early 19th century by William Chalmers, a director of the Swedish East India Company. The institution began as an industrial school, then became a governmental university with the authority to award doctoral degrees in 1937. In 1994, in order to gain greater flexibility and independence, Chalmers became a private university, governed by a foundation. From its inception, Chalmers has had strong connections with industry.

3.1.1 Regional and national framework

Chalmers University of Technology is situated in Gothenburg, Sweden’s second largest city with 500,000 inhabitants. A recent ‘benchmarking for growth prospects’ survey by the international consulting firm BAK Basel in 119 European regions, including Gothenburg, found that:

- Gothenburg was among the 20 fastest growing regions in the 2000s
- Gothenburg appears in the top 30 in terms of productivity (GDP per capita)
- Gothenburg is ranked 5th for future growth potential

As a dedicated university of technology Chalmers has one faculty, the Faculty of Technology, of which there are 17 departments, and approximately 11,000 students, including doctoral students.

Undergraduates have a choice of courses in engineering, marine engineering and architecture in seven disciplines, while there are Master programmes in the following areas: architecture and civil engineering; computer science and engineering and electrical engineering; engineering physics and mathematics; biotechnology and chemical engineering; mechanical, automation and industrial design engineering; engineering for sustainable development; and management of innovation and technology.

The university employs 2,493 people, of whom 1,751 are teaching and research staff. Chalmers is located on two campuses in the city of Gothenburg, at Johanneberg and Lindholmen.

Chalmers University of Technology has a strong research focus which has produced more than 1,900 peer reviewed scientific articles and conference contributions. Approximately 40 per cent of Sweden’s graduate engineers and architects are educated at Chalmers.

3.1.2 Governance

Chalmers University of Technology is a private university, owned by the Chalmers University of Technology Foundation. The Foundation bears ultimate responsibility for guaranteeing that the University discharges its undertakings to the state and other key parties. The work of the Foundation is funded through its own assets. The ownership role of the foundation also includes appointing the university board, while there are members appointed by the Swedish government (4 to 8 seats); the departments appoint one member, the student union appoints one member and the president is a member ex-officio.

The university top management consists of the President and chief executive officer with overall responsibility for Chalmers University of Technology. The First Vice President and deputy executive officer serves as the president's deputy and is responsible for planning, development, resource allocation and the assessment of Chalmers departments and library. Additionally there are also five Vice Presidents with different areas of responsibility.

The relationship with the state is now based on agreements instead of public law regulation, which applies to state universities and colleges. There is, however, a certain degree of public law legislation that also applies to a foundation university such as Chalmers. This includes the right-of-access principle, procurement rules, examination rights and equal treatment of students.
3.2 Strategies and support system for the knowledge triangle

3.2.1 Dedicated governance system

Following a radical review some 5 years ago, Chalmers organised its 17 departments in so-called ‘Areas of Advance’, with the intention of better integrating education, research and innovation - the knowledge triangle - in the activities of the university. The Areas of Advance are seen as a focus for collaboration across disciplinary boundaries and with external actors.

The mission of the Areas of Advance is to create a unique integration of the knowledge triangle; research, innovation and education by including a new dimension to the existing organisation. Through this strategic instrument we are able to concentrate, visualize and advance our scientific excellence by bridging gaps and accelerating the interplay between academia, industry and society, as well as within our own environment at Chalmers.

Source: Chalmers University of Technology Roadmap of Scientific Excellence

The eight Areas of Advance are: Built Environment; Energy; Life Sciences; Material Sciences; Nanoscience and Nanotechnology; Production; Transport and Strengths and driving forces. The eight Areas of Advance are the universities main processes to support the prerequisites for education, research and innovation so that the departments can focus fully on their subjects.

This new dimension creates a virtual matrix organisation and enables a powerful way to work with an operational bottom-up process combined with a strategic top-down approach. The Areas of Advance offer platforms for interdisciplinary research and networks that adds to the basic research performed within departments. The Areas of Advance can thereby provide powerful meeting places over boundaries and a challenge for new interdisciplinary research. The research organised in excellence profiles makes it possible to address urgent issues within areas such as energy, health and sustainability by involving the requisite mix of disciplines to meet the demands.

Optimising the opportunities offered by the Areas of Advance, covering all infrastructures and interdisciplinary centres of excellence, Chalmers approaches the adoption of the knowledge triangle in practice.

3.2.2 Innovation support

Chalmers has a well-developed innovation support system, which helps researchers to discover opportunities for development within their own research, convert ideas into business and takes care of patents and other intellectual property rights. The innovation system meets all dimensions of the Areas of Advance from scientists to competence centres and more long-term collaborations with actors from academia, research institutes, industry and society. The comprehensive system provides the opportunity to bring research results into use in society and industry in an effective way.

Innovationskontor Väst (Innovation Office West), part of the Chalmers innovation system, provides support to individual researchers and research groups in matters regarding innovation, utilisation of research and its results. Innovationskontor Väst is one of eight Offices for Innovation in Sweden, and was founded by Chalmers in 2010 on behalf of the Ministry of Education and Research. The objective of these Offices for Innovation is to facilitate the efforts of universities in taking a greater role in the utilisation of research. The Office provides advice on how to navigate the innovation system, and assists in channelling support offered by others. Such support includes guidance on utilisation in many different forms, including commercialisation, patenting and licensing, and research collaboration.

In addition to providing assistance to Chalmers’ research activities, the Office has been assigned the task of supporting other universities in the region through innovation advisers based at each university. Consequently, Chalmers has opted to form a partnership with a further seven universities: University of Gothenburg, University West, University of Skövde, SLU Skara, University of Borås, Jönköping University and Halmstad University.

The activities of Innovationskontor Väst are informed by the wide range of tasks set out by the Ministry of Education and Research, in which commercialisation is only one of many efforts to facilitate the exploitation of research.

In addition to the Innovation Office West, there are many other elements of the Chalmers innovation system, such as Chalmers Invest and Chalmers Innovation, all with the aim of bringing research results into use in society and industry in an effective way.
The 'Academic Innovation Management' is used as point of departure including the cultivation of innovation capabilities and managing intellectual assets. This is achieved through a focus on developing a knowledge base, tools and various forms of support. The support is aimed at individual researchers, research groups and centres as well as university management.

3.2.3 Campus - a meeting point

Investments are being made on the two Chalmers campuses that are aimed at promoting greater interaction between academia, industry and the community. The Johanneberg Campus is located in the centre of Gothenburg and is an important part of the urban landscape. The Lindholmen Campus is in the expanding Norra Älvstranden area, an attractive location characterised by creativity, dynamism, knowledge and culture. Both campuses are located near the university’s science parks and there are also many knowledge-based companies on the campus areas.

3.3 Collaboration with external partners

Chalmers has a long history of collaborating with industry, and the Priority Operational Development Plan for 2012-2016 highlights the importance of collaboration with partners from other sectors as well both nationally and internationally.

"Collaboration with other universities, as well as private and public actors, is to expand from a local scale to the international arena. Greater local collaboration with the University of Gothenburg – within mathematics, computer science, information technology, physics, chemistry, life science and parts of innovation science, as well as education science – is important to further strengthen research settings in Gothenburg. Collaboration in the region should strengthen integration of education, research and innovation, such as through Chalmers's hosting of Innovationskontor Väst (Innovation Office West) and Chalmers's contribution to the dialogue group’s3 identified clusters of strength in West Sweden (Life science/Östergötland, Bio-based products/Green chemistry, Transport solutions, Marine and maritime, Urban future). Projects launched through Chalmers's Areas of Advance give us the opportunity to be highly proactive in developing regional clusters of strength in which academia, industry and the public sector jointly, though in their various roles, visualise ways that our part of the world can contribute and be attractive.” Source: 2011/663 Priority Operational Development 2012-2016., Original text adopted by the President on 26 September 2011. English version released on 10 November 2011

3.3.1 Strategic cooperation agreements with industry

Chalmers has longstanding strategic cooperation agreements with the industrial sector. According to Vice-Chancellor Karin Markides many companies and regions turn to Chalmers for partnerships, but it is for Chalmers to choose with whom to collaborate. It is an important strategic choice for the university. Over the last year Chalmers has worked with connecting these cooperation agreements with the Areas of Advance. The cooperation agreements are of long-term and should address questions as how industry and university collaborate within research, how competence can best be supplied to industry and how industry can get access to the universities physical environments, infrastructure and innovation system. Strategic cooperation agreements are signed with, among others, Ericsson, AB Volvo, Saab AB and SKF.

3.3.2 Science parks

There are today three science parks at Chalmers, described on the university’s website as: 'Johanneberg Science Park, Lindholmen Science Park and Sahlgrenska Science Park. The science parks combine companies' knowhow and innovative drive with academic expertise. A characteristic of Chalmers science park environments is that they offer more than mere accommodation. They offer their companies close proximity to a high-tech intellectual environment with research on the technical front and with up-to-date engineering expertise that can be recruited. They also offer qualified Chalmers organisations which can make an active contribution to technological and business development and have an overall view of Chalmers' whole range of skills and resources. Chalmers' science parks therefore constitute suitable environments for the development of new technology, innovations and business concepts, both for greater competitiveness in existing areas of business and for new business ideas.'
Johanneberg Science Park focuses on three of the Chalmers’ Areas of Advance: Built Environment, Energy and Materials Science; while Lindholmen Science Park brings together high-tech, development intensive companies within mobile communication, intelligent transport and the modern media industry. Sahlgrenska Science Park is a business incubator and technology park that gives people with ideas and new companies working in life sciences the best possible start to their new ventures.

The development of Lindholmen Science Park began at the turn of 1999/2000 as a joint initiative by Chalmers and Gothenburg City, with Ericsson, Volvo Group and Volvo Cars as partners right from the start. A key factor in the establishment was that many of Chalmers University programmes already existed at Lindholmen. In addition, Lindholmen had developed into a centre of excellence for high school education.

Ericsson was the first technology company to move its development of base stations to Lindholmen. The move happened in 2003, and Ericsson is now the largest company with 2,000 people in the building at Lindholmspiren. The expansion has continued gaining momentum and in 2011 there were over 300 other companies at Lindholmen Science Park with a total over 9,000 employees.

3.3.3 Competence centres in collaboration with industry

Chalmers also hosts a number of competence centres, of which many have been built up in collaboration with external partners. The SKF13-Chalmers University Technology Centre (UTC) for Sustainability is one of the newer competence centres with the main objective to deliver groundbreaking, industry-focused research. The Centre was initiated in May 2011 and it is located at the division of Environmental Systems Analysis at Chalmers University. The Centre fosters innovation partnerships through industry-based research and development within the field of sustainability, especially in:

- Resource productivity and life cycle management
- Sustainable production and consumption
- Sustainable business processes and strategies

3.4 Educational aspects of the activities/initiatives14

As already discussed, the main task of the Areas of Advance is to integrate education, research and innovation, and to shape programmes stimulated by the Areas of Advance themselves. The integration of education and research already has a long tradition at Chalmers, but courses that are inspired by the Areas of Advance necessarily put special emphasis on innovation. Innovation can manifest in many different ways, but the Areas of Advance are intended to serve as meeting places for teachers and students from various programmes to formulate relevant problems and address them in project-based courses, preferably with the support of industry and public sector employees. The mark of courses inspired by the Areas of Advance should be that students and teachers with different competencies work on a common occupationally-relevant problem. The idea is to draw inspiration for problem formulation both locally and from more distant parts of the world, preferably in interaction with industry. The intention is to better integrate consideration of sustainable development and interaction between people, technology and society into the programmes when students are able to bring their future occupational identities to the projects. Both undergraduate and master’s programmes and the Areas of Advance devote separate resources to encouraging and supporting development of these types of new and existing courses.

3.4.1 Integrated education

An example of how working with Areas of Advance can assist the integration of education in the knowledge triangle is given below from the transport Area of Advance.

13 SKF is a world leading supplier of products and solutions in the rolling bearing business
14 The chapter relies heavily on the information on the website of the university describing the different educational initiatives
Chalmers Automotive and Transport Academy (CATA)

CATA is a jointly organised interface between Chalmers and the automotive and transport industries, serving as a platform for contacts and forum of exchange between Chalmers and its industrial partners. CATA has three aims:

- To stimulate work integrated learning
- To establish future competency needs through interaction between Chalmers, industry and society
- To integrate higher education and work integrated learning

Maintaining close links with industry ensures that Chalmers can provide students with the opportunity to get involved in projects on site with industrial partners and apply their knowledge to real-life engineering challenges, undertake an internship or visit companies for a short period to gain a better understanding of the industrial environment.

CATA also enables industry to have access to the students and to influence the education e.g. by working closely together with the partners to develop Master's programmes relevant to the automotive and transport sectors focusing on future needs.

Source: [http://www.chalmers.se/en/areas-of-advance/transport/CATA/Pages/default.aspx](http://www.chalmers.se/en/areas-of-advance/transport/CATA/Pages/default.aspx)

3.4.2 Chalmers School of Entrepreneurship

Another example of integration of education, research and innovation at Chalmers is the Chalmers School of Entrepreneurship. Since 1997, Chalmers School of Entrepreneurship has offered a Master degree level education, designed to develop entrepreneurial individuals prepared for business development in a knowledge economy, through an action-based pedagogy where innovation and entrepreneurship is experienced and not only taught in classrooms.

The education combines a noted academic Master degree programme with real-life innovation management and venture creation of technology and bioscience innovations. In addition to the development of a more entrepreneurial mindset, the programme offers advanced reflective skill training in business design, leadership, innovation management, intellectual property and product and business development.

The programme is an integrated part of Chalmers' strategy of being an entrepreneurial university that takes responsibility for sustainable growth through innovation and entrepreneurship, and was the highest ranked advanced entrepreneurship program by the Swedish government in 2009.

As regards developing new companies, Chalmers School of Entrepreneurship increases both the quantity and quality of an early-stage deal flow stemming from research and innovations. At Chalmers School of Entrepreneurship, the responsibility of commercialisation is spread beyond the shoulders of one individual – typically the researcher or inventor – to a team of venture creators, in a process that emphasises sophisticated entrepreneurial learning. Thereby, the education adds entrepreneurial drive and commercialises technology otherwise trapped in an idea- or research-stage.
Education in the knowledge triangle

During the second year of Chalmers School of Entrepreneurship students are given the opportunity to try their own abilities as venture creators (bioscience and technology tracks) or to work with innovation management and develop early stage intellectual assets from R&D (intellectual property track). By contributing to the entrepreneurial capacity of the Gothenburg Innovation system the students play an active role in Chalmers’ ambition in the utilisation of innovations, one of the main goals of the university. Students also access Chalmers extensive industrial network and expertise in order to develop innovations towards commercialisation.

3.5 Main challenges and success factors in the approach of Chalmers

The Areas of Advance that have become most successful are those with a history of collaboration between different partners and areas. Where this has not been a case it is important for the university to create a situation of confidence in relations with external partners.

Teaching students to become entrepreneurs is seen as an essential part of the knowledge triangle. The Chalmers School of Entrepreneurship Master level education, designed to develop entrepreneurial individuals, has been very successful in integrating the three parts of the knowledge triangle. Chalmers is also the only Swedish university member of Unitech International, where it can offer students a management and leadership programme in collaboration with other European universities and industrial partners.

Barriers to a smooth integration of the knowledge triangle are seen in the surrounding society. In Sweden HEIs have their natural connection and contact with the Ministry of Education and Research. The knowledge triangle demands contact with other ministries as well, but this arena of cross-ministerial contacts for the universities does not yet exist in Sweden, a gap which will need to be addressed. At a European level it is perceived to be easier having a dialogue across, for example, the different directorates.

One possibly discouraging factor regarding the better integration of education in the knowledge triangle is the signals that are given by the Swedish research funds. It is perceived that as a researcher with a long track record of teaching and pedagogical qualities it is harder to obtain funds than if one’s career had been devoted only to research. Alongside this universities sometimes are forced to recruit researchers who might not be the most suitable for teaching, since they are dependent on receiving funding: this can in the end lead to research not feeding back into education as effectively as it might. The research funds might be encouraged to look at all three parts of the knowledge triangle and treat them with equal importance.

3.6 Future developments and transferability

“Working from a knowledge triangle perspective is natural for us. We believe in it. We cannot go back to working with the old traditional systems.” Source: Quote from the President and Vice-Chancellor of Chalmers University

The most complex question in connection with the knowledge triangle is how the innovative process can be assisted so that innovations feed back and benefit society? Discussion about innovation includes not only products and services, but also intellectual processes. The way, how the university can facilitate this utilisation process is essential for the future. Until now the successful examples have been rather dependent on dedicated persons in a specific sphere. New and better ways of working with the knowledge triangle are needed for the future so that many more innovations can contribute to societal benefit.

Chalmers is active in the European organisation CESAER - The Conference of European Schools for Advanced Engineering Education and Research - an association made up of about 60 European technological universities. This collaboration covers research as well as undergraduate and postgraduate education. There is a view associated with CESAER which suggests that the European universities of technology should have a higher profile in wider European higher education collaboration, and that universities of technology, with a long history of collaboration with industry could show the way for other HEIs regarding knowledge triangle activities.

Evaluation and monitoring of Chalmers approach to the knowledge triangle and the activities-related are seen as highly important. For this reason the University Management Group decided to perform an independent international evaluation of Chalmers in spring 2012 via the Areas of Advance. As a result
of the evaluation, recommendations were made on how to work with the integration of education in the knowledge triangle.

3.7 Contacts, references

3.7.1 Interviews/contacts

- President and Vice-Chancellor Karin Markides, Chalmers University of Technology

- Vice President and Deputy Vice-Chancellor Maria Knutson Wedel, Chalmers University of Technology

3.7.2 Internet sources

- http://www.businessregiongoteborg.com

- www.chalmers.se

- http://www.lindholmen.se
4  

Ecole Polytechnique Fédérale de Lausanne (EPFL)

4.1  Introduction

4.1.1  A Federal Institute of Technology with a broad disciplinary focus

Together with ETH Zürich, Ecole Polytechnique Fédérale de Lausanne (EPFL) is one of two Swiss Federal Institutes of Technology. Its creation dates back to 1853, when it was founded as a private school. In 1869 it was integrated in the public Académie de Lausanne, which then became a university in 1890. Separated from the rest of the University of Lausanne in 1969, it became a federal institute under its current name.

Over the past ten years, EPFL has undergone several reforms and has shifted from an engineering school – which was inspired by the French model of école d’ingénieur - to a more technology-focused university. It is listed number 126 rank in the 2012 Shanghai Jiaotong World Ranking of Universities (it ranked 40th in the 2012/2013 Times Higher Education world ranking), and is the 20th world university in the field of engineering/technology and computer sciences and the 2nd European university after Cambridge. The excellence of research conducted at EPFL is further demonstrated by the number of European Research Council grants received by the institute (66 between 2007 and 10/2012), placing EPFL in the company of Oxford and Cambridge for the top-tiered European universities in grant allocation.

Unlike the other 12 Swiss universities that are controlled by cantonal governments, EPFL is under the responsibility of the Swiss federal government, as part of the Federal Institutes of Technology Domain (ETH Domain) - a union of Swiss governmental universities and research institutions governed by a Board. The two Federal Institutes of Technology have three missions, which corresponds to the three dimensions of the knowledge triangle: training, research and technology transfer. Their purpose, as stated in the Federal Act on the Federal Institutes of Technology, is presented in the frame below.

![Purpose](image)


4.1.2  A matrix governance structure fostering transdisciplinarity

The management of EPFL has reinterpreted these three missions to position them in the global, internationalisation trend of the academic landscape. Since 2000, its management is composed of the president and four vice-presidents (the ‘direction’), who are assisted by a general secretary and a general council. From the academic point of view, the old departments were reorganised in five schools, each of them managed by a dean with extended power and autonomy (see Figure 24).

These schools are vertical structures that carry, essentially, the research efforts at EPFL, whilst the educational aspects are dealt with by transversal structures, such as the sections and programmes: the latter draw the necessary resources from the schools to elaborate and offer the educational content necessary for a first-class education. Similarly, transversal structures have been created to promote transdisciplinary research initiatives, in the form of centres (such as those for biotechnology and bioengineering, or neuroprosthetics) that operate across two or several faculties, bring together complementary competencies and share infrastructure and expertise.

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15 EPFL (2011), Annual Report
The net outcome of such a matrix structure is an increased number of inter-faculty connections, which in turn leads to a high number of creative educational and research initiatives of an interdisciplinary nature. Such a complex structure however also occasions increased management efforts. This translates into additional internal communication efforts and might sometimes cause decisional delays.

The figure below presents the organisational structure of the EPFL. For sake of simplicity and clarity, some of the EPFL components have been omitted (i.e. only two of the EPFL’s transdisciplinary centres are included).

Figure 24 Organizational structure of EPFL (2012)

EPFL’s study programmes and research activities are spread across the fields of Engineering, Basic Sciences, ICT and Life Sciences, as well as in the field of Construction, Architecture and the Environment. Despite EPFL being a technology institute, two colleges offer a broader disciplinary focus:

- The College of Humanities provides all EPFL students with cross-disciplinary educational programmes in social science and humanities. It also carries out some research, with mission to integrate problems of social science and humanities into scientific and engineering approaches and, conversely, to integrate the development of science and technology into social science and humanities.
- The College of Management of Technology provides entrepreneurship and technology management training at master or doctoral level, either in the form of full study programme or as minor studies. It also conducts research activities, which have expanded considerably over recent years.

All in all, 15 streams of studies are offered across EPFL’s Schools and Colleges. In 2011/2012, the Institute is host to 6,325 students (of which 69 per cent are Bachelor students, and 31 per cent master students), 1,975 doctoral candidates and 142 students attending continuing education. Overseas students account for 36 per cent of bachelor and master students and 75 per cent of all doctoral students in 2011/2012. The distribution of students by Faculty is presented in the figure below.
Figure 25 Key figures, students (2011/2012)

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<td>102</td>
<td>20</td>
<td>1,961 (23%)</td>
</tr>
<tr>
<td><strong>Doctoral</strong></td>
<td>466</td>
<td>239</td>
<td>657</td>
<td>272</td>
<td>288</td>
<td>53</td>
<td>-</td>
<td>1,975 (23%)</td>
</tr>
<tr>
<td><strong>Continuing Education</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>48</td>
<td>94</td>
<td>-</td>
<td>142 (2%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,686 (20%)</td>
<td>763 (9%)</td>
<td>2,224 (26%)</td>
<td>1,171 (14%)</td>
<td>2,329 (28%)</td>
<td>249 (3%)</td>
<td>20 (0.2%)</td>
<td>8,442</td>
</tr>
</tbody>
</table>

EPFL (2011), Annual Report

EPFL employs a total of 4,673.6 full-time equivalents, of which 6 per cent are professors, 64 per cent research scientists and lecturers and 30 per cent administrative and technical staff. The distribution of students by Faculty is presented in the figure below.

Figure 26 Key figures, staff (2011/2012)

<table>
<thead>
<tr>
<th></th>
<th>Basic Sciences</th>
<th>Life Sciences</th>
<th>Engineering</th>
<th>Computer and Communication Science</th>
<th>Architecture, Civil and Environmental Engineering</th>
<th>Management of Technology</th>
<th>Central services</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of FTE</strong></td>
<td>1097.7</td>
<td>682.3</td>
<td>1,187.2</td>
<td>457.3</td>
<td>542.9</td>
<td>80.9</td>
<td>625.4</td>
<td>4673.6</td>
</tr>
<tr>
<td><strong>Percentage of the total number of staff</strong></td>
<td>23%</td>
<td>15%</td>
<td>25%</td>
<td>10%</td>
<td>12%</td>
<td>2%</td>
<td>13%</td>
<td>100%</td>
</tr>
</tbody>
</table>

EPFL (2011), Annual Report

In 2010, EPFL Middle East campus was opened in the United Arab Emirates. EPFL Middle East is a research centre in the field of Energy and sustainability, which offers joint PhDs with EPFL in Lausanne, a master programme and continuing training.

4.1.3 An open innovation system

EPFL’s support for university-business cooperation dates back to 1986, when it launched its first industrial liaison programme, and it has strengthened over the past ten years, while the Institute increased its focus on technology development. Since 2004, the Vice-Presidency for Innovation and Technology Transfer (Vice-Présidence pour l’Innovation et la Valorisation, VPIV) is responsible for partnerships with businesses. It operates through various instruments:

- EPFL’s Technology Transfer Office handles research contracts as well as the evaluation, protection, management and licensing of EPFL’s intellectual property
- The Innogrants programme supports the creation of start-ups
- Strategic collaborations with large international companies are supported through a Partnerships programme
- Exploration of emerging fields is carried out through Strategic initiatives that include transdisciplinary programmes and centres (e.g. Transportation Centre, Energy Centre, Swiss Space Centre)
- EPFL also hosts Alliance, the Industry Liaison Programme for French-speaking academic institutions which is financially supported by the Swiss Innovation Promotion Agency (CTI),
Education in the knowledge triangle

Cantons of western Switzerland, State Secretariat for Economic Affairs (SECO), the association of companies Alliance and EPFL.

In addition to the VPIV, EPFL is part of a complex network which supports innovation at a different level. It includes the Science Park - PSE and the Foundation for Innovation and Technology- FIT (which provides pre-seed funding and support to technological innovative project) at the EPFL, as well as a wide range of funding and support mechanisms for research and innovation delivered at national, cantonal or private level (e.g. Swiss Confederation’s Commission for Technology and Innovation, Swiss National Science Foundation, private investors).

The Science Park-PSE became an ‘Innovation Square’ in 2010, confirming the open innovation model promoted at EPFL. Located on the EPFL campus, it is host to a number of companies’ R&D centres (of which Nestlé, Constellium, Logitech, Crédit Suisse, Nokia, Cisco) and more than 80 start-ups supported through an incubator16.

**Figure 4 EPFL’s support to innovation and technology transfer**

Due to the relatively small size of the country and its decentralised structure, the different components of the innovation system are well integrated and interact with one another. This results in an open innovation system, in which EPFL maintains close contacts with industry and business in order to foster research, innovative ideas and entrepreneurship. EPFL has also strong linkages with the University of Lausanne (UNIL) which specialises in the fields of Economics, Humanities and Social Sciences, Environmental Sciences, as well as in Biology and Medicine. Both institutions form a vast campus in Ecublens, a suburb South-West of Lausanne.

The Vice-Presidency for Innovation and Technology Transfer (VPIV) works alongside the Vice-Presidency for Academic Affairs (VPAA), which is responsible for the education and research areas. The two of them cooperate together on a regular basis and the VPIV is for example involved in some of the education and research activities (e.g. it participates in teaching activities at the College of Management of Technology).

### 4.2 Integration of education in the knowledge triangle and overview of specific initiatives

There has always been a strong practical focus in the education provided at EPFL, including internships and study projects. This practical focus has been increased over recent years with a series of wide-ranging reforms, which are described in the EPFL’s 2012-2016 Development Plan. Reforms have taken two main directions. The first is the increase of linkages between students and enterprises (e.g. introduction of mandatory internship of at least eight weeks for all master students in engineering courses), while the second one tackles greater interdisciplinarity (e.g. introduction of a common

---

16 EPFL (2011), 2012-2016 Development Plan
polytechnic basis for all first year students, introduction of minor studies for master students, and the inauguration of a new interdisciplinary library centre – the Rolex learning centre). Recent reforms and other relevant initiatives are presented in the sections below.

4.2.1 New interdisciplinary and experimental approach to education

Discovery projects

Through its transdisciplinary centres and programmes, the VPIV is involved in a number of support projects in collaboration with industry partners. These are called the Discovery projects and represent cutting-edge technological ideas at the intersection of basic and applied research and reach beyond the traditional frontiers of laboratories and disciplines.

Discovery projects include three navigation projects with boats: Alinghi, l’Hydroptère (a flying boat) and Rivages, as well as SolarImpulse which has developed a solar-powered aeroplane that can fly day and night.

EPFL acts as a scientific advisor on these projects. Several EPFL laboratories are usually involved, reinforcing collaboration between laboratories and the potential for transdisciplinary innovation. They work in cooperation with partner companies. A coordination of EPFL activities is ensured through the VPIV to maximize the output for EPFL and the partners.

A key aspect of the collaboration is that teams of students are involved in the Discovery Projects. Such projects give students a practical insight into the role of an engineer in a complex technological setup. They gain expertise from direct contact with EPFL and companies’ experts, while EPFL professors, researchers and engineers are encouraged to apply their research on a full-scale demonstrator17.

Beyond the Discovery projects, another example of education-focused development project is SwissCube, which started in 2005 and to which about 200 students contributed from the EPFL and other Swiss higher education institutions. The aim was to show students how to build a complex engineering system and to help them to develop their own satellite, which was sent into space in 2011.

Teaching Bridge

The Teaching Bridge project represents EPFL’s new pedagogical approach and is also the name of new premises that are being built to support it. To some extent, Teaching Bridge continues and enlarges the concept of the Discovery projects by articulating in the form of a new pedagogical approach practical experiments and project-based learning in interdisciplinary teams:

Teaching Bridge (... will allow students to build bridges between different scientific and engineering disciplines, between theory and experiments and between education and work life. The keywords of the initiative are: imagination, initiative, experimentation, teamwork, cooperation and collaboration. (Translated from the EPFL 2012-2016 Development Plan).

The Teaching Bridge’ pedagogy reform is currently being implemented in the EPFL’s Schools and in coming years it will lead to a complete overhaul of study curricula:

- For first-year students: the first year of study will consist of a common polytechnic basis for all students and introductory courses will be given to students to familiarise them with the experimentation methods and measurement techniques that they will encounter during their education as well as to give them the skills necessary to make full use of the equipment and facilities provided at EPFL.
- For second and third-year students: a review of study programmes will strengthen the coordination between theoretical courses and practical experiments and projects, thus increasing the articulation and coherence of study programmes.
- For students in the final year of the studies: the Teaching Bridge building will be host to interdisciplinary projects conducted by a team of students from various disciplinary

17 EPFL (2010), VPIV Activity report
backgrounds. The objective is to expose them to problems requiring the type of collaboration and autonomy that they will encounter in their future professional career.

When built, the Teaching Bridge premises will be composed of a main building and a number of satellites across the EPFL campus, which will bring together workspace and resources for the completion of interdisciplinary projects. Teaching Bridge is led by the Vice-Presidency for Academic Affairs (VPAA) and coordinated by the person in charge of Discovery projects at the VPIV.

4.2.2 Development of a competency-based approach to curriculum design: the ‘Competencies’ programme at the EPFL Mechanical Engineering Department

The ‘Competencies’ programme, a pilot initiative, is being carried out in the Mechanical Engineering study programme in cooperation with the Pedagogical research and support centre (CRAFT). The objective is to extend it later to all the EPFL’s study programmes and possibly other Swiss universities.

Basically, the programme implements a new curriculum design process which associates teaching staff and industry and is based on the use of learning outcomes that are expected from mechanical engineers at the end of their studies, with relevance as the key criterion for the introduction, suppression and adaption of courses. The process covers both specialist and transversal learning outcomes and is organised in three phases:

- Definition of required competencies: develop and implement a survey in order to determine societal and economic needs for EPFL mechanical engineers (based on the Delphi interactive method of forecasting with a panel of industry representatives), and establish a list of required transversal macro-competencies (with help from a team of teachers)
- Determine the corresponding learning outcomes: for each one of the six specialist areas in the Mechanical Engineering study programme (Energy, Solids & Structures, Design & Production, Biomechanics, Aero-Hydrodynamics, Control & Mechanics) as well as transversal learning outcomes (e.g. writing scientific and technical reports, forming and motivating teams)
- Implementation in the curriculum: drafting new course descriptions based on the newly defined learning outcomes (an example of course description is provided in the frame below).
Figure 27 Example of new course description

<table>
<thead>
<tr>
<th>Learning outcomes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain skills:</td>
</tr>
<tr>
<td>• Master the concepts of thermodynamic efficiency, E6</td>
</tr>
<tr>
<td>• Establish the flow diagram of an industrial process and calculate the corresponding energy and mass balance, E22</td>
</tr>
<tr>
<td>• Analyse the energy and exergy efficiency of industrial energy systems, E23</td>
</tr>
<tr>
<td>• Know the principles and limitations of the main energy conversion technologies, E7</td>
</tr>
<tr>
<td>• Understand the challenges related to energy: resources, energy services, economic and environmental impacts, E9</td>
</tr>
<tr>
<td>Transversal skills:</td>
</tr>
<tr>
<td>• Write a scientific or technical report, T6</td>
</tr>
<tr>
<td>• Make an oral presentation, T7</td>
</tr>
<tr>
<td>• Document and communicate a project, T12</td>
</tr>
<tr>
<td>• Analyse the consequences of a decision or solution, T20</td>
</tr>
</tbody>
</table>

| Content: |
| A paragraph to the teacher’s discretion |

| Keywords: |
| Energy efficiency, heat recovery, Energy conversion, Exergy analysis, Pinch analysis, Industrial processes |

| Required prior knowledge: |
| • Master the concepts of mass, energy, and momentum balance, E1 (Thermodynamique et énergétique I) |
| • Compute the thermodynamic properties of a fluid, E2 (Thermodynamique et énergétique I) |
| • Master the concepts of heat and mass transfer, E3 (Heat and mass transfer) |
| • Understand the main thermodynamic cycles, E5 (Thermodynamique et énergétique I) |
| • Calculate and design heat exchangers, E15 (heat and mass transfer) |
| • Notion of optimization (Introduction à l’optimisation différentiable) |

EPFL/ Mechanical Engineering, Competency-Based Learning in mechanical Engineering at EPFL (PowerPoint presentation)

In the longer run, it is expected that a thorough curriculum design process and a more detailed presentation of learning outcomes will lead to optimising and harmonising study programmes, by allowing for the identification of incoherencies or redundancies. It will make it also easier for teachers to coordinate and relate different courses, as well as to manage transitions when professors retire.

4.2.3 Teaching businesses and employees: UNIL-EPFL continuing education

In 2009, EPFL and the University of Lausanne (UNIL) grouped together their continuing education activities in the Foundation for Continuing Education UNIL-EPFL. The Foundation is managed by an Executive and a Board of Trustees, and offers a wide range of study programmes. These include: Masters of Advanced Studies (e.g. MBA in management and corporate finance), Diplomas of Advanced Studies (e.g. Marketing Management, Culture Management), Certificates of Advanced Studies (e.g. Public Risk, Disaster Risk Management), Short programmes and Corporate programmes designed and tailored to the needs of enterprises (e.g. Services’ marketing, Leadership). Education is provided in Science & Technology Management, Economics & Law, Health & Social and Human Sciences.

In 2011 the Foundation employed 15 staff, was host to 80 different programmes and 2,800 students, with a turnover of more than €4m in enrolment fees18. It is located on the Innovation Square on the EPFL Campus, hence offering close links with the enterprises established on the Square.

The Foundation is responsible for promoting the creation of continuing education programmes in the specialised fields of the UNIL and EPFL and adapting the range of continuing education programmes available according to regional, national and international needs. It supports academic staff who want to establish continuing education courses and enterprises or associations which are in need of a

18 Website of the Foundation for continuing education UNIL-EPFL: http://www.formation-continue-unil-epfl.ch/en
personalised continuing education programme for their employees or members. Its services include: analysis of educational needs and definition of target public, development of the programme (teaching methods, architecture, duration, etc.), drawing-up of budget, identification of faculty members, promotion and communication strategy, administration of the course (e.g. Processing of applications and participant follow-up), logistics (e.g. provision of classrooms) and development of evaluation questionnaires.

In addition to training businesses, EPFL also provides training in entrepreneurship and technology management in the College of Management of Technology (almost 40 per cent of all students enrolled at the College pursue a continuing education).

4.3 Ensuring the quality and relevance of education, research and technology transfer activities through Quality Assurance

4.3.1 The Quality Assurance process at EPFL

The EPFL has a Quality Assurance system with three facets. The first facet is the accreditation process. The majority of bachelor and master programmes with a professional engineering title have dual accreditation from the Swiss Centre of Accreditation and Quality Assurance (OAQ) and the French Engineering Titles Commission (CTI), as well as the European label for engineering programmes EUR-ACE. Thanks to this double accreditation, EPFL's programmes are accredited both in an academic way (OAQ) and in a professional way (CTI). Having a degree authorised by the CTI also facilitates the professional integration of EPFL alumni who settle in France. QAQ and CTI accreditation are conducted every four years, taking for basis a self-evaluation report followed by CTI's and OAQ's expert reports. The next accreditation round is due in 2014.

The second facet is the evaluation of EPFL units (Faculties and Colleges), carried out every five or six years at the EPFL. Evaluation is a requirement from the ETH Board that governs the ETH Domain and is common to both EPFL and ETH Zürich. The two Institutes have compiled together a guideline document on the evaluation process and potential terms of reference for the evaluations of faculties and Colleges. These are organised and implemented by the Schools, once they have been decided by the Senior Management of the Institute. The ETH Board functions as a supervisory body in this context and all evaluation reports are presented at the meeting of the Board of the ETH. The evaluations of institutes and laboratories of a faculty are similar to those of the Faculties and Colleges and may be combined with them. The overall activities of EPFL and ETH Zürich are also evaluated every two years within the framework of the intermediate and final evaluations of the ETH Board, under the supervision of the State Secretariat for Education and Research.

The third facet is the Pedagogical research and support centre (Centre de recherche et d'appui pour la formation et ses technologies, CRAFT). CRAFT supports teachers in their teaching approach and pedagogical skills, offering in-depth evaluation of courses, training and various support tools (e.g. publication of guidelines for teaching and learning, offers of learning technologies such as Moodle - EPFL's on-line learning platform). In-depth evaluation of courses is commonly requested by academic staff wishing to improve the quality of teaching. It is confidential and complementary to the systematic indicative evaluation of each course that happens every semester and consists of a short questionnaire to students. In addition, CRAFT conducts research on how to enhance learning and more efficient problem-solving through collaboration technologies and provide various courses to master and PhD students.

19 Website of EPFL: http://direction.epfl.ch/page-54921-en.html
21 Website of CRAFT: http://craft.epfl.ch/
4.3.2 Integration of education, research and technology transfer in the Quality Assurance process

The evaluations of EPFL Schools (Faculties and Colleges) include the three dimensions of the knowledge triangle - education, research and technology transfer - which are all part of the mission of EPFL.

Representatives from the private sector, including professional and employers’ associations are present on the evaluation committee set up for each evaluation by the EPFL Senior Management. The committees comprise eight to 12 experts, 50 per cent of whom are selected from a list proposed by the faculty and 50 per cent by the EPFL Senior Management. The standard composition of a committee of experts for the Faculty evaluations is typically 30 per cent from the United States, 40 per cent from the EU, 10 per cent Asia, 20 per cent alumni and members of the private sector.

Each evaluation is based on a self-evaluation report filled in by the Faculty or College, followed by a visit of the experts’ committee. Figure 28 below presents the full evaluation process.

Figure 28 The Quality assurance cycle for Evaluations of Units in the ETH Domain

In addition to the evaluation process, an advisory committee (comité aviseur) is appointed for each of the study programmes with responsibility for enhancing the quality of the teaching offer. A number of industrial representatives and top business managers are present on these committees, which enables to better take into account industry and business needs in the training content. There is also the new ‘Competencies’ programme which has been implemented in the Mechanical engineering study programmes and offers a new competency-based approach to curriculum design, with input from industry as to their needs and the societal relevance of courses.

4.3.3 Socio-economic relevance and societal and industrial impacts as core criteria in the evaluation process

The aim of the Quality Assurance process is to ensure quality and relevance in education, research and technology transfer. As it is mentioned in the Guideline document for the evaluation of Faculties and Colleges, questions related to the industrial and societal relevance of education and research are

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22 see Section 4.2.1 for further details.
one of the focus of the evaluations. Some of the indicative questions that may be used by the EPFL units in their evaluations are presented in the frame below.

| Possible terms of reference for the evaluation of Schools – abstract from main questions list |
| Education and teaching |
| • Is the curriculum appropriate for the needs of future development requirements and the responsibilities of professionals in public institutions or in the private sector? |
| • How is research integrated into education (especially master programmes)? |
| • Is the ratio of lectures, exercises, practical and individual projects (semester papers, degree theses and fieldwork) well balanced? |
| • Do the postgraduate courses offered to practitioners (in continuing education) provide a significant transfer of knowledge? |
| • Is the teaching (methods, contents) appropriate for the range of postgraduates (in continuing education) needed in industry and education? Would you suggest other (educational) programmes? |

| Technology and knowledge transfer |
| • Please comment on the interface between activities in the architecture, civil and environmental engineering faculties and industrial and public activities. |
| • How does the School involve professional associations and circles? How does the School incorporate their input? |
| • Does the School evaluate the degree of satisfaction of professional associations and groups? |
| • Are the School's research results recognised in terms of existing practical implementation by private institutions and public agencies (industry, trade etc.)? Do they support research sufficiently by making financial contributions? |
| • Does the School provide an adequate transfer of knowledge between the academic level and the practical level, including small and medium-sized enterprises? |
| • What contribution does the School make to national and international standards and norms? |
| • Do the publications in professional journals correspond to the needs of the end-users? |


4.4 Key success and enabling factors

4.4.1 A technology-focused education

EPFL is a Federal Institute of Technology and, as such, it offers a practical orientation to studies, which is in line with the strong tradition of apprenticeship in the Swiss education system. Its technology focus has enabled the development of strong linkages between research, technology transfer and education. The open innovation model and the recent launch of the Innovation Square have paved the way for closer interactions between the EPFL and businesses. In terms of education, students are involved in several experimental projects.

Overall, there is a strong focus on experimentation in the curricula offered at the Institute, and students are familiarised with research and innovation projects in their very first years of studies, with a view to reinforce a culture of experimentation and to instil good practice early on.

4.4.2 An iterative approach to reforms

A common feature of all the reforms mentioned in Section 4.2 is their iterative implementation. None of the major recent developments that has occurred was designed and led in a centralised fashion, but reforms were implemented and tested on a small-scale before being further extended.

One example is the ‘Competencies’ programme, a pilot initiative that is currently tested in the Mechanical Engineering study programme, and will be extended to all the EPFL's study programmes. Similarly, the Teaching Bridge concept built on previous initiatives such as the Discovery projects and SwissCube.
This iterative approach allows for testing, solving forthcoming issues and adapting new approaches. It also leaves room for bottom-up initiatives from staff and Schools.

4.4.3 A strategic approach to the recruitment of Junior and Senior International Faculty

The series of reforms that have occurred at EPFL since the early 2000s were complemented by a pro-active recruitment policy of world-class senior faculty members and the attraction of promising young scientists.

First of all, EPFL has been able to attract several of the world’s top scientists onto the campus by offering competitive packages in terms of: salary, start-up and hard money, top-rated facilities and technical infrastructure, in a very stimulating and open environment. As a result, the faculty has become increasingly international, as can be seen in figure 7. Moreover, this evolution towards “anti-inbreeding” in the recruitment of professors facilitates contacts with other worldwide partners, as well as enhancing EPFL’s knowledge and comprehension of the global academic landscape.

Figure 7 Evolution of the origin (country of recruitment) of EPFL professors. Snapshots in three time windows: prior to 1990, from 1990 to 1999, and from 2000 to 2012.

EPFL.

Secondly, EPFL introduced the position of ‘tenure-track assistant professor’, in an effort to bring onto campus several of the world’s best young researchers with an offer including a competitive salary, start-up money and facilities, as well as mentoring by senior faculty members.

Both programmes have proved extremely successful, with EPFL growing from 143 professors in 2000 to 326 faculty members by December 2011, of whom 64 are tenure-track assistant professors. Through this process, 75 per cent of EPFL’s faculty has been renewed. The benefits of having a body of young and motivated scientists on board can be seen by their outstanding success rate in obtaining funding through prestigious institution (e.g. ERC advanced grants).

The benefits of this international pattern can also be seen in EPFL’s membership in several academic networks dealing mainly with education. One of these is the EuroTech Universities Alliance - a network of four European institutes of technology (i.e. EPFL, Technical University Munich, Technical University of Denmark and Eindhoven University of Technology). EuroTech works as a cooperative forum in which are discussed guiding themes for research, education, technology transfer and entrepreneurship. It engages in policy definition with wider stakeholders and plans to recruit a EU affairs coordinator in 2012 in order to represent the EuroTech Universities in Brussels. EPFL has also contributed to the creation of the Network of Excellence in Engineering Sciences of the French-speaking Community (Réseau d’Excellence des Sciences de l’Ingénieur et de la Francophonie, RESCIF), with objective to promote scientific cooperation between top technological universities and universities in French-speaking emerging countries to promote technological innovation.
4.4.4 Educational technology support

CRAFT - the Pedagogical research and support centre – is a cornerstone of the EPFL’s quality assurance system (see Section 4.3). In addition to offering evaluations of courses, it researches on and provides specific education technologies to EPFL staff, with a view to reinforce the use of active pedagogy and the involvement of students in teaching activities.

An example of technology which was developed and is offered by CRAFT is the Clickers classroom response system, described below.

**Clickers** are small remote controls that allow students to respond to a question shown on the screen. Responses will generate a chart, which can be used by teaching staff in two ways:

- Engaging students during the course of a lecture: Start or break the lecture by using clickers. Viewing the response allows students to compare their answers with the entire class. An effect can be to ignite their curiosity or to reveal shared misconceptions. Once students view the response, a general or small group discussions can follow.

- Formative student assessments: After covering a significant subject, clickers would help gather some information on students’ learning. For instance; to get to know what they understand and if there are any gaps. Such information could help to clarify and redirect the evolution of the course.


4.5 Challenges and future developments

EPFL is a changing institution which is undergoing a series of major reforms leading to new pedagogical tools, technologies, curriculum design, study content, interactions with businesses, etc. The cultural aspect is therefore one of the main challenges of EPFL’s approach, with the need for EPFL staff and students to adapt to new pedagogical approaches and tools and take on new roles in the teaching/learning process. Teaching staff are, for example, required to strengthen their cooperation through team teaching, and students are encouraged to acquire the mindset to adapt to demanding new education models where their active involvement is required. To tackle these challenges, support to teaching staff is provided through CRAFT. Help is also offered to first year students through a tutoring programme involving third or fourth year students, with a view to provide adequate support to adapt to the learning opportunity EPFL has to offer.

Entrepreneurship and innovation are also cultural aspects which need to be strengthened amongst students, by encouraging them to link learning and practical projects or innovation courses. The Innogrants programme from the VPIV, which awards grants for the creation of start-up based on research carried out at the EPFL, organises various events involving EPFL staff and students, including presentations by grantees that serve as role models for the younger generation.

In the near future, EPFL will carry on implementing and completing the ongoing reform (e.g. Teaching Bridge). Two further developments are underway. In the first place, a dedicated space for entrepreneurship (‘La Forge’) will be created in order to raise awareness of entrepreneurship across the Institute and to offer co-working space for start-up creation. Second, the EPFL signed agreements with Coursera – which is a partnership of world-leading universities offering Massive Open Online Courses (MOOCs), which are web-based courses provided through an online platform and offered free of charge. Coursera was founded in the USA in 2011. So far, it has signed agreements with 16 institutions, including Caltech, Stanford University, the University of Edinburgh, the University of Toronto, University of Pennsylvania and Princeton23. Coursera offers courses in a wide range of topics spanning the Humanities, Medicine, Biology, Social Sciences, Mathematics, Business, Computer Science, amongst others.

The first EPFL MOOC - Functional Programming Principles in Scala - was offered on September 18, 2012 on Coursera's platform. At least 15 other courses will be launched in the coming years. EPFL’s

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23 Website of Coursera: [www.coursera.org](http://www.coursera.org)
involvement in MOOCs is a further sign of the modernisation of pedagogical tools at the EPFL, with Internet offering new opportunities in terms of international visibility and reach, but also raising new issues in terms of certification of online courses (e.g. incorporation of MOOCs from other universities into the curricula of students).

Another key aspect of EPFL’s investment in MOOCs is their development in partnership with developing countries. E-learning platforms offer the opportunity to disseminate educational content of the highest possible quality to students living in countries where the academic environment still falls short of the mark. Part of EPFL’s objectives to promote engineering sciences in French-speaking emerging countries through the Network of Excellence in Engineering Sciences of the French-speaking Community (Réseau d’Excellence des Sciences de l’Ingénieur et de la Francophonie, RESCIF) could therefore be achieved by organising MOOCs together with our academic partners of these countries.

4.6 Lessons learnt and transferability

At EPFL, education, research and innovation interact in several ways, served by the technological purpose of the Institute and the practical focus of engineering education. If several of the EPFL features are part of its technological focus and are not transferable as such, several other initiatives could be replicated in other contexts. This is for example the case with the ‘Competencies’ programme, which is piloted by the Mechanical Engineering study programme, but will then be transferred to all the EPFL’s study programmes and possibly to other Swiss universities. Another good practice that can be transferred is the early focus put on experimentation in studies, which enables students to develop their research skills early on and to successfully take part in multidisciplinary projects later on.

Similarly, the Quality Assurance system is particularly well developed at EPFL and could inspire other higher education institutions. With regards to the knowledge triangle concept, the evaluation of EPFL Faculties and Colleges aims both at verifying the quality of research, innovation and education activities, and at assessing the depth of the links between them. Quality assurance procedures are therefore a key feature of the integration of education in the knowledge triangle at EPFL, allowing for monitoring and reporting on progress inside each School.

Finally, CRAFT is an interesting mechanism, by which teaching advisors contribute to improvement in the quality of teaching through courses evaluation, technological support and advises. Within the context of the adoption of new pedagogical approaches and IT tools, it tells the significance of direct support to teaching staff in enhancing their teaching practices by making full use of new pedagogical support tools. If pedagogical support in some form or the other exist in several higher education institutions across Europe, the institutionalisation of the practice at the EPFL and the focus on pedagogical research and technologies is an interesting practice that could benefit to other institutions.

4.7 Contacts, references

The case study is based on a series of interviews as well as extensive help provided by the EPFL in order to integrate the most recent changes and reforms in the analysis.

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philippe Gillet</td>
<td>Vice-President for Academic Affairs</td>
<td>Vice-Presidency for Academic Affairs (VPAA), EPFL</td>
</tr>
<tr>
<td>Hubert Girault</td>
<td>Dean of the Bachelor &amp; Master School at EPFL</td>
<td>Vice-Presidency for Academic Affairs (VPAA), EPFL</td>
</tr>
<tr>
<td>Hervé Lebret</td>
<td>Innogrants Manager</td>
<td>Vice-Presidency for innovation and Technology Transfer (VPIV), EPFL</td>
</tr>
</tbody>
</table>

4.7.1 References

- EPFL (2011), 2012-2016 Development Plan
- EPFL (2011), Annual Report
- EPFL (2010), VPIV Activity report
Education in the knowledge triangle

- EPFL (2011), CRAFT Activity Report
- EPFL, Teaching Bridge Brochure
- EPFL (2012), Innovation support around EPFL (PowerPoint Presentation from Hervé Lebret)
- EPFL/ Mechanical Engineering study programme, Competency-Based Learning in mechanical Engineering at EPFL (PowerPoint presentation)
- EPFL’s website: http://epfl.ch/
5 Universities Joseph Fourier Grenoble (UJF)

5.1 Introduction

Université Joseph Fourier (UJF) is a public French University with roots dating back to 1311, when a university of medical, science, law and literature education was founded in the city of Grenoble. This original university was later divided into several specialist institutions and currently there are six higher education institutions in the Grenoble metropolitan area. Amongst these, the UJF was formed in 1971 and took over the scientific, technology and medical fields.

In spite of the segmentation and specialism of the higher education system, the six Grenoble higher education institutions were unified in 2009 as the ‘Grenoble University’, which is the name of the Grenoble PRES. PRES, or Research and Higher Education Clusters (Pôles de recherche et d'enseignement supérieur) are a national reform launched by the French government with a view to bringing together higher education and research institutions at the local level.

UJF has a centralised system of governance, led by a President and three Councils: a Scientific Council, a Council for Studies and University Life and an Administrative Council. The university is spread across 20 locations in the Grenoble metropolitan area and the wider Rhône-Alpes Region. Host to 15,400 students and 2,100 doctoral candidates, the university employs 1,490 teacher-researchers and 1,520 technical and administrative staff. International students account for 11 per cent of the total number of students and every year about 650 UJF students study or do an internship abroad. In addition, about 1,000 students (about 6.5 per cent) follow dual programmes combining studies and work experience. The key figures relating to students by broad field of education are presented in Figure 29 below.

Figure 29 Key figures, students (2011/2012)

<table>
<thead>
<tr>
<th>Science and Technology</th>
<th>Health</th>
<th>Social Sciences and Humanities</th>
<th>Teachers and sport teachers training</th>
<th>Other</th>
<th>Total number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of students</td>
<td>8,316</td>
<td>4,466</td>
<td>616</td>
<td>1,694</td>
<td>308</td>
</tr>
<tr>
<td>% of the total number of students</td>
<td>54%</td>
<td>29%</td>
<td>4%</td>
<td>11%</td>
<td>2%</td>
</tr>
</tbody>
</table>

UJF, Key Figures 2011-2012 (in French)

The university offers training in 15 units and departments, including a University Institute of Technology (Institut Universitaire de Technologie, IUT) and an engineering school. Studies range from vocational education to doctoral programmes and are presented in Figure 30 below.

Figure 30 Key figures, study programmes (2011/2012)

<table>
<thead>
<tr>
<th>Study programmes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate vocational education</td>
</tr>
<tr>
<td>Bachelor programmes</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Master programmes</td>
</tr>
<tr>
<td>Full study programmes</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

24 Teacher-researchers is the terminology used to define academic staff working in the French higher education system and who teach classes and conduct research in their field of expertise with a full tenure.

25 UJF, Key Figures 2011-2012 (in French)

26 Instituts Universitaires de Technologie provide undergraduate vocational technology curricula and are embedded within most of French Universities
Study programmes

- Medical and pharmacy school
- 10 Research and Innovation postgraduate programmes (equivalent to 18 months study after a master or engineering programme, during which the student is hosted by an enterprise and carries out a short industry thesis)
- 14 doctoral schools offering 90 doctoral specialisations

UJF, Key Figures 2011-2012 (in French)

5.1.1 A strong research focus

UJF is a research university, recognised for the excellence of its research\textsuperscript{27}. It reached the 151-200 rank in the 2011 Shanghai Jiaotong World Ranking of Universities and is the 7th French University in the ranking\textsuperscript{28}. The university is host to 50 research laboratories, active in four research poles: chemistry, life science and health science; mathematics and ICT; material science, engineering and environment; social and human sciences.

The focus on social sciences and humanities (SSH) research is a relatively recent development, unusual in a science, technology and medical university. This development is attributed to the willingness to build up an interdisciplinary approach to science and technology research in conjunction with the development of collaboration with other universities within the PRES-Grenoble University (such as that with the Pierre-Mendès-France University specialising in the SSH field).

The regional integration of research activities is further exemplified by the number of shared research structures between UJF, other higher education institutes and public research organisations (typically the CNRS). More particularly, the university participates in international research centres situated in the Grenoble area (e.g. the European Synchrotron Radiation Facility (ESRF), and the Institute Laue-Langevin (ILL), the world's leading facility in neutron science and technology).

5.1.2 The Grenoble area: a dynamic and collaborative environment

In spite of the fact that Grenoble is only an average-sized city, the Grenoble metropolitan area is a dynamic research and innovation environment, host to many and varied renowned research institutes, for example: the Centre for Atomic Energy (CEA); the National Centre for Scientific Research (CNRS); the National institute for Health and Medical research (INSERM); and the European Molecular Biology Laboratory (EMBL). It has the largest concentration in R&D jobs in France after Paris (23,400)\textsuperscript{29} and it has established itself as one of the leading European centres in terms of high-tech industries (e.g. STMicroelectronics, Orange Lab, Thalès, Sogeti, HP, Capgemini, Schneider Electric), in the fields of bio- and nanotechnologies in particular.

Grenoble saw the creation of one of the first French clusters, attesting the R&D intensity and long collaborative tradition within the area. This cluster – Minatec - specialised in the field of micro-technology and was initiated by regional and local policy-makers in 2005, pre-dating the 2007 national competitiveness cluster policy.

\textsuperscript{27} AERES (2010), Evaluation report on the UJD (in French)
\textsuperscript{28} UJF, Key figures 2011-2012 (in French)
\textsuperscript{29} Grenoble-Isère Economic Development Agency (2012), Key figures Grenoble-Isère, 2012
### Key Figures, Grenoble area

- 46,900 students of which 33% study at UJF
- 708 foreign-owned companies
- 3 industry technological research centres ( Mechanical industries technology centre, Construction science and technology centre, Paper technology centre)
- Four major research facilities ( European synchrotron radiation facility, Institute Laue-Langevin in neutron science and technology, European Molecular Biology Laboratory, International research institute for radio astronomy)
- 26,500 jobs in the advanced technology industry (which is the leading industry sector in the Grenoble area)
- 39,000 jobs in Information and communication technology (ICT), 10,000 jobs in the field of biotechnology


### 5.2 Drivers of the education model

#### 5.2.1 The open recruitment process

With the exception of a few study programmes (such as that offered by the University Institutes of Technology), French universities have an open recruitment process. In other words, all students who have achieved their secondary education can attend university. In addition, student fees at French universities are low in comparison with international standards (in 2011/2012 basic fees are €177 for bachelor students, €245 for master students and €372 for doctoral candidates). This means that universities welcome students coming from highly heterogeneous social and education backgrounds and it is core to their mission to ensure equal opportunities for all.

As a result of the variety of its students, the education activities carried out at UJF concentrate on two contrasting aspects: attracting the best students to the university and developing their potential, and supporting the students who are lagging behind to ensure success in their studies. Ensuring that support is tailored to all needs is by far the most challenging aspect of open recruitment universities. UJF relies on a balance between education schemes that are tailored for the best students (e.g. internships in research labs for the best bachelor students, specific research training for bachelor and master students), together with education schemes that support the inclusion and retention of people who are experiencing difficulties (e.g. tutoring, small group work, support for study orientation). With respect to the students who are lagging behind, the aim is to ensure that they do not drop out from university. Active support has been provided by the French government through the 2007 ‘Bachelor Plan’, which is aimed at developing personalised support for all students in the first years of their studies.

#### 5.2.2 Reforms at French universities

**Emphasis on vocational education**

The French university system has undergone major reforms over the past decade. A first set of reforms, within the framework of the Bologna process, focused on promoting vocational education at universities. More specifically, vocational bachelor programmes were introduced and vocational master programmes replaced the specialised tertiary study diploma (the so-called ‘DESS’). A typology of study programmes offered at French universities since the reform is presented below, with details of the terminology used above in the presentation of study programmes at UJF.

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Education and training in France (based on a review by the European Centre for the Development of Vocational Training, CEDEFOP)

The grading and diploma structure at tertiary level has changed following implementation of the three-cycle system (bachelor/master/doctorate). Types of qualification are as follows:

▪ Diplomas obtained after two years' study (equivalent to 120 ECTS credits) and that directly prepare students for entry to work: the tertiary technical diploma (DUT) and the advanced technical diploma (BTS). While secondary education institutions offer BTS, DUT are part of the university system and are developed at University Institutes of Technology (IUT). Unlike most of the usual university programmes, IUT select their students.

▪ Diplomas obtained after three years' study (equivalent to 180 ECTS Credits): general and vocational bachelor’s degree. Vocational bachelor programmes offer students a means of obtaining vocational qualification in response to specific needs and for specific trades. They combine theory-based study with practical workplace experience and the completion of a mentored project.

▪ The ‘masters’, a degree obtained after five years' study (equivalent to 300 ECTS Credits): while vocational master degrees prepare students directly for work, research master degrees lead on to what is normally a three-year doctoral programme;

▪ The doctorate, a postgraduate qualification equivalent to 480 ECTS Credits

Source: CEDEFOP, Vocational education and training in France, 2008

Autonomy, integration and university-industry links

A second set of reforms has followed the 2007 Law that granted wider autonomy to French universities. They have focused on two key challenges:

▪ The segmentation of the French higher education system

▪ The linkages between university and business

With regards to the segmentation of higher education institutions, the answer has mainly consisted in bringing local universities and research institutions within PRES, with a view to enhance critical mass and international visibility of higher education at the local level. PRES have been coupled with the ‘Operation Campus’ programme, which provides investment in premises for the development of 12 international campuses across France. The objective is basically to build new infrastructures and limit the physical segmentation of universities (which are traditionally fragmented across several locations, as the example of the UJF shows). The Grenoble PRES, Grenoble University, is carrying the ‘Grenoble University of Innovation’ project, which was awarded a €400m ‘Operation Campus’ grant in 2009. The project includes the development of eight ‘thematic poles’, which will bring together, under the same roof, education departments, research units, cooperation and technology transfer structures and continuing training providers. As of July 2012, most of the premises are still under construction, though some of the activities have already started.

With regards to university-industry linkages, the focus has been put mainly on three dimensions:

▪ Research and innovation collaboration (e.g. through national competitiveness clusters policy, five of which include UJF; the ‘Investment of the Future’ programme that promotes innovation through initiatives, laboratories and equipment of excellence)

▪ Development of entrepreneurship amongst students (through the 2009 ‘Students-Entrepreneurs Plan’)

▪ Facilitation of university staff mobility, consulting or entrepreneurship activities (with the ‘Public-Private Bridge’ programme).

Reforms at Université Joseph Fourier

These successive reforms have had wide-ranging impacts on the strategy of the Université Joseph Fourier. As noted above, the university is part of the PRES-Grenoble University and is part of several initiatives launched within the framework of the ‘Grenoble University of Innovation’ project. More specifically, it leads the ‘thematic pole’ International Software and Smart Systems Cluster (Pils). Pils is organised around three dimensions - basic research, applied research and training – and when fully developed, it will bring together more than 1,900 people. The integration research centre (CRI) started
in 2009 is Pilsi’s first major creation, with the purpose of building bridges between industry and research to reduce time-to-market for innovative products.

In terms of strategy, the 2011-2015 multi-annual contract between the university and the French State mentions society and industry needs as a key orientation of activities conducted at the university. It stresses the objectives of UFJ for the forthcoming period, such as that aimed at developing interdisciplinary research and training, entrepreneurship, linkages with enterprises (e.g. through a framework agreement with the General Employers Confederation for Small and Medium Enterprises), and dual study systems that include work experience. Several of these reforms are detailed in the section 5.4 below.

5.3 Collaboration with industry partners

5.3.1 Extensive university-research-industry partnerships

Research and innovation collaboration

The dynamism of the Grenoble ecosystem is served by the presence of a number of public and private research actors. There is a strong sense of belonging to the same locality and partnerships are very integrated locally. Many of the research and innovation collaborations happen in the local collaborative structures set up as a result of a series of national measures for science-industry collaboration, starting with the competitiveness cluster policy (see Figure 31 below).

Figure 31 Examples of participation of the UJF in collaborative research and innovation structures

<table>
<thead>
<tr>
<th>Description of the measure</th>
<th>UJF’s participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitiveness clusters</td>
<td>Participation of the UJF in five clusters in the fields of:</td>
</tr>
<tr>
<td>71 competitiveness clusters awarded by the French government</td>
<td>• Micro- and nano-technologies, embedded software,</td>
</tr>
<tr>
<td></td>
<td>• Health, vaccines</td>
</tr>
<tr>
<td></td>
<td>• New energies, nuclear energy</td>
</tr>
<tr>
<td></td>
<td>• Eco-technologies</td>
</tr>
<tr>
<td></td>
<td>• Chemistry, environment</td>
</tr>
<tr>
<td>Carnot institutes</td>
<td>UJF hosts two Carnot institutes, in the fields of:</td>
</tr>
<tr>
<td>Carnot is a label awarded by the French government to research units for four years label for their involvement with business enterprises</td>
<td>• Intelligent software and systems</td>
</tr>
<tr>
<td></td>
<td>• Future Energies</td>
</tr>
</tbody>
</table>

Technopolis, based on the website of UJF

Technology transfer

In line with the focus on technology transfer in the strategy of the university, the achievements of the university were praised in the last evaluation performed by the French Evaluation Agency for Research and Higher Education (AERES)\(^{31}\). Its success is manifest in the outcomes of the technology transfer office (TTO) – Floralis – created in 2004 in the form of a private subsidiary (see frame below). The UJF also takes part in a collaborative innovation and knowledge transfer support structure – GRAVIT – which brings together ten higher education and research structures in the Grenoble area, as well as in the local Grenoble Alps Regional Incubator (GRAIN).

\(^{31}\) AERES (2010), Evaluation report on the UJD (in French)
Education in the knowledge triangle

Key Figures of the UJF TTO (2011-2012)
- 350 active patents
- €5m annual income from intellectual property rights and €16m from contract research
- 31 start-ups created
- 50 ongoing technology transfer projects
Source: UJF, Key Figures 2011-2012 (in French)

Teaching, curriculum development, governance and evaluation

On the whole, close research and innovation linkages exist between UJF labs and industry partners, which contributes to create notable opportunities for education-centred cooperation. Examples are:

- Internships are integrated in vocational bachelor and master programmes, and even students who are involved in a research master programme have the opportunity to carry out an internship in a business R&D unit
- Industry partners teach 20 to 30 per cent of the courses that are delivered in the vocational master programmes and engineering programmes
- Industry partners can participate in the Development Board of study programmes (their presence is mandatory in all master and engineering study programmes)

In addition, out of the 20 members of the University’s Administration Board, seven are external to the university and at least one comes from industry. Industry partners also take part in the University’s Board for studies and university life, and the Scientific Board.

With regards to the evaluation of universities’ activities, 2007 saw the establishment of the French Evaluation Agency for Research and Higher Education (AERES), which is in charge of evaluating all research and higher education institutions, research organisations, research units, higher education programmes and degrees in France. The creation of AERES is associated with the unification and centralisation of evaluation mandates, which previously belonged to a range of different organisations. It is also a further step in the development of evaluation practices, as university-business cooperation (UBC) is part of the criteria that are used by the Agency. Examples of UBC criteria are: participation of industry partners in university’s boards and committees, involvement in research and education activities, incentives to develop collaboration, and participation in the strategic design of vocational tertiary education.

5.3.2 Bringing research, innovation and education activities together: the GIANT Campus and the KIC InnoEnergy

Bringing research, education and innovation partners together has been on the agenda of the local partners since 2006, with the central idea to promote integration over the traditional segmentation of the French university system. The GIANT Campus (Grenoble Innovation for Advanced New Technologies Campus) launched in 2008, was initiated by UJF, together with the Grenoble Management School, Grenoble National Institute of Polytechnic, CEA, CNRS, EMBL, ESRF, and the ILL. Local authorities and agencies as well as businesses are also involved as partners (including Schneider Electric, bioMérieux, Siemens, STMicroelectronics, SEM MINATEC Entreprises, etc). Three regional competitiveness clusters are also taking part in the initiative.

Essentially, GIANT is an infrastructure project, which brings together research, innovation and education activities around three areas of high societal relevance: communication technologies, renewable energies and environmental issues, and bioscience and healthcare. It is conceived as a space for experimentation, which fosters cross-disciplinary collaboration and offers opportunities for formal and more informal interactions. Once finished, the campus will represent a complex of premises and facilities, spread over 250ha.

The GIANT Campus is organised around three centres of excellence in applied research: the Minatec cluster, Nanobio and GreEN. Even though the initiative was launched by local stakeholders, GIANT is in line with the wider set of reforms undergone by the French higher education system and it has
received financial support from the different national initiatives (amongst others within the framework of the ‘Grenoble University of Innovation’ project, the ‘Investment of the Future’ programme, etc).

GIANT is also host to the premises of the Knowledge and Innovation Community (KIC) InnoEnergy in the Grenoble co-location centre (known as ‘Alps Valley’), which were opened in July 2012.

**KIC InnoEnergy** is one of the first three Knowledge and Innovation Communities that are part of the European Institute of Technology (EIT). KIC InnoEnergy addresses sustainable energy as its priority area. It is a European company fostering the integration of education, technology, business and entrepreneurship and strengthening the culture of innovation. The Consortium consists of 30+ shareholders and additional 50+ partners - companies, research institutes, universities and business schools covering the whole energy mix. They are organised around six regional units, the Co-Location Centres (CC): Alps Valleys, Benelux, Germany, Iberia, Poland Plus and Sweden.

The **Alps Valley co-location centre**, based in Grenoble, is in charge of the sustainable nuclear and renewable energy convergence. It associates the following core partners: National Polytechnic Institute of Grenoble, Grenoble School of Management, CEA and Areva. Associate partners include other research, education and industry partners, including Schneider Electric and GDF Suez.

Alps Valley is involved in several activities led by the KIC, including:

- Four innovation projects, in which research centres work closely with companies and industrials in developing innovative technologies leading to new products and services
- The European Master in Innovation in Nuclear Energy (EMINE), which was launched in September 2011 and involves the National Polytechnic Institute of Grenoble
- Business creation services


While the **Université Joseph Fourier** is not directly involved in the KIC InnoEnergy, it is nonetheless an important factor of development for its local industry partners. It allows the development of business-oriented innovation projects, and could lead to the development of a wider range of master degrees or e-learning programmes adapted to the new needs of the energy industry.

### 5.3.3 Schneider Electric’s interactions in the Grenoble area: a case in point

This section gives more insight in the regional collaborations within the Grenoble area, by taking Schneider Electric as an example of the ways in which local partners engage in cooperation activities with the university. Schneider Electric is a French multinational company specialising in the field of energy management, which is firmly implanted in the Grenoble metropolitan area and Rhône-Alpes region. The company has a strong presence within the Grenoble area and is one of the long-term partners of the **Université Joseph Fourier**.

Since the mid 2000s Schneider Electric has undergone major restructuring, considerably reinforcing its R&D intensity, while shifting from a mere electric-technical focus towards broader activities in the field of energy management. In order to operate this shift, the company has strengthened its relationship with external partners, in particular in Grenoble, which is one of the five innovation hubs in which the company develops local R&D partnerships (together with Boston, Monterrey, Shanghai and Bangalore).

In Grenoble, Schneider Electric collaborates actively with higher education institutions, research institutes (e.g. CNRS, National Institute for Research in Computer Science and Control) and other local industry partners. Examples of collaboration range from education, R&D and social-centred initiatives and include:

- Collaborative research projects
- Participation in the Board of the Minalogic competitiveness cluster, participation in University Boards (at the UJF, at the National Polytechnic Institute of Grenoble)

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32 Website of Schneider Electric: [http://www.schneider-electric.com/](http://www.schneider-electric.com/)
• Participation in the GIANT Campus and in the KIC InnoEnergy
• Hosting doctoral projects carried out through industrial PhDs, internships, and offering work experience for students in dual study systems
• Sponsoring students at the Vocational Higher Education School’ (ENEPS)
• Managing a programme designed to support the professional integration of young people from disadvantaged areas

Furthermore, the BipBop programme, which is part of the social responsibility agenda of Schneider Electric, is relevant here in two respects: first, it is a potential area for future collaboration between the Université Joseph Fourier and Schneider Electric; second, the programme is based on three pillars (i.e. business, research and training activities), which are close - even if different due to the underlying societal and development missions entailed - to the three dimensions of the knowledge triangle. BipBop details are presented in the frame below.

**Figure 32 Schneider Electric’s BipBop programme: Business, Innovation & People at the Base of the Pyramid**

Based on the willingness to involve local communities and local stakeholders in developing countries, the BipBop programme addresses three key issues to provide sustainable access to electricity:

- **Business**
  - Creation of investment funds to support companies dedicated to the electrical business for the Base of the Pyramid.

- **Innovation**
  - Build adequate offers/solutions to be a champion in the electrical distribution field for the Base of the Pyramid.

- **People**
  - Train young people from the Base of the Pyramid in electrical skills, sponsor them.

BipBop was launched in 2009 and is based on three pillars. Recent works have consisted in developing the synergies between these pillars.

Source: Website of Schneider Electric (http://www2.schneider-electric.com/sites/corporate/en/group/sustainable-development-and-foundation/social-commitments/communities.page) and interviews

5.4 **Overview of specific education initiatives**

5.4.1 **Vocational Higher Education School (ENEPS)**

In accordance with the core mission of French universities and as mentioned above, students from all backgrounds should be able to receive a university education and have equal opportunities to do so. However, in order to enter university, students are generally required to hold a certificate of completion of general secondary education, known as Baccalauréat Général (as opposed to vocational education awarded with a Baccalauréat Professionel).
A pioneering education scheme launched in 2009 at UJF departs from this general rule, in that it targets students who attended vocational secondary education and hold a Baccalauréat Professionel. This initiative, known as the ‘Vocational Higher Education School’ (Ecole Nationale de l’Enseignement Professionnel Supérieur or ENEPS), is unique within the French context. The objective is to offer students with promising results the opportunity to attend university and to widen their professional perspectives.

When it opened in September 2009, ENEPS only offered one programme in civil engineering. While the original idea had come from the university, local industry partners and research actors (e.g. the Centre for Atomic Energy) contributed significantly to bringing the School into operation. In particular, Schneider Electric helped to develop the idea. It also sponsors the electrical and industry computer engineering class (i.e. the second specialisation programme which opened in 2010) and offers bursaries to some of the students, on the grounds of social criteria. Other companies joined the initiative later on, such as Vinci (which sponsored the 2011/2012 civil engineering class) and Orange (which sponsored the students of the third and final class that opened in 2011, in the field of networks and telecommunications).

The three ENEPS programmes are based on existing study programmes offered at the university, which have been adapted to fit the specific needs of ENEPS students. The establishment of a fourth programme, which might be in the field of thermal energy, is being discussed. Within each field of study, ENEPS starts with a two-year programme at the University Institute of Technology, following which students can choose to stop their studies or continue with a third year bachelor programme and then a two-year master programme.

ENEPS was first designed as a pilot project. The success of the initiative and the low drop-out rate observed among the first intake encouraged academic and industry stakeholders to consolidate and expand the initiative. Due to its innovative character, ENEPS has been selected in 2012 by the ‘Investments of the Future’ programme which was launched by the government to foster innovation capacities in France. ‘Investments of the Future’ comprise a series of sub-programmes, with ENEPS selected as one of the ‘Excellence initiatives’ under the category ‘innovative training’. The School will receive €3.5m support.

5.4.2 Dual programme combining study and work experience

Université Joseph Fourier has committed itself to doubling the proportion of vocational master programmes offering dual study opportunities by 2015, as part of its wider efforts to increase the links with businesses, and to create bridges between education and industry. The objective is to offer dual study options in 50 per cent of all vocational master programmes, whereas in 2011 only nine out of the 36 vocational master programmes offer this opportunity (25 per cent). Several vocational bachelor programmes, programmes offered by the University Institute of Technology and engineering programmes are also eligible to dual studies.

In accordance with their objectives and situation, students can choose from two types of dual studies: ‘apprenticeship contracts’ (one to three years) for students attending general education, and ‘professionalisation contracts’ for vocational education (six to 12 months but can be extended to 2 years). The latter can also be provided in continuing education for job seekers. Contracts are regulated by the French government, which sets the pay levels and general working conditions.

Dual study systems are supported by regional authorities (i.e. the Rhône-Alpes Regional Council). The FORMA-SUP structure (of which the UJF is part) coordinates the regional offer for apprenticeship programmes and works as an interface between universities and enterprises. It also manages the administrative and legal aspects of apprenticeship programmes offered in regional universities.

The Research and Innovation postgraduate programme is a specific type of dual study offered at UJF. It is intended as a shorter and industry-focused alternative to a doctoral programme for students having completed a master or engineering degree (see frame below).

33 Further details are available on: http://www.formasup-rhonealpes.com
Research and Innovation postgraduate programmes

The Research and Innovation postgraduate programme (Diplôme de Recherche et d'Innovation, DRI) offered in partnership by the UJF and the National Polytechnic Institute of Grenoble consists of an 18-month work-study programme for students having completed a master or engineering degree.

The core study programme accounts for 150 hours and aims to equip students with basic skills in project and innovation management. Courses are combined with business work experience, during which the student (who has a status similar to that held by employees) develops an applied research project. The student receives support both from an industry tutor and an academic tutor from one of the university's research labs.

The DRI programme is offered both in initial and continuing training. The costs (€6,500) are paid by businesses and are eligible for various financial supports (such as the Research Tax Credit).

The DRI programme is unique within the French higher education system, where doctoral programmes are the only research-orientated postgraduate programmes usually on offer. It started more than 15 years ago and has allowed the development of a number of smaller-scale R&D projects articulated around business needs. Businesses benefit from qualified R&D human resources and have an insight in the knowledge developed at the university, while it gives students the opportunity to acquire a first work experience and to develop their R&D skills.


5.4.3 Entrepreneurship studies

An important aspect of the reforms at French universities has been the ‘Students-Entrepreneurs Plan’ (launched in 2009), by which the French government has encouraged the development of an entrepreneurship culture among university students. Initiatives have included:

- Students’ entrepreneurship clusters, intended to accompany the creation of enterprises by students: most of these were created as part of the Research and Higher Education Clusters (PRES) and Grenoble hosts the Grenoble students’ entrepreneurship cluster
- A national competition for student entrepreneurs
- Creation of junior enterprises inside universities (a relatively rare practice in the French university system)

In response to these reforms, entrepreneurship and enterprise creation courses have been introduced at UJF in master, bachelor and doctoral programmes and for those studying engineering. Similarly to the dual study programmes, the aim is to increase linkages with businesses and to prepare students for their future working life. These courses have been developed in partnership with the Grenoble students’ entrepreneurship cluster, as presented in the frame below.

Grenoble students’ entrepreneurship cluster

Grenoble students’ entrepreneurship cluster is one of the 20 students’ entrepreneurship clusters that received a label from the French government in 2010, following the call for projects launched within the framework of the ‘Students-Entrepreneurs Plan’. The cluster is a joint structure involving the six universities in the Grenoble PRES.

The cluster’s tasks are to raise awareness of entrepreneurship, train students and support business creation projects. It offers entrepreneurship courses that are integrated in the universities’ study programmes and organises various events such as forums, entrepreneurship competitions between students, and roundtables with entrepreneurs.

In addition to universities, the cluster involves several partners, including local authorities, the General Employers Confederation for Small and Medium Enterprises, the GRAIN incubator, the Floralis TTO, and Grenoble Angels (Grenoble’s business angels association).

Source: http://entrepreneuriat.grenoble-univ.fr/

In addition to the inclusion of entrepreneurship courses in some study programmes, the university also offers a stand-alone ‘Entrepreneurship and Innovation’ minor study programme. The programme lasts...
one year and is designed for students or professionals who want to develop a business creation project. Anybody can attend the programme, either as a complement to his/her studies or as continuing education.

5.5  Key success and enabling factors in the UJF’s approach

5.5.1  Local context and national reforms

In comparison with the average French university, the Université Joseph Fourier performs relatively well in terms of linkages with research and innovation stakeholders (local industry partners in particular). Local stakeholders have together initiated and developed several local collaborative structures and projects, which is evidence both of the very close links between them and their eagerness to undertake joint projects. In this respect, the GIANT Campus is a case in point and exemplifies the move towards a greater physical integration of research, innovation and education stakeholders around key thematic areas of competence for the region.

In structural terms, it seems that its success is due to a combination of two enabling factors: the local research and innovation eco-system (which has led to significant, long-term and high-quality partnerships between the university and local business actors), together with the various higher education reforms and policy measures (which have promoted entrepreneurship and provided financial support to most of the recent initiatives developed at the university).

5.5.2  A decentralised approach to partnerships inside each institution

The list of collaboration activities between the university and external partners (such as that with Schneider Electric) suggests that the wide range of collaborative activities in the Grenoble area is spread across all three dimensions of the knowledge triangle - education and training, research and innovation. Even though recent reforms have sought to bring these activities together in the same location (e.g. the GIANT Campus), there are however few examples of integration between the three dimensions in the ways in which the partnerships are conducted inside each institution. At UJF, external partnerships cover units in charge of technology transfer and education activities, which are divided between the Deputy Vice-President for Research Valorisation (part of the UJF’s Scientific Council) and the Vice-President of the Council for studies and university life (that also integrates the Deputy Vice-President for continuing education). Likewise, the example of Schneider Electric shows that external relationships of businesses are not centrally governed since they call for different sets of competencies: some staff collaborate on research and innovation activities, some on education activities and some on social responsibility initiatives such as ENEPS.

On the whole, the advantage is that collaboration is relatively bottom-up and is intensive in each single dimension. An obvious disadvantage is, however, the lack of coordination between the different dimensions of the knowledge triangle at the level of individual initiatives, even if initiatives in one dimension can lead to further initiatives in the other dimensions. Furthermore, even though responsibilities are separate at the governance level, there exist coordination arrangements between the different units and stakeholders. To cite just one example, the continuing education service of UJF cooperates actively with the TTO (Floralis) thus combining education and innovation activities.

5.5.3  Shared social mission between universities and enterprises

It is interesting to note that some of the university-industry partnerships reviewed in this case study are not based on professional or academic excellence, but rather on a social mission shared by university and business partners. For example, ENEPS shows how long-term partnerships between university and industry can rely purely on the education aspect, with no benefits for industry and university other than that derived from ensuring equal opportunities in the education system. The initiative opens the doors of university to a new potential public and increases the diversity of students at UJF. It also creates bridges between the vocational and general education paths, commonly two separate entities within the French education system.

34 AERES, Evaluation report on the UJF, 2010 (in French)
Even though research and innovation are not the core dimensions here, the list of collaborations between Schneider, for example, and UJF shows that such education-centred partnerships are only one aspect of the wider spectrum of existing collaborations and they accompany the usual range of research and innovation collaboration.

5.6 Key lessons and transferability

UJF has succeeded in developing close, long-term relationships with local research and industry partners in a wide range of activities. The integration of education in the knowledge triangle is seen in the multiple characters of these collaborations, which integrate amongst other aspects initial and continuing education and training, as well as in the move towards the physical colocation of research, innovation and education stakeholders (as exemplified by the development of the GIANT Campus and the KIC Inno-Energy).

Even though one of the main reasons for this success is the local eco-system for innovation, some interesting lessons can be drawn on the ways partnerships are managed within the Grenoble area. In particular, the relatively decentralised approach to collaboration at the university and amongst partners is noteworthy and has contributed to the wide range of collaborative activities that can be observed within the Grenoble area. This is coupled with the fact that partnerships are increasingly embedded within local collaboration structures or projects, which are shared by local research, innovation and education partners (within the PRES-University of Grenoble and the eight ‘thematic poles’ developed within the framework of the ‘Grenoble University of Innovation’ project).

With regards to education activities, French universities face many challenges and have undertaken major innovative reforms over the past few years. The Université Joseph Fourier is a case in point and has developed two main responses to these challenges:

- Strengthening the vocational component of its education activities (vocational education pathways at bachelor and master level, dual study system, continuing education, etc), with a view to enhance the employability and the future professional integration of students
- Developing entrepreneurship education, with a view to spread entrepreneurship culture amongst students and to encourage business creation and risk-taking in France

More specifically, some of the initiatives reviewed here present interesting features which could be replicated in other contexts. In particular, the ‘Research and Innovation’ postgraduate programme could be transferred to other higher education institutions as a way to enhance students’ integration in the job market and enterprises’ access to research and innovation skills. Likewise, ENEPS is a valuable initiative that could be copied in the longer run by other French universities. It shows the benefits resulting from the diversification of the student public, both for businesses, which can access to more vocational profiles and for the students themselves, who are offered new pathways to university education.

Key to future training activities at UJF is the development of lifelong training for enterprises. Even though apprenticeship and dual study systems have been considerably expanded over the past few years, when it comes to a shorter-term training offer, universities are traditionally not the main providers of continuing training to enterprises in France. For UJF, the challenge therefore consists in developing its attractiveness and establishing a thorough communication strategy towards enterprises. In this respect, the Grenoble PRES plays a key role in coordinating the approach of the six universities in the Grenoble area and enhances their visibility on the market against private providers.

5.7 Contacts, references

5.7.1 List of interviewees

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<tr>
<th>Name</th>
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<tr>
<td>Jean-Claude Fernandez</td>
<td>Vice President of studies and university life</td>
<td>Université Joseph Fourier</td>
</tr>
<tr>
<td>Jean-Gabriel Valay</td>
<td>Deputy Vice-President for charge of</td>
<td>Université Joseph Fourier</td>
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5.7.2 References

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- Website of the IUT of the Université Joseph Fourier: http://www-iut.ujf-grenoble.fr/accueil.html
- Website of the Grenoble University: http://www.grenoble-univ.fr/
- Website of Schneider Electric: http://www.schneider-electric.com/

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<th>Name</th>
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<tr>
<td>Sylviane Benistant</td>
<td>Administrative Director, Vice-President for training, university life and professional integration</td>
<td>Université Joseph Fourier</td>
</tr>
<tr>
<td>François Milioni</td>
<td>Training Director, ‘Energy access’ programme</td>
<td>Schneider Electric</td>
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<tr>
<td>Sylvain Paineau</td>
<td>R&amp;D Partnerships &amp; Valorisation Manager</td>
<td>Schneider Electric</td>
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6 Karlsruhe Institute of Technology

6.1 Introduction

Karlsruhe Institute of Technology (KIT) is one of the most prominent scientific institutions in Germany, established by the merger of a university and a national research centre in 2009. KIT is located in a very innovative region of Germany, between Frankfurt and Stuttgart and has capitalised on the resources of the broader region and the merger by diversifying its faculty to include business professionals and research scientists. The institute is managing the transition with tools to encourage innovative teaching practices, and with aim of educating world-class scientists.

6.1.1 National / regional framework

KIT is located in Karlsruhe, in the state of Baden-Württemberg, ranked the most innovative region in the EU according to the 2010 Innovation Index. Research expenditure was 4.8 per cent of GDP in 2009, the highest in the EU, with the private sector as the primary R&D investor with an investment of €13billion. Twenty per cent of the jobs in the region are in research and development. The automotive, mechanical engineering, software and pharmaceutical sectors are especially strong.

The research infrastructure in Baden-Württemberg consists of 70 institutes of higher education. Additionally, there are many research organisations, including 12 of the 85 internationally renowned Max Planck Institutes and 14 of the 60 institutes of the Fraunhofer-Gesellschaft. The private sector cooperates closely with the research-oriented universities and institutes in the region. It invests in research and teaching, this includes financing over 70 endowed professorships at the universities in the region.

The vast number of research institutes are connected through a range of intermediaries. Research networks and clusters stimulate interdisciplinary research and joint projects. Comprehensive networks of transfer centres, such as the technology transfer offices at the universities, play an important role in developing relationships and opportunities. Other intermediaries include organisations dedicated to research marketing, transferring technology to SMEs, non-profit organisations devoted to business assistance, and a range of technology and sector specific institutions.

Strong performance of the universities in the region is reflected by the results of Germany’s ‘Initiative for Excellence’, a €1.9billion programme designed to fund top-level research facilities. Four of the nine universities awarded ‘elite’ status were from the Baden-Württemberg area acquiring a total of €600million in funding. It was as a result of this initiative that Karlsruhe University and Karlsruhe Research Centre merged to form KIT in 2009. The university and research centre have a history of joint research and many overlapping areas of competence, making them a good fit.

6.1.2 Basic information on the institution

KIT brought together the resources of a university with those of a large-scale research centre in natural sciences and engineering. The institute is modelled on the Massachusetts Institute of Technology, the aim being to excel in the areas of research, innovation, and teaching and to eventually join the ranks of the top universities in the world. In the 2011 QS World Rankings, the university was ranked 147th in the world. Addressing the knowledge triangle of research, education, and innovation is an explicit goal of the institute. This can be seen in KIT’s five ‘visions’ which orient the activities at the institute:

- Attracting the best minds from all over the world
- Becoming the leading European centre of energy research
- Playing a role in nanosciences that will be visible worldwide
- Being a leading innovation partner of industry
- Setting yardsticks in teaching and promotion of young scientists.

With state, federal, and third-party funding, KIT now is a legal entity pursuing several approaches to research, education, and innovation. Some 9,000 employees and around 370 professors supervise
the work of about 22,000 students. KIT has an annual budget of approximately €800 million. In addition to the Excellence Initiative, KIT is funded partly by the German Research Foundation. Apart from public funding, the university has received funding from many companies and private donors, such as a €200 million donation from the SAP co-founder Hans-Werner Hector.

In terms of education, the university offers 60 courses. The university is investing €96 million in future-oriented fields, such as nanobiology, optics, and photonics. KIT has defined 29 fields of competence in 6 areas: matter and materials, applied life sciences, earth and environment, impact on society, information, communication and organisation, and systems and processes. To provide for interdisciplinary and innovative approaches, KIT has established Centres as well as Focuses (potential KIT centres with medium-term strategy in highly specialised field). According to the ranking of scientific impacts of leading European research universities, KIT is currently ranking 6th in Europe and 2nd in Germany in terms of citation impact.

6.2 Governance of the institution

For historical reasons, the innovation culture of the university and that of the research centre were very different. The research centre was organised as a centralised facility and served a single research orientation, cooperating very closely with industry in the fields covered. Innovation was aligned to its research programmes. The university, on the other hand, had a decentralised focus on research. Many projects were carried out and innovation was the individual focus of the various faculties. The current goal is to combine the two innovation cultures, keeping the best attributes of each. The first objective is to develop trust and confidence between the scientists of the research centre and those of the university for them to openly discuss their ideas and share contacts. Part of this change in culture will support the teaching of ideas that may have the potential to be transferred to business. A second goal is the promotion of interdisciplinary research.

Education at KIT is of a high quality and closely coupled with research. KIT has developed a joint competence portfolio, with scientists from the research sector now having the opportunity to teach students at KIT. Specific methods to include research scientists in university work vary from department to department.

In addition to teaching and research, innovation is the third pillar at the institute. Research relevant to business and society is encouraged at KIT. External partners are approached through various formal and informal networks. Examples are business clubs on campus in which business leaders are invited to give talks and the innovation advisory board that consists of stakeholders from business who advise the university board.

6.3 Educational aspects of the initiatives

At KIT, students are fully integrated in research through complementary exercises, tutorials, and projects. Students are expected to achieve advanced qualifications and capabilities for teamwork, project-oriented learning, and intercultural experience. Interdisciplinary programmes for undergraduate and graduate studies have also been developed to break down disciplinary silos. Internships and projects provide for an early contact with large-scale research. They are integrated in the knowledge triangle. A large-scale and innovative method of evaluation of courses is implemented to ensure high quality education practices.

KIT has launched a series of initiatives that address research, education, and innovation. The following initiatives are related to education.

6.3.1 Shared professorships and associate lecturers from industry

Prior to the formation of KIT, several departments at the university granted endowed chairs to industry representatives, teaching one day a week in courses of their choice. The success of this initiative has led to a follow-on initiative with a large number of part-time lecturers and professors from industry who teach at KIT. The state funds the initiative on behalf of KIT. Cooperation between industry and university produces new perspectives for both sides.
Similarly, shared research groups give research students an opportunity to interact with industry representatives in a laboratory setting. The shared professorships are financed half-and-half by KIT and partners from industry.

Industry professionals are given the opportunity to lecture students through sophisticated networks in the Karlsruhe region. Professors from the university offer relevant teaching positions to professionals that they know external to the university, while intermediaries also play a role in aligning business interests with the needs of the university. The incentives for business professionals to teach are primarily personal - they want to share their experience and motivate students. They are personally motivated to work with students specifically at KIT because of its reputation for excellence.

The industry professionals value the opportunity to teach in order to identify and direct the best students for future employment and to gauge trends in technology among future scientists. They also add an industry perspective to the curriculum.

6.3.2 Professorships for scientists

A new professorship is being granted to scientists working in the research sector so that they can teach. As a result, the number of scientists and engineers available for teaching has increased.

While studying, the students are familiarised with large projects in research and application driven teaching modules. In these modules students learn to apply theoretical concepts in illustrative and case-driven projects. For example, students may be given a patent and asked to develop a business plan.

The House of Competence (HOC) integrates research scientists in the domain of lecturing. It focuses on developing 'Study cultures under large-scale research conditions'. Project-based learning and teaching formats compatible with large-scale research are encouraged throughout the university. Scientists who are incorporated as professors are better able to find opportunities for these new forms of teaching because they are familiar with large-scale research. The HOC is explained in more detail in the following section.

6.3.3 Development of teaching and learning capacities

Teaching and promoting young scientists are among the main objectives of KIT. Promotion of young scientists at KIT starts early: they are assigned a mentor who is a member of the faculty, or a staff member in the research sector. The mentor engages the young scientist in teaching functions, allowing him or her to work with students at a much earlier age than previously.

As introduced above, the HOC is a centre devoted to the acquisition of key competences in developing and delivering lectures and courses. Alongside administration, the centre conducts research in the field of skills development. It is part of KIT and funded by the Ministry of Science, Research, and the Arts of the state of Baden-Württemberg and has many partners, such as the intermediary organisations in the Karlsruhe area. It promotes the development of interdisciplinary training programmes at KIT and provides a basis of practical knowledge relevant to research and business.

Interdisciplinary research groups at the HOC consider new scientific approaches in both social and natural sciences. They implement their research findings through training. The HOC focuses on three complementary learning objectives:

- The first is the understanding of the social and cultural context of research. It is aimed at ensuring that students are able to consider the views of others and reach across disciplinary and cultural silos
- The second learning objective is the practical application of knowledge in general professional practice. Students are to gain insight into professional processes and strategies, such as legal and management issues, in the course of their education. Students also learn to develop professional relationships
- The third learning objective is the development of non-scientific cross-over skills, such as social, intercultural, and media skills. Students are to be able to solve problems and evaluate their own work. Students are also taught time and knowledge management techniques.
The HOC also offers several elective courses, such as Personal Fitness and Emotional Competence, for advanced bachelor and master students. They focus on the development of general transferable skills applicable to a range of specialised courses. These courses use innovative teaching and learning methods, including research-based learning, problem-based learning, hands-on project work, self-directed work, role-play, case studies, expert interviews, group exercises, and excursions.

6.3.4 Student enterprise club

The institute hosts PionierGarage e.V, a student enterprise club at KIT encouraging entrepreneurship amongst KIT students. Currently there are 50 members. The platform provides an opportunity for students to present their business ideas to an international network of students, start-up founders, investors, and experienced entrepreneurs for advice and review. The club provides know-how and methodologies through a series of events where students, researchers, and business advisers meet. The club cooperates closely with internal and external organisations related to entrepreneurship, especially startups. It serves to develop a culture of entrepreneurship at KIT.

6.3.5 Research to Business Live

Research to Business Live is an extracurricular platform where researchers, students, and experienced entrepreneurs can work together. Students work in interdisciplinary teams to design business models for technologies developed by KIT researchers. Successful entrepreneurs from the Karlsruhe region supervise the work. The students also cooperate with local initiatives, such as the Cyberforum, a non-profit organisation that provides resources, e.g. moderated collaboration platforms, events and lectures, and a business angel programme to a network of over 8,000 stakeholders in the Karlsruhe region.

The students are the main facilitators of the projects. They are involved in every phase of the project from team building to marketing technologies from KIT. Students submit their business plans to experts, business angels, and mentors for feedback and advice. They may go on to submit the proposal to entrepreneurship competitions.

6.3.6 Entrepreneurship education

KIT has developed several bachelor and master programmes that cut across disciplines and prepare students for research and business with innovative teaching methods. Some of these degrees combine business and economics and engineering modules. Students customise their own degree. The course work is split equally between natural and social sciences. In the case of master’s degrees, students are obliged to spend 6 months at a company to develop a business plan for their thesis, in addition to coursework.

The faculty responsible for teaching is well connected to both business and research. Staff often provide counselling on marketing, cost reduction, or reduction of energy consumption for new technologies. An increasing number of faculty members in both engineering and economics departments at KIT have worked in industry. Prior to the formation of KIT, the university primarily employed full professors, few of whom had business experience. The new teaching methods focus on project-oriented work. Whenever possible, course work is performed in an innovative manner, with, for example, guest lecturers from industry giving lectures.

Students are engaged in ‘action-learning’ where they are asked to tackle relevant problems. They may be asked to develop a new concept for a venture, design a prototype product for a real company or to counsel young companies. The goal of this type of learning process is to learn as much as possible about how research, business, and entrepreneurship operate in practice.

6.3.7 KIC InnoEnergy

KIC InnoEnergy is one of the Knowledge and Innovation Communities (KIC) of the European Institute of Innovation and Technology which pools actors from education, research, and business in the field of sustainable energy. The InnoEnergy KIC is organised around six co-location centres. KIT is a formal partner of the co-location centre in Germany and has established two study programmes under KIC InnoEnergy. As a result of participation in the KIC, KIT recently started an executive education
programme in Energy Engineering at its Hector School of Engineering and Management. This programme addresses engineers with industry experience, and the course combines technical and management modules. KIT is also responsible for a new Master’s programme in Energy Technologies that also includes an interdisciplinary curriculum and hands-on experience. The first class is due to commence in the winter of 2012.

6.4 Transferability of the approach

KIT has a short history in its current organisational structure. Many of the education platforms mentioned in the previous section are less than a year old. Before the merger, the vast majority of academic staff were full-time professors and few had industry experience. Now, many professors have industry experience. Integration of business and research professionals in teaching is changing the nature of education at the university.

Currently there are efforts to improve the structuring of teaching opportunities for industry professionals: one suggestion for the improvement of the link between education and industry is the development of a web portal that lists profiles of classes industry professionals may access, and lecturing requirements. This would create a web-based marketplace for those interested in teaching. It would also create a space for communication and networking between associate staff.

Interesting developments will be revealed with the help of a careful system of evaluation35. KIT has developed a teaching quality index, for which students are asked to evaluate whether their courses meet their individual learning needs. Also the lecturers are keen to use the course evaluation scheme, because it gives them critical feedback on how to improve the quality of their courses. Fifteen other universities are interested in adopting the evaluation method36, among them universities in Brazil and Vietnam37.

The KIT evaluation results will illuminate lessons to be drawn from the change of education practices, many of which will be of interest to the wider higher education community considering how to improve the integration of teaching and learning in the knowledge triangle. In the meantime, the development of the House of Competences, as an institute that researches education and applies its findings in the form of classes, is a model that may be transferred to other universities.

6.5 Key lessons

Education at KIT combines conceptual and theoretical concepts with illustrative and case-driven teaching. The Institute is committed to educating students so that they acquire a high degree of know-how and hands-on experience in business and research.

The development of these new methodologies links education to business and research. Innovative new teaching strategies and diverse faculties with experience in research and industry ensures the development of new curricula. Teachers encourage students to apply design thinking to concrete problems.

The role of students themselves in KIT’s approach is very prominent, not only in the action-learning approach which brings them face to face with real-life challenges, and the customising of their own degrees, but also in the Research to Business Live platform and the Student Enterprise Club.

KIT has developed structures and methods, such as the House of Competence and the evaluation system, to assist teachers in this new style of education. Young scientists and students are trained from an early age to become leading scientists.

The engagement of professionals from industry as teaching practitioners appears to be a dynamic and productive feature of the KIT approach, alongside the inclusion of researchers as teachers, further strengthening the education dimension of the knowledge triangle.

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6.6 Contacts, references

- Professor Orestis Terzidis, Director, Institut für Entrepreneurship, Technologie-Management und Innovation, Karlsruhe Institute of Technology
- Dr. Rüdiger Eichin, Product Manager, Research and Breakthrough Innovation, SAP AG
7 Mondragon University (MU)

7.1 Introduction

7.1.1 A pillar of the regional Mondragon Corporation’s model

Mondragon University (MU) is located in the Basque Country, in Spain, with its main campus in the small town of Mondragón itself, in Gipuzkoa Province. MU has a unique status in Europe, as a private, not-for-profit, cooperative university.

This unique status originates in the history of the Mondragon Cooperative Corporation (MCC), the world’s largest worker cooperative and possibly the most successful example of worker-owned enterprise in the world. Father José María Arizmendiarrieta, a Jesuit priest, founded the MCC in the 1940s, after the Spanish Civil War, with the objective of creating employment based on solidarity. At the end of 2010, the MCC comprised 256 companies, providing 83,859 jobs in four core areas of activity: finance, industry, retail and knowledge (including the Mondragon University)\(^{38}\). The MCC is the largest business company in the Basque Country and the seventh largest in Spain, as regards both sales and workforce. The Corporation has now globalised its activities and in 2011 was operating internationally, with nine corporate offices and 93 industrial plants overseas.

The university was created in 1997 as a cooperative within the MCC. It was based on the association of three existing cooperatives: a Polytechnic School (which started in 1943 as a technical college), a Business Administration School (1960) and a teacher training college (1976). These provide the university with its existing structure, divided into three faculties and one school: a Polytechnic School; a Faculty of Business Studies; a Faculty of Humanities and Education. The Culinary Science Faculty was created more recently in 2011.

The historical development of the MU alongside the MCC has created a firm basis for cooperation between the university and its local ecosystem. In addition to the university, the three pillars of the MCC’s research and innovation system, orientated through the Mondragon Science and Technology plan 2009-2012, are as follows:

- The Garaia Innovation pole, which is part of the Basque Technology Parks network. It encourages R&D collaboration and projects in various fields of activities, including energy, materials, business and management, electronics, microelectronics, nanotechnology, and ICT. It hosts the SAIOLAN Business Innovation Centre, charged with supporting entrepreneurship and the creation of local businesses

- The 15 technology centres, of which some are part of the two Basque networks of technology centres (IK4 and Tecnalia) are engaged in research in specific fields: mechatronics, machine tools, packaging machines, lifting systems, automotive, forming and assembly, energy, optics, thermoplastics, business management. The technology centres’ objective is to provide services and support for technology transfer

- The Mondragón New Business Development Centre, which develops new sectors of activities for local businesses, and focused on the energy and health sectors

Mondragon’s dynamic local R&D system has also been influenced by the numerous developments in the overall Basque country’s R&D strategy over the last 20 years. The Basque country is an autonomous community with large prerogatives in terms of research and innovation, compared to other non-autonomous Spanish provinces. According to the OECD regional review of 2011, it is one of the leading regions in Spain with respect to several economic and innovation-related indicators, more particularly with regards to enterprises’ R&D activities\(^{39}\). One of the strengths of the Basque innovation


\[^{39}\] OECD (2011). Reviews of Regional Innovation, Basque Country
Education in the knowledge triangle

system lies in its technology centres, noted above. These were created in the 1980s and have a strong international reputation in the European Research Technology Organisations (RTOs) landscape. A new impetus has been given recently to the regional innovation system with the 2007-2010 Science and technology Plan and the creation of the Basque Innovation agency (Innobasque).

7.1.2 A cooperative and decentralised governance

Mondragon University has a very decentralised structure, which is articulated around four cooperatives (one for each Faculty/School) with their own governing bodies. The cooperatives forming the university are owned by their staff.

The MU is the overarching cooperative. It comprises three governing bodies, (see Figure 33 below): a General Assembly, a Governing Board and an Executive Board. Staff (‘Worker partners’), students (‘user partners’) and associated companies and entities (‘collaborating partners’) are represented in the General Assembly and – to some extent – in the Governing Board. The cooperative is collectively self-managed, and has the interests of the collective stakeholders at its core. Any vote at the General Assembly is based on the principle of one person, one vote (with no distinction as regards to qualification and hierarchical level). Participation and mutual engagement are therefore fostered at all levels.

Figure 33 Mondragon University’s cooperative governance structure

Presentation document from the Mondragon University (2011)

7.1.3 A strong focus on education

With 3,018 undergraduate, 472 graduate and 120 PhD candidates enrolled during the course of 2009-10, the university is relatively small. In 2010/2011, 565 staff were employed (of whom more than 60 per cent at the Polytechnic School, 18 per cent at the Faculty of Business studies and 19 per cent at the Faculty of Humanities and Education\(^40\)). This also includes 100 students (at undergraduate and graduate level) working at the university. In line with the unique history and status of Mondragon University, the education and research focus is atypical: communication, education, engineering, business management and culinary science. Education (understood as the training of a skilled workforce able to adjust to industrial needs) is the main focus and a key driver for the university’s strategy:

\(^{40}\) These figures do not include the Culinary Science Faculty, which was created after 2010.
However, research is also important and as much devoted to the needs of local companies and society as is education. Applied research is an important focus compared to more traditional research universities. All in all, 90 per cent of lecturers also work on R&D projects and the number of PhD students increased between 2000 and 2010 from 4 to 161 (of which 21 were funded by industry). Research is led in cooperation with the 13 technology centres and businesses that are part of the Mondragon Corporation, thus based on long-term cooperation and benefiting from the local innovation ecosystem. The Mondragon Corporation’s Garaia Innovation Pole brings together the university, technology centres and company R&D departments, with the objective of encouraging the joint development of research. However, the university also has strong links with companies outside the Corporation, which represent about 50 per cent of the university’s external partners including a fair share of international companies.

7.2 A business-orientated education model

7.2.1 Innovative teaching and learning

Mondragon University is based on an atypical approach to education that focuses on the practical orientation of studies, a balance between academic education and in-company training with knowledge and skills that can be directly used in ‘real life’ situations. The founder of the Mondragon cooperative model described the approach as:

“Education as a didactic and existential process should involve the awareness and the practice of work” (J.Ma Arizmendiarrrieta) \(^{42}\)

Non-elitist, the university is structured around the principles of collective learning, teamwork, solidarity, creativity, risk-taking and the promotion of a business culture.

7.2.2 A pool of talents for regional companies

Training and education are central to the Mondragon cooperative model: the founder of Mondragon saw education as a prerequisite to the development of local businesses and innovation activities. He spent some years educating people in the technical college he set up in 1943 (now the Polytechnic School), before putting some of the graduates at the head of the first Basque cooperative. Nowadays, education and training enable the adaptation of the training of future workforce to the needs of local companies. For example, the recent creation of the Basque Culinary Centre was initiated by Basque chefs to deliver undergraduate, master’s level and professional training in gastronomy.

This work-orientated approach to education is manifest in numerous features. Students carry out final study projects, which are compulsory part of the curriculum in the Polytechnic and in the Business School and can last up to one year. They also gain work experience through placements and internships in companies. About 15 per cent of the degree students and 32.4 per cent of the master students combined their studies with part time jobs in the university’s research labs or in companies in 2011, thus developing their professional experience and receiving financial support for their studies. The university’s time schedule is adapted to such work placements, with alternate morning and afternoon shifts. For work placements and final year projects, a bursary of €500-600 a month is granted to students by the hosting companies. A three-way relationship is involved between the student, an academic supervisor and a tutor in the company, thus contributing to creating new contacts between industry and Mondragon University. Companies also fund PhD students working on industrial projects. For example, ten PhDs are funded every year by the lift and elevator company Orona, which is part of the Mondragon Corporation. In addition, industry participates in classes and conferences at the university, either around professional skills and career development, entrepreneurship, or on technical knowledge.

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\(^{41}\) Translated from Spanish (MU Strategic Plan 2008-2012, available online: http://www.mondragon.edu/es/sobre-nosotros/que-es-m-u/plan-estrategico)

\(^{42}\) Quote from a presentation document of the Mondragon University, issued in 2011.
The many and varied ways for students, MU researchers/professors and businesses to interact are schematically presented in Figure 34 below.

**Figure 34 Network of collaboration between the Mondragon academics, students and external partners**

Presentation document from Mondragon University (2011)

### 7.2.3 Vocational and continuing education

In addition to university-level education at Mondragon University, there is also a wide range of vocational education and life-long learning programmes (as many as 5,000 professionals are trained every year at the MU). Spanish universities are not traditionally allowed to deliver vocational education (a prerogative of specialised public and private schools), and the Mondragon University is one of the few exceptions to the rule. This illustrates the innovative character of the education provided at Mondragon University. Likewise, life-long learning and continuing education are still uncommon in Spain’s education system, while the MU and its predecessors have been implementing such programmes for more than 30 years.

### 7.2.4 Benefits driven from education-centred cooperation

For companies involved in partnerships with the university, education-centred collaboration is a complement to the wider links established with the university in order to promote regional innovation activities. The benefits of such cooperation are far-reaching. Regional companies have a pool of talent that they can mobilise whenever they are looking for additional staff or new expertise, and benefit from the expertise of students on their technological projects. Recruitment is facilitated by the first working contacts that are established with potential future workforce (27 per cent of students find a job where they did their final placement). As a result, companies’ demand for students far exceeds the number of students at the Mondragon University.

The Mondragon approach can be summarised as follows: innovation is the main driver and education activities provide a professionally trained workforce adapted to the needs of companies. The ultimate objective is to improve the competitive position of companies and the Mondragon corporation on the global market. Continuing education is a way to ensure that professionals and companies adapt to the constant changes in knowledge and technologies. It is notable that some 45 per cent of business partners involved in education activities are regional companies belonging to the Mondragon Corporation. Yet, collaboration with partners external to the Mondragon Corporation has expanded widely over the last five years, including increasing collaboration abroad (e.g. Eastern European countries, European multinational corporations, and Brazil). Most of the collaborative activities take place at the Polytechnic School, which is also the biggest of the four faculties and schools of Mondragon University.
At the end of the 1990s, Mondragon University was still very much a technical-orientated institution with a rather traditional approach to pedagogy, where the learning process – even if strongly work-centred - was understood as the transfer of technical knowledge and skills from academics to students. However, the combined influence of the Bologna process and the growing awareness of the needs to develop further transversal (or 'professional') competencies among students fostered the introduction of an innovative education model: the Mendeberri model.

The Mendeberri project started in 2000. Following a cooperative and participative approach, various partners (including companies, ex-students, and experts) were invited to diagnose the Mondragon education profile. Innovative education projects worldwide served as a basis for inspiration (e.g. Aalborg University in Denmark, the University of Maastricht in the Netherlands, the MIT in the USA). This work resulted in the adoption of a 'professional' profile not only linked to specific technical and methodological skills, but also around seven transversal competencies, that are presented in the figure below.

Figure 35 Mendeberri: the Mondragon University's education model

The professional profile contributed to a substantial reform of the Mondragon University curricula and pedagogy from 2001-02. This included the update of study plans and the introduction of new learning methodologies (project-based, problem-based and case study-based learning). Overall, the process led to a decrease in the number of traditional courses and an increase of the work carried out in small groups supervised by tutors.

The Mendeberri model was an important overhaul for the MU, in the sense that it implies a new understanding of the concept of education, where students are pro-active agents of their own education. Their participation, responsibilities and accountability are boosted at all levels and they are considered as an integrated part of the research activities and collaboration undertaken at the university. Consequently this leads to some significant changes in the teaching and learning culture. Gradually academics had to adjust to new pedagogical approaches, where they were no longer transmitters of knowledge but rather guides taking part in a progressive learning process.

The Mendeberri model can therefore be interpreted as the ultimate manifestation of the business-centred and innovation-driven approach to education. It is crucial in such an approach that students learn not only technical, discipline-related knowledge, but they also acquire general competencies that can be mobilised in their current and future working environment, either in companies or research labs. Eventually, this contributes to turning them into operational professionals who can quickly integrate and adapt to the reality of working life, both during their work placement and as young professionals.
7.4 Key success and enabling factors in the Mondragon University’s approach

7.4.1 Dynamism and openness of the local innovation eco-system

Key success factors in the Mondragon’s business-centred approach to education are to be found in the local Mondragon context itself that offers a unique, dynamic ecosystem for innovation. Beyond simply cooperation, one might even speak of real integration of the three dimensions of the knowledge triangle, served by a long history of interactions. A truly local open innovation model, Mondragon is a place where the university, technology centres and the students are actively engaged in developing the capacities of local companies, and thus participate in the development of new markets, products and services.

7.4.2 Alignment of strategies between the university and key external partners

While the education model described above concerns all university faculties, the Polytechnic School (i.e. engineering students) is the prime target in terms of collaboration on technical and technological research and innovation projects. The alignment of research objectives and agendas between the different stakeholders forms the basis of the Mondragon open innovation model. Each year, partner businesses develop a technology roadmap in partnership with the university’s R&D unit, technology centres and other relevant stakeholders. The roadmap serves as a basis for the development of the R&D project portfolio to be carried out jointly. Mondragon University therefore takes an active part in setting the innovation agenda of companies and it also influences their technological agenda by highlighting key trends and issues. The university is not simply an instrument at the service of companies’ strategy, but there is a close cooperation and a shared definition of key strategic developments. This alignment makes it possible to develop a critical mass of researchers, and to train students for businesses and technology centres.

An example of such cooperation is the network built by the elevator multinational company Orona, Mondragon University and the IKERLAN technology centre. IKERLAN was created in 1974 by staff from the Polytechnic School and offers R&D innovation services to business enterprises in mechanics, electronics, computing, microtechnology and fuel cell technologies. The Orona Elevator Innovation Centre (EIC) manages the network and implements joint research projects with IKERLAN, the university, involving R&D units and students through their final year project, as well as a wider net of actors. This means for Orona that it can rely on a strong research and workforce base that is orientated towards its changing needs and specific development interest areas.

7.4.3 Cooperation culture

Such an open innovation model is centred on the application of the research developed at the university and the knowledge and skills acquired by students. Key success factors in the implementation of this innovation-driven approach are:

- Trust between the partners, who share their strategic agenda and directions
- Formal commitment of the partners and existence of a technology roadmap, which formalises and validates common objectives, priority lines and future needs
- Strong cooperation and knowledge transfer culture (i.e. the ‘cooperative’ culture) at the partner organisations. At Mondragon University, this is illustrated by the fact that as many as 90 per cent of the teaching staff leaving the university do so to work in industry
- Business-orientated and entrepreneurship culture among the partners. For example the SAIOLAN incubation centre – part of the Mondragon Corporation and situated on the campus of Mondragon University – fosters the creation and development of business projects among students, academic staff and the Mondragon business cooperatives
- Flexibility, granted by the common cooperative management model, that allows for the emergence of new research lines, research projects and collaborations
7.4.4 **International openness**

Last but not least, the Mondragon model is firmly based on a local approach and orientated towards the local innovation eco-system. This however does not mean that the university is not open to the rest of the world or that it operates in a closed local system. Mondragon University and its predecessors have actively promoted international exchanges with businesses and universities abroad, with the objective of learning and acquiring new skills that could benefit to the Mondragon’s industry. The University has very long tradition of international mobility and the Mondragon Corporation started funding international student exchanges in 1972, well before the Erasmus programme began.

7.5 **Main barriers and potential solutions**

7.5.1 **Training for academic staff**

The main challenge in the adoption of the Mendeberry education model was the cultural transformation it demanded in the way students are taught and need to learn. Academic staff themselves needed training to adjust to their new role and the new curricula.

7.5.2 **Coordination and constant exchanges between partners**

More broadly speaking, the need for a continuous exchange of information between the companies and their academic and technology centre partners represents a major challenge for the Mondragon cooperation approach. Apart from the technology roadmap, the approach is very much bottom-up and horizontal: companies provide feedback to the university when they need new students for the workforce in specific areas. Alternatively the university contacts its business partners to assess industrial needs, when it wishes to adjust its curricula and programmes. The coordination between industrial needs and the university’s research activities and curricula is ensured through the high degree of specialisation of the university that focuses on very specific niches of expertise.

The financial autonomy of the university is also key factor and it ensures its independence. Mondragon Corporation only funds technological equipment. Almost 50 per cent of the university’s income came from tuition fees in 2010–11, while competitive projects - the university is an active participant in FP research projects - and the transfer of research results respectively represent 27 per cent and 16 per cent of the total income. This however also means that the university has no sustainable core funding.

7.6 **Future challenges: creation of innovative space bringing together research, innovation and education activities**

Future challenges lie in the launch of the project Orona IDeO-Innovation City, a new innovation space fostering collaboration and creativity. The innovation city concept is a step further in the innovation network set up between Orona, IKERLAN and Mondragon University. Providing a physical space for collaboration, the objective of Orona IDeO is to deepen the existing links and provide a stable structure for cooperative projects. It will also expand the partnership to new fields of activity i.e. eco-efficiency and energy management in buildings, thus contributing to the development of new products and creating access to new markets.

The project responds to a strategic interest of Orona and makes use of the specialisation of Mondragon University in the fields of energy. A new Master's degree in eco-solution and energy management will be developed to support the needs for skilled workforce. Broadly speaking, Orona IDeO will also be a further opportunity to develop the links between businesses and students and to raise engineering students’ interest in careers in the field of eco-management.

The innovation complex will be opened in 2014 and will host Orona’s headquarters and Orona Elevator Innovation Centre, research facilities working on energy storage systems, an energy

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Note: 1.1% of the profit of the MCC’s cooperatives is dedicated to funding the equipment and building of the Corporation’s R&D entities (including the MY, the technological centres and the Garaia Innovation pole).
showroom to display products and services for the energy management in buildings, shared services and space for teaching. Located in an extension of the San Sebastian Technology Park, the project represents a total €160m investment financed by Orona.

A next stage of the project is also planned with the aim to expand and incorporate a wider network of companies in the activities to allow the set-up of a truly open innovation ecosystem, integrating a wide range of synergies and profiles.

7.7 Key lessons and transferability

Even though Mondragon University is very specific, due to the particularity of the regional context and its cooperative status, some of its elements are nonetheless transferable. The university has already set up a company to transfer their model to other universities abroad. For example, Mondragon University has helped the Panamericana University in Bogota (Colombia) to adopt the Mendeberri teaching model and the Mondragon strategy for liaising with companies and knowledge transfer.

The case gives us several interesting lessons on how to integrate the three dimensions of the knowledge triangle successfully in an innovation-driven model. To sum these up, key to the Mondragon University’s approach are:

▪ Making education an integrated part of the local innovation strategy and acknowledging the place of students in the innovation ecosystem
▪ Fostering the acquisition of key transversal competencies among students, that they will need in their future professional life
▪ Implementing smart regional specialisation model based on strategic niches of interest shared by the university, businesses and technology centres (e.g. the innovation city Orona IDeO is focused on energy management in buildings and involving a strong alignment of the education, research and innovation agenda
▪ The co-existence of very strong links with local businesses but also an active cooperation with businesses and universities abroad

7.8 Contacts, references

7.8.1 List of interviewees

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Jon Altuna</td>
<td>Academic Vice-Chancellor</td>
<td>Mondragon University</td>
</tr>
<tr>
<td>Antonio Pérez Berdud</td>
<td>Research Manager</td>
<td>Orona Elevator Innovation Centre (EIC)</td>
</tr>
</tbody>
</table>

7.8.2 References

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▪ Mondragon University (2011), Presentation of the Mondragon University (kindly provided by the interviewees)
▪ Brochure of the Orona IDeO – Innovation city project (kindly provided by the interviewees)
▪ OECD (2011), Reviews of Regional Innovation, Basque Country
8 Umeå University

8.1 Introduction

Umeå University was founded in 1965 as the fifth university in Sweden. Since the foundation, the total number of enrolled students at Umeå University has steadily increased, and is currently around 36,000, including postgraduates. Umeå University has approximately 150 degree programmes and 2,000 courses, with more than 9,000 students taking courses via distance education, or off-campus. The university has a staff of 4,185, including 365 professors and 2,027 lecturers/researchers. Campus Umeå is one of Sweden’s largest campus areas (236,500 m2). In addition, there is also Umeå Arts Campus, Campus Skellefteå and Campus Örnsköldsvik. The university has a strong research focus and has designated 14 research environments in different areas, including gender studies, global health, plant and forest biotechnology and solar fuels.

8.1.1 Regional and national framework

Umeå University is one of two universities in the city of Umeå, the other being the Swedish University of Agricultural Sciences. Umeå, the seat of Umeå Municipality, is the capital of Västerbotten County in the northern part of Sweden. Umeå is the twelfth largest city in Sweden, with approximately 80,000 inhabitants (2010). The municipality has about 115,000 inhabitants.

The county’s population is decreasing, with the exception of the city of Umeå itself, which is a multi-faceted regional capital with the largest industry sector in the northern part of Sweden and an expanding service sector. Employment in private commerce and industry has grown by more than 30% in 10 years and has now overtaken the public sector. The population in Umeå has doubled since the beginning of the 1960s.

8.1.2 Development of the university

During its first ten years, Umeå University housed 2,000-3,000 students, divided between the faculties of medicine, odontology and philosophy. The faculty of philosophy was split into mathematics-science, social sciences and arts faculties in 1968/69. This grouping of faculties was in effect up to 1999, when the medical and odontology faculties were combined.

New subjects and professors were rapidly installed during the university’s first years. The expansion went hand in hand with an increased enrolment of students, and by 1970, the number had risen to around 8,000. The period was distinguished by an active student life with protests and demonstrations. This political activity was the origin of the epithet “the red university” – a designation that was justified at the time, and a reputation that has persisted for many years.

During the 1970s the expansion continued but at a slower pace. New large buildings on campus were built during the decade, and at the beginning of the 1980s a balance existed between the scope of activities, number of students and campus accessibility.

In the 1980s a huge expansion took place within research, as its budget rose 38 per cent in connection with an economic recession during the early 1990s, student enrolment increased dramatically. In the 21st century the university has had a continued student growth, reaching the current level noted above.

8.1.3 Organisation of Umeå University

Umeå University is a public university, with a board composed of eight members appointed by the Swedish government. The university management consists of a Vice-Chancellor, a Pro-Vice-Chancellor, three Deputy Vice-Chancellors in charge of education, research, and external relations and innovation, and a University Director.

There are four faculties at the university; Faculty of Arts, Faculty of Medicine, Faculty of Social Science and Faculty of Natural Science and Technology, and there is a total of 53 departments. Eight schools and institutes exists within the university: the School of Architecture, the Institute of Design, the School of Business and Economics, the Academy of Fine Arts, the University School of Restaurant and Culinary Arts, the Institute of Technology, the School of Education and the Sport Sciences Centre.
Research at Umeå University extends over many disciplines and scientific fields: Arts and Humanities, Medicine, Science and Technology, Social Sciences and Teacher Education.

8.2 Strategies and support system for the knowledge triangle

8.2.1 Dedicated governance system

Umeå University has a focused strategy with reference to the knowledge triangle, and there is a strong view of the importance of collaboration with external partners. In the last few years a formal structure has been built up for better coordination between the different aspects of the knowledge triangle. Three Deputy Vice-Chancellors are now in place, one responsible for research, one responsible for education and one responsible for external relations and innovation. There is a strategic council for each area and the whole system is integrated within the different faculty managements. This kind of structured way of working is seen as fundamental to being able to develop a strong competence in research, education and innovation.

The university’s approach to the knowledge triangle can be characterised as holistic, where the university and all the external partners together enrich each other’s work on various levels. This can come from different kind of partnerships and collaborations with external partners, such as research collaborations with the private or public sector, internships for students in organisations or companies, or guest lecturers from industry.

“It is of great importance that we move away from the old way of seeing things where the university was seen as a producer of knowledge to the surrounding society and where that in the end would lead to innovations. All three aspects of the knowledge triangle are of importance.” Source: Vice-Chancellor of Umeå University

8.2.2 Support system for collaboration with external partners

In addition to the organisational structures in place to support the work and integration of the knowledge triangle, there are support systems and other kinds of resources in order to assist collaboration with external partners.

The contacts between the research community and the corporate sector are improved and strengthened by the establishment of holding companies associated with the university. They provide opportunities for the transfer of research projects, which have reached the level of concreteness necessary for commercial application, from the regular research organisation of the university to an environment suited for commercialisation processes. Uminova Holding AB is the holding company of Umeå University and has five affiliates.

Uminova Innovation AB and Uminova Invest AB

Uminova Innovation AB is 50.3 per cent owned by Uminova Holding AB. The other owners are Umeå Kommunföretag AB, SLU Holding and Almi Västerbotten. Uminova Innovation is active in transforming business ideas into business activities. It assesses the feasibility of the business idea, coaches the innovator, provides office space at no cost, and determines whether the idea has already been put into practice. Uminova Innovation is open to researchers, employees and students connected to the university, the hospital and other research centres in Umeå.

Uminova Invest AB is another affiliate of the Holding AB (13 per cent ownership), and the other owners are Industrifonden, Norrlandsfonden, Innovationsbron and Balticgruppen. Uminova Invest provides potential growth companies associated with Umeå University or other educational and scientific establishments in Västerbotten with capital and capabilities to promote growth.

Incubators

Umeå Biotech Incubator AB is a company helping biotechnology researchers to promote their ideas in as many ways as possible. The company provides facilities, including laboratory premises, plus expert advice, to help develop ideas with commercial possibilities. The incubator is also owned by Uminova Innovation AB.

In the new Arts Campus opened in May 2012 there is to be a business incubator for the creative industries. The incubator will help entrepreneurs and promote entrepreneurship by providing active
and customised business support, office services, technical and commercial networks, and financial support – all in a creative environment. The incubator at Umeå Arts Campus will be similar to the Biotech Incubator, as it will be a wholly owned subsidiary of Uminova Innovation.

### 8.2.3 Building for meetings

In addition to innovation support systems and offices for cooperation with external partners, the university has given much thought to building and creating environments that facilitate meetings between different groups. An example of this is the newly-built Umeå Arts Campus noted above, the single largest project in Umeå University's history since its foundation. The objective is for the Arts Campus to function as a venue for education, research and professional activities within architecture, design, art and digital culture – a creative environment which can be quite unique in Sweden, Europe and even worldwide. Umeå Arts Campus brings together the university's art colleges by the banks of the Umeå River: the School of Architecture, the Institute of Design and the Academy of Fine Arts. It also includes Bildmuseet – the university's museum of contemporary art and visual culture which will be open to the public, the digital experimental workshop HumLab-X, and the dynamic "Sliperiet" incubator which opens in 2013.

### 8.2.4 Dedicated university offices for cooperation with external partners

**Office for External Relations**

The task of the office for external relations is to function as support and a contact point for companies, organisations, and authorities wishing to cooperate with Umeå University. It acts as an intermediary for degree projects and papers, trainee jobs and study visits, contacts and various forms of support for the cooperation between industry and researchers, contract training and education. It also initiates meetings between academy and industry with the purpose of informing people about what Umeå University has to offer. Apart from Umeå the office is represented in Lycksele, Skellefteå, Örnsköldsvik, and Kiruna, with the regional offices functioning as the university's operative resource in the dialogue with local industry and society.

**International Office**

The International Office cooperates with faculties and departments at Umeå University to facilitate opportunities for students, teachers and administrative staff to participate in mobility schemes that aim to provide an international dimension to their study or work experience. The International Office manages and coordinates the university’s participation in the Nordic Centres in India and as well as the Erasmus, Nordplus and Linnaeus-Palme programme.

**Grants Office**

The Grants Office supports external stakeholders: enterprises, organisations and individuals – in finding partners for collaboration on research and development, and for joint action in areas of mutual interest. They provide information and support to the university’s researchers concerning funding from the European Union Structural Funds, and the Framework Programmes for Research and Development.

**Innovation Office North**

Within Umeå University's innovation system, the Innovation Office operates in the interface between Uminova Innovation, the Grants Office, the Office for External Relations and Umeå Biotech Incubator. Researchers, employees and students are encouraged to find new ways to pass on their knowledge and research findings so they serve as a useful resource for both individuals and society. The Innovation Office has been established in order to help develop ideas and give further guidance in finding a suitable organisation.

### 8.3 Collaboration with external partners

Umeå University has a diverse range of external partners. For example Umeå University cooperates with more than 600 international universities throughout the world, and has an extensive collaboration with many other Swedish universities. Umeå collaborates with industry, both within the region and internationally. The university operates in specific conditions, where the region is very dependent on
the university, meaning that the municipality of Umeå is an important partner, as are the smaller municipalities in the region. The university also collaborates with the county of Västerbotten, with collaboration regarded as having great future potential both for the county and the university.

8.3.1 **Industrial Doctoral School for Research & Innovation, IDS**

In 2008 Umeå University started an Industrial Doctoral School for Research & Innovation (IDS), with a second intake in the autumn of 2010. In 2011 IDS ran 20 research projects with 26 industrial partners and the first PhD students were somewhere in between half-way and dissertation. The long-term plan is to start a new round of IDS with 12 new projects/doctoral candidates every other year.

IDS accepts projects from all scientific fields and each project is chosen in a competitive process, as are the doctoral candidates. The projects have to be generated and driven in collaboration between the supervisor and an external, non-academic partner. The partner might be a company as well as a non-profit, governmental or other organisation. The only partners excluded are those who have research funding as their main objective.

Projects within IDS are financed by the university and the collaborative partner. The partners contribute with 50 per cent of the salary of the doctoral candidate. Participating in IDS means that PhD students will be part of a group from different disciplines and given a course package with generic skills (15 ECTS) over 2 years. The course package is set up to be a preparation for the students to work outside of academia within their field of expertise, either as an employee or in a spin-off company. Another goal is to improve external partners’ understanding of research and doctoral studies. IDS is a participant in the project DOC-CAREER II led by the European University Association, and therefore the setup and operation of the Doctoral School has been presented at several conferences and work-shops. IDS has obtained considerable attention outside Sweden, due to the efficient collaboration between the university and the external partners, the course package applied and the competitive recruitment procedures of both project and doctoral candidates.

8.3.2 **Collaboration in the field of education**

The university’s collaboration with the surrounding world is also notable in its many educational programmes. The Umeå International School of Public Health, at the Department of Public Health and Clinical Medicine, was established in 2001, and has students from all over the world. The recently renamed Umeå Sport Sciences Centre, in operation since the autumn term of 2002, offers education in collaboration with several of the Swedish sports club organisations. The Basic Training Programme for Police Officers was established in the autumn term of 2000 – commissioned by the National Police Board – and has 384 students spread out over four terms.

8.3.3 **Research collaboration / research centres**

Umeå University has a total of 19 research centres, for which collaboration with the surrounding world is often a natural way of working. One of these research centres is Umeå Plants Science Centre (UPSC), focusing on experimental plant biology. UPSC was initially only a ‘virtual centre’ with two departments located in different buildings on the campus, but with coordinated teaching, PhD education and seminar series. In 2001 the two departments moved together to create a common scientific environment and new facilities, in particular a new growth facility. One of the ongoing projects within the Centre is the UPSC Berzelii Centre for Forest Biotechnology. The Berzelii Centre was established to develop the research environment at UPSC and to become the world’s most innovative milieu where top-class basic research in plant science is translated into innovations with commercial potential. It is financed through the Swedish Governmental Agency for Innovation Systems (VINNOVA) and the Swedish Research Council (VR). The Centre, with six industrial partners, is planned to be active from 2007 to 2016 and to have a turnover of more than SEK200million, of which one half is funded by VR and VINNOVA and the other half is matching funding from SLU, Umeå University and the industrial partners. The Centre also welcomes new industrial partners interested in finding out how new plant and forest biotechnology knowledge and innovations can be applied.
8.3.4 Regional development centre (Regionalt utvecklingscenter, RUC)

The teacher education at Umeå University and the schools in the surrounding region have a long history of successful cooperation. Since 2003 there has been a formal organisation for collaboration: Regionalt utvecklingscenter. RUC is owned by the University and the municipalities in the region and it is aimed at developing collaboration leading to competence and organisational development for all partners.

For example RUC runs an induction programme to provide support for new teachers in the Umeå region. In combination with competence development training and a mentoring scheme, the programme is aimed at speeding up the professionalisation process for new teachers.

8.4 Educational aspects of the activities/initiatives

8.4.1 Umeå Institute of Design

Umeå Institute of Design is an example of where the education is characterised by close cooperation with industry. The students’ project work is carried out in collaboration with industrial partners or research institutions including major Scandinavian companies such as Volvo Cars, Saab Automobile, Ericsson, Nokia, Tela Research, Electrolux and IKEA. Since the establishment of Umeå Institute of Design in 1989 it has cooperated with more than eighty companies; small and medium-size companies as well as major corporations. Some 30 to 40 projects are carried out each year either as term projects or as individual examination work. Project collaboration also takes place with their own research projects strengthening the relationship between their educational programmes and applied research work. For Umeå Institute of Design the objectives for running projects in collaboration with industry are:

▪ To give students the opportunity of working with important problems in a realistic context
▪ To give students insight in the industrial product development process
▪ To acquaint students with people in the industry
▪ To get fresh technical and marketing information integrated into the education
▪ To spread information about Umeå Institute of Design among industrial companies

In practice, the above-mentioned objectives are achieved by including obligatory work practice in the educational programmes and by additional types of cooperation. On two occasions during the bachelor programme, students gain practical experience by working at a design consultancy or in industry. The first period of work experience is organised and arranged by the school. The individual student arranges the second period based on a list of available consultancies and companies. Additional types of cooperation between the Institute and external companies include conference participation, prizes and scholarships, workshops and courses.

The website for the Umeå Institute of Design further explains what the external partner and the students gain from the collaboration:

“The problems we are dealing with in these projects are not the same as a professional industrial designer usually addresses. We are working with dilemmas that are outside of what the company's product development teams have on their daily agenda. We often work with problems they would like to work with but do not have the time for. Our projects have a future horizon of three to five years depending on the branch. They are purely conceptual projects, only covering the early stages of product development. It should be noted that this kind of project does not restrict the students' artistic freedom, the extent of innovation, creative ambition or disposition for experiments. On the contrary - the students often enjoy working with urgent and timely problems in a realistic context with representatives from the company's development staff”.

8.4.2 Umeå School of Education

Umeå School of Education collaborates with the surrounding municipalities through the RUC organisation noted earlier. This particular collaboration relates to mathematics and mathematical
didactics, and the collaboration between the School of Education and the municipality goes back a long way. The contact between the two partners was initiated by the RUC and was part of a larger activity where several municipalities in the region were contacted.

The collaboration is seen as very valuable for both partners and it is of a long-term nature. According to the plans it will continue at least until 2013, and probably longer since both partners feel they gain valuable benefits from the collaboration. The schools in the municipality receive assistance with, for example, competence development for the teachers and help with process evaluations. RUC is regarded by the municipalities as a doorway into the university and the academic world, a way to develop and gain further expertise that can be applied in the schools. The School of Education benefits from the collaboration by gaining access to and examples from ‘reality’ and by working with teachers in the schools. The School runs courses and seminars and they can, for example, give teachers ‘home work’, where the teachers are to test methods developed by researchers. The results and feedback gained through these exercises are shared and the responses can be directly built in and used in the training of new teachers at the School of Education.

8.5 Main challenges and success factors in the approach of Umeå University

The case study shows that Umeå University has a very clear strategy in its work with the knowledge triangle and that a great deal of effort is made in order to bridge the gaps between education, research and innovation.

In interview, both Vice-Chancellor and deputy Vice-Chancellor made clear that they see education as the ‘motor’ of the knowledge triangle.

‘Education is what we do best, education and research is something that we can give to the surrounding society and if we succeed with that part, innovations will follow. Apart from supplying the society with educated people our mission is also to create environments where different actors can meet and new ideas and creative thinking can be generated.’ Source: interviews

Much attention has been paid to how research outcomes and the latest industrial/commercial techniques are used to inform and develop the curriculum content. Research feeds back into education by having a high number of researchers as teachers. Many new educational programmes have also emerged through the university’s support to different research centres. By having a specific research competence at the university, ideas regarding new educational programmes come up. As explained earlier many educational programmes also have collaborations with the surrounding society, both the private and the public sector, as a natural part integrated in the curriculum. Furthermore the university works with professors and lecturers from industry in order to get direct access to the latest information in that specific industry. The importance of the knowledge triangle and its educational aspect is also shown in the entrepreneurial courses offered to the students.

There are several important factors for a university’s success with the knowledge triangle work:

- There must be a clear strategy for how the university intends to work with all three aspects of the knowledge triangle
- It is important that the whole management is involved (also the faculty management) and that the links between the three aspects are understood
- There is a need to work together with other HEIs and to create alliances
- Learning from other examples and experiences is of high importance. Look at how other HEIs are working (benchmarking) both nationally and internationally

Barriers to a smooth integration of the different aspects of the knowledge triangle can be seen in the surrounding society. One is the public debate in Sweden, where high quality research and collaboration between industry and the university are seen as incompatible. The other is that Swedish politics in the educational area today are much focused on student employability, meaning that humanities within the universities are seen as less important. This can however lead to the surrounding society missing out on important perspectives that humanities can give to society.
8.6 Future developments and transferability

A big question for the future is how to find ways for new knowledge and innovation to benefit society. The Deputy Vice-Chancellor of Umeå University highlighted the importance of enabling teachers and researchers to have their own enterprises alongside their employment at the university, or to be a partner in an enterprise.

“We need to look at this with a new perspective since it could enable for important knowledge transfer between the HEIs and the surrounding society. A new platform for this is needed, since the essential of knowledge triangle work must be finding ways of sharing knowledge useful for the society’

There is no exact plan of how initiatives and activities are to be monitored and evaluated, but monitoring and evaluation is seen as very important. “We need to know if we are doing well regarding all three aspects of the knowledge triangle”. The strategic councils created by the university management, working with all three aspects of the knowledge triangle also have the task to find indicators on how the co-operation with the surrounding society is functioning and what the partners receive from the collaboration.

Several of the features of the Umeå University approach may lend themselves to transfer and application elsewhere: in governance and management, for example, the conscious allocation of knowledge triangle constituents as responsibilities at deputy vice-chancellor level is a significant endorsement of the whole strategy. Second, the major industrial involvement in the operation of the university but particularly in the Industrial Doctoral School and the Institute of Design, may offer other Higher Education Institution practical models of collaboration for mutual benefit.

8.7 Lessons learnt and recommendations

It is important to involve the whole management in the knowledge triangle approach and strategy for a successful implementation, where management also includes lower levels, not just the central management of the university, such as the management of the faculties and the departments

Collaboration and benchmarking with other Higher Education Institutions to see how they work with the knowledge triangle is seen as valuable.

Some barriers or discouraging factors regarding the integration of the knowledge triangle, and the integration of education in the knowledge triangle, are seen in the surrounding society. In particular:

- Swedish research councils need to prioritise teaching and good pedagogical qualities when funds are given to researchers
- The public debate in Sweden tends to see high research quality and research collaboration between university and industry as incompatible

8.8 Contacts, references

8.8.1 Interviews/Contacts

- Vice-Chancellor Lena Gustafsson, Umeå University
- Deputy Vice-Chancellor for External Relations and Innovation, Agneta Marell, Umeå University
- Headmaster pre-school, pre-school class and childcare, Margit Näsström, Municipality of Dorotea
- Researcher at “Umeå forskningscentrum för matematikdidaktik” (UFM) Margareta Wolf-Watz, Umeå School of Education

8.8.2 Internet sources

- Umeå Municipality: www.umea.se
- Umeå University: www.umu.se
- Umeå Institute of Design: http://www.dh.umu.se
Education in the knowledge triangle

- County council of Västerbotten: www.vll.se
- Statistics Sweden: www.scb.se
9 University of Trento - (EIT ICT Labs)

9.1 Introduction

The University of Trento is part of the living lab initiative of the Province of Trentino, an initiative providing a guiding framework for research and innovation in ICT. The university has capitalised on this infrastructure by establishing a co-location centre for a Knowledge and Innovation Community (KIC). This KIC, ICT Labs, is a programme under the European Institute of Innovation and Technology (EIT) for catalysing the knowledge triangle. Using the regional framework, the university has focused its education activities within the KIC on service innovation and well-being, two defining characteristics of the Province. The support of the KIC gives the university international recognition in these areas. The Trento RISE initiative is a single organisational body that connects several of the major actors in ICT research, education and business in the Trento region, including, among others, Fondazione Bruno Kessler and the University of Trento. With its mission of open innovation rooted in education and research, Trento RISE firmly places education as an equal element of the knowledge triangle.

9.1.1 Regional and National context

Italy has no separate designation for research universities, as in principle all universities have a commitment to research. Increasingly, there is an orientation towards targeted and mission-oriented programmes. Ministries use a range of instruments to support innovative entrepreneurship, including excellence poles which pool competences and resources. These poles are cluster consortia of firms and public institutions in high technology districts.

The University of Trento has locations in both Trento and Rovereto, in the Autonomous Province of Trentino. Trento, Trentino’s capital city, has about 115,000 inhabitants, while Rovereto has a population of about 36,000. Trento is also one of the nation’s wealthiest and most prosperous cities, located in one of the richest provinces in Italy. Trento’s economy is a combination of commerce, services, tourism, high-quality agriculture and food production. Over 70 per cent of employment is in the services sector, with only 9.2 per cent in industry.44

Per capita investment in R&D in Trentino (€261) is higher than both the average for Italy (€142) and for the EU (€200), with almost €190m a year invested in research and development activities in both the public and private sector (businesses, research institutes and non-profit-making institutions).

Regional governance in Trentino was reformed in 2005 making the province not only the regional governmental institution, but also a coordinator and intermediary between those entities promoting scientific research and those making use of it for development purposes. This reform was aimed at making research more efficient, and less bound by bureaucratic rules.45

There is a range of regional and national initiatives to support technological innovation in the region, including the development of Science and Technology Parks, Business Innovation Centres (BICs) and Integrated Centres for Entrepreneurship Development (CISI) and incubators. As with other Italian regions, Trentino has the flexibility to manage the regional budget with direct administration of 90 per cent of tax revenue. The region also has public control over basic infrastructure such as transportation, telecommunication, and energy. There is a Multi-Annual Programme for Research, backed by funding.

9.1.2 Smart Specialisation with a focus on ICT

The region is very attentive to innovation, specifically in ICT. There are three main protagonists. First, there is the Trentino system of higher education and research with over 800 researchers (out of 2000 total in the Trentino region) working in the ICT sector. There are 12 public research centres and the university hosts internationally renowned research institutes. Second, there is a group of 960 ICT companies, employing 4500 professionals; and finally, there is the local government, which has

44 Regional Innovation Monitor, regional Profile of Autonomous Province of Trento: http://www.rim-europa.eu/index.cfm?q=p.regionalProfile&r=ITD2&fj=true#economy
45 Ferrari, Valentina, et al. Innovating ICT Innovation: Trentino as a Lab
supported this focus on innovation in ICT-enabled services through a number of legislative acts, including horizontal measures to support the establishment of a knowledge society as well as vertical interventions to stimulate sustainable growth and industrial competitiveness.

Since 2007, the Autonomous Province of Trento has promoted ‘Trentino as a Lab’ (TasLab), an adaptation of the ‘living lab’ approach to regional innovation. It is an ICT innovation network that brings together research centres, enterprises and the government of Trentino with citizens for concurrent research and co-creation. The living lab operates under the principles of user-driven, open innovation. The TasLab promotes projects by analysing the area and market to find potential solutions and collaborations.

The Autonomous Region has engaged the principles of ‘smart specialisation’ and focused on service oriented and programmes rather than, for example, manufacturing. By focusing on the strengths of the Trentino region, Trento RISE is developing the local economy and providing real problems for students to analyse as part of their studies. The participatory policy model involves local stakeholders and users to develop ‘lead markets’. These markets are expected to develop links with international actors through initiatives such as the Trento co-location centre of the ICT labs.

9.1.3 Basic information on the institution

The University of Trento ranks highly amongst Italy’s top 30 colleges, coming in 1st in the Italian Ministry of Education ranking for research and didactics in 2010, 1st in engineering and in general (according to the newspaper Censis-La Repubblica) and 5th among Italian public universities according to Il Sole 24 Ore. In the QS World University Ranking (2011) the University of Trento is one of the few Italian universities listed, placed in the 451-500 bracket, while science and engineering is placed in the 201 to 300 bracket.

The University of Trento was founded in 1972, starting with the Faculty of Science followed by the Faculty of Economics. In 1984 the Faculties of Arts and Humanities and Law were added with the Faculty of Engineering in 1985. Finally the Faculty of Cognitive Sciences was founded in 2004, the first of its kind in Italy.

The university is a medium sized institution with over 16,000 students and 563 faculty members and researchers. The 7 faculties offer 53 programmes along with 13 research departments and 15 doctoral schools. The University of Trento is primarily a research university with a focus on applied research.

Trento is a highly international university and one of only a few in Italy where all courses are taught in English. As a result, it has a high percentage of international students. Sixty per cent of doctoral students in ICT are from abroad.

9.2 ICT Labs KIC – Trento Co-location Centre

Trento RISE has partnered the European Institute of Technology (EIT) to host a co-location centre of the ICT Labs Knowledge and Innovation Community (KIC), giving the region international recognition and support. The Trento co-location centre is based in Povo, in the outskirts of Trento, and clusters its core partners Engineering, Telecom Italia and Trento RISE, and connects with its affiliated partners CRF (Centro Ricerche Fiat), STMicroelectronics, Politecnico of Milan, Politecnico of Turin, Istituto Superiore Sant’Anna - Pisa, University PF Bologna and CNR (National Research Council).

The Italian ICT labs co-location centre is one of six. Inaugurated in April 2012, it is the youngest of the six co-location centres. The co-location centre activities and partners reach out across the territory, with the University at the heart of the education activity. There is strong coordination across the innovation, business and education activities at Trento which as a region benefits from good communication infrastructure and innovative companies. The Trento Co-Location Centre is not only active in all parts of the Knowledge Triangle - Education, Research and Business Innovation but also contributes to all the thematic action lines of EIT ICT Labs: Digital Cities, Smart Spaces, Smart Energy Systems, Intelligent Mobility and Transportation Systems, Healthcare & Wellbeing and Future Media & Content Delivery. It specialises on the issues of quality of life and well-being as this is a regional

\[46\] This is sometimes referred to as a node in the ICT labs nomenclature

\[47\] The other five co-location centres are Berlin, Eindhoven, Helsinki, Paris and Stockholm
strength. The province of Trento ranks amongst the highest of all 106 provinces in Italy for quality of life. ICT in Trent is treated as a transversal topic, not to be studied in isolation, with application to critical sectors such as health and transportation. The co-location lab strategy is to become the hub for all trials and experimentation going on in the Trentino territory to provide a single view on how ICT can contribute to quality of life.

9.2.1 Governance of ICT Labs

The Executive Steering Board (ESB) of ICT Labs is formed by two representatives per Node, a core partner from industry and one from academia. In the case of Trento, the industrial partner is Telecom Italia. The representatives are elected by the General Assembly from a list of candidates provided by each node. The ESB appoints its chairman, the CEO and other main officers. It also provides guidance to the CEO in strategic tasks, decides on specific funded actions, evaluates and validates the progress of these actions, approves co-funding eligibility, and makes recommendations on the admission and exit of partners. The Chairman will be responsible for the strategic external positioning of EIT ICT Labs and for securing long-term increases in private funding. Each Node is governed by a Node Executive Committee (NEC) elected by the Core Partners associated with that Node. The NEC appoints the Node Director who is responsible for the daily operations and who is a member of the KIC Management Team.

EIT ICT Labs Italy has a management structure, which is relatively light. The Node Steering Committee is the highest management body and is responsible for strategic decisions of the node. The committee consists of core partners and affiliated partners. They agree upon, amongst other issues, the education curricula. The EIT ICT Labs Italy Management Team, consisting of a co-location manager, financial manager, administrative manager, marketing and communications manager and secretarial assistance, supports the Node Director in all its administrative and operational tasks.

9.2.2 Partnerships

All affiliated partners of ICT labs, public and private are required to acknowledge the knowledge triangle and the mechanism of contribution in the contract that they sign. Some examples of this integration include agreements by businesses to mentor graduate students and an agreement by the university to customise the curricula to business’s needs. There are dedicated reference contacts at every company participating in the initiatives. Often, there are multiple contacts, one for internships and curriculum development and one for research. The general approach is to locate the labs regionally instead of within the university, though this approach is as yet untested.

9.2.3 Development of the co-location centre

As the newest co-location centre, the University of Trento complies with the policies developed by the other nodes, including financial, ownership, privacy and security policies. There is little flexibility in strategy at this point and a clear set of rules has been established. The Italian node received €76m over 5 years for co-funding EIT ICT Labs activities. Trento RISE received €23m from Framework Programme 6 and €36m from FP7. The node contributed to over 40 proposals for 2012.

The node is both reactive and pro-active. While it receives money from various EU initiatives it also responds to local companies that are interested in partnership. Currently, many companies are interested and this is the main success that can be attributed to the newly opened centre. Trento is geographically advantageous because opportunities are easier to spot and exploit in the small region.

9.3 Regional Innovation Structure

As noted at the beginning of this case study, an important initiative of the Province of Trentino, the university, and regional private companies has been the development of Trento RISE, a subset of the living lab approach mentioned earlier, integrating the research infrastructure - namely, businesses, higher education and research. Trento RISE is an open innovation governance model that includes the University, several public and private research centres, such as the Bruno Kessler Foundation, the FIAT Research Centre, Microsoft, and a regional branch of the National Research Council (CNR). With Trento RISE the knowledge Triangle is explicitly addressed with the regional government acting as a driver.
Trento RISE combines the public/private dimensions of the knowledge triangle and provides the system for regional innovation. Taslab is the inclusion of government and citizens in a public/private/people partnership model that drive Trento RISE. The local government provides a framework for action with its planning, coordinating and investment capacity. Private enterprises and research institutions experiment in on new products and services, while citizens are included to enable user-driven open-innovations.

Trento RISE operates as follows. Results from research are tested in realistic settings. Students gain hands-on experience in their Master’s and PhD courses and during summer/winter schools. Businesses receive market tests, comparisons of alternative business models and impact assessments from the students and researchers. Educational links are delineated further below.

The scientific and research activities are organised into research groups called Research Areas, each of which has a high social and market impact and participates in projects with companies.

The business activities have two components. EIT ICT Labs supports sustainable growth in established companies, that is, companies that have been in the market for at least 5 years and have a solid customer base. The second activity consists of new business creation. Young high-tech ventures have access to EIT ICT Labs for research and project-oriented resources. The goal is to increase the volume of successful start-ups and create larger SME companies by stimulating their growth.

9.3.1 Portal for innovation

A key characteristic of the Territorial Lab is the online portal and social network developed by the Autonomous Province\(^{48}\). The portal provides services such as a search engine of projects, a wiki for project development and collaboration, space for blogging, and roadmaps. For each function, users can access customised information on how best to utilise the function for their own purposes along with technical instructions for implementation. This portal creates a forum for communication between the local and international stakeholders. It also provides a means to monitor and contribute to a digital ecosystem that is continually evolving. This form of institutional networking is a contrast to the personal networking that many geographical regions thrive upon for innovation and collaboration.

9.4 Education initiatives inspired by the local region

Education at the Trento Co-location Centre takes several forms. First, there are orienting activities that generate interest amongst potential students. These include events such as camps and presentations. Second, there is teaching. Third, there is project-oriented course work which focuses on parallel activities, usually in enterprises. Businesses in the Trentino region are encouraged to submit problems and students are presented with a marketplace of projects to choose from. Finally, there are group-based projects that aim to develop social skills and networks alongside problem-based methods. The territorial labs provide opportunities for hands-on experience in service design, user-related issues, business prospect evaluation, etc. The educational aspect of Trento co-location centre consists of four mechanisms for delivery.

9.4.1 EIT Master School

The first courses at the EIT Master School will begin in September 2012 with the subject of study at Trento as Service Design and Delivery. Specifically, the programme will focus on social services which are advantageous for citizens at large. These citizen-oriented services include those targeted toward better living (health and well-being) and government coordinated services. The local environment, with its high ranking in quality of life, high percentage of businesses in services, and active projects involved in this area is well suited to host this degree. Moreover, the degree gains international recognition because it is quality ensured by an international organisation. Businesses want to cooperate with the degree because of its international standing.

The ICT education programmes are highly interdisciplinary, combining a technical major with an innovation and entrepreneurship minor. The minor has been designed in cooperation with local businesses, schools, and industry. The faculty draws on a range of departments including Computer Science, Cognitive Science, Sociology, and Humanities. In order to complete the degree, a quarter of the required courses must be related to business innovation. Further, the thesis must be completed using mentoring and internship experience at an enterprise. Often the thesis requires the development of a business plan for the commercial exploitation of a project developed in earlier courses. All courses are transferable, and students are encouraged to study at multiple co-location centres in order to complete the degree. A video-café also encourages networking through the Internet.

The students who take part in this programme are put in contact with a local network of SMEs working on new technologies and innovative services in these domains. They will also work with Telecom Italia and Engineering Spa. Students will have access to the projects and practical experiments of Trentino’s Living Lab infrastructure. They can test prototypes and collect and analyse data from Living Labs such as retirement homes, social networks such as citizen associations, etc.

### 9.4.2 Doctoral Training Centre

The Doctoral Training Centre has been established this year. The primary goals of the EIT ICT Labs Doctoral School are to develop an innovation and entrepreneurial mindset among PhD students and to set up the appropriate environment where young PhDs may grow business projects founded on their thesis research. The Centre will have 10 new PhD students per year. Students share their time with a participating industry and co-located Training Centre. All PhD students share a theme, - in the case of Trento the theme is security. All supervisors must contribute and participate to the work completed at the DTC for at least the duration of the theses. Seventy-five per cent of PhD scholarships at the Trento Co-location Centre are funded by enterprises.

### 9.4.3 Training Camps

Summer and winter training camps offer activities such as presentations, demonstrations, introductory courses, laboratory tours, social events, discussions, and networking opportunities. These camps may in future be aimed at secondary and tertiary students as well as graduate students. The first camp in Trento was held in February 2012 with the intention of encouraging students to apply for PhDs within two specific fields: Human Language Technology, an active area of research in five different local laboratories; and Data/Knowledge Technologies, a key research area in the Trentino Province.

### 9.4.4 Internships

Internships offer undergraduate and graduate students an opportunity to gain direct access to a company. They develop links with enterprises and transfer knowledge. Internships provide hands-on experience with external projects owned by local businesses. Local businesses are keen to offer internships because they are working with an internationally recognised centre.

### 9.5 Main challenges, key success and enabling factors

At this early stage, the results of the education initiatives of the Trento Co-location Centre are unknown, as most of the education activities have yet to begin. The goal is to foster a territorial lab in the long-term, while Master’s courses, starting in the autumn, focus on shorter-term linkages and results from project-oriented work.

### 9.5.1 Strong regional support system

The close location of the co-location labs in Italy may be advantageous for communication and development of the educational initiatives. The regional support from Trentino is quite significant and has been a critical driver in setting up the initial conditions for a successful co-location centre. By focusing on the strengths of the local region, service-related innovation, ICT infrastructure, and an orientation toward well-being, the Trento co-location centre is using local strengths to develop an internationally-oriented programme.
9.5.2 Engagement with EIT

Businesses and stakeholders have quality assurance and monitoring due to the European level design of the educational initiatives of ICT Labs at the Trento co-location centre.

9.6 Transferability of the approach

A key characteristic for transferability of the success of the Trento region is the small size. With fewer actors, networking is easier, there is greater financial and administrative reliability, and programmes can be delivered at a faster rate. Decisions are easier to make with fewer stakeholders involved in negotiations. The Province of Trentino has used its small size and autonomy to deliver a large programme to enhance its innovative potential.

According to interviewees, the objective of these initiatives is to become an international ICT hub. A potential barrier to the success of the education initiatives may be a number of students who do not complete their degrees due to involvement in a start-up or project. Given the experimental nature of the initiative, further obstacles and transferability are yet to determined.

9.7 Key lessons learnt

While it is too early to identify lessons from the education initiatives of the Trento co-location centre, regional initiatives to promote collaboration between the various protagonists in the region are worth highlighting:

▪ Support for innovative activities within a technology sector
▪ Incorporating users and the public in the innovation process
▪ Analysing and focusing in on a few key thematic areas to compete in an international environment
▪ Finding international support and promoting internationalisation generally
▪ IT resources such as the Portal for Innovation for centralised knowledge management facilities to access resources in the local area

The Trento RISE initiative in particular illustrates the commitment of the partners to secure the place and contribution of education in the knowledge triangle.

9.8 Contacts, references

9.8.1 List of interviewees

▪ Robert Saracco, Trento ICT Labs Node Director, University of Trento
▪ Maurizio Marchese, Director of Education, Trento ICT Labs, University of Trento

9.8.2 Internet sources

http://www.trentorise.eu/
http://www.unitn.it/en
http://eit.ictlabs.eu/
10 University of the Arts London

10.1 Introduction
The University of the Arts London (UAL) is Europe’s largest provider of education in art, design, fashion, communication and performing arts. It is located in the centre of London, the most densely populated and wealthiest region of the UK, and the sixth largest city economy in the world. The creative industries represent the second largest sector, following finance, accounting for £32bn per year, 16 per cent of the city’s gross value added. Nearly 400,000 people work in the creative industries.

Interviewees emphasise that London does not have any relevant regional policies regarding collaboration and higher education. The regional development agencies had policies for collaboration but they were replaced in the Spring of 2012 by local enterprise partnerships (LEP) which involve local authorities and businesses to drive economic growth. The London LEP does not have any higher education representatives.

10.1.1 Basic information on the institution
UAL is a collegiate university comprising six constituent colleges, brought together in 1989. Each of the colleges has a different mechanism for business client outreach and for the operation of the knowledge triangle. The education and outreach activities vary according to the type and range of clients. Altogether the University has 13000 undergraduates, 4000 students pursuing further education and 3000 postgraduates. Central Saint Martins College of Art and Design (CSM) was formed from four original colleges: St Martin’s School of Art (founded 1854) and the Central School of Arts & Crafts (founded 1896) merged in 1989. Drama Centre London (founded 1963) joined CSM in 1999 and Byam Shaw School of Art (founded 1910) in 2003. This case study will focus on CSM as it widely regarded as one of the best art design institutions in the world. CSM is currently comprises 4 schools (See Figure 36).

Figure 36 Structure of University of Arts London

Historically, the majority of the teachers at the constituent colleges that formed CSM were successful practitioners of their disciplines and provided the school with a variety of practical skills and contact with the creative industries. This was combined with a strong drive from key figures in the history of the school to be innovative in educational objectives and teaching methods. This tradition continues today.

Together the colleges at CSM cover a very diverse range of subjects that cut across many sectors. For that reason CSM has links to wide range of external partners in addition to those in the creative industries. In 2011, the different schools of CSM were moved to one location at King’s Cross in a purpose-built building. CSM’s strength lies in the diversity of student body and the large number of fractional staff and lecturers that they employ. Roughly 4,500 students are currently enrolled at the College and an additional 12,500 take short courses.

In 2008 the Research Assessment Exercise, an exercise taken every 5 years on behalf of four UK higher education funding councils to evaluate the quality of research undertaken by British higher education institutions, ranked UAL 44th out of 132 universities in the UK. In the ‘Art and Design’ subject
tables the university was placed 22nd out of 72 submissions. In 2011, the Times Good University Guide ranked UAL 86th out of 116 institutions in the UK. The Quality Assurance Agency for Higher Education, which evaluates higher education qualifications in the UK, gave the colleges very high rankings for the ‘art and design’ category.

The majority of UAL’s income, £107 million out of £209 million, comes from tuition fees. Although the majority of its Funding council income is for teaching, the university expects to get no government assistance for teaching by 201549.

**Figure 37 Income of UAL**

![Income of UAL](image)

2011 Annual Report, University of Arts, London

**Figure 38 Breakdown of funding Council Grants**

![Breakdown of funding Council Grants](image)

2011 Annual Report, University of Arts, London

10.1.2 **Governance**

Historically UAL had a central support system for knowledge exchange and enterprise, which has recently been restructured to better support income generation which takes place at college level. Currently, the colleges each operate their own strategy pertinent to their individual specialities and UAL runs technical support functions in areas such as law, finance, tax and funding intelligence. There are multiple Teaching and Development Managers. One Manager sits at the University level. Individual managers sit at the College levels.

CSM does not have specific strategies to foster cooperation with external partners but it does have specific strategies to foster innovation. The main goal at CSM is to generate a surplus while benefitting the College’s academic mission. The strategy to do this is centred on students and education, as that is their greatest strategic asset. The knowledge triangle is not explicitly mentioned in the strategy.

The decision to dismantle the centralised offices in favour of a decentralised approach has been widely regarded as a successful for the governance of enterprise, i.e. managing industrial clients, at the University’s constituent colleges. The clients and relationships are at the college level. The various colleges at UAL share information on their activities with external contacts primarily through peer to peer conversation and a monthly cross University Enterprise Working Group. At present there is no customer relationship management system in place outside the fundraising department.

10.1.3 **Business oriented management**

CSM has employed talented business managers and adopted a non-hierarchical culture of leadership. Enterprise staff, responsible for liaising with industry, at all levels are empowered to develop relationships on behalf of the college. There is no separate organisational unit for promoting

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49 Annual Report 2011, University of Arts London.
collaboration. There are 10 managers who handle different areas of business financial targets for the college. The innovation centre is managed in a similar way to a business in that it is surplus-oriented and staff are evaluated based on the amount of business they bring in. Every year Central Saint Martins meets or exceeds its financial targets.

Business development staff at CSM tend to have backgrounds in industry rather than research. The majority are intermediaries not disciplined specialists. They also tend to have experience in a wide range of sectors. They have a great deal of flexibility and are not micro-managed. CSM recruits managers through head-hunters and networking in addition to formal advertising and people who apply on their own initiative. Most of the new appointments have very good soft skills and are very capable but there is an active training procedure with coaching and mentoring from more experienced members of the team. This serves to retain staff and increase delivery. The management of the staff promotes a culture with a high degree of trust. With increased autonomy amongst the colleges there is more potential for innovation. Each college is better able to find its own opportunities for change.

10.2 Strong focus on the engagement of external partners

10.2.1 Collaboration with external partners

External collaboration is developed through a number of channels and mechanisms to develop links.

First and foremost, networks are developed and managed by the academics at CSM who have links to external organisations through previous experience or because they are associated concurrently with external projects. This results in the greatest number of collaborative projects.

Second, networking is made possible by the brand that Central Saint Martins carries. Widely regarded as one of the best colleges for art and design, organisations approach the college through the Innovation Centre, to the extent that CSM cannot actually fulfil the demand. The networking opportunities are also enhanced due to the college’s location in London. The recent bringing together of all the schools at CSM under one roof with more spaces for collaboration further expands the possibility for networking. External parties access the building through formal and informal events, where they come into contact with students and staff.

Collaboration takes place thorough individualised contacts as well. The majority of the teaching staff at CSM are simultaneously employed by a variety of enterprises. These lecturers are a major source of collaboration for the college because they have many personal contacts from their pursuits external to the college.

Collaborations result in project oriented work or consulting assignments. They are primarily developed between external partners and academics. The academics have the relationships and sell projects that include students. The academics are able to maintain and develop these relationships because they themselves practise and work in central London. The external partners have a variety of relationships with CSM. Some are short-term while others are longer-term and repetitive. CSM has a very strong brand name around the world and the luxury to manage their demand. Many of the clients that come to CSM have seen student work elsewhere and want to commission similar assignments, and CSM has many repeat clients. At times there may too much work coming in from regular clients and CSM may not have the resources to follow alternative paths. Increasingly, international clients are commissioning work from CSM students.

10.2.2 Mobility

There is a high degree of mobility at CSM. The majority of the teaching staff at CSM are simultaneously employed by a variety of enterprises. The senior management support and encourage dual employment for teaching staff in order to transfer knowledge. Increasingly, international mobility is guiding further collaborations and opportunities. Finally, students are encouraged to participate in exchange programmes with design universities around the world.

CSM actively seeks out partners and students from around the world in order to tap into an international market. Internationalisation is not difficult.

10.2.3 Innovation Centre

The historical reputation for practice relevant work and innovative education has been taken forward with an Innovation Centre launched in 2007. This Centre was developed through a combination of
funding from the London Development Agency (prior to termination) and the college's own resources. The Centre's objectives are as follows:

- Link innovators and creators in new networks and ways of thinking
- Work with businesses to exploit Central Saint Martins research and expertise
- Lead opinion and debate in the arts and design
- Provide a bridge for Central Saint Martins' graduates into the complex world of international design projects

The Innovation Centre is very successful. The level of income is very high and continually increasing as are the number of external institutions who are seeking to partner with the Centre.

The Innovation Centre has five roles. They work with students to develop links with business either through joint projects or through managing one-off commissions. They offer business services in the form of consultancy and negotiate contracts for sales of art. The research component encourages collaborations with industry and offers scheduling flexibility in the form of part-time and extended degrees that encourage conducting research while simultaneously employed in industry. Professional training services is a fourth component of the innovation centre which includes services such as the development of bespoke one-day courses designed specifically for businesses and the commissioning of in-depth research. Finally, the graduate support function prepares students to go into industry by offering a series of short courses, advice and support networks.

10.3 Education Initiatives: innovative and student oriented approach

10.3.1 Innovative Teaching and Learning methods

The students are the central focus of the university and most resources at CSM are tailored towards them. The students are also paying for the courses so they take a role as a customer. Tuition fees are expected to triple for British students in the following years due to government cutbacks in the UK. With this increase in tuition fees, universities will be expected to cater more resources to the students who are paying the higher fees.

Education at CSM is project-oriented and varied. Most of the research and education at CSM is in collaboration with industry, commerce, museums and galleries, governmental organisations and other internationally recognised academic institutions. External partners in the creative arts sector want access to the students, so Central Saint Martins develops links between students and research and/or external parties through a wide range of approaches.

Creativity at CSM is not actively managed; it is ingrained in the culture and the sector in which the school operates. Students and staff are keen to experiment with new methodologies. These methodologies may derive from different sectors or different areas of studying. For example, philosophy lecturers will come and teach in the industrial design courses. There are a number of active researchers in the college, all of whom also contribute to the teaching programme. A significant percentage of the research activity is industry or sector related. The researchers take teaching very seriously because it is an opportunity to test and refresh their thinking. It is also a means of generating ideas and insight.

10.3.2 Curriculum development

The courses are continually redesigned to react to market needs. Lecturers read trends across students by monitoring projects - these trends are then incorporated into the curriculum as they provide key market insight, and are the basis for future research.

A key success factor of these courses is the hands-on component. The students do not just design a product or service but see it through to prototype. Most importantly, these projects are developed in response to requests from external partners and have a high degree of relevancy. The curriculum at CSM is innovative due to the nature of the subject matter and the culture of the students and staff.

CSM also has the benefit of from the recognition by senior management at the university that teaching is the central asset of the university. However, delivery of programmes and the development of relationships amongst clients is bottom-up.
10.3.3 Flexible Masters Degrees

Most of the graduate degrees at CSM operate under a full-time extended option over two years. This allows students to pursue their degree for 30 hours a week and use the remaining time to work, find work, or develop their own personal portfolios. Students gain life experience and connections with industry. Further, the extended option means that many older students have the option to study at CSM, bringing their own contacts and life experience.

10.3.4 Non Accredited Short Courses

Central Saint Martins has a large short course programme with over 1,200 evening, daytime, weekend, Christmas, Easter and Summer School courses attracting some 12,500 short course students from all over the globe. These short courses can act as 'taster' and portfolio building courses to develop a prospective student's application to art college or for creative professionals to 'upskill' and continue with their creative and professional development. The courses tend to be taught by the large number of associate lecturers and technicians that work part-time at the university while working in the arts sectors. The students taking the courses tend to be an even split between professional, general, and leisure artists and designers. These courses are a major source of the surplus generated by CSM.

10.3.5 Sponsored projects

External organisations can pay for problem-solving by CSM graduates, usually in the form of project-based coursework. This is a core activity for CSM and a source of many collaborations. Businesses in the creative arts sector are interested in the undergraduate and graduate students at CSM because of their reputation for creativity and innovative solutions. These projects may also provide an opportunity for innovative teaching methods and the exploration of cutting-edge methodologies. The businesses pay the students for the projects and students are taught to negotiate contracts in a professional manner. Intellectual Property is owned by the students. The university clarifies the IP position of the students in contracts, holds it for the duration of projects and helps students set a price. This provides a valuable service for the students and prevents them from undervaluing their intellectual property.

10.3.6 In-House Design Consultancy

Consulting opportunities are made available to students as means to learn directly from clients in addition to normal project-based courses. CSM is distinctive in that they have many clients beyond the creative arts sector, such as financial and consulting companies, requesting consulting services. The Design Laboratory is a design studio that runs through the Innovation Centre at CSM delivering media, graphics, fashion and product consultancy for a wide range of international clients. Students, freelancers, and graduate interns in design, communication, fashion and film from the University of the Arts London are given an opportunity to start their career while overseen by experienced creative managers. Through this programme, researchers, students and external contacts collaborate and share ideas. The Design Laboratory offers product solutions, from initial concepts through to finished products and may even oversee the manufacturing process. The Design Laboratory currently houses four teams in fashion, communication, strategy and product design.

10.4 Main challenges, key success and enabling factors

10.4.1 Clarity of Purpose

The student-oriented initiatives are driven by CSM and cannot be attributed to external policies or legislation. The main rationale behind them is to generate a surplus by focusing on projects that engage students. In that sense, CSM is run similar to an enterprise, catering most of its resources to education and fulfilling student demands because that is where the surplus is generated. This approach is a direct consequence of UK government policy in which students pay substantial fees for undergraduate and postgraduate education.

The CSM brief is clear and much more straightforward than at other universities - to develop collaborations, enhance the brand, etc. Decisions are also straightforward; the staff prioritise opportunities that bring in the most money while also benefiting the students. In the case of CSM, the best way to prioritise opportunities is by focusing on the education aspect of the knowledge triangle through a variety of mechanisms including: engaging students, developing courses, and conducting
project-oriented work. According to interviewees, government cuts in higher education mean that universities will have to focus more and more on the bottom line.

10.4.2 Demand from businesses

A second driver behind the student-oriented focus of CSM is the demand from businesses. Businesses seek out CSM students because they are not able to get unconditioned responses from users, employees and academics. Businesses that come to CSM are looking for innovative and creative ideas that are not embedded within a well-established and risk-averse system of thought. Students also give businesses a perspective from future clients. The creative arts sector might be quite peculiar in that businesses seek young talent in the form of students more than research. CSM continues to develop a range of initiatives to develop links between students and businesses. Senior management at the university support these initiatives and orient university strategy toward the students.

The main barriers that CSM has managed to overcome are the expectation of clients. CSM actively negotiates contracts so that they are broad and allow for a range of deliverables. Herein lies CSM's success. The projects and links that have the most repeat clients and successful feedback tend to be those in which students had a great deal of autonomy, albeit supported by experienced academic staff who also often run their own consultancy businesses.

10.4.3 Flexible approach to collaboration

CSM has a 'word of mouth' reputation as to the quality and innovativeness of its deliverables. Businesses and employees tend to be risk-averse and usually come to CSM when they are looking for new ideas. CSM is better able to provide these by negotiating contracts that allow for exploration, that are not narrowly defined or limited. External partners expect the unexpected when they approach CSM. Creativity is possible because there are no preconceived conditions in the contracts and the possibility for innovative outputs is greater. According to interviewees, their experience at other universities with similar programmes is where clients set a brief as a favour to the university and are not interested in the outcome. Open briefs and autonomy implies respect for the quality of the output and collaboration managers are not hesitant to require these types of briefs in the sales process.

10.4.4 Direct Sales Process

When approaching potential clients, CSM takes a very direct approach having appointed dynamic business focused managers. They do not undervalue their students and engage in straightforward negotiations. Businesses appreciate this approach because the managers communicate with them on their level. The negotiations are clear because both parties are profit-oriented and share drivers and motivations. This style of communication ensures a strong and direct relationship with the businesses that will employ the graduates.

10.4.5 Threat to internationalisation

There is some concern that bringing in students to the UK may be difficult due to rising fees for university education. There is also a concern that international students are not able to obtain a visa to work within the UK after their education. If UAL has fewer British students, and more international students who are not able to remain in the UK after graduation, they will not be able to fulfil the demand from the national economy for arts graduates.

10.4.6 Space for Creativity and Collaboration

The other major barrier that CSM faces is space and resources. The demand cannot be fulfilled because the College simply is not big enough. The university has made attempts to remedy this with the development of an award-winning building in central London.

The new building in which CSM resides has been a success in several ways. The building has been designed with spaces for interaction and ideas development. Staff and students have many spaces for informal and formal contact and do not work in isolation: they meet spontaneously in spaces designed for collaboration and networking. The building has also been designed to promote a pleasant and creative atmosphere. Having the different schools under one roof with open spaces means that
opportunities for sharing knowledge increase. Its location in central London attracts external partners who want access to the building. Giving students access to a network of practitioners from various sectors means that they do not operate in a theoretical vacuum/ivory tower.

10.5 Transferability of the approach

CSM delivers added value to its clients in the form of design solutions to business problems concerning new product innovation, communication, marketing, branding and corporate identity. They are able to fulfill a large demand for this practice by recruiting highly skilled students and graduates in the various initiatives mentioned earlier.

Much of CSMs success lies in its location, the sector in which it operates, and the students that are enrolled. These are not transferable. The location in central London allots many resources to the University. Other universities do not necessarily have access to the local cosmopolitan resources that London offers. The sector actively seeks younger students for contract work as they are perceived to have fresh ideas. Once again, this is not transferable because in many sectors, especially science and technology, businesses prefer students with higher education. Finally, the students are attracted to the location and brand that CSM offers. Although other universities are working on brand development, CSM is widely regarded as one of the best. Developing a brand that is widely noted to be one of the best requires a long track record amongst other factors.

However, the innovative teaching methods, risk-taking culture, and focus on students and their education are effective. When the curriculum is flexible, collaboration with the outside world is fruitful and is more likely to be absorbed into the teaching curriculum at the university.

10.6 Key lessons learnt

- Support for teaching and education activities from the management of the University is critical to driving these activities forward
- Encouraging students from a range of backgrounds through short courses brings money and diversity amongst the student population
- Developing sophisticated communications with industry encourages business links with students. This includes teaching students to have a professional attitude and value their intellectual property
- Promoting creative and flexible projects and innovative teaching
- Developing well-designed spaces and buildings for interaction and networking

10.7 Contacts, references

- Dani Salvadori, Director of Enterprise and Innovation at Central Saint Martins College of Art & Design, Head of University Enterprise Development, University of the Arts London
- Alisdair Aldous, Research and Enterprise Collaborations Development Manager, University of the Arts London
- Nicholas Rhodes, Course Director Product & Industrial Design at Central Saint Martins, Creative Director at Rhodes & Lauritsen, University of Arts London
11 University College London (UCL)

11.1 Introduction

11.1.1 From England’s first purely secular university to a top world institution

University College London (UCL) was founded in 1826 as England’s first secular and non-discriminatory university. Its foundation opened up for the first time in England the opportunity for non-Anglicans to proceed to higher education, challenging the monopoly of access to higher education then exercised by the Church of England. It also set out to remove the barriers of social class, race and gender, opening access to women on equal terms with men as early as 1878. UCL has maintained its original values and remains an open-access institution, with a fully merit-based recruitment process, admitting students from all religious, social, economic and ethnic backgrounds.

Over the years, UCL has become a global leader in research and a top-choice university for students worldwide. It ranked 21st in the 2011 Shanghai Jiaotong World Ranking of Universities and was the third highest English University (after Oxford and Cambridge). In the 2008 Research Assessment Exercise (RAE) of English higher education institutions, UCL was rated the best research university in London and third in the UK overall. With regards to education, it attracts an increasing number of student applications every year, specifically from postgraduate and overseas students.

11.1.2 A comprehensive university reorganised recently along three schools

The university maintains the comprehensive character enshrined in its foundation charter. Research and education activities are spread across 10 Faculties organised in three Schools (School of Arts & Social Sciences, School of Life & Medical Sciences and School of Sciences), which were constituted to promote greater interdisciplinarity in research and teaching. UCL is known as the largest biomedical research centre in Europe and a global leader in combined medical and health research, while also valuing arts, humanities and social sciences with a commitment to excellence in all disciplines.

UCL’s governing body is the UCL Council, with the UCL Academic Board as the senior academic authority. The operational management of UCL is the responsibility of the Provost’s Senior Management Team (SMT), while six vice-provosts are in charge of specific areas of activities (Education, Research, Enterprises, International Relations, Operations, Health). Deans are responsible for the governance of each of the ten Faculties.

UCL is host to 24,859 students for the academic year 2011-2012. Most of them study full-time, but some departments permit part-time study, which involves 13 per cent of the total number of students (mainly graduates). About 45 per cent of students attend graduate study programmes, of which over a third pursue research degrees. Key figures on the number of students by Faculty and level of study are presented below (Figure 39).

Figure 39 Key figures, students (2011/2012)

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Undergraduate students</th>
<th>Graduate students</th>
<th>Total number of students</th>
<th>Percentage of the total number of students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arts &amp; Humanities</td>
<td>2,157</td>
<td>1,075</td>
<td>3,232</td>
<td>13%</td>
</tr>
<tr>
<td>Bartlett Faculty of the Built Environment</td>
<td>722</td>
<td>1,457</td>
<td>2,179</td>
<td>9%</td>
</tr>
<tr>
<td>Brain Sciences</td>
<td>570</td>
<td>1,241</td>
<td>1,811</td>
<td>7%</td>
</tr>
<tr>
<td>Engineering</td>
<td>2,049</td>
<td>1,642</td>
<td>3,691</td>
<td>15%</td>
</tr>
<tr>
<td>Laws</td>
<td>528</td>
<td>458</td>
<td>986</td>
<td>4%</td>
</tr>
<tr>
<td>Life Sciences</td>
<td>1,183</td>
<td>486</td>
<td>1,669</td>
<td>7%</td>
</tr>
</tbody>
</table>

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51 UCL, About UCL Brochure
52 UCL, Students statistics 2011-2012: http://www.ucl.ac.uk/ras/statistics
### Faculty Students Distribution

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Undergraduate Students</th>
<th>Graduate Students</th>
<th>Total Number of Students</th>
<th>Percentage of the Total Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical &amp; Physical Sciences</td>
<td>2,187</td>
<td>677</td>
<td>2,864</td>
<td>12%</td>
</tr>
<tr>
<td>Medical Sciences</td>
<td>1,773</td>
<td>1,342</td>
<td>3,115</td>
<td>13%</td>
</tr>
<tr>
<td>Population Health Sciences</td>
<td>64</td>
<td>815</td>
<td>879</td>
<td>4%</td>
</tr>
<tr>
<td>Social &amp; Historical Sciences</td>
<td>2,539</td>
<td>1,894</td>
<td>4,433</td>
<td>18%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13,772</strong></td>
<td><strong>11,087</strong></td>
<td><strong>24,859</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Technopolis, based on: Students statistics 2011-2012 ([http://www.ucl.ac.uk/ras/statistics](http://www.ucl.ac.uk/ras/statistics))

As at March 2012, 8,129 FTE work at UCL, of which 24 per cent are academic staff, 30 per cent researchers and four per cent teachers and teaching assistants. Distribution of UCL staff by category and Faculty is presented below.

**Figure 40 Key figures, staff (31/03/2012)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Academics</th>
<th>Researchers</th>
<th>Teachers &amp; TAs</th>
<th>NHS Related Administration</th>
<th>Managerial Support</th>
<th>Manual and Craft</th>
<th>Technician</th>
<th>Total FTEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of staff</td>
<td>1,920.86</td>
<td>2,373.18</td>
<td>363.95</td>
<td>77.39</td>
<td>2,593.83</td>
<td>109.58</td>
<td>690.65</td>
<td>8,129.45</td>
</tr>
<tr>
<td>Percentage of total number of staff</td>
<td>24%</td>
<td>29%</td>
<td>4%</td>
<td>1%</td>
<td>32%</td>
<td>1%</td>
<td>8%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Technopolis, based on: Staff statistics 2011-2012 ([http://www.ucl.ac.uk/hr/statistics/](http://www.ucl.ac.uk/hr/statistics/))

#### 11.1.3 London’s Global University

UCL describes itself as ‘London’s Global University’, referring to its approach to internationalising research and teaching as well as engaging with academic and business partners worldwide. Almost 40 per cent of all students come from outside the United Kingdom (13.5 per cent are from the rest of the EU and 26 per cent from outside the EU, with a strong representation of Asian countries\(^{53}\)). Similarly, a large proportion of staff is made up of non-UK nationals (32 per cent)\(^{54}\). True to its history, UCL commits itself to being an open institution, selecting on merit excellent students from the United Kingdom and abroad, while embracing global issues and international perspectives in its education and research model.

This means that UCL competes both nationally and internationally with the best higher education institutions in the world to attract students. Overseas applications have increased strongly over the years and now exceed those from British students\(^{55}\). As a result of its international openness, UCL benefits from a wide network of alumni, with alumni groups spread across the world.

A new impetus was given to international activities in 2008, with the UCL initiative for two campus-based activities abroad. The first one in Adelaide (Australia) offers an MSc in Energy and Resources Management and PhD opportunities, while the second one, in Qatar, is a partnership between UCL, Qatar Foundation and Qatar Museums Authority, offering master programmes in Archaeology, Museum and Gallery Practice, and Conservation Studies. The establishment of overseas operations depends upon the demonstration of clear academic advantages and restricted solely to graduate education and research.

#### 11.2 Social and economic impacts as key strategic drivers

From its earliest days, UCL engaged in research in new areas as a response to the emerging industrial and commercial society, and it pioneered research and teaching in new disciplines of high

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54 UCL, Staff statistics 2011-2012: [http://www.ucl.ac.uk/hr/statistics/](http://www.ucl.ac.uk/hr/statistics/)
relevance such as architecture, medicine, geography, physics, chemistry, engineering and modern languages. Today, it is still a core feature of the UCL’s strategy to achieve maximum socio-economic impact:

*(UCL is) committed to achieving maximum positive social, environmental and economic benefit through its achievements in education, scholarship, research, discovery and collaboration (UCL Council White Paper 2011-2021)*

This social mission is at the apex in the engagement activities carried out at the university –(described below) and combines education, research, innovation and knowledge transfer, outreach, public engagement and public policy.

**11.2.1 Engagement and knowledge transfer extends research and teaching activities**

On the whole, UCL sees in knowledge transfer not a third dimension but rather the extension of teaching and research activities. In UCL’s understanding, teaching, research and knowledge transfer have a reciprocal influence on each other, in that teaching is becoming more experiential, research is increasingly articulated around living labs and knowledge transfer gains in relevance thanks to the increasing connection and dissemination that occur in research and teaching activities. UCL vision is that “all academic communities are enterprising” and it encourages all academic staff to take part, even in those fields where there is traditionally less involvement in innovation activities (for example within the School of Arts & Social Sciences). While the knowledge triangle may not be explicitly mentioned in the university’s strategy, the different dimensions of the triangle are thus strongly interconnected with one another.

UCL’s activities are not restricted to research, innovation and education. In addition to transferring knowledge, the university engages broadly with external stakeholders, society and policy makers, contributing to the university’s wider impact on its environment. In turn, it is expected that better engagement activities and closer connections with businesses, public and policy-makers will lead to more relevant and better research and teaching opportunities.

Collaboration and engagement activities can be classified into three types.

The first type is knowledge transfer and enterprise activities. The commercialisation of UCL research results, the advancement of entrepreneurship culture and the embedding of enterprises across the breadth of academic activities are the main objectives of the UCL Vice-Provost(Enterprise), who was first appointed in 2006 to oversee the whole strategic area related to knowledge transfer. The Vice-Provost works together with a team comprising three units: UCL Business for technology transfer and commercialisation, UCL Consultants to support private consulting of UCL academic staff and UCL Advances for the diffusion of entrepreneurship culture and entrepreneurship training across the university and beyond. UCL Advances’ prerogatives are much broader than those of other UK universities centres for entrepreneurship, in that it offers courses, support schemes, events and networking activities to UCL staff, students and external enterprises. In addition to these three units, UCL Enterprise Operations offers overarching support for industrial collaborations and sponsorships (see Figure 41 below).
The second type is public and community engagement, for which responsibility is shared between three units. UCL’s Outreach Unit is in charge of outreach activities (such as that promoting the access of under-represented groups in university education), while the Voluntary Services Unit promotes the participation of students in volunteering activities. In addition, the Public Engagement Unit helps staff and students to disseminate the work done at the university towards the general public and enables people outside the university to contribute to the university’s programmes. Activities include Lunch Hour Lectures featuring UCL’s researchers, which are open to anyone, streamed online and take place during lunchtime to allow for a large attendance.

The final type is participation in public policies. Growing attention has been paid to putting research into policy at UCL, with the idea that universities play an increasing role in shaping public policies and that the research they undertake, across and within a breadth of disciplines, can open new approaches for policy-makers. Activities include a policy secondment scheme, public events on policy issues and specific policy-oriented research activity and briefings.

In practice, making impact is a common strategic driver for research, education and engagement/knowledge transfer activities, with a coverage ranging from economic and innovative to social and political impact. Making impact is also the common denominator connecting altogether the three dimensions of education, research and knowledge transfer/engagement, in that knowledge transfer and engagement activities are referred to as extension of research and teaching activities, and as a way to ensure their impact. They are spread across education and research activities and influence strongly the ways and modes in which these operate, as exemplified by the ‘Grand Challenges’ and ‘Global Citizen’ approaches which are described below.

### 11.2.2 Research excellence across Grand Challenges

Regarding research, in 2007 the university launched the ‘UCL Grand Challenges’: these are concentrations of cross-disciplinary and cross-thematic specialist expertise across UCL and in partnership with other institutions and agencies. They coordinate institution-wide responses to the societal agenda, aiming to disseminate research outputs widely to business, society and policymakers in four key global challenges: Global Health, Sustainable Cities, Intercultural Interaction and Human Wellbeing.

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56 UCL (2011), UCL Public Policy strategy
Inspiration comes from the idea that global issues can rarely be addressed using the findings of a single research advance, but that dialogue and collaboration between people from various backgrounds can contribute to developing new innovative ideas. By bringing together a critical mass of researchers and resources, the Grand Challenges aim at providing an environment in which researchers’ work can intersect with one another and benefit from the cross-pollination of ideas and disciplines.

The four objectives of the UCL Grand Challenges

- Creating networking opportunities – to connect, from across the full spectrum of disciplines, academics who would not otherwise interact, and foster networks of experts able to respond to emerging issues and opportunities
- Providing spaces for debate – to bring together differing expertise, perspectives and methodologies, in order to provoke new understanding and to inculcate a culture of collaboration focused on the judicious application of knowledge to major problems
- Facilitating novel research – to stimulate new areas of interdisciplinary research that would not otherwise take place, generating wisdom and societal impact
- Improving policy and practice – to benefit individuals, organisations and nations by stimulating economic performance, increasing the effectiveness of public services and policy, enhancing quality of life, health and creative output, and furthering social justice and equity


The Grand Challenges are not intended to cover all research activities carried out at UCL, but are implemented in parallel with the UCL Research Frontier programme supporting exploratory and curiosity-driven research. They encompass a Student Fund, launched in April 2012, to enable students to engage in research activities around the Grand Challenges. Grants of up to £750 are offered to student projects that draw from, are based around or linked into existing UCL research activity. Alternatively, students can engage in new research activities, provided that close academic mentorship is ensured.

11.2.3 Education for global citizenship

UCL strives both to develop the professional skills of its students, and to give them the aptitude to have impact in their personal and social life (e.g. leadership, creativity, constructive criticism, ambition, ethics, cultural differences, entrepreneurship and innovation). In this way, a UCL graduate is both highly employable and ready to engage actively in the world and the community, as a ‘global citizen’:

(UCL provides) an outstanding education to students from across the globe that imparts the knowledge, wisdom and skills needed by them to thrive as global citizens (UCL Council White Paper 2011-2021)

UCL’s approach of an ‘Education for Global Citizenship’ is illustrated in several features:

- Extra-curricular activities are seen as an integral element of UCL education, with students being encouraged to become fully involved in university life (through the Student Union’s many clubs and societies) and to lead innovative initiatives
- Students are fully involved in the volunteering and outreach activities carried out by the university (e.g. Student Ambassador Scheme to promote higher education in schools in the London area, Tutors and Mentors scheme to support promising pupils from these same schools)
- Degree courses are designed to ensure that students are developing an interdisciplinary, global and multi-dimensional perspective on their subjects

Regarding the latter point, the frame below develops further on the distinctiveness of UCL’s study programmes and teaching methodology, with elements selected from the Institutional Learning and Teaching strategy 2010-2015 setting out to establish UCL as an international hub for innovation in teaching.

57 UCL Global Citizenship website: http://www.ucl.ac.uk/global_citizenship/students
11.3 Specific initiatives integrating education in the knowledge triangle

To illustrate the range of initiatives that can be found at UCL, three types of initiatives are presented below, each driven by different dimensions of the knowledge triangle: the first in the governance of enterprises activities, the second in the education model and the third in a specific R&D initiative for SMEs.

11.3.1 Embedding of knowledge transfer within and across UCL Schools

A direct consequence of UCL’s strategic orientation towards impact is the integration of knowledge transfer in the ways academic activities operate. As exemplified with the “all academic communities are enterprising” motto, knowledge transfer covers all departments within the Faculties and all aspects of academic life. It encompasses both commercial (e.g. technology transfer, commercialisation, business creation) and non-commercial activities (such as that targeting collaboration with social enterprises or translational research activities for the charitable sector).

Wider embedding of enterprises across the breadth of academic activities, especially in those faculties with the lowest performance in terms of orientation towards enterprises, is one of the core aims pointed out in the 2011-2015 Enterprises Strategy, which sets out two innovative mechanisms within and across the Schools and Faculties:

- School Knowledge Transfer and Enterprise Board, established in order to ensure that there is an appropriate and specific governance structure to promote academic engagement in each of the three UCL Schools. The Board is the entity into which information about departmental and faculty initiatives can be fed and through which best practice and school-wide strategic alignment can be achieved. The Board works with the departments in identifying the resources required for these strategic areas of enterprise activity, and contributes to monitor progress and the status of business relationships. It works together with the commercial and industrial liaison coordinator, specific to each School, who provide assistance in forming external relationships and profile-raising.
Education in the knowledge triangle

- Appointment of 19 Knowledge Transfer and Enterprises Champions from UCL’s academic staff who have distinguished themselves for their leading role in knowledge transfer within their field. Their tasks include promoting knowledge transfer, building an understanding of related opportunities, facilitating the growth of projects and partnerships, and supporting colleagues in developing their knowledge transfer portfolios. They come from various backgrounds and represent all of the three UCL Schools, with aim to create better interdepartmental links and joint working throughout UCL.

11.3.2 Key Skills

As part of the emphasis put on the professional as well as personal development of UCL students, UCL has developed a Key Skills scheme, which encompasses four groups of key transversal skills and are presented in the table below.

Figure 42 Key Skills grid

<table>
<thead>
<tr>
<th>Key Skills</th>
<th>Library Research; Synthesis of Data; Critical Thinking; Active Learning; Problem Solving; Project Management; Creativity/ Innovation; Numeracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic skills</td>
<td>Reflection on Learning; Self-awareness/ Assessment; Action Planning/ Decision Making; Time Management; Autonomy; Initiative/ Proactive Approach; Budgeting; Career Management</td>
</tr>
<tr>
<td>Self-management skills</td>
<td>Written Materials; Oral/Visual Presentations; Active Listening; Foreign Language(s); Information Skills; IT Skills</td>
</tr>
<tr>
<td>Communication skills</td>
<td>Groupwork/ Teamwork; Understanding Others; Negotiation; Peer Assessment; Leadership; Adaptability</td>
</tr>
</tbody>
</table>

Technopolis, based on: [http://www.ucl.ac.uk/keyskills](http://www.ucl.ac.uk/keyskills)

Key skills are of high relevance for the study, in two respects. In the first place, in that it is a framework that allows students to develop the professional and personal skills they need for their future life and career and thus enhances their employability. In the second place, many of these skills result from participation in innovation- and research-led activities as well as in volunteering and outreach activities.

The UCL approach is to make students responsible for the development of their own set of skills, while the university offers support through appropriate resources available online and a Personal Tutors scheme. Throughout their studies, students record their skills development in a systematic way on an online platform for later reference, with aim to help them to articulate their knowledge, skills and attributes.

11.3.3 HELO project (Higher Education London Outreach)

In contrast to the key skills scheme, which is an education-led initiative, HELO relates primarily to research and innovation and is led by UCL Advances (UCL Centre for Entrepreneurship) in partnership with London Business School and supported by Meganexus, ACCBA, Business Link, Camden Council, Capital Enterprise and Leonard Cheshire Foundation. With a view to bridge the gap between small businesses and higher education institutes, HELO transfers expertise, research and knowledge from UCL to SMEs in the London area. The European Regional Development Fund supports the programme and services are offered free of charge, in fields as diverse as business plan development, technical issues, marketing support, etc.

The particular feature of HELO is that it mobilises student teams. They act as channels between SMEs and university, conveying UCL’s knowledge to the business sector and mobilising UCL academic staff whenever they encounter challenges that they can’t solve on their own. An average project lasts between eight and twelve weeks and students typically spend around 120 hours on the

58 The list of knowledge triangle champions as at August 2012 is available on: [http://www.ucl.ac.uk/enterprise/about/kt-champions](http://www.ucl.ac.uk/enterprise/about/kt-champions).

59 Webpage of the HELO project: [http://www.ucl.ac.uk/advances/business/support/helo](http://www.ucl.ac.uk/advances/business/support/helo).
assignment. According to their needs, they can benefit from specific training provided by UCL Advances (the major part of which are non-credit courses but can be added to the list of Key Skills).

A key requirement for businesses participation is to be prepared to fit in with a student’s academic commitments. In turn, there are significant benefits, such as that provided by students’ creativity and fresh views on problems as well as their knowledge of new areas such as social media. For students, participation in a HELO project opens valuable learning opportunities and offers an insight in ‘real-world’ problems faced by SMEs. The benefits are also likely to have further impacts on research activities, in that they indirectly provide an original dataset from companies that might be used by UCL researchers to observe the impact of public intervention on small businesses.

11.4 Key success and enabling factors

UCL culture and the institutional support to all types of activities engendering economic and societal impacts are the prime enabling factor in the UCL approach. Critical requirements for success can also be found in the governance process, in the training opportunities offered to UCL staff and in the active involvement of academics in the quality management processes.

11.4.1 Coordination and simplification of the governance structure for enterprise support

In 2011 UCL formed a central UCL department for Enterprise Operations, with a view to address the lack of a university-wide unit supporting collaborative research with industry. Enterprise Operations complements the structures implemented at School level (School Knowledge Transfer and Enterprise Board and knowledge triangle Champions) and works with the commercial and industrial liaison coordinator in each of the three Schools.

The Enterprise Operations department also provides a central port of call for internal or external parties who do not know who to approach within UCL Enterprises. Thus, it participates in the efforts to operate an “effective and professional enterprise communication strategy”⁶⁰ towards businesses and, through the UCL Enterprise portal, it contributes to maximising external awareness of possibilities for cooperation.

In the future, it is expected that more coordination will stimulate multi-dimensional initiatives with wide-ranging impacts and benefits such as that resulting from the above-mentioned HELO project. A major challenge however remains in the segmentation of public support, with a division of funding programmes according to the one-sided nature of activities, which results in the lack of full support for initiatives combining research, knowledge transfer and education.

11.4.2 Training and development opportunities for staff

Professional development through training is how UCL ensures that academic staff are at the forefront of developments in the use of new technologies and teaching methods, in conformity with the Institutional Learning and Teaching strategy 2010-2015. The UCL Council White Paper notes that:

None of the learned professions faces a comfortable future, and all practitioners require constant continuing education and skills development to perform at the highest levels. (UCL Council White Paper 2011-2021)

Staff are entitled and expected to undertake a minimum of three learning events per annum. For staff who have management responsibilities this should include at least one leadership or management development activity. Courses range from short courses in learning, teaching and assessment and IT to Continuing Professional Development opportunities. While Continuing Professional Development courses are organised with contributions from private providers, the UCL Centre for the Advancement of Learning and Teaching (CALT) delivers short courses internally. Tailored support is also offered to PhD supervisors.

In addition to training opportunities, CALT plays a key role in developing collaboration with and between academics across UCL on teaching and learning enhancement projects. It has six teaching

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fellows – two per school – dedicated to providing subject-specific teaching and learning guidance and advice on how to implement UCL’s teaching and learning priorities. In another field, this echoes the knowledge triangle Champions mechanisms and gives one more illustration of the breadth and diversity of development opportunities offered at all levels.

11.4.3 Academic-led approach to quality management processes

Extensive quality management activities (including both assurance and quality enhancement) are undertaken at UCL, from wide review systems of departments’ operation during the internal quality review process, to peer observation of teaching and students’ feedback mechanisms. Quality management process is the assessment channel for the quality and effectiveness of activities with regards to the strategic orientations and approaches devised at UCL.

A distinctive feature at UCL is that academic staff at all grades are actively involved, playing a significant role in the identification of UCL strengths, weaknesses and particular issues in the delivery of teaching and research activities. In particular, quality processes are based on peer review by fellow academic staff (rather than professional administrators), and they participate in a number of committees with quality management responsibilities. Through staff involvement, UCL ensures that its strategic goals, values and vision are recognised, adhered to and followed up, including those relevant to the present study (e.g. innovative teaching and learning methods, interdisciplinary research and teaching, and diffusion of entrepreneurship culture).

As an example, the UCL Council’s White Paper provides for a review of all study programmes at UCL, in order to ensure fitness for purpose in the new strategy adopted. It is planned that review questions include: how successful is the course in embedding teaching in research and scholarship and engaging the relevant research community in the course? How effectively are new technologies being deployed in teaching? What progress has been made with internationalisation of the curriculum? How far is employability embedded in the programme?

Quality management is an even more critical requirement in the context of pilot initiatives and reforms, for UCL promotes a gradual implementation of changes, using quality management to review and assess effects and decide on the future of the initiatives. This is, for example, the case for the pilot undergraduate BASc programme combining science and arts, which is expected to undergo a thorough review process, based on which UCL will decide if there are grounds for a shift to more generic entry points for a more significant proportion of undergraduate students.

11.5 Challenges and future development

The changing UK context of higher education is one of the main challenges for UCL. It includes first the new fee regime that is to be implemented from the academic year 2012-2013, with higher tuition fees for students. This potentially means new challenges in implementing the open and social diversity model of UCL and in attracting the best international students, in a context where international competition between higher education institution is sharpening with universities in China, India and elsewhere in Europe entering the international market and offering lower cost study programmes taught in English. Secondly, intake of international students in the United Kingdom has also been recently constrained by the government’s reviewing the student visa to reduce significantly the present numbers of overseas students. This directly affects university such as UCL with a significant proportion of international students.

- These elements however challenge the university strategy as a whole, and they are not specific to the integration of education, research and socio-economic innovation activities. In this respect, there is evidence of working interactions between these three dimensions both at strategic level and in the university’s practices, due to the UCL culture of aiming towards impacts and thanks to the strong institutional support and encouragement for collaboration and enterprise activities. As underlined in the UCL Council White Paper, improvement can however still be made and future development will try to address the following challenges:

- Promotion of enterprise activities in that fields where they are commonly less developed, such as the Social Sciences, Humanities and Arts.
Education in the knowledge triangle

- Undergraduate curriculum reform, which will be influenced by the review of undergraduate programmes and of ongoing initiatives such as that of the pilot BASc undergraduate.
- Reform in the infrastructure, including more openly accessible student and academic workspaces with provision for a range of hubs across the campus to provide well-serviced space suitable for study purposes, individually and in groups, supported by appropriate services in each hub. To foster interdisciplinary, it is also expected that a single central library group together all disciplines and collections.

11.6 Key lessons and transferability

Education, research and innovation activities are strongly interlinked, due to the university’s strategic approach, which places impact at the core of all the activities conducted at UCL. The UCL vision is that cooperation with external institutions and collaboration between disciplines and thematic fields constitute the best way to create and diffuse impacts, resulting in strong linkages between research, education, innovation, public engagement and outreach activities. The integration of education in the knowledge triangle is not an aim in itself but serves the pursuit of UCL goals as a whole.

This leads to another particularity of UCL, which is that engagement and collaboration are not limited to knowledge transfer and innovation/enterprise activities but extend to public engagement, outreach and policy-making. UCL’s impacts relate to society and policy as much as innovation and economic impacts. As a result, education and students participate in and benefit from a wider array of socio-economic interactions than in the majority of higher education institutions.

Like the governance set-up, UCL strategic agenda is part the university’s history and values and is not transferable as such. However, some interesting features could be replicated in other contexts, in particular the strong institutional support, which is underlined at all levels (including governance, strategy, education approach, training opportunities for staff, quality management processes, etc). Another transferable practice is the active involvement of academic staff in developing on new initiatives and in implementing strategic orientations. Practices such as the knowledge triangle Champions and the CALT’s teaching fellows are, for example, a good way to ensure academic-led, widespread support, by giving academic staff the responsibility for guiding and mentoring their peers in the areas of knowledge transfer and teaching. They contribute to model a flexible approach to engagement, with the most active staff leading the way for the others. They also enables joint working and sharing of good practice across Faculties and Schools, by creating networks of leaders in their fields who contribute to UCL achievements towards its strategic goals.

Finally, the recognition of transversal skills and extra-curricular activities once students graduate could also inspire other higher education institution across Europe. UCL was among the first institutions to implement the British HEAR system, a country-wide mechanism that provides a detailed picture of student achievement throughout a student’s time at university, including not only academic work but also extra-curricular activities, prizes and employability awards, voluntary work and offices held in student union clubs and societies. UCL’s approach gives students responsibility for the development of their academic and personal skills and offers them practical means to record and follow on their own development, as exemplified in the Key Skills system.

11.7 Contacts, references

11.7.1 List of interviewees

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timothy Barnes</td>
<td>Director Executive</td>
<td>UCL Enterprise Operations</td>
</tr>
<tr>
<td></td>
<td>Director</td>
<td>Executive Director</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UCL Advances</td>
</tr>
</tbody>
</table>

11.7.2 References

▪ UCL Manifesto for Teaching and Learning at UCL.
▪ UCL’s website: http://www.ucl.ac.uk/
▪ Brochures available on the UCL’s website: About UCL, About UCL Enterprises, About UCL Community
12 Zurich University of the Arts (Zürcher Hochschule der Künste - ZHdK)

12.1 Introduction

Zurich University of the Arts (ZHdK) is one of Europe’s largest universities of the arts, situated in one of Europe’s leading cities in terms of economy, quality of life, and culture. The university offers degree programmes and further education courses in Design, Film, Fine Arts, Music, Theatre, Dance, and Arts Education (including Curating and Museum Education), and Transdisciplinarity. It also hosts two affiliated museums, the Zurich Museum of Design and the Bellerive Museum. Created in 2007 by a merger of two predecessor institutions of longstanding tradition, ZHdK now unites Zurich’s School of Art and Design (established in 1878) and Zurich School of Music and Theatre. The university is committed to bridging higher education, professional practice, and the interests of the wider public, and orients its teaching and research towards the cultural and creative sectors. All Masters programmes have recently been restructured and newly accredited, parallel to a reform of the university’s internal governance structure. Firmly anchored in Greater Zurich, its activities and influence extend to the national level, and well beyond Switzerland to the wider international stage. Closely interrelating teaching and research, the university aims at providing an ideal setting for transdisciplinary projects.

The university has 2,028 students, with 1,148 in Bachelor programmes and 879 in Master programmes. Of the student population 26 per cent are foreign students coming from some 50 countries all over the world, with 12 per cent on BA level and 46 per cent on MA level.61 Additionally, the university counts 454 students in further education courses and programmes, with a proportion of 11 per cent to 52 per cent coming from abroad. The university has a staff of 630 full-time equivalents, of which 364 are teaching and research staff62.

12.1.1 Key elements of Zurich University of the Arts’ educational model

Teaching is dedicated to both intellectual and artistic development, promoting each student's artistic and creative development. The approach to teaching is guided by the idea that upon graduation students will assume active roles and responsibilities in the cultural and creative industries. Coursework is highly individualised, designed to make students learn how to take responsibility for their own work. The development of creative talent begins with entry exams and runs through the entire study cycle. It is supported by facilities to provide an ideal framework for outstanding programmes. The university has its own concert halls, stages and exhibition spaces where students present and test what they have learned and developed. Zurich University of the Arts provides professionally equipped classrooms and studios, as well as an IT infrastructure that is further developed in close consultation with teaching. Most of the teaching staff are practising designers, musicians, or artists, who make their daily professional experience an integral part of their teaching.

The university’s programmes are dedicated to bringing forth innovative artistic individuals capable of shaping the development of society. All educational fields are linked to research and build on the general understanding and purpose to “make innovation the measure of what we do”.63 The pursuit of this approach is tied to a concept of the active learner: while the university is providing a wealth of opportunities, students need to seize these opportunities themselves and show personal commitment.

Essential elements of educational provision lie with flexibility and with the manifold networking opportunities at the intersections of the broad scope of different fields and disciplines hosted by the institution. Diversity and a multi-perspective character of educational provision play a distinctive role, setting out from a specific tradition which also differs from the mode of arts education which has been historically dominating in other German-speaking countries. Art education in the Swiss higher education system, and in Zurich, has not so much been anchored in the master-pupil relationship.

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61 Data for 2011 (Jahresbericht); student numbers are head count.
62 Data for 2011 (Jahresbericht); staff numbers are full-time equivalents.
63 Zurich University of the Arts Image Brochure p. 1.
which remains stable across the entire duration of studies, but has traditionally embraced the idea of systematically exposing the student to different experiences and environments. Innovative teaching and learning are now fostered by this tradition. The new Master programmes offer flexible learning paths through specialisations and modularisation.

All educational programmes are closely tied to the future working environment and the markets that today’s students will enter. The main mode by which education links to creative industries, and to other fields of professional activity, is to be found with the following pattern: qualifications refer to markets which are also understood in terms of ongoing transformation, and which are simultaneously the focus of research and innovation in a way which is not provided by other types of universities. The results of these unique processes feed back into education, so that students are provided with most up-to-date qualifications. Project work is integrated in the university’s Master studies where appropriate (e.g. in Design, Fine Arts, or Scenography). In these programmes, students are obliged to apply with a self-defined project that involves external partners in fields of practice, and so acquire competences in direct contact with real-world contexts. Teachers and researchers maintain manifold networks from which students can profit.

The university’s legal status does not allow the offer of Doctoral programmes, though it organises third cycle studies in cooperation with other universities of the arts in Germany and Austria, making supervision by Zurich University of the Arts’ staff possible. Simultaneously, this cooperation contributes to international exchange in research.

While much of the university’s cooperation and development of talented individuals into high-skilled professionals are anchored in the specialism of the different disciplines, it is the potential of the institution as a whole which represents today’s major concern. The approach taken is marked by the keyword of „networked diversity“ and by engagement in the promotion of transdisciplinarity. The present case study will focus on this cross-cutting component concerning teaching, research, and cooperation.

12.1.2 Governance of the Institution

The University is an independent legal entity under public law, and forms part of the larger Zurich Universities of Applied Sciences and Arts (ZFH). Characteristics of teaching at Zurich University of the Arts, and of the whole spectrum of the university’s activities regarding the knowledge triangle, are connected to the university’s history and status as a university of applied sciences. On the grounds of this specificity of the Swiss higher education system, the university has been charged with research, service, further education, and teaching oriented towards professional fields and markets. Nevertheless, the legal status of the institution cannot be regarded as the single decisive factor in the shaping of the institution as it is encountered today. Restructuring efforts driven by academia itself and internal reform have been playing essential roles in the institution’s development.

12.1.3 Ongoing institutional reform

The university is governed by an executive board formed by the president, the five department directors, and the head of administration. The department directors are simultaneously in charge of one of the administrative areas of Teaching and Learning, Research, Further Education, Quality Management, and International Relations. Through this integrative structure, which is purposefully diverging from the traditional principle of prorectorates, the university aims at the facilitation of strategic discourse and prevention of segmentation.

Figure 43 Structure of ZHdK
While the basic structure of Zurich University of the Arts was created in 2007, institutional reform is continuing. In 2010, a new structure for research management was created. The university now has a cross-cutting and encompassing research conference comprising the directors of its research institutes, research managers, and researchers. The conference deals, amongst other things, with the allocation of seed financing to promising research projects. In 2011, university leadership has dealt with an update of the university’s mission statement, with educational provision of cross-cutting character and e-learning, with the further introduction of quality assurance measures and tools, and with legal provisions for staff outside tenure. In 2012, it devised a new internationalisation policy which provides the grounds for further development.

The university has undergone a strategy discussion process viewing the institution in the context of the knowledge triangle. The process has addressed the mode of existence of a university of the arts in today’s world, so as to ensure the institution’s relevance in a longer-term perspective, and has involved the definition of societal, cultural and economic fields of orientation in the private and public sectors.

The university has established a marketing unit in charge of promoting the university’s achievements and potentials to the outside world. It has also recently created a dedicated unit for fundraising and cooperation. Located in the Rectorate, this unit is designed to enable the development of themes of strategic importance and of relevance to society, as well as to the institution’s further profiling. Along with financial aspects, the unit is charged with the identification of enlarging the university’s network with cooperation partners, specifically outside the realm of well-established cooperation areas and with view to more untypical partners.

Quality management incorporates a variety of issues related to the knowledge triangle. Official labour market data of alumni are integrated into assessment procedures. Stakeholder relations include involvement of external partners in the university’s Advisory Committee. A strategy-related indicator system is being developed which also accounts for inputs from and outputs to markets. Research projects undergo external peer review, and parameters for the assessment of research include third-party financing, societal relevance, and the focusing of research activities on external fields of cultural and creative production. Alumni feedback on the developments of diverse markets, and on the relevance of the education received, informs curricula and course design. Individual performance contracts with teachers and researchers are also in place, though these do not address university-business relations at the current stage of development.
Specific attention is being paid to internal communication. The university's spread across some 35 locations calls for substantial investments in communication, especially with view to transversal communication crossing the boundaries of the individual disciplines. Informal communication is accorded a cardinal role here. In 2013, the university will move to its new location in Zurich West (the Toni Campus), which will allow for the co-location of all activities and the forming of a research cluster. The university is expecting this move to provide a boost for its efforts in transdisciplinarity and cross-cutting activity, and is preparing for the new situation by conducting a dedicated, centrally initiated project focusing on spaces for informal interaction (“Orte des Informellen”).

12.1.4 Multiple contexts

Zurich occupies a special position within Switzerland due to its size and to the scope of international networks in which it is inserted. This situation brings about an exposure to international competition and promotes themes of international relevance which are not necessarily dominant within the national framework. Zurich thus takes a pioneering role which is also acknowledged and supported in higher education governance. The formation of Zurich University of the Arts as it is today has predominantly been driven by ideas articulated by the predecessor institutions, and it is being developed by the institution in line with its changing contexts. Regional governance has specifically been in support of the institution’s development as a merger of predecessor institutions, and has been aiming at the provision of appropriate structures. Main concerns in this reform have been a conscious effort in steering, and the level of risk-taking in creating a large and unique structure. Regional politics and administration perceive Zurich University of the Arts as a contributor to the advantages of the business location in Zurich. Specifically, Zurich’s creative industries are seen in direct connection with the presence of Zurich University of the Arts, and expectations are on an ever-growing support for the flourishing of this segment of the economy. At the same time, the university’s focuses on cultural development and creative thinking are regarded as an integral part of Zurich’s overall identity.

The university is embedded in a multi-layered governance system which positions universities of applied sciences in the context of three types of authorities. The federal level, the region (Kanton), and other regions (Kantone) where mobile students are coming from, each contribute to the financing of the institution and articulate expectations towards the institution. Policy development and legal provisions are devised at the federal and regional levels, with the latter holding the main responsibility for the institution. A range of authorities and consultative bodies, and instruments for coordination, have their role in shaping the institution’s reality. The shaping of today’s Zurich University of the Arts has been achieved through successful coordination of efforts on the various levels, and ongoing coordination is also providing the context for the university’s further development. Interviewees here refer to a tacit culture of cooperation and mutual support, where actors are able to bring others on board for effective efforts in advancing the higher education landscape.

Nevertheless, the complex framework has not always been completely free of tensions, and is putting limits on the university’s autonomy. Concerns about over-regulation of universities of applied sciences have been articulated. Efforts among regional politics and administration are ascribed a central role in ensuring sufficient autonomy in practice. Initiatives for new teaching and learning, for institutional change, and for cooperations have predominantly been driven by ZHdK itself, bringing regional and national bodies on board. The context of three layers of authorities vis-a-vis the university has secured a good financial situation as well as room for manoeuvre. With the new Swiss university act, which will come into force in 2014, universities of applied sciences will be placed on an equal level with universities in almost all aspects of their activity.

While regional policies for the creative industries are in place, interviewees do not see a link between these and the establishment of the university’s current approach and its recent development. Rather, it is national agencies for research financing which have been supportive of fostering the knowledge triangle. The Commission for Technology and Innovation (CTI) has supported research projects that by definition involve external cooperation partners. Within the overall framework of Swiss innovation policy, a type of research has been promoted for several years which involves entrepreneurship and a two-way flow of knowledge between the university and its partners. The Swiss National Science Foundation (SNSF) has been supporting the genuine type of research pertinent to the university by the dedicated programme DORE (DO Research) for eight years. This dedicated funding instrument for
practical research has targeted good research with commercial and practical potential in the areas of social work, health, education, art and design, music and theatre, and an array of applied sciences. While the dedicated programme was terminated in 2011, the Swiss National Science Foundation is now integrating this type of research into regular project funding. By financing research in line with the notion of ‘Use-inspired basic research’ (anwendungsorientierte Grundlagenforschung), the Fund continues to play a substantial role in the unfolding of the university's potential. Thirdly, the Federal Office for Professional Education and Technology (OPET) has been investing CHF 19.6bn in innovation in the context of universities of applied sciences in the period 2008-2011, and has run a dedicated programme for the build-up of research competences. The university has been profiting from this programme in the implementation of its new research strategy, the creation of research management, and by professionalisation of research staff. The value of these programmes is also seen in the promotion of a discourse on the specificities of research according to the mode in which the university operates.

Recent developments concerning educational initiatives with specific attention to the knowledge triangle are embedded in a nationwide trend. Joint provisions of educational programmes in film and Performing Arts together with other Swiss universities of the Arts, and of programmes concerning cultural entrepreneurship within an overall national framework, are under way. While these developments are supporting the institution’s needs and ambitions, they again point to the issue of broad actor coordination on a national level.

### 12.2 Teaching and research for innovation and the knowledge society

#### 12.2.1 Specific links between teaching and research

Teaching and learning at Zurich University of the Arts are directly related to manifold research activities. Research at Zurich University of the Arts is research in the arts (with their different sub-disciplines), in design, and in art education and curating. It brings together theory with practice, basic with applied research, and production with critical reflection. It is aimed at establishing independent theory and practice in the fields the university is operating in, at devising alternative modes of thinking and action, and thus at initiating innovation.

Teaching and research is organised in five departments which cover a diverse spectrum: Department of Performing Arts and Film, the Department of Design, Department of Cultural Analysis, the Department of Art & Media, and the Department of Music. Research runs through the departments in the form of ten research institutes and research focuses, and often reaches beyond disciplinary confines. Research promotes innovation in accordance with a broader concept which also extends to social innovation, and to innovation inside the institution itself. In this way it plays a decisive role in further enhancing the relevance and quality of teaching.

Historically deriving from the fact that Swiss universities of the arts have been charged with research and vocational preparation, research at Zurich University of the Arts has developed distinct and unique research specialisations. The notion of research in the arts (or Use-inspired basic research in the terminology of the Swiss National Science Foundation) includes the investigation of transforming cultural fields and markets, and of corresponding effects on educational provision. Fields where innovation is envisaged are dealt with by research efforts, which further contribute to changes in the markets themselves. Markets are understood to demand ongoing research efforts so as to secure most up-to-date insights for appropriate education.

Zurich University of the Arts combines under one roof two major strands of preparation for, and contribution to, innovation and creativity. In the cultural arena, educational programmes are not so much research-based per se, but concerning disciplines are research-driven. By direct involvement with transforming contexts in culture and society, reflective artistic activities provoke new forms of delivery of cultural products, and new modes of thinking about cultural and creative production. In fields which are strongly technology-based and technology-driven, such as the various sub-fields of design, innovation is pursued in the general pattern that also characterises other non-artistic technological fields. Nevertheless, the positioning of Zurich University of the Arts in the provision of education is linked to knowledge and skills concerning the “black box of aesthetics” which is not contained in a technological approach, alongside the search for technical solutions. For example, the educational offers and acquired skills in game design build primarily on advantages from non-technological knowledge and skills.
Swiss universities of applied sciences in general are, from the viewpoint of governance and politics, strongly tied to the technological innovation concept. Yet, it is in supported external governance that a broader concept of innovation matters. Broader knowledge and skills are seen to contribute to the realisation of innovation, and external expectations of the university’s activities help to avoid a too narrow concept of innovation. Regional governance actors regard Zurich University of the Arts as representing a higher education institution where such broadening and deepening aspects are specifically hosted and promoted.

12.2.2 Outreach and cooperation

Staff and students and teachers display their work at the various facilities which form integral part of the institution (exhibition spaces, theatres, and various dance and concert halls). The Museum of Design and the Bellerive Museum present a rich array of acclaimed art and design exhibitions. In all, the university hosts more than 600 events each year, and thus makes a significant contribution to cultural life in the city and region of Zurich. Events and exhibitions frequently contain a future-oriented dimension, and serve to communicate an internally developed agenda to the outside world.

There is a wide range of teaching and research cooperation with regional, national, and international partners in diverse fields of cultural production, creative industries, and innovation. An extensive network serves to promote international cooperation and exchanges in teaching and research. The university conducts joint projects with various government bodies (such as the Swiss Arts Council Pro Helvetia, or Swissnex - the Swiss government’s international promotion agency for education, science, art, and innovation) and has collaborative arrangements in place with non-governmental institutions. Cooperation partners in business and industry include Audi, BMW, Volkswagen AG, Phonak, Philips, Bally and Kunzli. In fields of design (Game Design, Industrial Design, Interaction Design, Scientific Visualisation), the university cooperates with the Swiss Federal Institute of Technology (ETHZ), Max Planck Institute Leipzig, hospitals, and a range of SMEs. The Institute for Computer Music and Sound Technology, to give another example, interacts with partners such as CNMAT University of California Berkeley, BEK Bergen Center for Electronic Arts Norway, Telekom-Lab TU Berlin, or the Artificial Intelligence Laboratory at the University of Zurich. The university is also approached by business and industry looking for creative or cultural services.

Zurich University of the Arts maintains partnerships with more than 140 arts universitites worldwide. On a national level, the university closely cooperates with other Swiss universities of the arts and builds on the proximity of the Swiss Federal Institute of Technology (ETH Zurich) and the University of Zurich. Along with exchange programmes and partnerships with higher education institutions, manifold contacts relate to museums, theatres, and other cultural operators, both in the Zurich area and beyond (e.g. Tonhalle Zurich, Zurich Opera House, Schauspielhaus, Kunsthau Zurich, museums, galleries). Relations to this segment are still permanently improving and contributing the university’s reputation.

The primary focus of the university’s activities remains on talent development. It is specifically through the development of human resources that knowledge transfer to the public and private sectors is brought into effect. The diverse cooperations here play the role of ensuring close ties to future working environments, and bring about a two-way flow of knowledge which continuously updates and enhances the university’s teaching.

The university’s teaching, meant to provide culture and society with the designers, artists, musicians, film-makers, and creative personnel of tomorrow, essentially comprises the development of individual authorship and critical thinking. It also comprises teaching and learning on cultural entrepreneurship. Take-up of professional life frequently already happens during the course of studies. Students and graduates are successful e.g. by engagement in professional orchestras or theatres, and by receiving national and international awards. In the specific case of the fine arts, the determination of success in the market is seen to be more difficult, since the relation between artistic success and economic success is less clear. In the case of design, the quality of the design product is seen in relation to a value chain, making the creation of added value as well as individual success more openly an economic issue. Some of the university’s programmes are addressing professions in the public sector, in foundations or in unincorporated associations, and thus remain a certain distance from market criteria in the narrow sense. In all, the university also perceives tensions, across the whole range of its provisions, between needs of today’s market as they might be articulated e.g. by professional associations, and the role of the innovator who is searching for the solutions of tomorrow and beyond.
12.3 Mobilising the potential of transdisciplinarity

Zurich University of the Arts is undertaking efforts to unlock the potential which lies in the wide range of its educational offers, research activities, and external cooperation, by promoting new forms of cooperation between disciplines, and giving incentives to experiment at their interfaces.

The formation of the university as such relates to the idea of bringing different disciplines together with view to potential synergies. In the course of the restructuring after the merger, the university has continuously been making transdisciplinarity a focus of research and teaching, and is further investing into cross-cutting activities. Fostering and enhancing the potential of transdisciplinarity is at the core of the university’s new research strategy. This is also reflected in, and supported by, dedicated organisational structures.

Specifically, the newly-founded Department of Cultural Analysis is home to an effort in positioning transdisciplinarity as a research focus, and in the provision of teaching outside and beyond the boundary of disciplines.

12.3.1 The Department of Cultural Analysis

The formation of this department occurred with the merger that constituted the university of today. The department specialises in art education and the dissemination of culture and is home to three research institutes (Institute for Art Education, Institute for Cultural Studies in the Arts, Institute for Critical Theory). Along with its own BA and MA programmes and its own research activities, it is the privileged location for promoting and implementing cross-cutting activities and novel transdisciplinary initiatives concerning the entire university.

Given the richness of the university and the diversity of its various competences, essential aspects of the department’s activity are concerned with the approach by which the creation of added value out of this potential may become possible. Dedicated activities build on, and develop, the numerous interfaces present across the university’s portfolio. The department puts themes on the agenda of the university which lie outside the individual departments’ daily activities, but are considered to carry specific potential for future development, or are of over-arching relevance. Purposefully tapping the opportunities of exchange and synergetic research and teaching themes, it seeks to enable the take-up of novel issues and make these part of the university’s daily business.

Z+, the university’s new over-arching platform for transdisciplinary activities, has been created in order to position transdisciplinarity as a research focus. Since the creation of the university, transdisciplinary projects have been developing out of different parts of the institution. These are now given a distinct place in the university’s organisational structure which is enhancing their visibility in a programmatic manner, with view to the promotion of further integration. The platform encompasses teaching, research, dedicated events targeted at exchange between the institution’s different departments and institutes, and thematic consulting. In the course of its first year of existence, the platform has financially supported 18 transdisciplinary projects.

12.3.2 Cultural entrepreneurship as a cross-cutting theme

The Department of Cultural Analysis is carrying out research on the cultural and creative industries in the region of Zurich and of Switzerland. These empirical investigations of relevant labour markets and the development of sectors feed back into the institution and also inform teaching.

Furthermore, the university has been making cultural entrepreneurship a systemic element of its educational provision. While the involvement of students in business projects is mostly governed by teachers’ networks and initiatives, the university has searched for efficient means to extend its responsibilities concerning the fitness of students for the business world and professional life. It also regards this responsibility as a matter that extends fairly beyond the study cycle of undergraduate and graduate programmes.

The Department of Cultural Analysis provides a series of teaching modules (the “Z modules”) on the BA-level, which are oriented on transversal themes and competences beyond individual disciplines, and also address cultural entrepreneurship. Each year, some 1200 bachelor students coming from all areas of study participate in the approximately 40 courses offered. The provision of this line of teaching and learning is mostly devised on a non-mandatory basis where students are choosing
among a range of educational offers, and in a manner which is not intervening with the regular programmes' scope and content. Students are interested in the opportunities, and the take-up of cultural entrepreneurship in the university's education has become an integral part of its BA level education in a non-problematic way.

For the MA level, the university is working on the exact ways of providing the most appropriate cultural entrepreneurship education. The concept is to provide this type of educational offer within the framework of a national competence network also involving other universities for the Arts under the leadership of Zurich University of the Arts. The most promising way of offering the type of education concerned is found to be summer schools and winter schools. This conceptualisation is also motivated by a view to dynamics of exchange between students of different backgrounds, and is at the same time also driven by limits to capacities in the relatively small country. The realisation of cultural entrepreneurship education on the MA level is currently dealing with coordination needs and bilinguality, and is anticipated to start within one year.

In further education, the links of teaching to markets are specifically sought at the borders where the institution and markets intersect. While there are already plenty of further education offers in place, the portfolio is currently under revision with view to most suitable qualifications. Teaching provisions are conceptualised which can serve as custom-fit updates and refreshments in pragmatic orientation on specific needs of professionals. The most suitable way of such provision is found to be non-accredited courses. These shall nevertheless have assigned ECTS credits, so as to also be eligible for accumulation e.g. in a Ma programme.

12.3.3 Master of Arts in Transdisciplinary Studies

The university’s effort in mobilising novel potential is also reflected in the creation of a dedicated Master of Arts in Transdisciplinarity offered by its Department of Cultural Analysis. The programme addresses the interfaces between traditional disciplines which become visible in the arts, sciences, or in real-life contexts. Within Zurich University of the Arts, the programme assumes a pivotal role at the intersection between art, science, and society. It emphasises cross-disciplinary cooperation, and opens up innovative perspectives, questions, and solutions.

The Master of Arts in Transdisciplinary Studies is designed to enable students to deepen, extend, and position their existing professional skills through cooperation with other fields so that new questions, methods, and core working areas can be further developed and successfully pursued. The programme is also designed to professionalise transdisciplinary fields of work and to qualify graduates for unforeseeable professional challenges and roles. Drawing on the core areas of study at Zurich University of the Arts, the programme offers a privileged environment for cutting-edge skills development. Coursework focuses on practice, and students are advised to combine coursework with relevant professional practice. The three-semester course offers students ample flexibility.

Graduates are expected to be able to transfer discipline-specific, communicative, and media skills to new questions and to render these fruitful for new solutions. They shall have developed the meta-skills needed for blending their own skills with other skills profiles, in order to develop and understand complex artistic and social constellations.

12.3.4 A balanced approach

The Department of Cultural Analysis is pursuing the efforts in identification and promotion of cross-cutting and transdisciplinary themes of relevance in a manner which does not directly intervene with the educational programmes and research portfolios present in the university’s various disciplines. Rather, it follows a philosophy of promoting a new dimension in the scope of the university’s provisions and activities, and of setting an agenda which is meant to be taken up and anchored in the different departments and research institutes.

While the Department of Cultural Analysis forms a dedicated structure for the promotion of transversal activities within Zurich University of the Arts, cross-cutting and outward-oriented projects are also carried out within the framework of other departments (such as the ‘Public City’ project, which is located in the Department of Art and Media, with this department’s Institute for Contemporary Art Research coordinating with other institutes). In addition, central and coordinating units have their role in the university’s overall approach to the development of novel approaches at the intersection of
teaching, research and society, such as the already mentioned over-arching Research Conference and the fundraising unit in the rectorate.

In the overall picture, the creation of structures and top-down initiatives has played an initiating role in overcoming traditional confinements of the university’s constituting disciplines, but the mobilisation of its potential in day-to-day activities is essentially sought by means of shared discourse, bottom-up initiative, and informal communication. Teachers and researchers engage in the transversal dimension on these grounds.

Having devised the above provisions and structures, the university nevertheless emphasises that the most valuable links to societal contexts and business are not constructed ones, as they would be if deriving from an abstract top-down strategy, but are anchored in personnel who actually brings the concerning links to life. Anchored in both contexts of teaching and professional activities at the same time, understanding their interdependence, and being interested in furthering knowledge flows, appropriate staff are representing the crucial factor after all. In this regard, the university is following a strategy of hiring teaching staff only for a percentage of their time, so that they will be able to simultaneously remain in their professions in cultural life and creative business.

12.4 Key success factors and future developments

Zurich University of the Arts’ strategy for the knowledge triangle is explicit. It has historically been driven by its mission entailed by its status as university of applied sciences, and the university has been moving beyond this point of departure with the support of regional as well as national actors in the governance system. Zurich University of the Arts is moreover conceived as the positioning of an alternative concept of innovation by regional politics.

Building on longstanding tradition of its constituent disciplines, the university has well-established contacts with cultural institutions, is attractive to private partners in the provision of cultural services, and is interacting with diverse governmental and non-governmental actors and businesses. In addition it continues to seek new partners from the regional level to worldwide cooperation. The proximity of the leading universities ETHZ and University of Zurich is a factor in the unfolding of the university’s research activities.

In shaping today’s Zurich University of the Arts, an aspect of steering is present in the provision of its structure and in initial top-down efforts towards the triggering of transversal activity. In the first instance, the university profits from its size, and the diversity that goes along with it, which has been created by the merger of former institutions. Cross-cutting and transdisciplinary activity is building on this new structure’s inherent potential. Cross-cutting and transdisciplinary activities with a view to outreach are conceptualised as a new dimension which does not cut down on the room for disciplines. The approach is tied to a philosophy of not devising abstract strategy without sufficient grounding among teachers and researchers. Flexibility, openness and bottom-up initiative are core to the university’s understanding of its day-to-day business. A framework is provided which research is meant to fill by building on its own expertise, visions, and curiosity, and is also meant to enable quick reaction to international developments. The connectivity of teachers and researchers to external environments and their ability to interact with market partners at eye level is regarded as vital.

Cooperation and outreach are primarily based on individual teachers and researchers bringing in real-life contexts, often remaining in their cultural and creative professions while simultaneously working at Zurich University of the Arts, and on their personal networks. Internationalisation is also primarily embedded in the unfolding of diverse networks in a pragmatic way. While insertion of students into real-life contexts by way of project-based teaching and learning happens mainly on a basis of individual initiative, both from students and teachers, education concerning essential qualifications in cultural entrepreneurship, and for qualification and creativity driven by transdisciplinarity, is provided in a cross-cutting manner.

In the university’s effort to create added value out of the potential of synergies across its various disciplines, it is building on a philosophy that puts exchange, provision of opportunities, promotion of discourse, and incentives at centre stage. This approach is working well with students, while take-up among teaching and research staff has been slower in the beginning and is the focus of future promotion. Dedicated structures have been recently created which are meant to promote the cross-cutting dimension. One department is home to continuing efforts in transdisciplinarity and the visibility of these efforts throughout the institution, and centralised activity concerning over-arching projects and
new partners further supports the development. The university also envisages dedicating funding for highly interesting and promising projects in the future.

Informal communication is a specific concern. The move to a new campus will bring co-location of all disciplines and facilitate informal communication through adequate built space. On the new campus processes of exchange will be specifically supported, and a high-end presentation platform for students’ work shall be provided.

The university’s formation and development have been supported by regional as well as national actors in the Swiss multi-level governance system for higher education. While support on the regional level has provided the grounds for the university’s operations and is viewing it in the context of the potential of Greater Zurich, national approaches to innovation and research have been in support of the creation of two-way knowledge flows with cooperation partners and the furthering of the university’s specific approach to research and innovation.

The university has moved into the logics of competition and cooperation on historical grounds and organic development, and is developing within a framework of a collaborative system. A tradition of actor coordination can be seen playing its role here. Also with regard to the orientation of teaching on markets, interviewees point to a tradition of coordination which relies on coordination and informal networks. The relatively small size of the country is regarded as a favourable condition in this context. The university argues that further policy integration on the national level, such as the example of the Finnish design initiative, could provide additional incentives for the unfolding of the potential of the university’s role for the creative industries.

Public financing of the university has provided a sound basis for its operation. Third-party funding has been enabling activities beyond the operation of day-to-day business, and is expected to play a growing role for the unfolding of the university’s cross—cutting and transdisciplinary ambitions. A discussion of student fees in the national framework is also expected. Availability of funding modes which take account of research, and of dedicated pots for build-up of innovation capacities, is regarded in terms of the creation of a favourable environment.

While there have been limits to the university’s autonomy, the new Swiss university act is expected to bring substantial improvements. The university has not been able to provide its own doctoral studies, yet regards the introduction of third cycle studies as an important contribution to its further profiling and realisation of potential.

### 12.5 Transferability of the university’s approach

Essential aspects of the university’s shape and activity found today derive from a concept of bundling capacities and unlocking the potential of synergies, acting on the internal interfaces between fields of teaching, learning and research, as well as on the interfaces between disciplines and external environments, these essentially including transdisciplinary developments. This concept is furthermore supplemented by increasing informal communication and encouraging a culture of openness. It is also connected to integrative and lean management structures aiming at a good balance between central initiatives and bottom-up developments. With regard to students, teaching and research staff, as well as networks of external cooperation, flexibility and individual initiative play a substantial role. Management style, curricular design, and dedicated premises (in the near future) serve to foster these. These elements and ideas might well be regarded as transferable.

On the other hand, much of ZHdK’s approach lies with its location, with the fields where its activities are anchored, with specific properties of the Swiss governance system, and in the character of its teaching and research staff. Tradition plays a role with view to the potential of individual disciplines, which contributes to the potential of the university’s new transversal focus, which again enhances the university’s potential and profile. Contextual factors are also present in the existence of well-developed markets in the cultural and creative sectors, including a well-established brand of Swiss design. The specific location of Zürich as a centre of research and international orientation, providing co-location with excellent universities as well as cultural producers, enables good ties with real-world actors of national and international relevance. These factors should also be seen together with the cooperative culture which is historically present in the multi-level governance system for higher education, which can be seen accounting for support of the university’s recent development.
12.6 Key lessons learnt

- Top-down initiative and the concept of university steering can help to provide the grounds for the knowledge triangle by provision of structures and agenda-setting inside the institution, but flexibility, openness and good room for bottom-up initiatives are vital to the ongoing pursuance of the knowledge triangle.

- Intensification of internal communication and purpose-built space which specifically favours informal communication are important.

- Teaching and research staff play a decisive role in bringing in up-to-date knowledge about professions and markets, in driving exchange between teaching, research and cooperation partners on the grounds of personal motivation and interest, and in the ability to interact with market partners at eye level.

- Favourable governance arrangements and political will to take up the concepts arising out of academia do play a role. Different incentives may be provided by different actors in the governance system, on regional and national level, so as to integrate into a consistent system and enable the institution to play out its strengths, and continuously work on its potential, without suffering over-regulation.

- Co-location with well-developed research and well-functioning sectors with which the university can interact foster the unfolding of the university’s potential, since they enable synergies and high quality of the feedback loop between the elements of the knowledge triangle.

- Innovation orientation of higher and further education and research is acting at different levels and on different time-scales, ranging from identified needs and possibilities of today’s markets to longer-term questions of qualifications and thinking modes for tomorrow, and beyond.

12.7 Contacts, references

12.7.1 List of interviewees

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<tr>
<th>Name</th>
<th>Position</th>
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<tr>
<td>Prof. Dr. Thomas D. Meier</td>
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</tr>
</tbody>
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