Research & Development

Funding challenge

The University – Industry Partnership

A new format to promote innovation

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Preface

The 19th century was characterized by the Industrial Revolution which, through the introduction of the industrial scale production, sharply transformed world economy, as well as human lives.

During the 1900s, the world changed once again thanks to the development of electronics, making transistors and computers basic features in our lives. The new century will be focused on production and process innovation, to guarantee high value added products for an always more competitive global market.

In this context, a competitive industry must cooperate with universities and research centres to keep up-to-date on cutting edge research of their products and processes, as well as involving high skilled personnel in the innovation process.

At the same time, universities need to commercialize their research results and tailor their courses and basic research programs to market needs, following a “real world” approach.

In building a University–Industry relationship, several factors could represent a challenge, as well as an improvement opportunity. Government policies, the funding institutions’ interests, intellectual property management, internationalisation, etc. are all issues which must be addressed to guarantee a positive outcome from the cooperation. Within this framework, manufacturing clusters stand as fertile ground to provide both infrastructure and scientific skill in state of the art technology, promoting research and knowledge commercialisation.

Moreover, many universities have already developed their own organizations to maximize benefits from industrial partnerships, often involving non-profit organizations to manage the existing relationships and develop a network of public and private contacts, that will be useful to launch new joint projects.
On the other hand, many multinational companies have established international networks known as “Centres of Excellence” (both Universities and Research Institutions) to provide new ideas, expertise and patent rights, ensuring the companies’ technological future.

Governments with this policy could certainly influence the success of the University-Industry relationship. An important example of policy where the government has played a key role in promoting the University-Industry partnership is the Framework Programme, established by the European Union in 1984 and planned to continue through the FP8 until 2020.

Australia, and more specifically South Australia, is developing several policies to take benefits from this new fashion and transform the Adelaide and South Australian university network into an international technology hub.
A useful tool for this purpose is the innovative Tonsley Park Redevelopment Project which aims to attract expertise and prestigious partners from all over the world.

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1. Introduction

The economic crisis, which hit in 2008, has had a significant impact on science, technology and innovation (STI) domains and policies. It has accelerated a number of trends and magnified certain challenges which had already appeared prior to 2008.

The global economic crisis had a strong negative impact on innovation worldwide. Total OECD-area business expenditure on research and development (R&D) declined by a record 4.5% in 2009. At the same time, the recovery that occurred in some countries did not always imply a return to pre 2009 R&D levels, as confirmed by several indicators such as patents and trademarks.

The crisis has affected the innovation policy agenda both in terms of objectives and instruments, determining a general intensification of R&D policies which have to be relevant, coherent, and inclusive, to provide a valid tool to bail out the crisis and ensure a long-term growth.

Research and experimental development comprises of ***"creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications"*** [1]***.***

Research activities are articulated in three separate phases[2]:

- **Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of the phenomena and observable facts, without any particular application or use in view.
- **Applied research** is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim or objective.
- **Experimental development** is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices; to installing new processes, systems and services; or to improving substantially those already produced or installed. R&D covers both formal R&D in R&D units and informal or occasional R&D in other units.

In knowledge-based economies, innovation is a major driver of growth. During the last decade, because of the emergence of new developing economies, competition in knowledge-intensive segments has sharply increased. This has forced forcing developed counties to climb the value-added ladder, but at the same time, due to the particular economical and political moment, government budgets are under pressure, and the R&D sector has suffered several cuts. Moreover, the crisis has shown how market actors are becoming more reluctant to further fund government deficits, increasing research investment difficulties.

[1] [2] Frascati definition of research and development

In such a delicate contest, companies are strongly affected too. Consumption reduction due to future uncertainty, job loss and tax increases, has led to the necessity of finding new resources to fund research and development of new products, opening new challenges in term of long-term sustainability, cost reduction, quality of products, and eco- compatibility.
Moreover, the increasingly higher technological level that even simple products contain is forcing companies to cooperate with other institutions to develop new solutions and satisfy the increasing demand for new high-tech tools.

In this scenario, developing new technological knowledge, and new concepts, has become a necessity in order for companies to launch new products.
To raise the probability of success, the general R&D strategy, which had been used until the 1990s, was to invest further in R&D facilities and human resources to raise the research capability within the company. However nowadays, new R&D policies are moving corporations towards a deeper relationship with external knowledge providers, to reduce cost increasing efficiency and limit exposure to failure.

The research scenario is largely articulated, characterized by highly interrelated players which cooperate amongst them. Multinational corporations have a leading role in investing important resources to keep competitiveness worldwide. In many cases, Multinational corporations are the core of new cluster/technology hubs attracting smaller companies which specialize in that area to supply them or favour the development of new research centres focused on very specific areas. These clusters, are a key driver in local economies, providing work opportunities and technological knowledge, and are highly integrated within the local society, to the point of a true mutual dependency.

Often, governments on both a regional and national scale are involved in developing new policies to incentivize R&D, and help existing clusters to face the increasing foreign competition by promoting internationalization and partnerships with other counterparts. In some cases, governments are also directly involved in R&D processes through public foundations (National Science Foundation in USA) or public research centres (CNR in Italy).

Moreover, the banking sector, as well as private equity investors, pay attention to business possibilities in venture capital or seed financing of new ideas. This represents an alternative funding option to government, and a valid network of expertise to turn new ideas into growing and competitive businesses.

Finally, Universities play an important role in being more involved, under a theoretical perspective, in developing new knowledge that companies can turn into market products.

This report aims to provide a wide overview over the University–Industry Partnership, focusing on the most critical aspect of deal making, the potential for further development and government involvement on a national and local scale.

2. University – Industry Partnership

General overview

The discussion about the importance of University-Industry collaboration starts during the 1980s due to the cold war efforts, when research applied to military devices gave a significative advantage to the USA.

Nowadays, this has become a main resource for scientific development in a context which, due to 2008/2009 financial crisis, saw public R&D funding decline.

Both Universities and Industries have mutual interest in cooperation.

What Academies offer to industry	What Industry offer to Academies:
Fundamental research and enhancement of own research	Access to world–class and important problems
High profile personnel	Access to other activities in the innovation cycle (development, engineering, manufacturing, etc...)
Access to consultants	Market awareness
Patent rights	Enriching teaching programs
New ideas and business opportunities	Job opportunities
Recruitment of graduates	
Leveraging of federal funds	
Costs – lower overheads	

Universities provide a ready pool of graduate and undergraduate students that industry may access for their work requirements; students in return receive critical workforce training that supplements theoretical courses. Workforce training is increasingly recognised as a critical component of education in a know-edge-based, international economy.

A mutual integration between university and companies operating in the same territory can advance the service mission of Universities as they become more involved in their community's growth and prosperity. Such services are often given incentives by the local administration to attract knowledge and capital in their community. Universities often have research infrastructure that industry needs at the same time. For many companies it is more cost effective to contract out the research to the institutions that have the research infrastructure in place, rather than building from the ground-up or renovating existing facilities.

Technical opportunities also exist in industry for university faculties and students that may not exist in institutions of higher education. Further, there may be possibilities for future employment within the partner company.

From a technical and economic point of view, materials exist in industry for research and education purposes that again may not exist in institutions of higher education. Many big companies can also count on relevant the R&D budget providing new resources to university research.

Finally, through market awareness, universities have the opportunity to think differently, have a new market approach, and face challenges which could not be otherwise be exploitable if focusing only on theoretical aspects. They are able to enrich their programs with a practical approach, and update their courses to follow a market driven path.

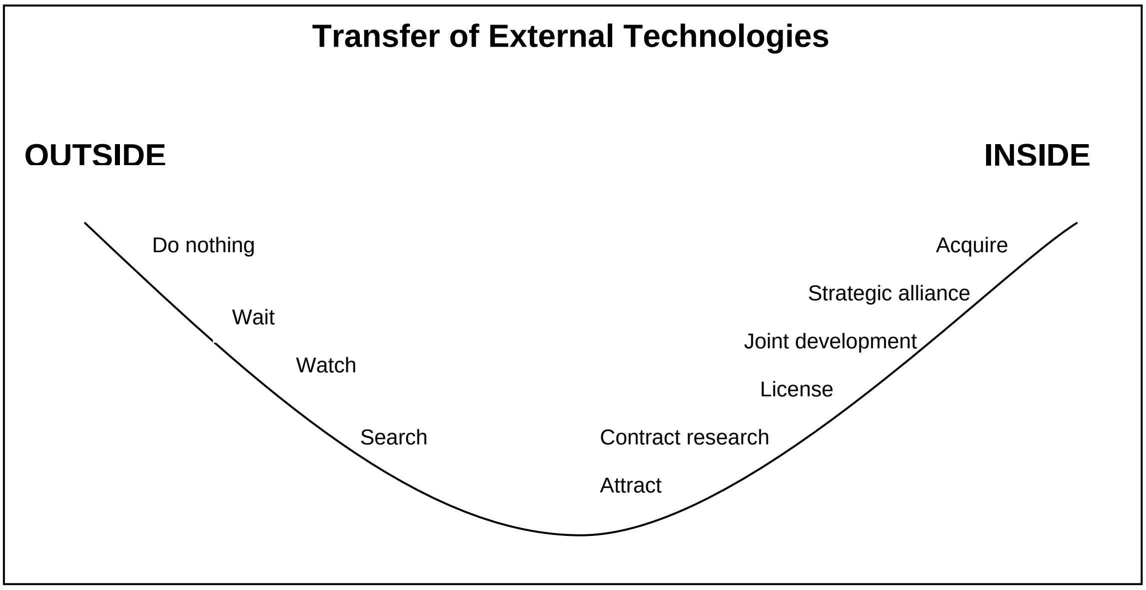


Figure 1: Technology Transfer (company perspective)

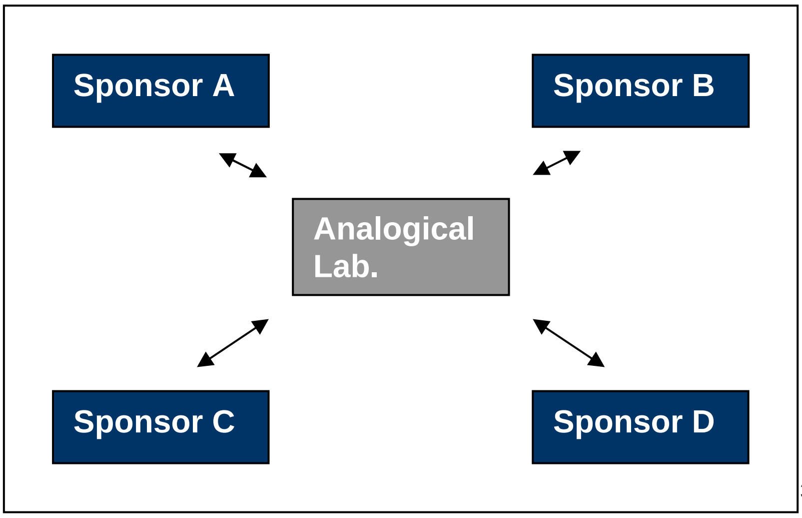
Partnership structure

Due to the potential for conflicts of interest, as well as the necessity to share sensitive information within the involved institutions, coordination and control issues are necessary in this kind of cooperation.

Partnerships can have different structures, involving a plurality of players, or just a few of them.

Industry – University Research Partnership Models
1. Single Company – Multiple Universities - Hoeschst Celanese with Rutgers University, North Carolina State University, University of North Carolina - Air Products and Chemicals, Inc. with Imperial College, Pennsylvania State University, Georgia Institute of Technology **2. Multiple Companies – Single University** - MIT Media Laboratory with Hewlett Packard, Phillips, Digital Equipment Corporation, and others - Imperial College with Air Products and Chemicals, Inc., British Petroleum, Rhone Polenc, Unilever, Fujitsu, Microelectronic and Computer Technology Corporation **3. Multiple Companies and Multiple Universities** - Pennsylvania Infrastructure Technology Alliance with Leigh University and Carnegie Mellon University

Different models imply different relationships with the subjects involved. While one to one relationships limit the flow of information, reducing the potential of the project to a mutual exchange between two partners, the multiple companies/ universities model set the basis for a more articulated partnership based on a wider diffusion of information and knowledge, increasing the probabilities of success, and producing new avenues for further work.



[3]

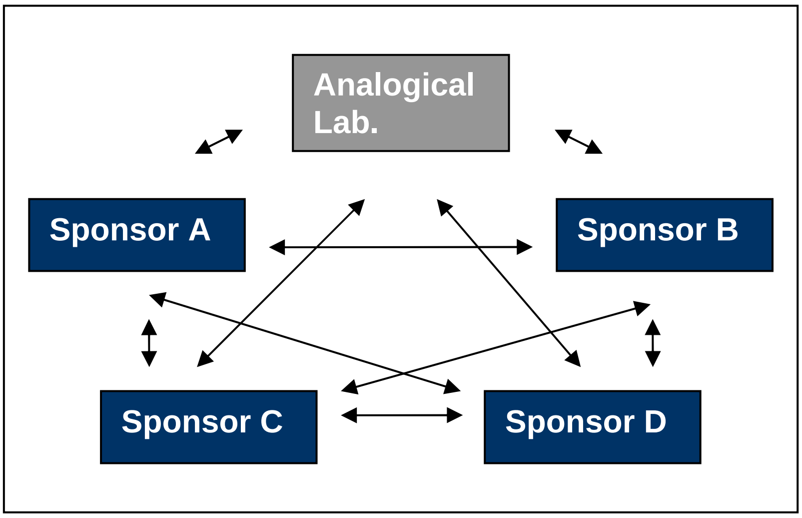
Figure 2: Traditional Research Model

Characteristics

- **Single Project**
- **High cost**
- **Lost opportunity**

[3] McNeil, " A model for University-Industry Collaboration" EWME2004

[4]



Characteristics

- **Take advantage of common interests**
- **Free flow of information contact among members**
- **Pooling resources allows reduced entry cost**

Figure 3: Collaborative Design Centre

In spite of their common interest in cooperating, universities and companies share different goals, which could compromise the success of a long term partnership.

Industry	University
• market driven • focus on return on investment • extremely cost conscious • oriented to profit • particularly sensitive to timing	• Advancement of Knowledge • Academic freedom • Publication of results • Education of students • Relaxed time frame and milestones

Figure 4: Different driver to University and Company

When defining collaborative projects which involve big national and multinational companies, in order to focus on deal's proposals and avoid dangerous conflict of interests, it is necessary to clearly set out all the collaboration details *ex ante*.
Best practice suggests the creation of an **Advisory Board**, where representatives from member companies sit together with faculty experts and researchers to analyse the project's development and address problems.

Depending on the project's complexity, an Advisory Board can set a one-day meeting (or longer if required) which aims to identify the research situation and set further development. In this way, managers and professors can directly

[4] McNeil, " A model for University-Industry Collaboration" EWME2004

interact with PhD students and other researchers involved in the project, receiving direct and qualified feedback.

Normally, two Advisory Board's meetings are settled yearly. The first meeting is to present the project and set the general research priorities by highlighting inputs from the faculty members, and defining specific proposals for recruiting students.

The second is to present an advanced or completed work, and assess the technical and communicative skills required to publish the work's results. Once that one project is completed, the Advisory Board votes on which projects will be carried out from amongst the different ideas now proposed by faculty members.

In spite of some consolidated guidelines which provide a general framework, there is never one deal that is identical to another. Every institution has its own rules, principles, and culture and all these factors influence the shape of the deal, and sometimes the results.

However a different approach is followed by small/medium companies and multinationals. Generally, small companies operate locally, employing the human resources that they can find in the area. They usually focus on establishing one-on-one relationships with universities and research centres, due to their less complex structure, and because they are usually operating in a very specific business area, which needs highly skilled but specialized knowledge. This type of relationship is generally not able to be managed with multilateral cooperation.

At the same time, due their local/national horizon, partnership with universities and the consequent the hiring graduates can be a positive resource in being "accepted" by the local community, indirectly increasing market position, and ensuring a long term growth on a regional scale.

Multinational corporations instead have the resources to operate all over the world and differentiate their presence in different markets, gaining more flexibility and, through local personnel hiring, include new cultures and knowledge. Such companies often sign research contracts with universities not only to focus on a single topic, but to include a wide range of research areas, taking advantage of scientific interactions whilst at the same time setting the basis for further development of new ideas.

Analysing University – Industry partnership, there are three main topic to focus on:

- Government policies to incentivise R&D investments;
- Cluster and Foundations, as key players in the university–industry collaboration framework;
- IP management;

2.1 Government participation in University – Industry partnership

Due to the increasing importance of university-industry collaboration within the R&D development framework world-wide, national and specifically local administrations are often taking part in highly innovative projects following three main directories:

- **National or international R&D programs** which provide a large amount of public funds to incentivise the national innovation system.
- **Direct granting** of specific and detailed programs, to promote the creation of new companies in specific and strategic areas.
- **Tax-relief** through fiscal credit, to spur national companies to be more competitive in innovation.

At the same time, many countries own their own research facilities, or operate in the market through public companies. Traditionally, those institutions were involved in military research, but are now increasingly focusing on social utility projects such as medical research, or development of new energy sources.

The USA is a pioneer in this sector. The first significant example of University-Government-Industry partnership dates back to WWII times, where the contribution of several academic personalities such as Fermi and Einstein contributed to generate a technological advantage which led the country to ultimate victory. In less dramatic circumstances, this format has been strongly developed during the cold war. Beginning in the 1970s, Government–University-Industry (GIU) partnerships took the form of inter–firm research consortia as research centres sought to develop a significant technological advantage over the Soviet Union.

Nowadays, the pressure faced by industrial innovation to decrease time to market new inventions and to conduct new research represents a critical issue for high–tech companies. As a result, the traditional basic research activities in corporate laboratories are being substituted with a more decentralized research format based on collaborations.

Within this framework, GUI strategic partnership represents an organizational form designed to integrate disparate tools of intellectual capital, focusing on specific projects where, other than knowledge, each partner brings very different operational issues and business cultures.

Moreover, government presence in a business partnership may foster the formation of trust more readily than purely a private sector alliance. The government can play a fundamental role in guaranteeing the transparency of information and the correct application of disclosure rules fixed in the contracts.

In these cases, participant companies are not racing against each other to take strategic resources from their counterpart; rather they are cooperating to achieve a social utility purpose, while benefiting at the same time from the development of new knowledge.

As a proof of its success, the GUI partnership model is emerging in different nations and economies, suggesting the presence of strong motivating forces that are common across different national cultures, political structures and economic systems.

The following section reports two examples of successful GUI collaborations in different countries and contexts, proving how flexible and adaptable this format is.

Engineering Research Centres Program

The Engineering Research Centres (ERC) Program was established in 1983 in the USA for the purpose of achieving two main goals:

- To improve engineering research so that U.S. experts would be better prepared to contribute to engineering practice.
- To assist the U.S. industry in becoming more competitive in world markets.

Its establishment was motivated by the perception that significant engineering advances were occurring through the integration of new developments across traditional disciplinary boundaries, and that new educational programs were required to prepare students for a more competitive engineering market. Within these boundaries, the centres established by the programs shared the following objectives:

- **Provide continual interaction of academic researchers**, **student and faculty with their peers**, to ensure that the research programs in the centres remained relevant to the needs of the engineering practitioner facilitating and promoting the flow of knowledge between the academic and industrial sectors.
- **Emphasize the synthesis of engineering knowledge** to enrich research programs with different disciplines in order to bring together the requisite degree of knowledge, methodologies and tools to solve problems important to engineering practitioners.
- **Contribute to the increased effectiveness of all levels of engineering education.**

The National Science Foundation (NSF) funds each ERC for a period of eleven years, during which time each centre is expected to generate funding from sources outside the NSF in order to be self-sufficient by the end of the grant period. In 1994, the twenty one centres in the ERC program received $51.7 million from the ERC Program Office; $53.7 million from the industry in both cash and asset donations as well as associated grants and contracts; and $73.5 million from university, non-profit and other U.S. government institutions.

To measure the output of the program, several parameters are taken into consideration: the number of partnerships formed; patents filed and awarded;

licenses granted to industry; and undergraduate degrees awarded to students involved in ERC projects.

In 2013 the program is still operating. The 17 centres still active provide an intellectual foundation for industry to collaborate with faculty and students on resolving generic, long-range challenges, producing the knowledge bases needed for steady advances in technology, and their speedy transition to the marketplace.

	FY 2012 (17 ERCs) (17 ERCs)		FY 2007 – 2011 Annualized		FY 1985 – 2012 (34 ERCs)
Intellectual property Transaction	**Total**	**Per Centre**	**Total**	**Per Centre**	**Total**
Invention disclosed	105	6	98	6	1,554
Patent Application Filed	46	3	93	6	1,190
Patent Awarded	16	1	32	2	382
Licensed Issues	5	< 1	64	4	669
Economic Development	**Total**	**Per Centre**	**Total**	**Per Centre**	**Total**
Spinoff Companies	15	1	9	1	117
Spinoff Employees	49	3	32	2	1,015[5]

Table 1: This table illustrates ERCs outputs in FY 2012 and FY 2007 – 2011 periods and the total program's output from 1985 to 2012. The data are reported for both the total amount of ERC centres and the average value for each item.

Framework Programs for Research and Technological Development

The Framework Programs for Research and Technological Development is a series of eight R&D projects launched by the European Union in 1984 within its innovation policy framework. These projects had a starting budget of €3.75 billion which will reach an estimated €80 billion budget in the last seven years, from 2014 to 2020.

The aim of the program is to encourage knowledge development within the European Research Area (ERA). In 2006, it was estimated that the contribution of €7 billion/year might generate a GDP increase of €200 billion/year by 2030, with benefits for the entire European Union.

The Framework Program projects are generally funded through three main tools:

Integrating Project (IP)

IPs are medium / large collaborative research projects, where a minimum of 3 partners (mostly small and medium enterprises) coming from 3 different EU countries focus on "*addressing major needs in society*" through innovation in

[5] Source "ERC Products of Innovation, FY 1985–2012*" from ERC official website: http://www.erc-assoc.org/about/erc_data/erc-products-innovation-fy-1985%E2%80%932012

basic research and applied science fields, in order to commercialize the newly developed ideas. The program is funded by the European Commission with grants that can reach tens of million of Euros during the project development.

Network of Excellence (NoE)
NoEs are medium-sized research projects co-funded by the European Commission "*designed to strengthen scientific and technological excellence on a particular research topic*". The program requires a minimum of three different EU member nations and receives grants from 1 to 6 million Euros for a maximum period of 7 years.

Specific Targeted Research Projects (STReP)
STReP projects are comprised of a minimum of 3 partners coming from 3 different countries from associated states, with a typical duration of 2 to 3 years and an average budget granted by the European Commission of about €2 million.

Currently the most important project that the European Union is funding, within the FPRTD framework is the IP7 which benefits from a total €53,272 billion grant, of which €32,365 billion (60.37%) is invested in the cooperation Program[6].

2.1.1 Local Government's role in Promoting R&D[7]

On a local scale, governments are increasingly involved in the development of innovation policies that can match the local territory's needs, within the framework of a more general national policy. Two European areas are a good example of local government involvement in R&D development: the Tampere region in Finland and Baden–Württemberg in Germany.

Finland
In 2011, the Finnish government set the policy guidelines for the 2011-2015 period, highlighting six priorities:

- **Broad-Based Innovation Policy**: Innovation policy should be aimed to a wider idea of social benefits considering interactions among innovative centres.
- **Demand-Driven and User- Driven Innovation.**
- **Globalisation of Business Activities.**
- **Growth Entrepreneurship and Finance**: Two channels: Internal restructuring of existing firms that become more productive; and higher productive companies gain market share.
- **Geography of Innovation Activity**: innovation must involve the entire country, allowing poorer areas to catch up with the richest.

[6] Within the IP7 program, cooperation includes a series of different areas: food, health, energy, environment, etc

[7] The material presented here is mainly drawn by Ms. Federica Querin's "Innovation policy – A comparison between South Australia (Australia), Baden - Württemberg (Germany) and Tampere (Finland) regions (October 2012).

- **Education, Research and Economy**: research is based on an excellent education system and they both determine a greater innovation rate.

Within this framework, the Regional Council of Tampere has developed a fashion for promoting university partnership with both the private and public sector. The council plays a fundamental coordination role which has become an effective channel and catalyst for funds for quality projects.
One of these is the collaboration with Tampere University of Technology (Optoelectronic Research Centre) in a LaserNano project aimed at fabricating various nano-particles and materials by laser ablation.

Tampere also hosts the Finish ICT cluster, where the Nokia Research Centre is located. This company plays a key role in promoting innovation, enhancing several cooperation projects with world-leading institutions by sharing resources, leveraging ideas and tapping each other expertise.

Germany

Germany has a long tradition of innovation and together with Finland stands as one of the countries with the highest GERD[8] (2.82%) in the world.
Along with Japan, Germany has the highest manufacturing percentage of GDP, and this sector represents a resource for the country's development.

It's important to underline that the majority of domestic R&D (92%) is funded mainly by private enterprises (69.3%) with only 30% of the funds coming from government. This is a clear sign of a higher dynamic that the German R&D system has been able to develop year after year involving universities, research centres, companies but with the government only marginally being involved. The overall innovation system is based on a series of political and governmental authorities which cooperate side by side with many intermediate bodies such as the Science Council and the German Research Foundation in the mutual development of new knowledge and policies, to ensure a long-term exploitation of further opportunities.

One of the most successful projects is the "High Tech Strategy", implemented in the period 2005-2008, which raised investment of the private sector by 19% and increased the R&D intensity to 2.7% of the GDP. Due to its success, this initiative was extended to 2020; identifying five main fields of intervention: **Climate Energy; Health Nutrition; Mobility; Security; and Communication.**

The main goal of this project was to develop these areas, focusing on specific objectives on a long term basis, identifying the main players in each market and promoting a series of partnerships with several actors, universities and Research Centres first, to develop a new product which could match the high standards set in each area. Many of the companies that participated to this project attributed their innovations to the improvement of government policies at the federal level. This gave a high brand return to the Federal Government itself.

[8] Gross Expenditure in Research and Development

In this dynamic framework, Baden–Württemberg represents a region of excellence, with huge manufacturing resources and great companies which constantly invest significant resources in R&D.

This region is in fact home of three of the most famous and prestigious German automotive Brands: Audi, Mercedes-Benz and Porsche. These companies create an highly interrelated cluster which includes 194 operating plants producing high value-added components (€13 billion) as well as hosting around 1000 electronic companies which employ 210,000 workers.

The local government has contributed to this success by specialising the entire regional education system to the automotive sector. It has introduced specialized programs of study at its universities and provided incentives for the concentration of research centres and technology transfer centres in the area.

Baden-Württemberg is also the region with highest expenditure in R&D within Germany (3.7 of GDP) and it has the highest rate of patent application 144/100,000 (144 patents every 100,000 inhabitants) while the German average is 59/100,000. A large share of those results must be attributed to the automotive sector.

2.2 The manufacturing clusters

As stated by Morosini, clusters are "***socioeconomic entities, characterized by a social community of people and a population of economic agents, localized in close proximity in a specific geographic region***[9]".
They play a key role within the University-Industry partnership framework, providing a fertile ground for higher industrial and scientific integration.

Being a "local" phenomenon, a cluster's geographical scope can vary significantly from region to region, but a common basis for its formation is the necessity to optimize a **competitive advantage**.

There are many forms of clusters: formal or informal; in the public or private sector; horizontal or vertical; and so on.

All cluster examples present three core characteristics[10]:

- **Knowledge spill–over**: knowledge is generally believed to flow more easily between local players than over longer distances; this influences the local inter–firm cooperation.
- **Labour pooling**: labour pooling benefits attract new firms to a certain geographical area determining two main advantages, knowledge transfer and improvement of industrial skills.
- **Cost advantages**: the extended division of labour and the high level of specialization increase inter–firm cooperation with extensive knowledge and resource sharing, which leads to a more efficient research activity.

Clusters are a dynamic environment where several players cooperate in a highly interrelated network, providing mutual benefits to each other within the legal framework, which often stimulates new hubs of development.

[9] Morosini, 2004
[10] Trotta 2012 – "Cluster and Automotive Districts, Potential cooperation between South Australia and Piedmont"

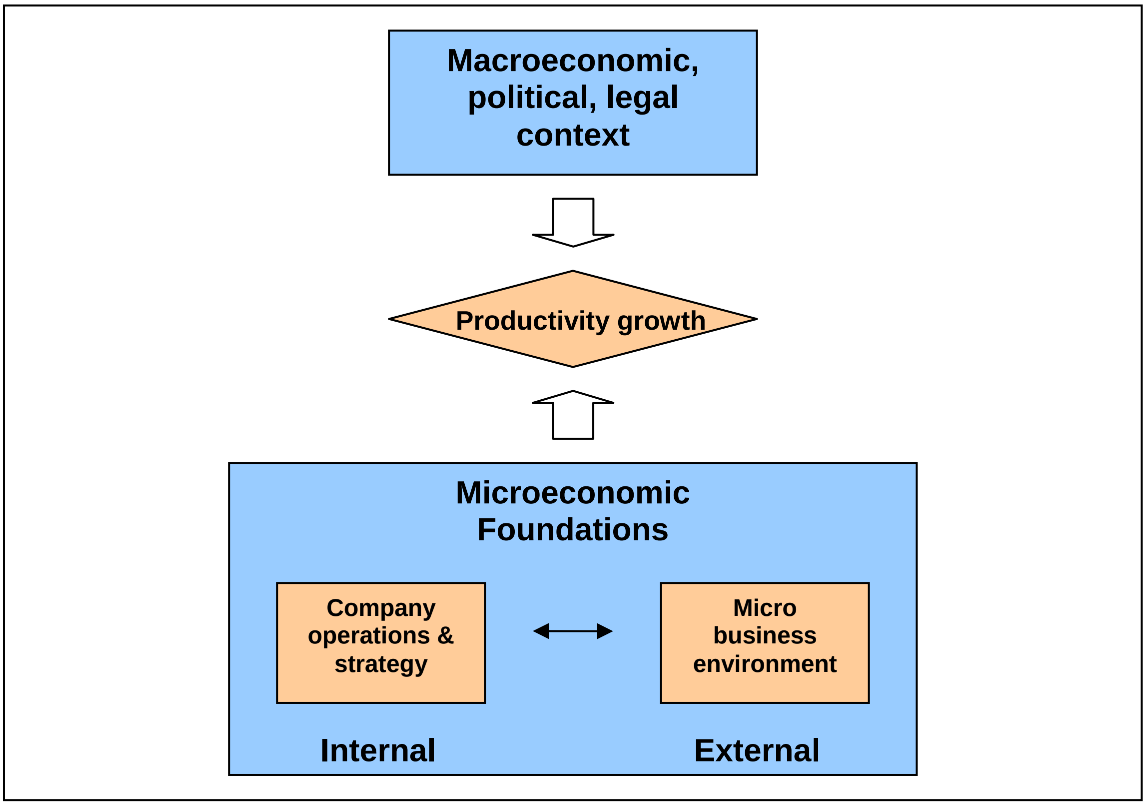


Figure 5: cluster Macro – Micro economic framework

As shown above, how clusters develop is based on the interrelation between several local subjects such as suppliers, government or other public institutions, universities and research centres. Learning and knowledge creation among cluster participants can improve its efficiency and effectiveness and may act as a spur to innovation.

As the cluster gains an identity, it attracts new entrants, suppliers, buyers, and institutions, and creates major external economies for cluster participants.

The competitive advantage, which is the main reason for cluster formation is "*created and sustained through a highly localized process*" (Porter, 1990) and ascribes competitiveness in the global economy to develop local knowledge, relationships and motivation that cannot be duplicated on a global scale.

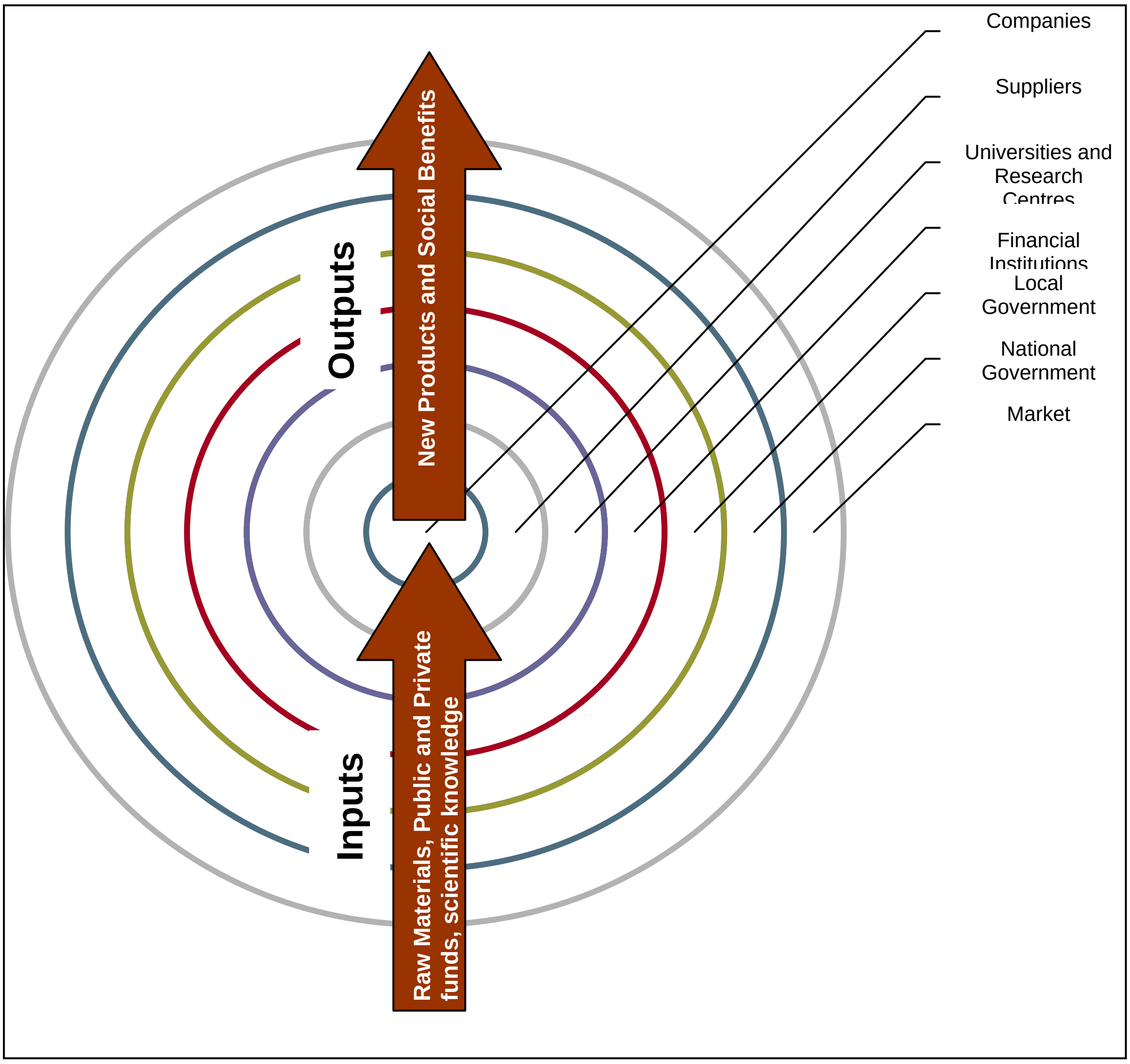


Figure 6: Cluster stakeholder interrelation

2.2.1 Models of cluster

Clusters develop over time, they are not a phenomenon that appears or disappears overnight; and their structure is highly influenced by the territory's resources and economic tissue involved.

Different factors can have a determining role in the hubs' development. For example, for many clusters the abundance of natural resources is one factor that could enhance the cluster's growth (the typical situation in the mining industry or in steel production, Pittsburgh).

Within a defined region, a plurality of small firms operating in the same area may naturally move towards establishing a homogeneous relationship, taking advantage of shared infrastructure, collaborating to develop new knowledge, and specializing in well defined business sectors (horizontal integration).

Small and Medium Enterprises (SMEs) are limited in their access to specialised resources and intelligent capital; when small firms are not in the position to integrate the production chain through economies of scale, they cluster to access resources, to reduce costs, to compete with larger firms and to innovate.

By networking and sharing knowledge, small firms are able to compete for access to specialised resources and information systems, as well as internalise competencies and assets that are typically developed by large firms through economies of scale. Clustering hence, provides SMEs with benefits that would otherwise be unavailable, or be available at a greater cost to non-clustering members.

The presence of a big firm changes the equilibrium; moving small companies to a supplier function towards the bigger one. The big firm, in turn, becomes the main market for a plurality of smaller players, establishing a symbiotic relationship based on mutual benefits (Vertical integration).

To summarise, two main situations can set up the right conditions for the development of a cluster:

- The endogenous evolution of traditional knowledge based on local expertise;
- The presence of an international company which focuses its production in a relatively small area.

In the first case, clusters rise where, for cultural and historical reasons, specific knowledge is already rooted[11]. In this framework, their development can be considered as an industrial evolution of small scale business.

A good example is the Italian company “Natuzzi Industries”, which specialises in high quality furniture. Here, traditional knowledge in leather and wood manufacturing was turned into a solid industrial business, stimulating the birth of several other smaller companies, as both competitors and suppliers (“Mirandola biomedical district” and Sassuolo ceramic hub represent two more examples).

In the second case, the cluster development over time is motivated by the necessity for the productive chain to reduce cost and production timing. To match the increasing demand for specific goods, a dense network of small and medium companies grows around the bigger player, which comes to represent their main market.

This mutual relationship represents at the same time a strength and a weakness; the small companies’ network is in fact highly dependent on the core firm, and its crisis or failure would determine the collapse of the cluster.

More complex cases are multinational companies. A multinational’s involvement in a cluster is usually limited to few a research departments, highly specialized in a specific business area. Innovation is the key factor in this case. These companies in fact invest in high research intensity areas, taking advantage of the scientific synergies created between different research institutions and providing,

[11] Usually high manufacturing skills, which root in local traditions

at the same time, a real growth opportunity for the local knowledge through the launching of new marked-driven projects.

Flexibility represents the key point for multinationals as they have the capability to invest in different parts of the world, can easily assimilate knowledge from different environments, get in touch with different business cultures and enter new markets.

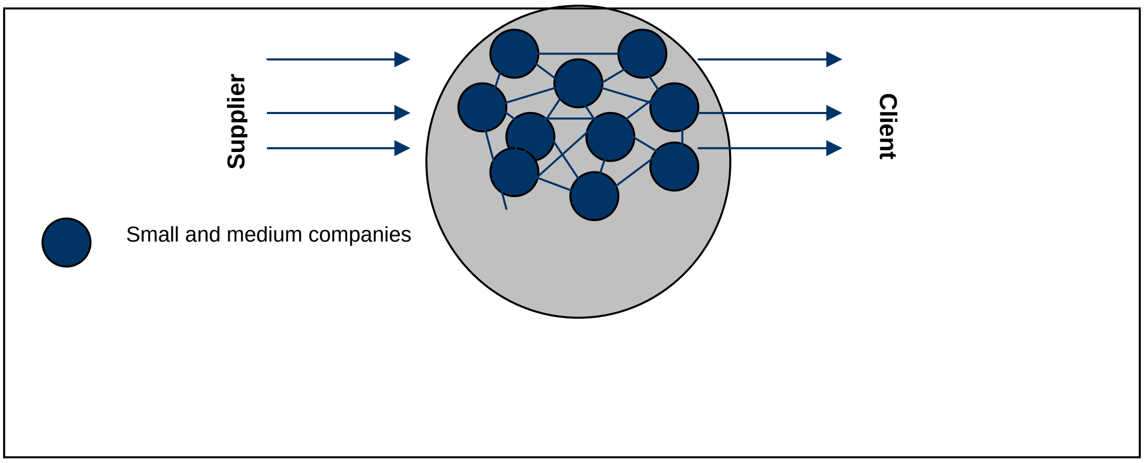


Figure 7: Endogenous cluster, composed by small firm in an homogeneous relationship among them

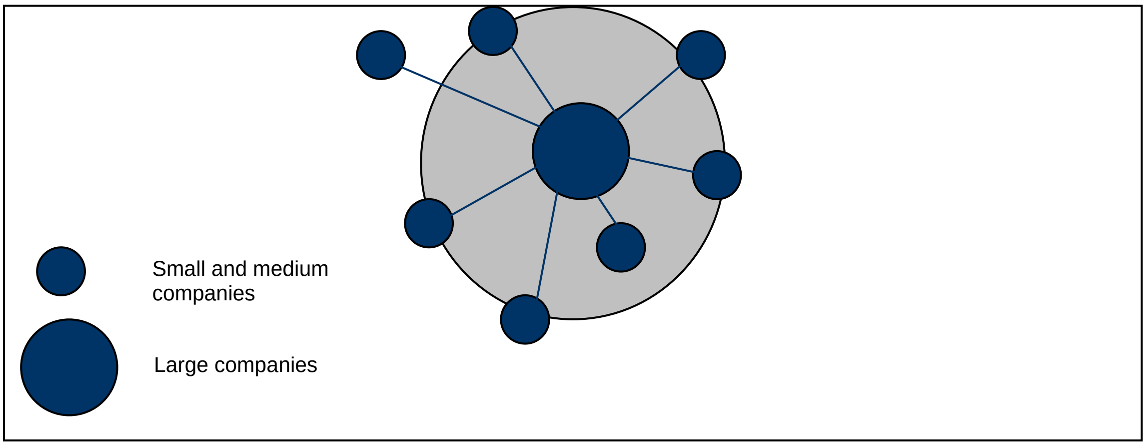


Figure 8: Large Company set the bases for the creation of a cluster of suppliers

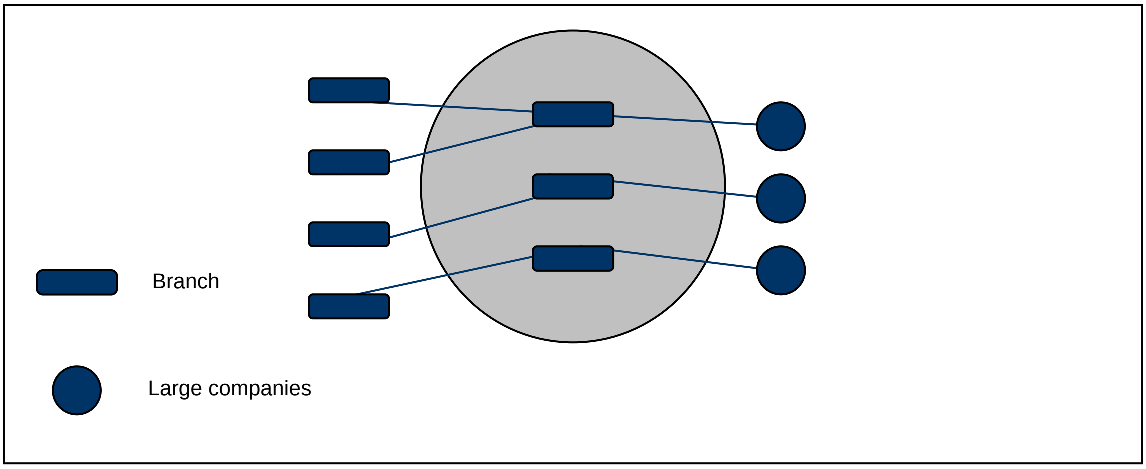


Figure 9: Multinationals involve just some branches in a cluster, depending to the sector specialization[12]

The affirmation of one model rather than another, highly depends on the national or local industrial tissue.

In countries like Italy, Spain, England and France, the economic system is based on small/medium enterprises, counting on just a few global operating players. In these cases, due to the natural conformation of the entrepreneurial system, an endogenous cluster development will be more likely.

On the other hand, the USA and emerging countries (such as China, Brazil and India) are more likely to develop hubs based on big corporations operating on a global scale. This is in response to the bigger size of the internal market and to a different focus on international competition.

Studying clusters' competitive advantage and characteristics, Andres Malberg developed a model to distinguish different forms of industrial agglomeration on the basis of their specific characteristics, underlining how innovation is the key driver in cluster development.

[12] Trotta 2012 – "Cluster and Automotive Districts, Potential cooperation between South Australia and Piedmont"

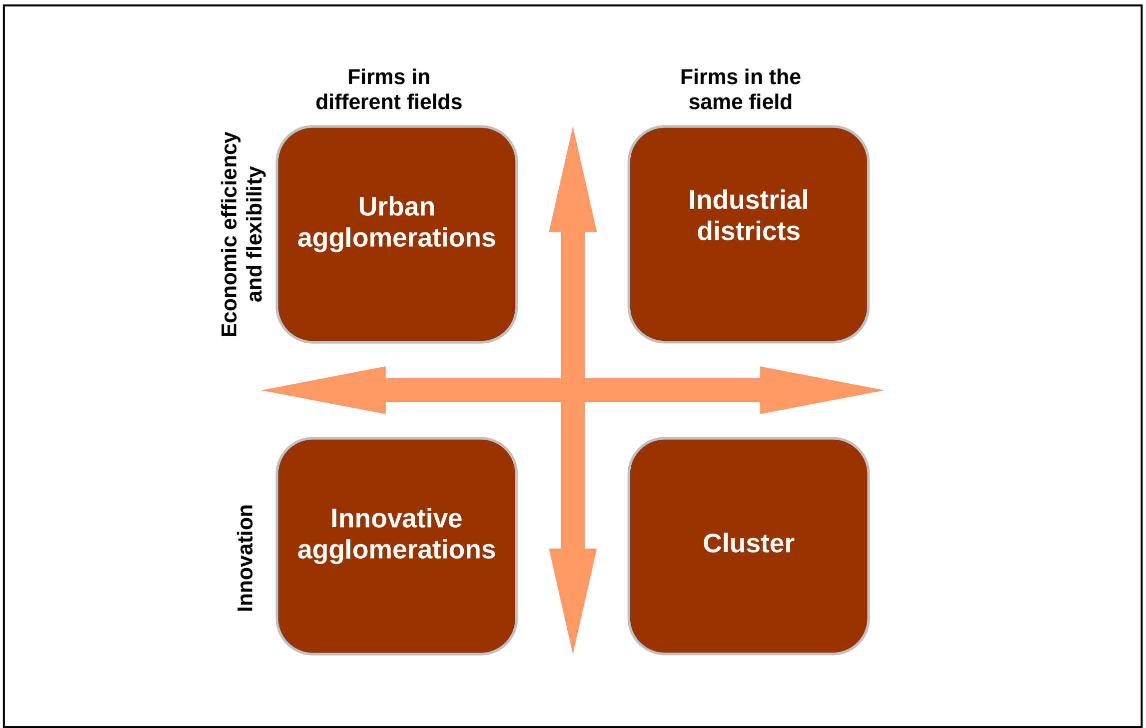


Figure 10: Malberg's model[13]

2.2.2 Clusters' performances

Clusters are a prosperity factor which strongly influences the local economy in different aspects: employment, salaries, innovation and research, public policies, prestige, local business culture, tourism, and so on.

Research on salary dynamics in cluster' areas provides useful information to understand the microeconomic benefits brought in by a cluster:

- High correlation between cluster development and higher than average regional wages.
- The more the regions concentrated their employment across clusters over time, the higher their wages grew. Being strong in some fields seems to be more important that having a presence in all fields.
- Regional economic performance is positively related to a cluster's activity, which creates a strategic advantage in competing across regional boundaries.

There is increasing evidence and agreement amongst researchers that clusters create a number of positive economic effects. What is needed is a conceptual model for cluster - based economic policy, and tested against empirical data.

[13] Trotta 2012 – "Cluster and Automotive Districts, Potential cooperation between South Australia and Piedmont"

Knowledge spill-overs increase innovation and productivity growth.
R&D activities and outputs from innovative activities are geographically clustered.
Patents are two to six times more likely to cite other patents that were filed in a geographically proximate area than patents that were filed farther away.
Knowledge flows, not only within an industry, but also between geographically proximate related industries. Some new technologies can be adapted in multiple industries, creating returns to innovation.
The presence of a large, local, R&D intensive firm enhances a cluster's ability to convert local university research into commercially valuable innovation.
Increase in innovating patenting activity for firms within a cluster.

In an international economic market where small companies struggle to face international competition and multinationals delocalize their production in developing countries, a cluster-based economy could provide a valid alternative to increase SMEs' competitiveness and develop a fundamental technological advantage.

Research receives great benefits from clusters. Market competitiveness forces industries and universities to cooperate locally to develop new products and technologies to satisfy market demand.
Moreover, Multinationals have the possibility to merge knowledge from different parts of the world, benefiting from different scientific cultures and increasing results through information sharing. Clusters become not only a manufacturing but also a scientific centre, where local prosperity depends on innovation intensity over the cluster's life-time.

The Australian Government is extremely focused on creating incentives for new research and development projects. Within the last decade, it has launched several projects on both national and local levels. These efforts aim to provide new assets for the further development of the already good level in R&D, contributing at the same time to increase the integration rate between companies and Universities.

A successful example is demonstrated by the Cooperative Research Centres Program (CRC), which is a federal government project that aims to develop the national innovation system through "***medium–long term collaborations between the producers and end users of research***" that are capable of developing the research outputs to deliver significant economic, environmental and social benefits to Australia.

The CRC program seeks to stimulate a broader education and training experience for a post–secondary students, particularly research students, to enhance their employment prospects, by providing them with the skills needed to utilize research outputs and produce innovative “end–user” centric solutions.

Minimum activities requested from CRCs
Medium and long term end – user driven collaborative research
End–user focused education and training program
SME strategies that build their innovation and R&D capacity
Utilisation activities to deploy research outputs and encourage take up by end - users

The CRC program is directly funded by the government, for varying period of up to ten years and without a specific limit. Since 2008, it has received about $3.7 million of funds per year which activated 38 CRCs operating in 4 main area of interest (Agriculture, Services, Manufacturing, and Mining).

2.3 A new player: Foundations

Foundations are defined as a "***legal categorization of non-profit organizations that will typically either donate funds and support to other organizations, or provide the source of funding for its own charitable purposes***".

Both public and private, foundations have a key role as an important R&D funder, constituting in many cases a direct connection between Government, Universities and Companies.

Many Colleges (especially in the USA) manage private foundations for the purpose of providing grants and financial aid to the highest skilled students, but often becoming an active subject in charge of building relationships with the companies and public administrations.

Private philanthropists are also involved in charity and scientific progress through legal entities that often hold their own name. The Bill & Melinda Gates foundation, for example, promotes charity initiatives, as well as innovative research projects, focusing on a social aspect instead of a proper business approach.

Finally, Governments manage public foundations for the purpose of promoting networking amongst national and international scientific partners in the national and international scenario and to directly fund new business ideas or research projects (National Science Foundation in USA).

Fondazione Politecnico di Milano

Politecnico di Milano Foundation is a leading Italian non-profit organization created in 2003 by the Politecnico di Milano[14] in order to :

- Improve the university's knowledge to match the innovation need of several public and private partners;
- Establish a network within small/medium/multinational corporations and research centres; and
- Focus on research opportunities provided by the public and private sector on a national and international scale.[15]

In order to incentivize the participation of young researchers to the innovation process and help innovative ideas to become new businesses, the Foundation launched the "Acceleratore d'Impresa" platform, which helps new entrepreneurs to create new high tech companies, by providing advisory services and, in some cases, direct funding.

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[14] One of the most prestigious engineering Universities in Italy, founded in 1863 by Francesco Brioschi. For further informations: http://www.polimi.it/index.php?L=1
[15] Fondazione Politectnico di Milano's mission

Its activity is articulated in various stages which provide prompt assistance in every step of a new idea development:

- **Scouting** within the university looking for innovative ideas
- **Consulting** to create a sustainable Business Plan
- **Formation** to develop managerial skills
- **Developing** a competitive business strategy
- **Networking** with Business Angels, venture Capitalist, Industrial investors
- **Tutoring** of new entrepreneurs by affirmed professionals
- **Internationalisation**

Foundation efforts are mainly focussed on five scientific areas:

Energy and transports	Necessary infrastructures for a developed or developing country
Technology, Design and new materials	Increase quality of life from an eco-friendly point of view
Public administration	Increase efficiency of public services
Cities and Inclusive society	City services to increase citizens' welfare
Formation and Talent for innovative companies	Human capital developing

So far, the foundation has established a network of more than 1200 subjects, realizing 192 projects, with 702 partners. It has also funded 16 new start-up companies, mainly focussed in the High Technology, electronics and biomedical sectors.

Within the several prestigious founding members we can name: Intesa Sanpaolo (second biggest Italian bank in 2009); Lombardy regional Council and Siemens, which show perfect examples of partnership between public and private sector.
Some of the principal business partners are Ansaldo Breda, Edison, Enel, Milan Local Council, Trenitalia.

Bill and Melinda Gates foundation

"We believe every person deserves the chance to live a healthy, productive life"

The Gates' foundation was founded in 1997 on the Microsoft founder sons' idea to actively help millions of people suffering disease and malnutrition, all over the world, to lead healthy and productive lives.

The main goal of the foundation is to discover and disseminate innovative approaches to address extreme poverty and poor health in developing countries whilst improving US education system, cooperating with governments, private sector and other donors and organization in order to achieve the greatest possible impact.

Since the very beginning, also taking into account consistent economic possibilities, ($36.2 billion asset value in 2012)[16] the Foundation has strongly invested in a medical campaign against diffused illness such us poliomyelitis and HIV/AIDS, mostly operating in the third world countries in Asia, Africa and South America.

The Gates foundation operates by directly providing medical advice, vaccines and infrastructure, but also by funding top rated research institutions like universities and research centres through millions of dollars worth of grants, invested in specific projects.

Two of the R&D funded projects in which the Gates Foundation was involved, collaborating with American universities are:

Cornell University Partnership to Combat Wheat Rust Disease and protect poor farmers

Cornell University[17] received a $26.8 million grant to launch a broad-based global partnership to combat a deadly wheat disease that poses an enormous threat to global food security. The partnership will bring together 15 partner institutions to combat the emergence of deadly new variants of stem rust, focusing on developing rust resistant varieties to protect poor farmers in vulnerable regions in India, Pakistan, East Africa, China, Middle East and North Africa.

Michigan State University (MSU) partnership to Bolster Africa's Biosafety Capacity

MSU received a $1.5 million grant to develop the African Biosafety Network of Expertise (ABNE) to help regulators access the most up-to-date training, data and resources needed to properly regulate biotechnologies, ensuring that African countries are able to take full advantage of advances, whilst safeguarding consumers and the environment.

National Science Foundation

The NSF is the USA government agency that supports fundamental research and education in all the non-medical fields of science and engineering. It operates to ***"[p]romote the progress of science; to advance the national health, prosperity and welfare and to secure the national defence"***[18].

With an annual budget of US $7.0 billion in 2012, the NSF funds approximately 20% of all federally supported basic research conducted by the United States colleges and universities.

The NSF doesn't own laboratories, it seeks to fulfil its mission chiefly by issuing competitive, limited-term grants in response to specific proposals from the

[16] Bill and Melinda Gates Foundation financial statement
[17] One of the Ivy League colleges , the oldest and highest ranked American Universities
[18] NSF mission

research community. On average, the NSF funds 10,000 out of more than 40,000 proposals yearly, usually top ranked projects[19] in a strict merit review evaluation.

Mostly, NSF grants go to individuals or small groups of investigators who carry out research at their home campuses, other grant tranches, provide funds to mid-scale research centres, or instruments and facilities that serve researchers from many institutions.

European University Foundation (EUF)

The EUF constitutes the common body for a network of European universities committed to excellence. It is an umbrella organisation for the Campus Europae (CE) university network.

The overall purpose of the EUF is to:

- Build up a close co-operative network of universities in Europe
- Promote excellent performance in research, teaching and services
- Foster and develop the university culture and university organisation required for this purpose.

To achieve these goals, the EUF has the task of creating a university network by reaching co-operation agreements with universities, and establishing an institutional and strategic framework which forms the basis for co-operation between the associated universities to achieve joint results.

The financial resources that the EUF can count on are both European Funds, paid by each country in proportion to its GDP (as every European Union Project) and private donations.

[19] Reviews are carried out by panels of independent scientist, engineers and educators who are experts in the relevant fields of study.

2.4 Intellectual property management

The third issue is Intellectual Property management. This aspect is critical in every collaboration, representing at the same time a big opportunity if a deal can easily found, or the biggest threat to university–industry collaboration if a deal can not.

As collaborative R&D is constantly growing, together with the necessity to share proprietary and intellectual assets, intellectual property management is becoming relevant to develop some constraints to protect shared information from unintended use.
Technology transfer from Universities takes the form of publications, consulting, graduates hiring, research contract, spin-off companies, etc; this makes it necessary for a clear discipline about knowledge sharing.

Common Intellectual Property Problems
• Patent ownership • Royalty – free nonexclusive • Option period for royalty-bearing exclusive • First right of refusal • Up-front fees and annual minimums • Patenting costs and maintenance fees • Right to use all other know -how • Third – party funding and their rights (special focus on government) • Use of confidential and proprietary information

To face these threats, firms use both legal and non-legal methods:
Legal methods include crafting a series of agreements and linking the agreements to the activities of the collaboration.
Non-legal methods include ensuring that employees in both firms understand what information must be shared with the partner, may be shared with the partner and must never be shared with the partner.

The nature of intangible assets such as know-how and trade secrets is a barrier to their protection but still, four main areas of intervention may be highlighted:

- Collaboration agreements
- Issues in Non-Disclosure Agreements
- Issues in Joint Development Agreement
- Organizational issues that affect intellectual asset protection

Collaboration Agreements
The reality of the collaborative process is based on a series of agreements built on one another as the collaboration moves through various phases.

A Non-Disclosure agreement is normally the first agreement in the series. It may be followed by an agreement covering the development of new technology, such as a collaborative research agreement, a joint development or an agreement to purchase development from one of the parties.
If the collaboration is successful, it is followed by agreements that enable the operation of a business such as purchase agreements, join marketing agreements and various types of licenses to assure each party has the necessary rights to operate its business. In each stage, specific people carry out specific activities under the appropriate agreements.

Non – Disclosure Agreement
The first line of defence for protecting proprietary information is the Non-Disclosure Agreement (NDA). Also known as the Confidential Disclosure Agreement (CDA), this document allows employees from different firms to share proprietary information, typically technical capabilities, application requirements and business models.

The hope is that the companies could combine knowledge, or match the capabilities of one with the needs of the other, to create significant business value. These early discussions include information about the market-place, and the specific technical needs, resources or know-how that each firm requires to meet those needs. These discussions are sensitive and should be held under an NDA.

It also creates an opportunity to share information, as the people in charge of creating and implementing the NDA, take time to understand the purpose of the disclosure and reveal only enough information to meet that purpose.

The goal is to provide just enough information to allow the partners to make the next decision. This may require a series of meetings, with each meeting exposing more and more details within the areas identified in the NDA.

Three key issues require special attention:

1. What confidential information is being disclosed
2. Each firm's right to use the disclosed information
3. The timing of confidentiality

Firms avoid misunderstandings when the NDA clearly and accurately identifies the information that each party will disclose under the agreement.

It must be broad enough to allow each potential partner to evaluate the other's intellectual assets (IA) and make a go/no-go decision to enter joint development negotiations.

It must be narrow enough that only that subset of the firm's science base, relevant to the potential collaboration, is disclosed.

After the parties understand what information will and will not be disclosed, they must agree on each firms “right to use” the information. A common clause in NDAs states that each party can use the information only for the purpose of evaluating the technology, or for discussion related to establishing a potential business relationship.

Another common clause is to enable the parties to coordinate in the preparation of a joint response to a solicitation. These clauses place a burden on the disclosing party to think through its freedom to operate after the disclosure.

The time periods specified in NDAs are information management tools; the first is the disclosure period, it states the specific dates during which the disclosure will take place. The confidentiality period is the length of time during which the information must be protected; it is common to see three year, five year, or in some cases, perpetual confidentiality periods.

The real risk in these deals has less to do with time and more to do with managing information in a modern organization. As people transfer to other departments or leave the company, the risk of improper disclosure increases.

In spite of these possibilities, it can be assessed that most of all NDAs serve most of all two valuable functions: first, they raise awareness in the minds of both firm’s employees about the proprietary nature of the information being shared; second, they protect the patent of the disclosing party.

Joint Ownership

Another kind of agreement, more detailed and protective than an NDA is the Joint Ownership Agreement. It is better that both firms negotiate how intellectual property, developed during the course of the agreement, will be allocated between the parties and write this into the Joint Development Agreement.

There are three main details which must be discussed during the negotiations:

1. How to develop a clear description of the joint project.
2. How to bind the agreement.
3. Defining each firm’s rights to use both background and foreground intellectual assets.

Therefore it’s hard to asses each other’s skills and capabilities and ensure that the firms’ combined resources are sufficient to carry out the development. ‘Good Statements of Work’ carefully and completely describe the obligations of the parties, including what each party will do separately and together. The outcome is in fact uncertain; the worst case scenario is when employees in both firms carry out their responsibilities but the final result is lacking because the initial plan was incomplete.

The second challenge is bounding the agreement. Boundaries are a clear statement of the scope of the alliance; inside the boundaries, the firms are allied; they will play by a set of rules defined by the alliance agreement.

Outside the boundaries, the firms are competitors and a different set of rules will apply. Boundaries are determined by translating each firm's business and technical intents into a set of statements that determine the scope of the alliance.

The third challenge is defining each firm's right to use background and foreground assets. For any collaborative research agreement to succeed, each partner must have the necessary background rights from the other to carry out its role in the alliance.

Maximizing the Intellectual Assets (IA) portfolio value

The companies maximize the value of their IA portfolio by entering into a wide variety of licensing and collaborative agreements. Tracking these collaborations is an onerous task, especially when exclusivity is granted. Exclusivity is the "third rail" of collaborative agreements.

Well-crafted NDAs and JDAs are a necessary, but not sufficient, condition to protect intellectual assets. An equally important line of defence is a technical staff that understand how IAs create value for the firm and knows how/when to share them. Management takes a giant step forward when it creates an environment in which every member of the business and technical staff understand more than just the principles, but also the rigors of protecting IA.

Intellectual asset training is an organizational protection mechanism that increases the legal protection of the NDA and JDA.
At a minimum, this training must clearly outline to team members what intellectual asset they:

- Must share with the partner
- May share with the partner
- Must never share with the partner

When the technical staff understands these limits, they monitor their own behaviour. Educating the employees on IA solves half the problem, the other half is ensuring that the partner's employees are equally sensitive to IA protection. - Behavioural training ensures that employees in the partner firm understand the basic principles of IA management and how they apply to this particular collaboration.

The collaboration's first meeting is an important intervention point. It may be one of the few times that all of the collaborators are together at the same time. Leading companies use this opportunity to ensure that team members from both firms come to a common understanding of what will be shared, and how the shared information will be protected.

For instance, third-party involvement is another aspect of protecting know-how that deserves management attention. Most research collaborations include one or more consultants, contract employees and/or third party companies.

The concern goes beyond what is written in the NDA regarding third parties; it also goes to the third party's understanding of what proprietary information is, and the responsibility to protect that.

Training employees is particularly important in University partnerships. Universities have a culture of open sharing, graduate students must in fact produce a thesis that is publishable, which encourages them to share intellectual assets, not protect them. These students will work in their chosen field, and may work for a competitor. Their continuing responsibility to protect the firm's IA upon graduation is an important discussion topic.

The university culture of open sharing is both a leverage point and a barrier to industrial collaboration. From a leverage perspective, a university researchers' contribution is the leading-edge thinking that results in future products, but from a barrier perspective, university researchers share information vigorously.

For these reasons, when dealing with universities, leading firms use all the techniques outlined and take two additional steps to protect their commercial interests:

- First, they clearly outline the university's rights to disclose the results of the collaboration at conferences and in academic journals.

- Second they ensure that every academic colleague working on the project, including graduate students, understands the terms of the agreement/s.

Most graduate students have in fact, little or no experience with contracts such as non-disclosure agreements or joint ownership contracts, making it necessary for the university to describe the obligations of the agreement to its personnel, and for the corporate partner to make sure that each university employee understands this obligation.

From the point of view of IP ownership instead, two different scenarios can take place, depending on which subject owns the patents:

Company Owns Intellectual Property: possibilities for University	
Rights	***Benefits***
• No rights without permission of company • Equal rights and free use for own purpose; negotiated rights for third parties • University can use for research; no rights for third parties	• No reward for commercial exploitation • Subsequently negotiated reward • Pre agreed upon reward

University Owns Intellectual Property: possibilities for Company	
Rights • Company pays for exclusive • Company pays for nonexclusive • Company receives free nonexclusive	***Benefits*** • Company receives pre-agreed reward from third–party licenses • Company receives subsequently negotiated reward • Company receives nothing from third parties

2.5 Cases of study

We conclude this section, with several examples of successful University-Industry partnerships where all the issues we have been discussing so far can be demonstrated.

It can be seen how different institutions have very different approaches in terms of goals, organization, relationship equilibrium and intellectual property management. Moreover, in some cases, the Government has played a key role in launching new initiatives to touch new grounds of potential returns.

2.5.1 UK: *Imperial College Multidisciplinary strategic alliances*

To combat the constant reduction of UK government funds, the Imperial College has developed an articulated support infrastructure for managing research contracts, internalizing specific competencies concerning intellectual property exploitation and for the provision of scientific services and consultancy.

To manage the different deals with industrial partners, the Imperial College has created a technology transfer company (IC Innovations) that is staffed with professionals who employ the commercial potential of research projects by forming spin-off companies or, more often, by licensing to third parties.

When a spin-off company is created, the college normally takes a share in the equity, which is justified by its investment of its intellectual property rights in the spin-off. The share is usually, but not always, a minority one, and the independent companies are left to exploit the intellectual property rights in the best commercial manner possible, with a strictly arm’s length relationship with the college.

Imperial College also operates a consulting company called IC Consultants (ICON), which markets the expertise of the academic staff as consultants. It accepts the professional liability for the provision of such consulting activity and negotiates the fees for the work of individuals and groups.

ICON also markets the use of the college’s scientific research facilities by industrial partners when they are not in use for their prime purpose of college research. Thus, for example, unique wind tunnel facilities have been made available at commercial rates for development work by Formula 1 racing teams, in a complementary manner that provides funding for future college research.

ICON has been important in establishing linkages with small companies with fewer than 200 employees, which had proved to be rather difficult for Imperial College to reach and engage in research, in part due to the fact that small companies are often involved in short-term work rather than longer-term strategic research.

Strategic alliance model

This aggressive and efficient mode of participation has been called "Strategic Alliance". The concept of the strategic alliance is a relatively new concept in Europe, in terms of the relationship between universities and industrial partners.

Characteristics are:

- **Time duration**: long term partnerships across a number of the university departments or disciplines, with no limitations on what sort of interaction might be involved.
- **Contracted structure**: open negotiation is fundamental in getting an alliance to work, and must proceed from a position of mutual trust, toward an agreement for mutual benefit.
- **Flexibility**: The partnership must be intersectional in the sense that it is not to be limited to a single faculty, but must be transversal to several departments.

One example of such a strategic alliance at Imperial College has been the involvement of two pharmaceutical companies, Smithkline Beecham and Zeneca, who have not merely supported a research project, but the entire discipline of analytical chemistry by funding a research centre at Imperial College.

This centre was created because the two companies believed that the national need for people with such skills was not being fulfilled by existing institutions. The centre has grown from their initial support into a dynamic hub training students and staff and performing innovative research for those two companies and others.

The use of a broadly based management group for each strategic alliance has also been a key part of the University - Industry partnership development. Each group includes representatives from both sides involved: members of several college departments and several members of the company at the corporate level. This body has operated to remove barriers to communication between the two partners, and internal barriers within the two individual components of the partnership.

The inclusion of high–level representation in the group has the added benefit of a communication between entire organizations rather than individuals, which enhances networking, trust, robustness and effectiveness.

An example of alliance

Amongst the strongest alliances that Imperial College has established is that with Air Products and Chemicals Inc., a company operating in a number of sectors throughout the world.

The relationship has been a productive one in terms of scientific output with commercial potential, effective student exchanges and access to new funds. In this arrangement Air Products has provided an annual sum to fund research, which is available to bids from academic groups within the college, and judged by a panel made up of staff from the college and members of the company.

The result of such an arrangement is of obvious academic benefit to the college and potential commercial benefit for the company. The projects have brought together members of the Chemistry, Chemical Engineering and Material departments at Imperial College in a new manner to achieve a common end (The material department has raised its research income from industry to nearly 70% of its total research income thanks to this deal).

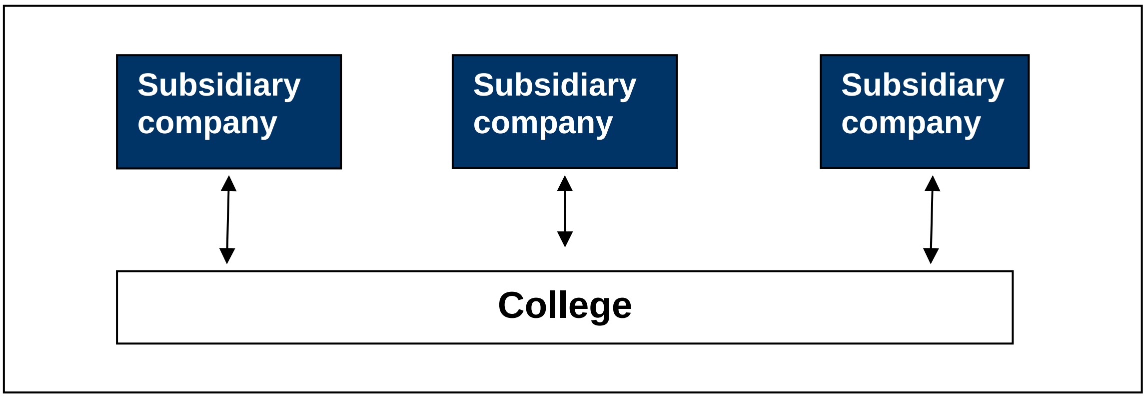

Figure 11: Traditional situation = Interaction easy to break down

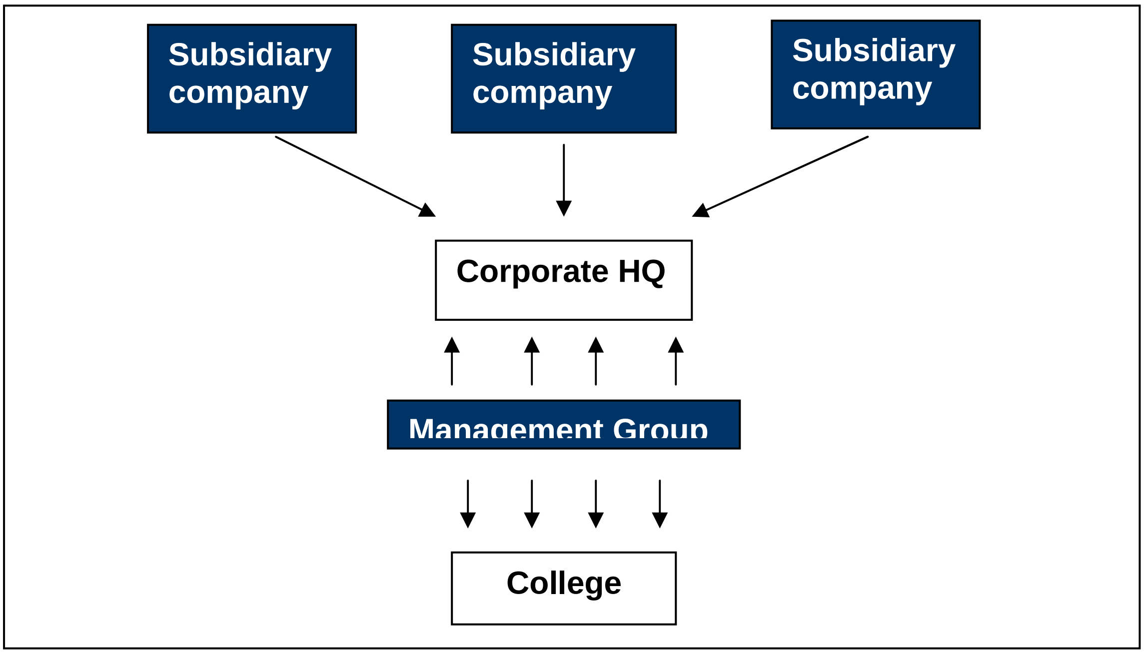

Figure 12: Interaction at Imperial College via Management Group

As shown above, Strategic Partnership favours collaboration amongst different players increasing outputs and research development instead of limiting collaboration to a face to face agreement between college and company. This approach maximizes collaboration effects, and sharply increases the probability of success in developing new market products.

2.5.2 USA: *UIPP and UIDP experiences*

Due to the strategic importance that a long term R&D process represents for the entire economic system, many central governments are arranging programs to coordinate academic research efforts with company innovation strategies.

In many cases, there is not a proper public office in charge of creating a University–Company network but in most of the cases, the government plays an overall role contributing to attract investments from local and foreign companies in a wider framework of cooperation between Market and Knowledge.

The USA is the leading country in this context. They have constantly considered technology development as one of the economic priorities and are focused by the intention to maintain their world leading position in technology. Since 2003 the US has arranged an articulated network of institutions, made up of both companies and universities, which aims to promote further technological development, as well as contributing to keep the USA the leader in high-tech industry.

UIPP

In 2003, two American Organisations NCURA (National Council of University Research Administration) and IRI (Industrial Research Institute) inaugurated the **University-Industry Partnership Project (UIPP).**

This was a congress of delegates from industries, universities and government set up to explore the principles that should govern industry/university collaboration, and identify an array of strategies for translating those principles into research agreements.

The UIPP brought together 170 registered attendees, representing 32 companies, 47 universities and several nonprofits/government foundations. This resulted in a heterogeneous group of experts, representing both small and large companies, as well as universities and different sectors of US economy.

In broad terms, the UIPP was focussed on achieving five main results:

1. **Turning challenges into successes**. This meant turning the primary challenges of contract negotiations and intellectual property into positive results.
2. **Building trust and teamwork**. In the first year it appeared there was significant distrust among some of the participants, either on a general level or based upon prior bad experiences.
3. **Defining and prioritising the issues** finding a commons cause and creating an “action plan”.
4. **Developing flexibility**. This is giving recognition that a university-industry partnership must be flexible to meet future demands and changes of an internal and external nature.
5. **Reducing negotiation duration and consequently, transactional costs.**

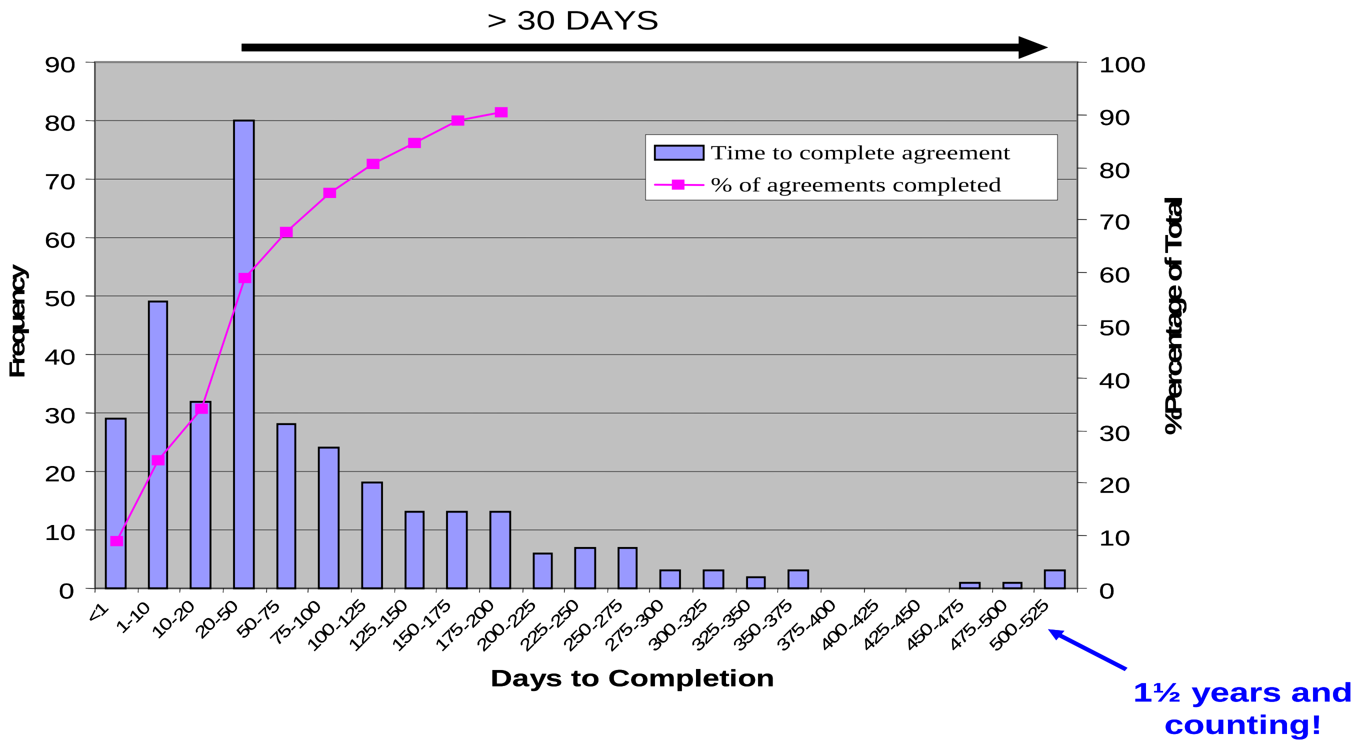

Figure 13: Time to agreement

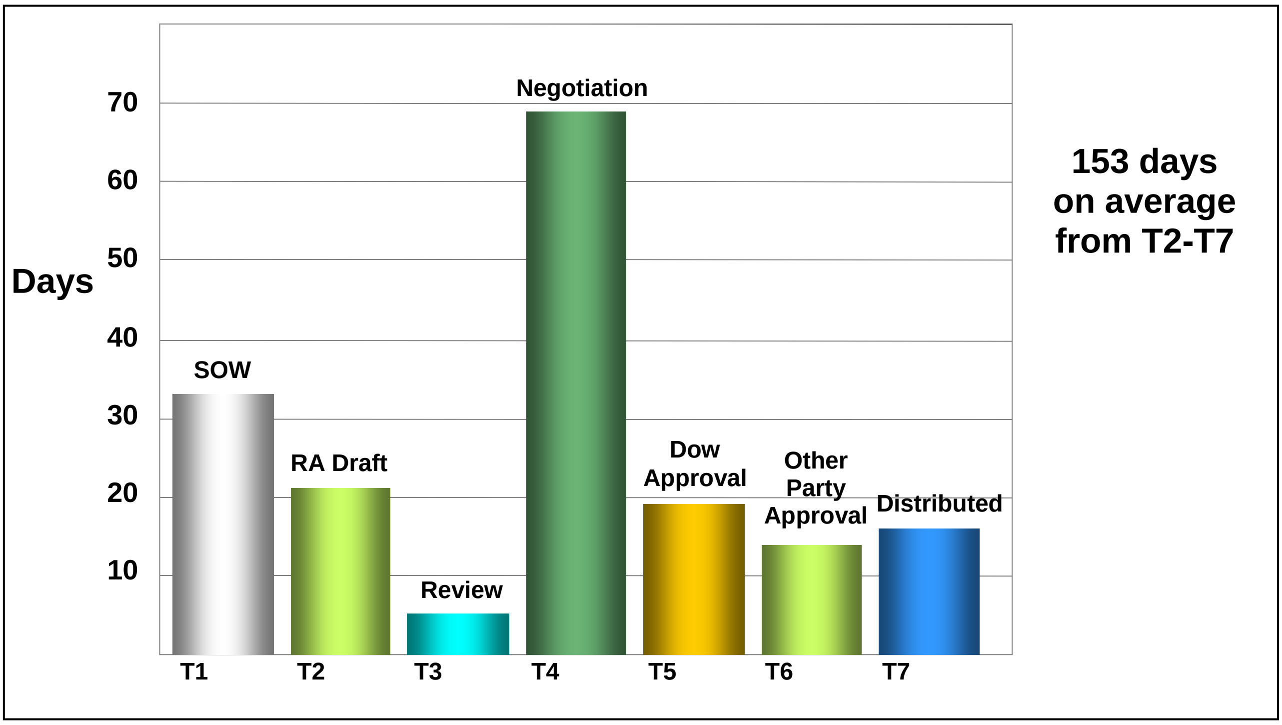

Figure 14: The chart above shows that negotiation is the step which treats the most the agreement

From the university's side, the biggest impediment was often the high percentage of no licensable intellectual property, about 95-97% of all research projects.

Furthermore, sponsored research offices spent disproportionately more on staffing to manage industry-funded research agreements, compared to government-funded research agreements.

Prolonged discussion in reaching an agreement can pose a problem for universities too, if time is too long:

- Source of funding can be lost
- Technology of interest become outmoded
- Sponsor may focus on different projects
- Faculty become discouraged

UIDP

The UIPP conclusion was UIDP's beginning. This consisted of a new partnership which aimed to "***support mutually beneficial U.S. University-Industry collaborations encouraging U.S. competitiveness by developing and disseminating strategies for addressing common issues between the two sectors***"[20].

The UIDP also focussed promoting the development of a deep understanding and respect of the driver's goals, missions and cultures amongst our universities and companies, and foster open communication and transparent negotiations.

The UIDP was created to perform several strategic and operational goals, representing a turning point in US strategy to promote University-Industry partnership:

Strategic goals

- Promote education and research between companies and other research organisations to improve competitiveness, advance the U.S.'s scientific knowledge base, and create an educated workforce.
- Provide professional development opportunities for contracting and research-performing practitioners.
- Serve as a test bed and undertake demonstrations to experiment and model innovative approaches to university-industry collaborative efforts.

Operational goals

- Support organisations committed to high value return from university-industry partnerships
- Promote principled, transparent and timely negotiations
- Promote collaborative efforts to accelerate cooperative, multi-dimensional, long-term partnerships
- Pursue efficiency and effectiveness, seeking to streamline transactions

[20] UIDP mission

- Maintain a cross functional set of UIDP projects and demonstrations that serve the needs of the members and other interested parties who sponsor and perform research.

Considering that university expenditure in R&D is over $16 billion (2010) involving companies, with market capitalisation above $1billion, and at the same time, government funding is constantly decreasing, the need for a good negotiation platform is sharply rising.

Moreover, it is the unique membership compositions of the UIDP, and its focus on demonstrable strategies to enhance collaborations between universities and corporate partners across a broad array of business sectors, that represent the UIDP advantage. Most ideas are in fact a direct emanation from members work experiences and challenges.

Turbo Negotiator
TurboNegotiator stands as the first project proposed by the UIDP. It aims to create an interactive platform which can provide information, best practice issues and softwares that can make negotiation easier, increasing efficiency, communication and transparency between the parties.
This new tool is based on several issues:

- Interview sections, aimed to guide both sides to reach an agreement on nature of project.
- Answers to interview questions allow the project to be plotted in a dimensional framework.
- “Project Space”, which make easier identify criticism and strengthens.
- Depending on the location in the project space, the software suggests potential applicable clauses.

For further information see Appendix 1

2.5.3 USA: *the Centre for Interfacial engineering partnership with Universities.*

The Centre for Interfacial Engineering (CIE) was founded by the National Science Foundation (NSF) as an Engineering Research (ERC) in 1988 with yearly funding between $ 1.5 million and $ 3.0 million.

The original vision of the CIE is to:

- Lead the development of a fundamental understanding of interfacial process.
- Establish synergistic transfer of technology between CIE and industrial partners.
- Produce well-educated graduates who can apply their knowledge of interfacial operations to new processes in a productive manner.

The expectation is that the research program will be first rate, addressing issues that will impact national competitiveness and will be carried out in direct collaboration with industrial researchers.

All ERCs are exhaustively and seemingly continuously evaluated. The NSF performs an annual site visit with five to seven external reviewers, who typically produce a 7–14 page review. Critical reviews for continuance of the program occur during years three and six. Several ERCs have been terminated as a result of an unsatisfactory third-year review.

Organization

The University of Minnesota is a key player in this format; within the CIE framework it has four research programs, each under the leadership of a professor. Associated with each of these projects is a technical advisory committee that meets twice a year with the faculty to review progress and suggest new research challenges and directions.

There are two main membership categories:

- Sponsors, who pay $ 80,000 per year and are involved in all of the research programs
- Affiliates, who invest 0.03% of annual sales with a cap of $ 30,000, are involved in only one of the research programs.

Membership fees are paid into the University of Minnesota Foundation, free of indirect costs, and according to the membership agreement. Sponsors can license all the intellectual property developed in the centre, but affiliates rights are limited to the programs where they are involved.

The obsession with the licensing of patents is often counterproductive; most universities spend more on legal fees associated with patenting and licensing than they take in from the process.

To allow effective technology transfer, sponsors can send an employee as an Industrial Fellow to the centre for three months or longer and receive a $50,000 rebate on their dues membership. These fellows work on a generic research project, negotiated between the centre and the company, and most of the fellows continue to remain involved in the program's activities through an Industrial Fellows alumni association.

Companies offer the university every bit as much as the university offers companies, driving a cultural change that, if successful, leads to the establishment of a true partnership between university and company researchers.

***2.5.4 USA**: Berkley – Novartis agreement*

At the end of 1990s, Berkley was looking for a partner to provide resources for both expensive genetic researchers and research infrastructure, and at the same time crack the hold on proprietary genomic information held by several multinational corporations mainly in USA and Switzerland, which in this sector, is traditionally very conservative.

The College of Natural Resources (CNR), collected a number of proposals from various companies that were considered predatory, only Novartis stood as a potential good partner.

The deal

Based on the contract, the CNR was to receive $25 million over five years for unrestricted, largely faculty–allocated research support. The spending was to be overseen by a steering committee that also had some Novartis representation. About 33% of these funds were reserved for overheads, including renovation of the space, support for graduate programs and overheads for the university.

According to the contract, Novartis allowed Berkley specialists to access its agricultural genomic database on a confidential basis, and provided a $3 million facility to be used as a workstation. Further, 30 Berkley students and faculty members were allowed to access Novartis personnel on an information basis.

The contract gave Novartis the first right of negotiations to acquire a percentage of the intellectual property from discoveries that may result from the research.[21] Novartis would also be able to license commercially viable discoveries at their own expense and its scientists would have informal access to faculty and graduate students.

Governance

A six member advisory committee oversees the relationships between Novartis and the university; generally three from Berkley, and three from Novartis including the CEO of the Novartis Agricultural Discovery Institute (NADI).
Managing the day–to–day affairs is a five–member research committee that allocate funds amongst the faculty. It is responsible for the distribution of over $5 million every year.

2.5.5 EU Framework Programmes

An important example of policy where the government has played a key role in promoting the University-Industry partnership is the Framework Programme established by European Union in 1984.

Research and technology have been estimated by the European Commission to account for 25-30% of economic growth – this puts research and technological development policy on top of its economic agenda.

The Framework Programmes, the EU's chief instrument for funding scientific research and technological development are one of the most important elements in realising the Lisbon agenda for growth and competitiveness in Europe.

This strategy was established in the 1980s and the first framework program (FP1) ran from 1984-1988. The framework programs up until 'Framework

[21] The right of first refusal allowed the university to refuse (at least in theory) if it is not offered at fair market value

Programme 6' covered five-year periods, but from 'Framework Programme 7' on, programs will run for seven years.

The 6th Framework Program for the period 2002-2006 had a budget of 17.5 billions Euro (about €3.5 billion per year). The budget approved by the Commission for the 7th Framework Program (FP7) over the period 2007 to 2013 is about €55 billion (about €7.8 billion per year). The FP7 is organized in six programs corresponding to six basic components of European research:

- **Cooperation** (€32.4 billion);
- **Ideas** (€7.5 billion);
- **People** (€4.7 billion);
- **Capacities** (€4.2 billion);
- **Euratom** (€4 billion);
- **JRC** (€2 billion);

The FP7 allocates about 60% of the total budget to the program "Cooperation" which support cooperation between universities, industry, research centres and public authorities throughout the EU. The Cooperation Programme concentrates its resources on the following 10 high-level themes proposed for EU action:

1. **Health** (€5.5 billion);
2. **Food, agriculture and biotechnology** (€2 billion);
3. **Information and communication technologies** (€9 billion);
4. **Industrial Technology** (nanosciences, nanotechnologies, new materials and new Production Technologies) (€3 billion);
5. **Energy** (€2 billion);
6. **Environment and Climate Change** (€2 billion);
7. **Transport and Aeronautics** (€4 billion);
8. **Socio-economic sciences and the humanities** (€0.6 billion);
9. **Space** (€1.4 billion);
10. **Security** (€1.3 billion);

Across all these themes, support to trans-national cooperation will be implemented through.

- Collaborative research: European Excellence
- Coordination between national research programs
- Joint Technology Initiatives
- Technology Platforms

The Work Program for 2012 with about €7 billion is the European Commission's biggest ever funding package under the FP7. It is expected to create around 174,000 jobs in the short-term and nearly 450,000 jobs and nearly €80 billion in GDP growth over 15 years. Grants will promote research to tackle the biggest societal challenges facing Europe and the world. Universities, research organisations and industry will be among more than 16,000 funding recipients. Special attention will be given to SMEs, including a package close to €1 billion.

There will also be a new EU Prize for Women Innovators whose work has been funded by FP7 or earlier programs. Moreover the other FP7 programs have a connection with private companies.

The next basic component of European research, Ideas, attracts €7.5bn in funding for basic research at the scientific frontiers through the European Research Council (the research area can be anything cutting edge or frontier, except nuclear fission and fusion research)

The People component receives €4.7bn, and supports mobility and career development for researchers both within and outside Europe, including

- Marie Curie Networks – training of early career researchers;
- Outgoing and incoming fellowships, international cooperation schemes, and reintegration grants;
- Life-long training and career development;
- Individual fellowships;
- Industry-academia partnerships;
- Excellence awards;

Next, Capacities, attracting 4.2bn is the component of European research put in place in order to enhance research and innovation capacities throughout Europe and to ensure their optimal use.

Indeed, the FP7 is a key tool to respond to Europe's needs in terms of jobs and competitiveness, and to maintain leadership in the global knowledge economy. This money will (for the most part) be spent on grants to research actors all over Europe and beyond, in order to co-finance research, technological development and demonstration projects. Grants are determined on the basis of calls for proposals and a peer review process, which are highly competitive.

The next planned framework program, FP8, also known as Horizon 2020, will run from 2014 to 2020 and is the financial instrument implementing the new 'Innovation Union', a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. The program will have a budget of €80 billion and is part of the drive to create new growth and jobs in Europe.

Horizon 2020 will combine all research and innovation funding currently provided through the Framework Programs for Research and Technical Development, the innovation related activities of the Competitiveness and Innovation Framework Programme (CIP), and the European Institute of Innovation and Technology (EIT).

The proposed support for research and innovation under Horizon will:

- Strengthen the EU's position in science with a dedicated budget of €24,598 million. This will provide a boost to top-level research in Europe, including an increase in funding of 77% for the very successful European Research Council (ERC).

- Strengthen industrial leadership in innovation €17,938 million. This includes major investment in key technologies, greater access to capital and support for SMEs.
- Provide €31,748 million to help address major concerns shared by all Europeans such as climate change, developing sustainable transport and mobility, making renewable energy more affordable, ensuring food safety and security, or coping with the challenge of an ageing population.

Horizon 2020 will also attempt to tackle societal challenges by helping to bridge the gap between research and the market. For example, the program will aim to assist innovative enterprise to develop their technological breakthroughs into viable products, which have real commercial potential. This market-driven approach will include creating partnerships with the private sector and European Member States to bring together the resources needed.

International cooperation will be an important cross-cutting priority of Horizon 2020, and the program will be fully open to international participation, whilst targeted action is also be undertaken by key partner countries and regions focusing on the EU's strategic priorities. Through a new strategy, a strategic and coherent approach to international cooperation will be ensured across Horizon 2020.

Horizon 2020 will be complemented by further measures to complete and further develop the European Research Area by 2014. These measures will aim at breaking down barriers to create a genuine single market for knowledge, research and innovation.

2.6 Siemens Partnership with Universities

As analysed so far, many companies consider a partnership with a university as a chance to develop new knowledge within a limited framework. That is, multinationals refer research to universities, just for limited projects, or for a limited period of time, without developing a structured strategy of long-term partnership to overcome in-house research. Universities are the main interest holder in this relationship, due to the possibility of having several economic and scientific benefits, as previously discussed.

In contrast to this tendency, Siemens[22], the German engineering giant, has made the University-Industry partnership one of its best strategic assets. It has included it in a wider global innovation strategy aimed developing a deeper local presence in developing countries, as well as a competitive advantage in terms of human capital and scientific resources. In the process, Siemens has integrated scientific knowledge from a world wide network of partnerships with some of the most prestigious universities in the world, such as MIT and Berkley.

To reduce R&D costs and ensure flexibly in the R&D approach, Siemens has developed an outstanding partnership network, becoming a global benchmark in technology transfer from academia. It has taken also the opportunity to become the first employer of new talent and focused on the development of science and education policies.

Partnerships with leading international universities and research institutes are indispensable for Siemens' R&D activities. By 2008, the company had entered more than 1000 partnerships with universities, research institutions and industrial partners. About half of these partnerships involve corporate technology and these collaborations are indispensable for developing new strategically important technologies.

By sharing ideas with scientists from outside the company, Siemens researchers keep abreast of the latest findings of fundamental and applied research all over the world. Moreover, these partnerships provide new talents for the Siemens recruiting program, representing a big push for the company's human capital.

To better control research outputs and ensure the respect of Siemens innovation guidelines, Centres of Knowledge Interchange (CKIs) have been established at selected universities. Each centre is managed by a Siemens specialist, who has his or her own office on campus. These specialists coordinate cooperative projects, organize workshops and company sponsored competitions, help to promote scholarships, and arrange for dissertation research to be carried out at Siemens locations. The work carried out at all CKIs both in Germany and abroad, focus on the technological fields and markets that Siemens deems important for the future.

The **Chief Technology Office** is in charge of University and Research Cooperation (CT or UNI). Its main duty is to promote Siemens as a global

[22] For a detailed company businesses and strategic description, see Appendix 2

benchmark in technology transfer from academia, exploiting CT or University as a corporate “service provider”, in order to reach high quality and high speed access to academia involving all Siemens units (Divisions, Business Units, CT, CHR, CD, CC) in an articulated and potentially limitless cooperation.

Its main propositions are to identify the best suited cooperation partners, initiate strategic focus topics and flagship projects at partner universities, talent spotting, whilst at the same time recruiting and managing the different framework contracts with universities.

The sustained relationship from research university collaborations enables further benefits:

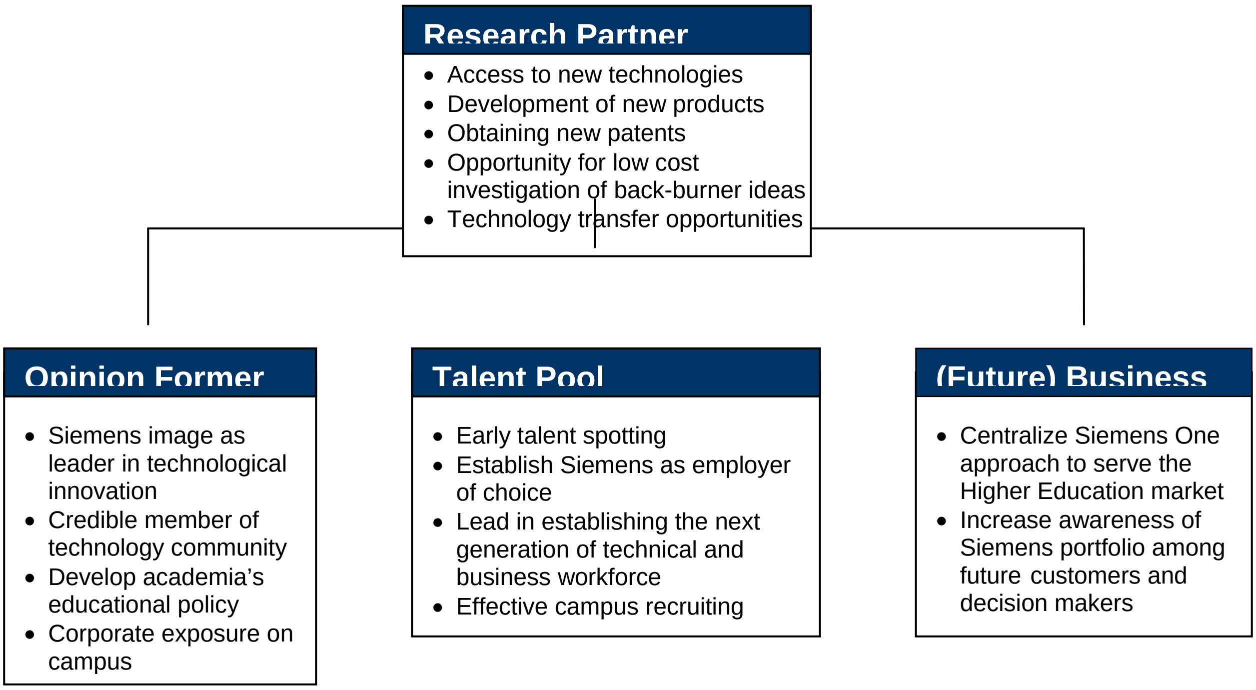

Figure 15: Source - Siemens’ Networks of Strategic Partners

Siemens pursues a three tier relationship model with universities searching for leading edge technology and exceptional talent. This relationship has a different grade of integration, and at the highest level Siemens research centres are almost merged with universities.

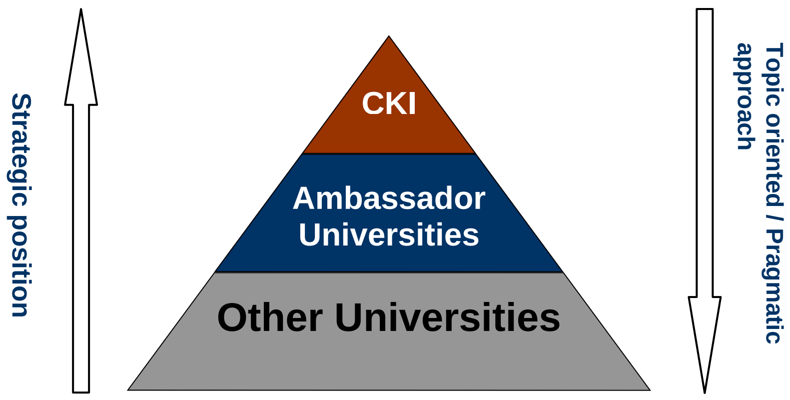

Figure 16: Source - Siemens' Networks of Strategic Partners

CKI (Centre of Knowledge Interchange)

The *"CKI program aims to create highly integrated research programs on a long term basis".*

Centre of Knowledge Interchange represents the top tier in Siemens partnership program with Universities. It only involves leadership institutions engaged in at least two research fields and related technologies, relevant for Siemens.

Excellence in infrastructures, teaching programs, and professors are the necessary characteristics of the project. All the universities involved are top ranking institutions (such as MIT and Berkley University) with a long and strong research reputation, and are settled in proximity to strategic markets for Siemens from both a local and international point of view.

Access to regional and national funding programs represent a positive incentive to involve the government directly in the development of a project on a long-term basis.

Scope:
The main scope at the highest level is to realize a long-term commitment, based on a CKI framework contract. This relationship is focused on a specific research area or technology field and usually does not have any limits in terms of possible further developments. Prioritisation of projects is the main duty of a Steering Committee which makes its decision based on different research proposals.

Governance:
Relationship management is articulated on different levels of integrations. A "Joint Partnership Steering Committee" is set up to oversee the collaboration in general and to select the different projects to invest in. A Senior Siemens Executive is appointed as the "Liaison Champion", that is, to overlook the entire project.

Research progress is guided and monitored by the CKI's "Implementation Team" which is strictly correlated with a dedicated university administration office, and a regional CT division to overall the program.

Collaboration:
Relationship management within the different players takes the form of annual workshops with the faculty and Siemens researchers, visiting researchers from Siemens, regular updates with CT or UNI, annual reportd and regular meetings with the CKI manager and CT or UNI KAM (Key Account Manager).

Funding:
Project funding is mainly provided by the CKI office but some resources could be arranged even by Company's divisions or BU levels.

Ambassador Universities

"The Ambassador program, strengthens Siemens innovation network by building strategic partnerships with leading universities worldwide"

Second tier partnerships involve top technologically-focused universities with a proactive interest in at least a strategic Sector / Division / Region for Siemens**.** The company's executives develop a strategic partnership with Ambassador Universities based on long-term collaboration, particularly valuable for innovation research and talent programs. Personal executive engagement drives university research cooperation and recruitment activities.

Scope
The aim of this relationship is to build a long-term collaboration with important academic institutions regarding several research areas, technology fields, project spaces. Cooperation focus can be freely defined and at least one sector must indicate interest in driving the relationship

Selection
There are two different approaches to select partner universities:

- **"Bottom up"**: the Company's Sector or Country division pro-actively encourage partnership with a best-in-class research university.
- **"Top down"**: Corporate strategy or HR, requires incorporating specific universities into Siemens' innovation and recruitment network.

Siemens' CT division or the university itself coordinates the overall Ambassador Program and nominates new Ambassadors in collaboration with CHR.

Collaboration
Cooperation management is pragmatically organised and it's less structured than CKI's one. A Siemens' executive is nominated as a University Ambassador and he's in charged of:

- **Initiating and strengthening interaction** between Siemens and university partner in the field of research and development, recruiting new researchers and define science and industrial policies.
- **Stimulating new collaborative projects and initiatives** in different Siemens Sectors and Divisions, to move the entire program towards further development and increase the company's overall network.
- **Promote alliance benefits**
- **Mobilizing own resources** to benefit from new opportunities.

Ambassador Program executive relationship and research cooperation scheme:

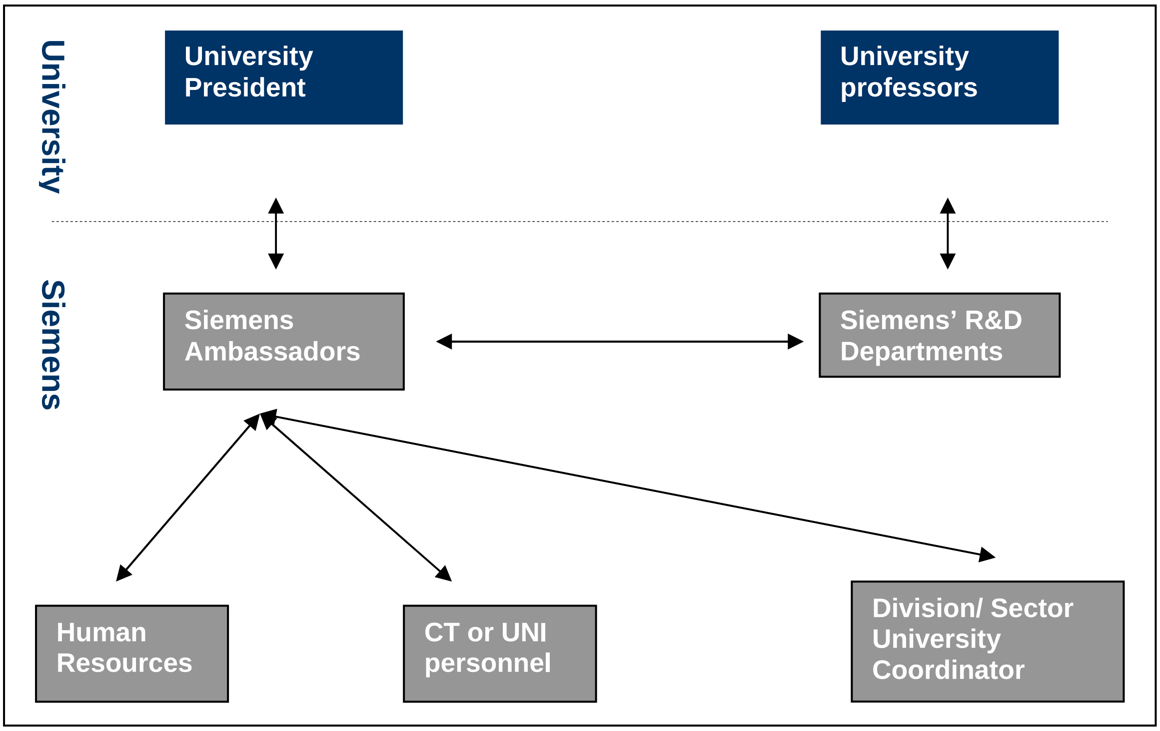

Figure 17: University - Siemens partnership organisation

Other Universities relationships

Less complex partnerships are established with several academic institutions world-wide (in 2009 these were more than 700). These connections are generally based on a single BU / CT department scope and are related to specific R&D projects. The management chain is very simple and is totally managed by the BU/CT Department in charge of the different projects.

2.6.1 Empirical results about Uni – Industry Partnership in Siemens

When questioning whether or not it is worth spending energy and resources in establish a long–term University-Industry partnership, several studies have analysed the main characteristics of different projects in order to identify some common conclusions regarding the quality and the worth of such collaborations.

In this framework, one of the empirical studies[23] conducted in recent years by independent researchers analysed the results obtained by 31 Siemens innovation projects with several different counterparts: universities, customers, component suppliers, competitors and start-ups. The study focussed on partnership characteristics, results, and highlighted several critical aspects which have led the different collaborations to success or failure.

The survey highlights two different phases "**Partner selection**" and "**Partnership management**" which constitute parts within the entire process, as determinant for the overall success.

In 'Partner Selection', they observed that a necessary condition to guarantee the partnership's success is the matching between the client firms' motivations and the provider's strengths. Matching refers to the correspondence between the provider's track record and the outsourcer's needs. 'Partnership Management' is instead critical for two main factors, the type of "Knowledge vendor" and maturity of technology. Researchers have classified the outsourcer's needs (Siemens) based on six motivations: costs, market, technology, manufacturing, strategic, and organizational.

These phases prove how the success drivers are contingent on the type of provider, as well as the maturity of technology. Some issues are relevant to all providers and others are provider specific. For example the transfer of project-specific knowledge will be critical in collaboration with a university, while the protection of intellectual property (IP) will have greater importance in collaborations with start-up companies and competitors.

Phase 1: Partner selection

The question of "How" to select a technology provider must be resolved by management. The main drivers are: collaboration history, geographical proximity and technology capabilities.

An embryonic technology is generally characterized by a non-defined problem structure, unpredictable results and unknown costs. Typical reasons to outsource at this stage are: need to understand market demands, explore better solutions, build expertise and identify potentially disruptive technologies.

[23] "How Provider Selection and Management Contribute to Successful Innovation Outsourcing: An Empirical Study at Siemens" – The Business School of World (2010).

Mature technology instead presents different challenges, and forces companies to focus more on their market strategies. With pressure to sustain profit increase, firms begin to concentrate on their core technologies, and government regulation and technical standards become important competitive weapons.

Phase 2: Partnership management

Innovation from outsourcing projects is vulnerable to opportunism on both sides, because of uncertainty and monitoring limits. The preferred governance structure will depend on the level of technology uncertainty and on the outsourcer's interests.

Depending on the partners different strengths and weaknesses, risks will be present that will need to be managed to ensure the success of the collaboration.

	Strength	Risk
Universities	Generic knowledge ;novel ideas; low costs	Possible huge distance to market; different incentives
Customers	Market requirement knowledge; potential new product concept	Not for new product categories; may not be appropriate
Component Suppliers	Knowledge of outsourcer's product and systems; component expertise; efficiency	Usually not novel ideas; might cause dependence
Competitors	Current market knowledge and technology	Potential technology leakage
Start-ups	Source of creativity; high upside potential; source for acquiring disruptive innovations	Block firm's own IP; high market risk; potential competitor; different culture

Figure 18: Innovation provider Strengths and Risks by type

The 31 projects analysed represented about 30% of the important technology outsourcing initiatives in the nine Siemens business units involved (and perhaps 3% of collaborations across all 100 Siemens business units).

Motivation for outsourcing changes with technology maturity for three primary reasons:

- ***First***, the importance of gaining technical expertise and understanding the dominant needs weakens as the technology matures.
- ***Second***, the manufacturing motivation becomes dominant in mature projects.
- ***Third***, the strategic motivation is more prominent at this stage: supplier tended to complement the firm's core technology.

When analysing the different projects within Siemens' partnerships framework, they stated that none of the non-matching programs were ultimately successful, whereas 20 of 27 match projects (74%) were.

Partner Type	Projects	Cost	Market	Manufacturing	Strategic	Technology	Organizational
University	U1					+	
	U2					+	
	U3					+	+
	U4		+			+	
	U5	+				+	
	U6					+	+
	U7					+	
Customer	C1	+	+			+	
	C2		+				
	C3		+			+	
	C4		+			+	
	C5		+				
	C6		+			+	
	C7		+			+	
Competitor	CM1					+	
	CM2		+			+	
	CM3	+	+		+	+	
	CM4	+	+			+	
Start-up	ST1					+	+
	ST2			+		+	
	ST3					+	
	ST4		+		+		+
Component Supplier (embryonic)	S1	+	+			+	
	S2			+		+	
	S3		+			+	
	S4					+	
Component Supplier (Mature)	S5				+	+	
	S6			+			
	S7			+	+	+	
	S8			+	+		
	S9			+		+	

Figure 19: The table above highlights what has been the biggest threat in each project for each type of provider considered. Every project is called with a code referring the type of partner (Ex.: university = U) and the number associated to the project, 1, 2, 3, etc. More details concerning the nature of each program cannot be reported, due to disclosure reasons and furthermore because the aim of this survey is to analyse the common characteristics, not details.

Conversely, unsuccessful projects was characterised as a non–match, while four (36%) of the 11 less successful projects were. The statistical correlation between “non-matching” and “less successful” is 0.52 with a good statistical relevancy (0.01 probability to rejects the null hypothesis that a non-match is equally likely among successful projects).

	Strength cover only a subset of motivation dimensions	Some motivation dimensions not covered by strengths	Set of motivation dimensions equals set of strength dimensions	Strengths cover a superset of motivation dimensions
Successful (20)	0	0	2 (10%)	18 (90%)
Less successful (11)	1 (9%)	3 (27%)	0	7 (64%)

Figure 20: % of successful / less successful project related to Strength and Common Motivation matching

Universal Success Drivers	Providers	Provider-contingent Success Drivers
• Trust and communication • Organizational stability • Defined goals	**Universities**	• Detailed process control • Incentive alignment • knowledge transfer (from client to university)
	Customers	• Expectations management • Incentive alignment
	Component Suppliers	• Detailed progress control • Knowledge transfer • IP protection • Incentive alignment
	Competitors	• IP protection • Incentive alignment • Flexible decision making
	Start ups	• Participation in partner's management

Figure 21: Common and Provider-Specific Success Drivers for Embryonic Technologies

	Drivers	In-House competency	Incentive Alignment	Organizational Stability	Defined Goals	Expectation Management	Trust and Communication	Flexible Decision Making	Knowledge Transfer	IP Protection	Detailed Process Control
Success	**U1**	+	+	+	+	-	+	-	+	-	+
	U2	+	+	+	+	-	+	-	-	+	+
	U3	-	+	+	+	-	+	-	+	-	+
	U4	+	+	+	+	-	+	+	+	+	+
Less Success	**U5**	+	-	+	-	-	-	-	-	+	+
	U6	-	-	+	-	-	-	-	-	-	-
	U7	+	-	+	-	-	-	-	-	+	-

Figure 22: The table shows how each partnership is characterized by specific drivers which can be determinant in ensuring the collaboration's success.

2.6.2 Common Success Drivers for Outsourcing Embryonic Technologies

The survey results proved how some fundamental factors must be "*ex ante*" conditions to ensure a good and successful partnership in technological development, no matter what kind of counterpart a company is dealing with.

Trust and Communication: as stated by one of Siemens managers interviewed, "*Do not collaborate with organisations that you do not know very well and where there is no mutual interest of continuing the collaboration for a long time*".

Organizational Stability: a change of top management or project management on either side can seriously disrupt both the financial commitment and the expectations of the collaboration. Stabilizing the partner organization requires reducing the dependence on individual employees; generally this aspect is less critical in universities' relationships but still, for example, star professors could leave, interrupting or reducing the program's overall potentialities.

Defined Goals: many interviewees highlighted the importance of setting key delivery time and overall costs targets. Each target should be specific and operational, for example; it might be stated as "decrease energy consumption by 30%".

Incentive Alignment: Incentive misalignment is a common threat to collaboration. The only provider type where it did not emerge as a success differentiator was the component supplier category, because all the suppliers had previously collaborated with Siemens and learnt to work with its Units.

To evaluate the strength of the potential university partner, Siemens self asses on five considerations:

- The partner owned a ready to use system to simulate functionalities developed by Siemens in-house (In-House competencies).
- The partner actively participated and contributed to research in the current technological evolution.
- The partner offered well-trained students with the potential to become job candidates in the future or to enter an exclusive agreement with Siemens during their studies.
- The Siemens projects manager had gradated from this university and personally knew the researchers.
- The partner was geographically close to the Siemens lab, facilitating communication and progress monitoring.

From a technical point of view, five issues stand as a fundamental basis to guarantee a good result:

Detailed process control: process control involves well-defined progress and cost milestones; it is necessary in the presence of misaligned incentives for Siemens' quality standards.

IP Protection: in these projects, the parties jointly sign an IP exchange contract which allows each partner to use the IP and share the benefit from selling the technology.

Knowledge Transfer: the expertise of universities and R&D institutes is usually quite general. To fulfil specific requirements, a university partner needs to acquire "local knowledge" so it can understand what has already been done and what still need to be accomplished, otherwise unnecessary replication will occur.

Technology Compatibility: when two companies start to cooperate, especially in the Supplier case, it's necessary to assess compatibility between different companies' products even if one is a market leader in a specific sector. It could in fact happen, that different parts from different companies, even employing the same technology, present a totally different lay out or functioning, slowing down the development of new technology in order to fix organisational issues.

Flexible Partner: in terms of management culture and organization

3. South Australia experience[24]

3.1 Australian Innovation Policy

General Overview

Australia, officially the Commonwealth of Australia, is located in the Southern Hemisphere and is the sixth largest country in the world, with a surface of about 7,741,220 square km in 2012. Despite its size, it has an estimated 2013 population of only 22,931,335 million inhabitants of which almost 27% were born abroad.[25]

The form of government is a constitutional monarchy with Elizabeth II as Queen, but it works as a federal parliamentary democracy. The federation comprises six states (New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia) and two territories, the Northern Territory and the Australian Capital Territory (ACT) where the capital, Canberra, is located.

A highly developed country, Australia is the world's 12th largest economy by nominal GDP (1.487 trillion $) and has the world's 5th highest per capita annual income ($ 66,371). Moreover, it has the second-highest human development index globally (0.938/1), together with very high ranks in many international comparisons of national performance such as quality of life, health, education, economic freedom, and the protection of civil liberties and political rights.

From an economic point of view, its growth has been less impacted by the global financial crisis, possibly because its proximity to Asian emerging countries that are still experiencing high growth rates. According to the OECD Economic survey "Australia weathered the world recession well [...] thanks to sound fiscal position and positive outlook".

[24] The material presented is mainly drawn by the "Innovation Policy – A comparison between South Australia (Australia), Baden – Wuttemberg (Germany) and Tampere (Finland) regions" (October 2012).

[25] ABS (Australian Bureau of Statistics) 2012, *Year Book Australia,* Cat. no. 1301.0, Australian Bureau of Statistics, Canberra, 2012.

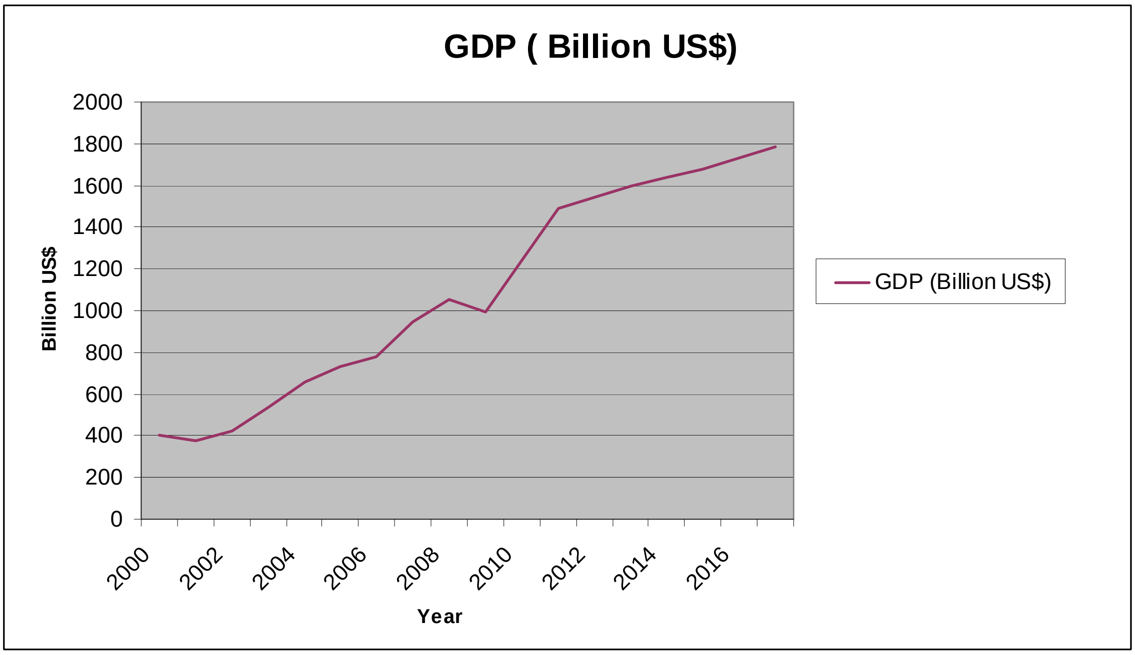

Figure 23: Australia's GDP forecast and future estimation from 2000 to 2017[26]

Future challenges for Australia will be ensuring a balanced expansion in the face of the mining boom and the potentially volatile terms of trade movements. These priorities have already been perceived and assimilated by the Australian Government, for example, the Government of South Australia inserts "*realising the benefits of the mining boom for all South Australians*" among its top seven priorities.

A relevant issue to face in order to maintain economic competitiveness is to promote innovation. The vision for Australia in the 21st century reflects what Lord Sainsbury, former Britain's Science Minister, stated: "*Business's ability to innovate is vital to its global competitiveness. It is only by continually developing new products, processes and services that business can gain the competitive edge necessary for the increasingly global economy. R&D is a key component of this, helping to generate the advances that lead to new value-added products and enabling people and capital to become more effective*".[27]

For this purpose, many federal programs have been launched to support innovation. Among the most recent are the two "Backing Australia's Ability" plans, in 2001 and 2004, and "Powering Ideas", an innovation agenda for the 21st century (2009) that is discussed in more detail in the following sections.

According to the Australian Bureau of Statistics, the GERD/GDP[28] ratio in the financial year 2008-2009 was 2.21% in Australia, emerging from a continuous increasing trend. It is important to outline that the share of GERD financed by industrial partnerships increased from 54.3% to 58.3% from 2004 to 2006, reflecting a more proactive role of the private sector towards innovation, as a

[26] For data forecast see Appendix 3
[27] Prime Minister's Science, Engineering and Innovation Council, 30 November 2000
[28] GERD: Gross Expenditure on R&D

response to the decrease of public funds (from 40.3% to 37.3% in the same period).
[29]

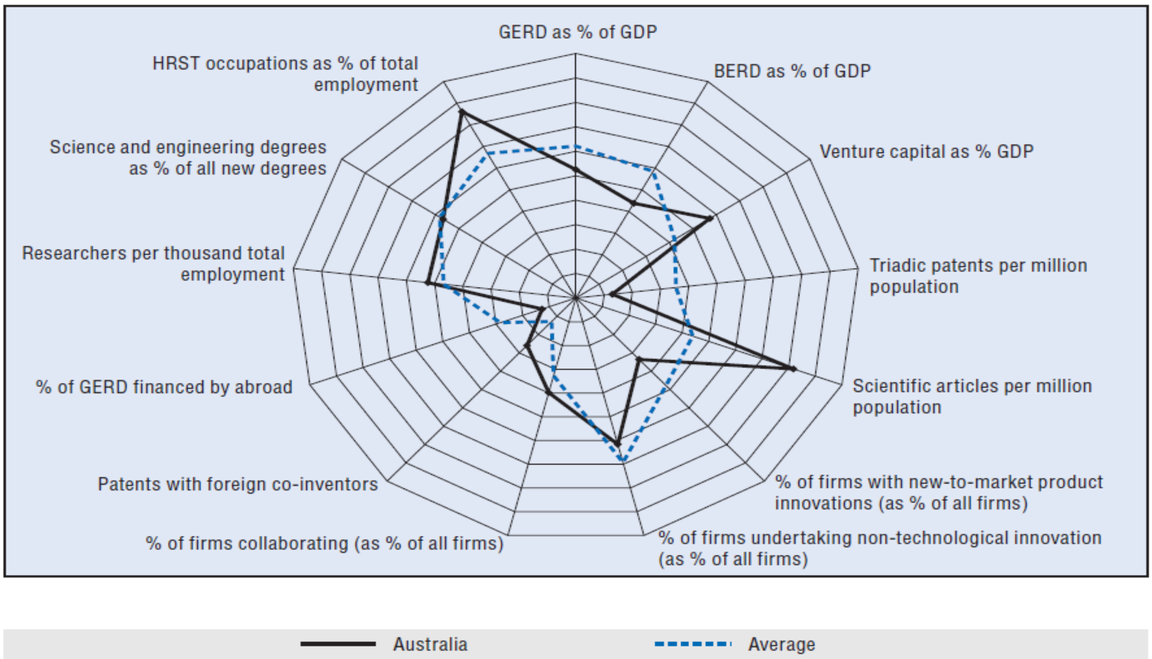

Figure 24: Research expenditure by Australian Government

Overall, all the human capital indicators are good and the unemployment rate has been comparatively low at 5.6% during the crisis. Remarkably, the Human Resources in Science and Technology (HRST) are distributed equally between men and women and this is important in terms of gender equality and parity of opportunities. At the same time, the unemployment rate stayed stable, with a low increase in 2009-2010 because of the crisis' impact on local economy.

[29] Source: Science and Innovation (Country Notes, OECD 2010)

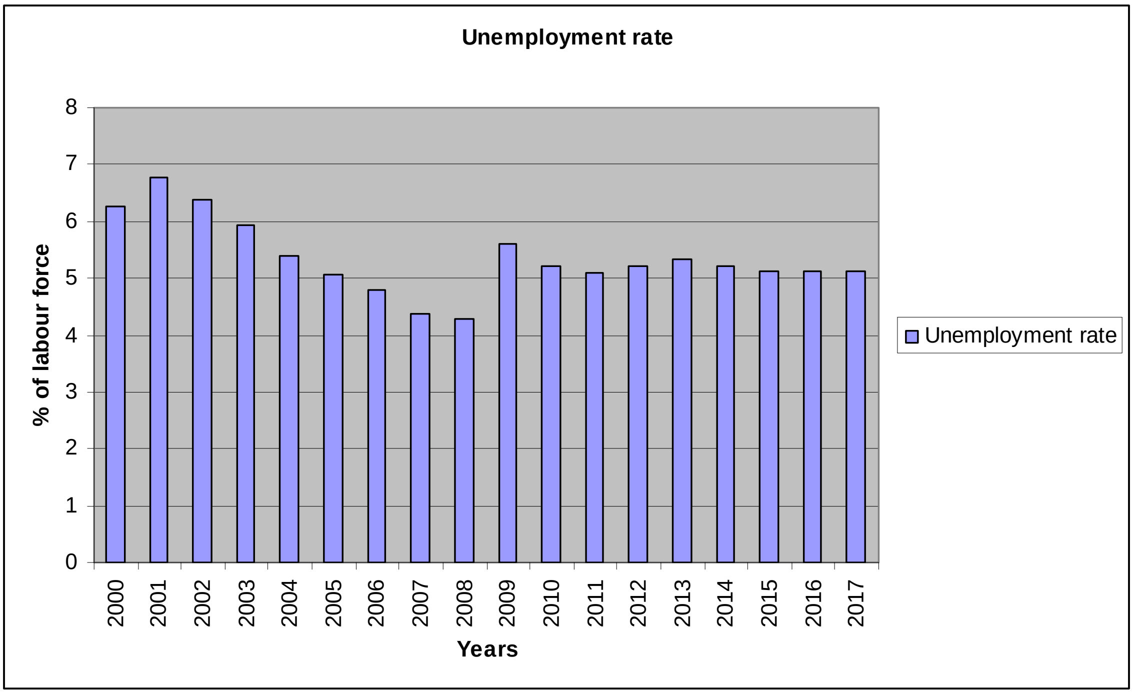

Figure 25: Unemployment rate in Australia from 2000 to 2017[30]

The OECD Science, Technology and Industry report suggests that the ***"key policy issues include developing an integrated approach to science and innovation and improving links with global research and innovation systems"***. This suggestion has been incorporated by the Department of Innovation, Industry, Science and Research through the publication of Powering Ideas (2009) where the main guidelines of Australian future innovation policy are drawn.

Policy aims

The Australian Government is very active in promoting innovation policies to address the relative weakness in business innovation and in collaboration between researchers and industry. To do so a first set of four National Research Priorities to foster public-sector research were established. These priorities are:

- An environmentally sustainable Australia;
- Promoting and maintaining good health;
- Frontier technologies for building and transforming Australian industries;
- Safeguarding Australia.
- Understand Cultures and Communities

[30] For data forecast see Appendix 4

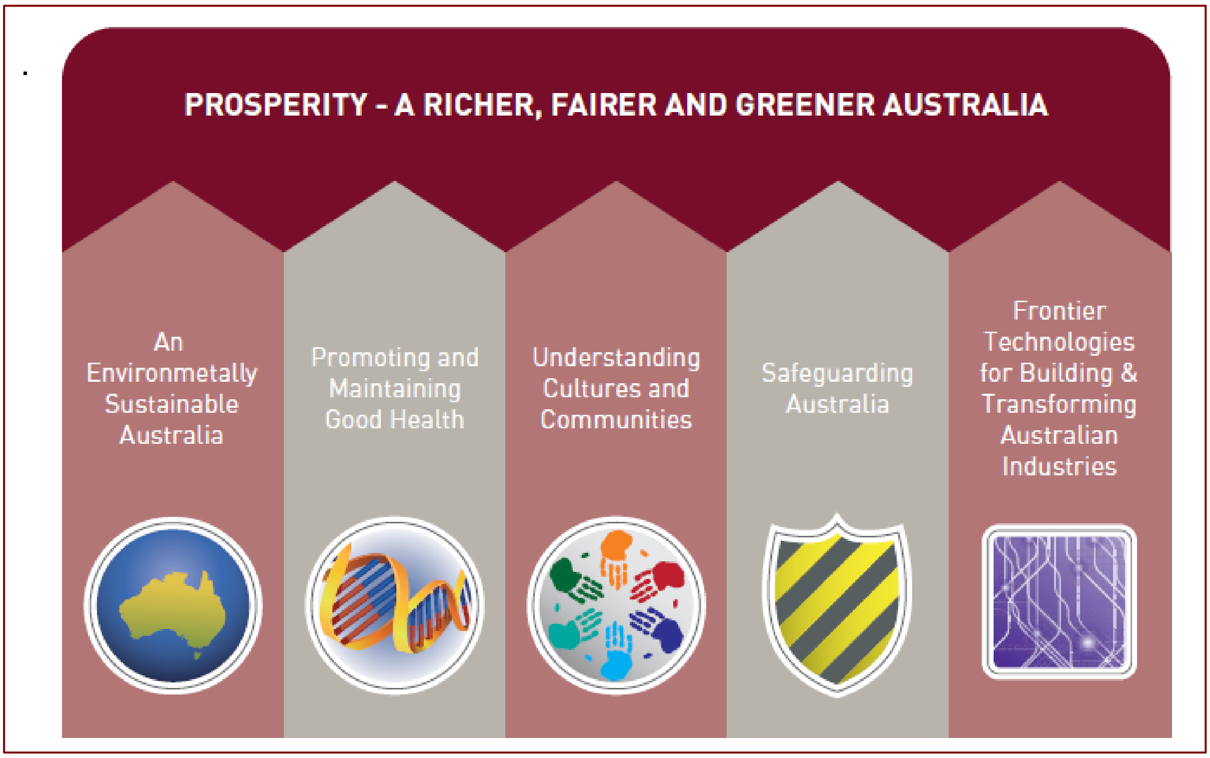

Figure 26: Australian research priorities [31]

To complement these research priorities, the Australian Government has adopted seven **National Innovation Priorities** focusing on the production, diffusion and application of new knowledge.

All these seven priorities, having equal importance, are specified and analysed in detail in ***Powering Ideas***, published in 2009 by the Department of Industry, Innovation Science, Research, and Tertiary Education (see Appendix 5). ***Powering Ideas*** projects are supported by concrete policy ambitions, which can be used to measure the country's performance over time. The aforementioned priorities are indeed the basis of the Australian strategic plan and are widely quoted by subsequent works in which it is recognized as a key element in identifying Australian federal innovation policy.

Amongst the initiatives undertaken, it also included the creation of the National Research Infrastructure Council (NRIC) to provide strategic advice on future research infrastructure investment. This council then established the "Strategic Framework for Research Infrastructure Investment" to guide the development of policy advice and the design of programs funding research infrastructure.[32]

[31] Source: 2011 Strategic Roadmap for Australian research infrastructure
[32] Research infrastructure is defined by the NRIC as: "Research infrastructure comprises the assets, the facilities and services which support research across the innovation system and which maintain the capacity of researchers to undertake excellent research and deliver innovation outcomes".

The Department of Innovation Industry, Science and Research used these principles as a base for its "*2011 Strategic Roadmap for Australian Research Infrastructure*" that follows the three broad categories of infrastructure, identified to define its range of action as follows:

Local: research infrastructure which could be expected to be owned and operated within a single institution.

National: research infrastructure on a scale generally not appropriate to be owned or operated by a single institution, which often supports collaborative research and is generally regarded as part of the national research capability.

Landmark: large scale facilities that serve large and diverse user communities, are generally regarded as part of the global research capability, and engage national and international collaborators in investment and access protocols.

The 2011 Roadmap covers capability areas that are of a national scale and generally require investment in the order of $20 million to $100 million over five years for each capability area.
It outlines research infrastructure capability areas required to support excellent research across priorities areas, to contribute to the economic development, social wellbeing, environmental sustainability and ultimately Australia's prosperity.

Policy Implementation

The Australian Research Council (ARC) has grouped the country's main priorities into a few key and enabling objectives which clearly state in which direction public policies will move:[33]

Key Objective	
RESEARCH	Funding research, and research training, through national competition across all disciplines with rigorous peer review processes.
CAPACITY	Critical research infrastructure and research in areas of national need are the means planned to build Australia's research capacity and support researchers' careers.
POLICY AND EVALUATION	Participation in policy forums, Government reviews, informed consultations, evaluation and ongoing monitoring of performance are the elements through which informed high quality policy advice to the Government can be provided.
Enabling Objective	
ORGANIZATION	Improve organizational performance to ensure Government support
COMMUNICATION	Key advocate for the benefits of Australia's research efforts to maintain productive relationships with stakeholders

[33] For a detailed explanation see Appendix 6

All these objectives are considered in the larger framework of a harmonized innovation policy with international and sub-national collaboration as cross-cutting themes that underpin the ARC's activities in all these areas.
Furthermore, the Australian Federal Government focuses on two main aspects to implement its innovation policy: incentivising R&D from Small to Medium sized Enterprises (SMEs) and promoting collaboration between industry and universities.

- SME's are indeed the dominant form of business in Australia, representing almost 99.7% of all businesses. According to OECD data, this figure is among the highest in the OECD countries and therefore it is vital that Australia has highly innovative small firms and an economic system facilitating productivity improvements.
- The Australian Strategic Plan, ***Powering Ideas***, emphasises the importance of collaboration between firms and between industry and research institutions as a key mechanism to enable firms to access knowledge and to transform it into economic value.

3.1.1 Government Programs to support R&D

R&D Tax Incentives

The R&D Tax Incentive is the Australian Government's flagship program to encourage investments in R&D, and it replaces the long-standing R&D tax concession, starting on 1st of July 2011.
The current program offers a more generous support for SMEs and new incentives for companies to participate in the program[34] . Its two core components are:

- 45% refundable tax credit for firms with a turnover of less than $20 million
- 40% non-refundable tax credit for firms with an annual turnover higher than $20 million

These measures are aimed at creating an innovation culture in SMEs and in supporting them in the start-up phase where they might have negative income and not be paying taxes.

Commercialisation Australia

Commercialisation Australia is an initiative of the Australian Federal Government. It is a competitive, merit-based assistance program offering funding and resources to accelerate the business building process for Australian companies, entrepreneurs, researchers and inventors looking to commercialise innovative intellectual property.[35]
Its aim is to support the transfer from invention to commercialised products; and it has a funding of $278 million over the five years to 2014, with ongoing funding of $82 million a year thereafter. It offers a range of funding options as well as multilayered networking opportunities.

[34] For more details on this program refer to the Australian Taxation Office (ATO) website at http://www.ato.gov.au/businesses/pathway.aspx?sid=42&pc=001/003/121&alias=randdtaxincentive (last access August 2012).
[35] Further information can be retrieved from its website www.commercialisationaustralia.gov.au

The funding offered is flexible to adapt to various stages of commercialisation:

- ***Skills and Knowledge***: up to $50,000 to access specialist advice and services required to commercialise intellectual property. This program lasts a maximum of 12 months and the participant contributes to at least 20% of the costs.
- ***Experienced Executives***: up to $350,000 to assist with the recruitment of senior executives. The participant has to contribute to at least 50% of the total costs and the program has a maximum length of two years.
- ***Proof of Concept***: between $50,000 and $250,000 to test the commercial viability of a new product, process or service. This program can last up to a one year maximum and has to be financed on a 50:50 matching base.
- ***Early Stage Commercialisation***: between $50,000 and $2 million to take a new product, service or process to market. This program lasts a maximum of 24 months and the participant contributes to half of the costs.

Enterprise Connect

Enterprise Connect (www.enterpriseconnect.gov.au) is another initiative of the Australian Government which runs a network of 12 centres across the country to connect business to the knowledge, tools and expertise necessary to improve productivity, increase competitiveness and fully capitalise on the growth potential of individual businesses.

The main targets are SMEs working in industries as manufacturing, clean technology, resources, defence, tourism and the creative sector. Among the other initiatives, the 'Researchers in Business' program is particularly notable as it places researchers from universities of public research centres into businesses so to create commercial potential, and this a powerful channel of technology transfer.[36]

CSIRO Australian Growth Partnerships (AGP) Program

The Australian Growth Partnerships (AGP) program is a competitive, merit-based pilot funding program managed by the Commonwealth Scientific and Industrial Research Organization (CSIRO).

This program is designed to assist SMEs overcome existing technical issues, providing them with an opportunity to significantly accelerate their growth in innovative industries aligned with the capabilities of CSIRO's National Research Flagships Program. The CSIRO National Research Flagships program is one of the largest scientific research endeavours ever undertaken in Australia, with the total investment to 2010-2011 expected to be about $1.5 billion.[37]

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[36] South Australia has 16 such 'researchers in Business' sponsored and associated by the three local universities and the South Australian Research and Development Institute (SARDI).

[37] More information on the CSIRO Australian Growth Partnership Program, on the CSIRO in general and on all its other programs can be found at http://www.csiro.au/en/Portals/Partner/Collaborate/AGP.aspx

Flagships Collaboration Fund (FCF)

The FCF supports the CSIRO National Research Flagships and provides a unique way to formally engage with CSIRO in one or more of the National Research Flagships (Climate Adaptation, Energy Transformed, Food Futures, Future Manufacturing, Light Metals, Minerals Down Under, Preventative Health, Water for a Healthy Country, and Wealth from Oceans).

Review of the Student Visa Program

The international education sector is substantial for developing an international network in advanced research. After reaching a peak in 2009 the enrolment of foreign students is declining.

For this reason, the Minister for Immigration and Citizenship announced a number of key changes to the student visa program including new streamlined visa processing (SVP) arrangements for international students enrolled in Bachelor, Masters or Doctoral degree courses at participating universities, resulting in a less onerous process for these applicants.

3.2 South Australia's Innovation Policy

General overview

South Australia is a state situated in the southern central part of Australia. It has a total and area of 1,043,514 square km and at December 2011, the Department of Foreign Affairs and Trade estimated a population of 1,645,600. The majority of its people reside in the state capital, Adelaide, located in the fertile area along the south-eastern coast.

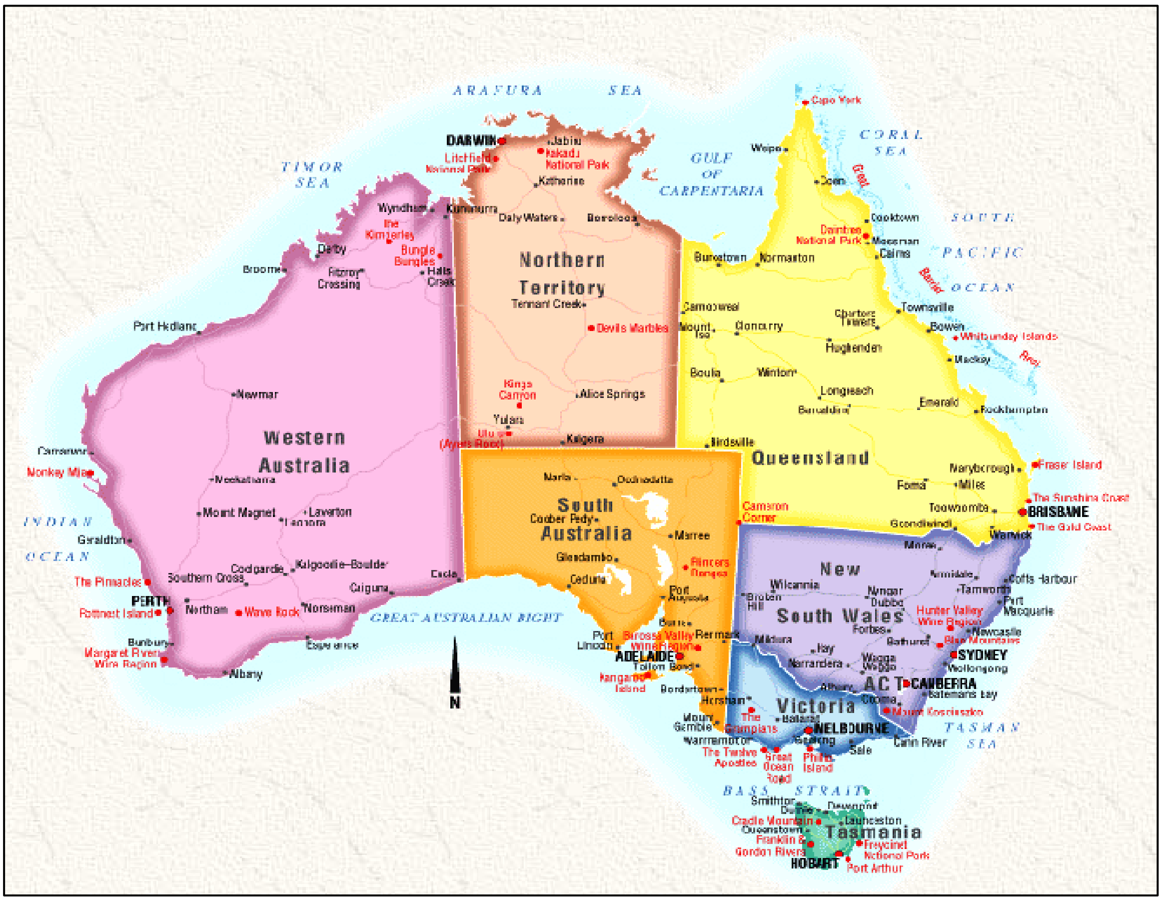

Figure 27: Australia's geographic extension

South Australia has emerged in good shape from the global financial crisis and it is evolving from its traditional manufacturing and agricultural base towards new, advanced industries and knowledge-intensive services.

To successfully complete this transition process, policy innovation needs to support technology transfer and investment in R&D mainly in SMEs that are the core of South Australian economic development.

The Gross State Product (GSP) of South Australia was AUD$90,172 billion in 2011, increasing by 2.4% from the previous year despite the crisis, thanks to the good performance of China, both the major importer and exporter for South Australia.

Traditionally, South Australia has based its economy on raw materials (both mining and food) but is now gradually changing towards a greater role in advanced manufacturing and services. According to the Australian Bureau of Statistics (ABS), the South Australian industries that contributed the greatest to the state's gross product in 2010-2011 in volume terms were: manufacturing (10.4%), financial and insurance services (8.7%), ownership of dwelling (8.3%), construction (6.9%), and health care and social assistance (6.7%). From these figures it seems that the transition towards advanced manufacturing is starting to provide some results given that manufacturing contribution to GSP is currently the most relevant among the disaggregate sectors.

Moreover, R&D expenditure increased everywhere in Australia, and in South Australia in particular. According to the Australian Bureau of Statistics, in 2008-09, research and development expenditure (GERD) in South Australia was $1.9 billion, or 2.38% of GSP, above the federal average. Business investment accounts for nearly 50 per cent of total research and development (R&D) in the State, while State Government expenditure accounts for 7% of GERD in the State.

The second highest contributor to GERD is higher education, mainly composed of universities. Adelaide has three high profile universities: the University of South Australia, University of Adelaide, and Flinders University, with their associated research institutes spread across various campuses.

Internationalization is a key concept in South Australian higher education: not only local universities are internationally recognized but also Carnegie Mellon University (USA) and University College London (UK) opened their offshore campuses in Adelaide.

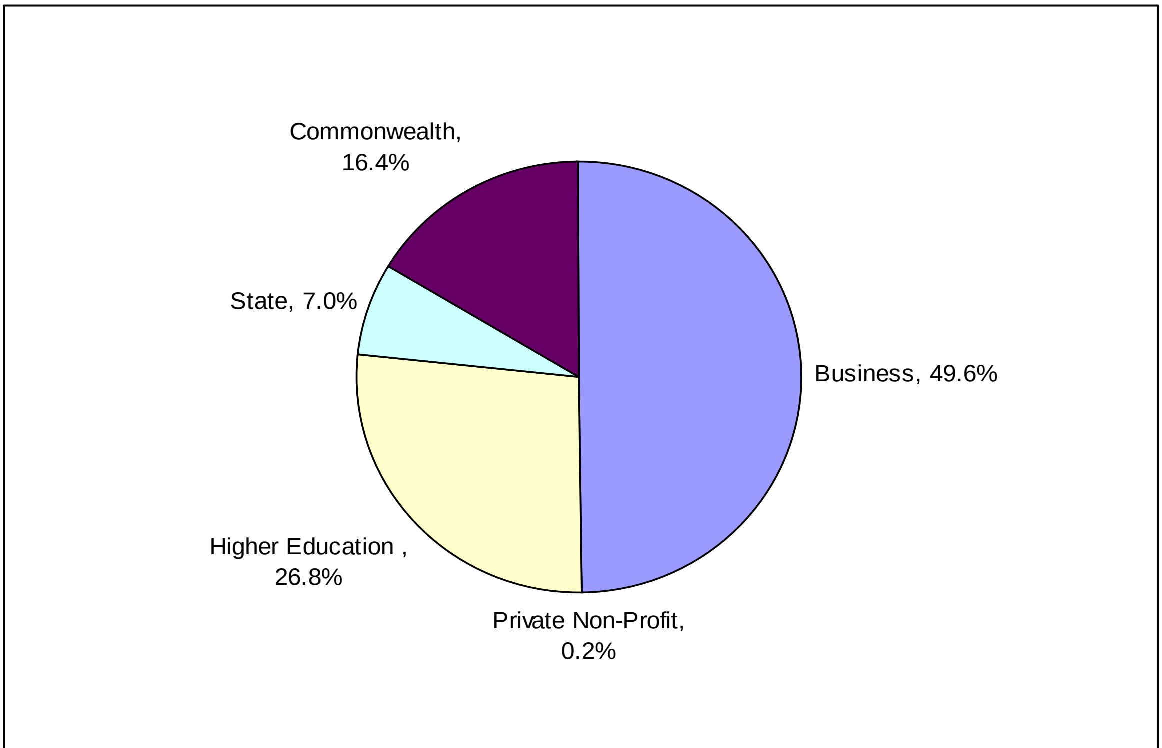

Figure 28: GERD funding by source

In 2010 Adelaide attracted nearly 15,000 international students, mainly coming from China (26%), India, ASEAN countries[38] (13%) and other Asian countries. These international students are a valuable asset because they make the research system highly competitive and create expanded networks of international relations.

Specific policies

To face a number of global challenges, the Government of South Australia published the South Australian Strategic Plan (SASP) in 2004, twice updated in 2007 and 2011, where six main guidelines are identified: **Our Community**, **Our Prosperity**, **Our Environment, Our Health, Our Education and Our Ideas.**

Within this priorities framework, the Government of South Australia has launched the 2012-2013 strategic plan which is based on 7 priorities which are now working as a driver for all of the Government's policies.

1. Creating a vibrant city	Particular attention is dedicated to make Adelaide a hub for cultural and economic activities, through re-qualification of central and peripheral areas.
2. Renewing our neighbourhoods to make them safe and healthy	Building a sense of community in a safe and healthy environment is a transversal necessity. In particular, crime rates in South Australia has been steadily declining, surpassing the 12% targeted reduction with a 33% reduction.
3. An affordable place to live	South Australia has activated numerous projects for social housing, affordable rental schemes, Home Smart Finance and Property Locator (for house buying). Affordable housing is critically interlinked with affordable living, which includes transportation costs, utilities and access to services.
4. Every chance for every child	SA is promoting several initiatives where parents find professional support about health, parenting and family services when they take their child to preschool or school.
5. Growing advanced manufacturing	To promote and develop the manufacturing sector through process and product innovation, the government is playing an active and sophisticated role in helping capture information, mapping current and future industry capacity, gap analysis and R&D technology forecasting.
6. Realising the benefits of the mining boom for all South Australians	South Australia's minerals and energy sectors continue to attract international attention. The risk is to let multinational companies drain all the benefits leaving no real returns to the local communities. Therefore the Government needs to be placed in a strategic position to promote specific training and to sustain inclusion policies.
7. Premium food an wine from our clean environment	South Australia's lifestyle and wellbeing is based on an important tradition in wine and local food. It is therefore important to strongly link tourism to local wine to promote quality brands abroad. At the same time, to keep SA food production competitive, government is focusing on markets (consumer focus, biosecurity and reputation), innovation (production and processing), and sustainable use of inputs (land use planning and transports).

[38] ASEAN stays for Association of South-East Asian Nations and it includes: Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam.

3.2.1 South Australia's new manufacturing hub: Tonsley Park

Completely integrated in the seven priorities framework, Tonsley Park redevelopment stands as an ambitious project to promote South Australia on the world stage as a new technological centre. It represents a turning point for the Adelaide territory, as well as the entire State policy on research and Development.

Covering approximately 64 hectares, and located 10 km south of the Adelaide CBD, Tonsley Park was developed in 1964 by Chrysler Australia. It was subsequently operated by Mitsubishi Motors Australia Limited (MMAL), being used for the production of motor vehicles until March 2008 when operations ceased.

Southern Adelaide's economy has historically had a lower growth rate and lower employment quality rating than the South Australian average. The loss of export jobs from the closure of the Mitsubishi plant at Tonsley Park, and further job losses from relocation of the motor vehicle component manufacturers associated with the plant, meant that a decisive intervention was required to redress the widening gap in economic sustainability in Southern Adelaide.

The Department for Trade and Economic Development explored the retention of industrial uses and the redevelopment of the former Mitsubishi site as a sustainable industries park including, but not necessarily limited to:

- **Clean tech**
- **Health and medical products and manufacturing**
- **Special purpose equipment**
- **Mining industry technologies**
- **University education / research**

The preference was for a campus style industrial estate as part of a re-branding of the southern metropolitan region as an employment hub for some 5000 jobs. To facilitate this option, a Concept Plan for the site was required to inform discussions and financial modelling as well as attract private sector partners to join the project.

In this framework, the redevelopment of the Tonsley Park area aims to provide not only new jobs opportunities, but to create a new manufacturing cluster where different partners are jointly working to develop South Australian manufacturing capability, promoting Adelaide as new international benchmark for interaction between industry, research centres, university and training institutions.

This project represents a unique opportunity for SA to incentivize an advanced manufacturing sector that competes internationally through innovation and excellence, thanks to superior organisation and a dynamic capability.

A modern and efficient manufacturing sector is aimed at driving productivity improvements across the whole economy, taking advantages from strategic leadership, highly skilled workforce and state of art technologies, whilst underpinning rising living standards across the community.

There are many target industries which could be involved in this project:

- Cleantech, renewable energy, water, environment and building technologies
- Health & Medical
- Mining and resource as well as remote mining technologies
- Sustainable building products and services
- Instrumentation, integrated management systems
- Process control
- Simulation and Modelling

Partnership SA - Siemens

Several companies have shown interest in taking part in the Tonsley Park Redevelopment, positively elevating the dense network of expertise that such a project could generate.

On May the 7th 2012, a Memorandum of Understanding (MoU) was signed between the South Australia Government (represented by the Premier, the Hon. Jay Weatherill) and Siemens executives, to involve Siemens as a strategic partner in the Tonsley Park redevelopment.

The MoU commits the State Government and Siemens to:

- Jointly endorsing and promoting Tonsley Park to national and global audiences.
- Investigating opportunities for education, research and industry collaboration.
- Sharing information on future trends and opportunities.

This initiative falls within the seven strategic priorities of government, particularly in the areas of Growing Advanced Manufacturing, Realising the benefits of mining boom for all, and Premium food and wine from our clean environment.

6. Conclusion

Through a descriptive analysis, this study has highlighted how University – Industry Partnerships represent a turning point in the research and development scenario. In the last decade, we have seen a slow but incisive change in the role that these collaborations have played within the companies' market strategy framework. The first example of contact between the academic and industrial world was during the dramatic circumstances of the WWII during which several scientists including Enrico Fermi and Albert Einstein collaborated in the Manhattan Project, developing the Atom Bomb.

The idea of a more inclusive cooperation between Science and Industrial production was strongly developed in the second half of the 20^{th} century, when due to the cold war tension, collaborations with university had very specific guidelines in order to develop new technologies, (mostly for the US Department of the Defence), to increase the technological gap with the Soviet Union.

At that time, university researchers were limited to specific areas and their results were hardly shared within the scientific community. Academics were mainly funded by Governments, influencing their freedom of activity and limiting the overall benefit of a broader scientific bustle.

The technological revolution of the last few decades has forced both University and Industry to review their strategic approach to research. This has highlighted on the one hand the necessity to have a market-oriented approach to developing new educational processes, commercialize research results and face the public funds decrease. However on the other, globalisation is transforming the economic tissue of many developed countries, forcing SMEs to cluster in order to compete on an international scale and moving multinational companies to fully employ their resources in order to diversify research processes within the markets in which they operate world-wide.
In this framework, the University – Industry partnership is no longer considered as a potential instrument to be employed in spare cases to promote single and isolated projects. Rather, it assumes a structural dimension, becoming highly integrated within the University / Company structure through specific networks of excellence institutions, non-profit foundations and specific company branches, which all operate exclusively in order to promote further and denser cooperation, strengthening the technology transfer.

At the same time, these partnerships have assumed a strategic relevance for the public administration on two different levels: from a national point of view, cooperation is orientated at increasing the national research and knowledge capital. From a local perspective, the involvement of all the principal regional economic and academic players represents a unique asset to promote a sustainable and long lasting development in the territory.

This report listed several examples in order to show how different each player's approach is in networking to cooperate with other subjects. One of the most significant is represented by Siemens.

Siemens is pursuing a long-term strategy which aims to increasingly involve universities on a global scale, in a progressive externalization of the R&D activity. The Corporate Technology department represents a turning point in the R&D approach to managing University partnerships on a global scale. On different levels of complexity through a dense network of collaborations, Siemens is investing about €4.2 billion to nourish a network of high profile institutions from the EU to the Americas and Asia, involving the most prestigious as well as rewarded Universities and Research Centre world wide.

As well as Siemens, several universities, such as the Imperial College of London, have created legal and management vehicles to maximize partnership outputs and easily manage critical issues, such as Intellectual Property, which often represent a threat to the deal's success.

Foundations, such as the Politecnico di Milano Foundation, are becoming key players in establishing a spread of networks of expertise and professionals which cooperate to launch new business ideas involving not only other universities and interested companies, but also public administrations and financial institutions to serve both social utility purpose and easily provide the necessary funds.

Finally, the US government and the European Union have been promoting the creation of national 'University Networks' through the University Industry Demonstration Project (UIDP), and the creation of the European Research Area (ERA), to integrate innovation technology programs within the US and the European Union. Showing how sensitive public administrations are becoming to this topic (to launch the next FP 8 program), the EU will invest more than € 80 billion over a 7 year period (2014 – 2020)).

Looking to South Australia, Tonsley Park is a clear example of the efforts that local government is making in order to promote its research system world-wide, creating a new model for high technology clusters, involving global players from abroad as well as the most prestigious SA universities and a wide variety of SMEs.

In such a competitive and hyper-technological world where high technology influences each aspect of everyday life, innovation is the key factor for companies to develop a real competitive advantage.

Due to the strategic relevance that University – Industry partnership is assuming, we could state that this format is about to become the main innovation source in the market, a big step forward to a more efficient employment of diversified knowledge.

Moreover, the decreasing Government budgets are forcing local administrations to find a new equilibrium between the taxation rate and the public services provided. In this framework, technology could represent the key to increase service quality and efficiency, reducing at the same time costs, and ultimately fiscal pressure. For these reasons it could be reasonable for many local administrations to invest public resources in developing new public research centres, focusing on developing new innovative assets for the common utility, through participation with local and international companies.

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APPENDIX 1

The TurboNegotiator model has upfront interview instruments that allow each partner to examine underlying assumptions regarding the type of project they are working on and identify mismatching expectations before the start of legal negotiations, preventing much wasted time.

It also focuses on three main directories which are essential for both partners - the nature of project; the nature/extent of contributions and investment from each party; and the nature of deliverables/ likelihood of a patentable.

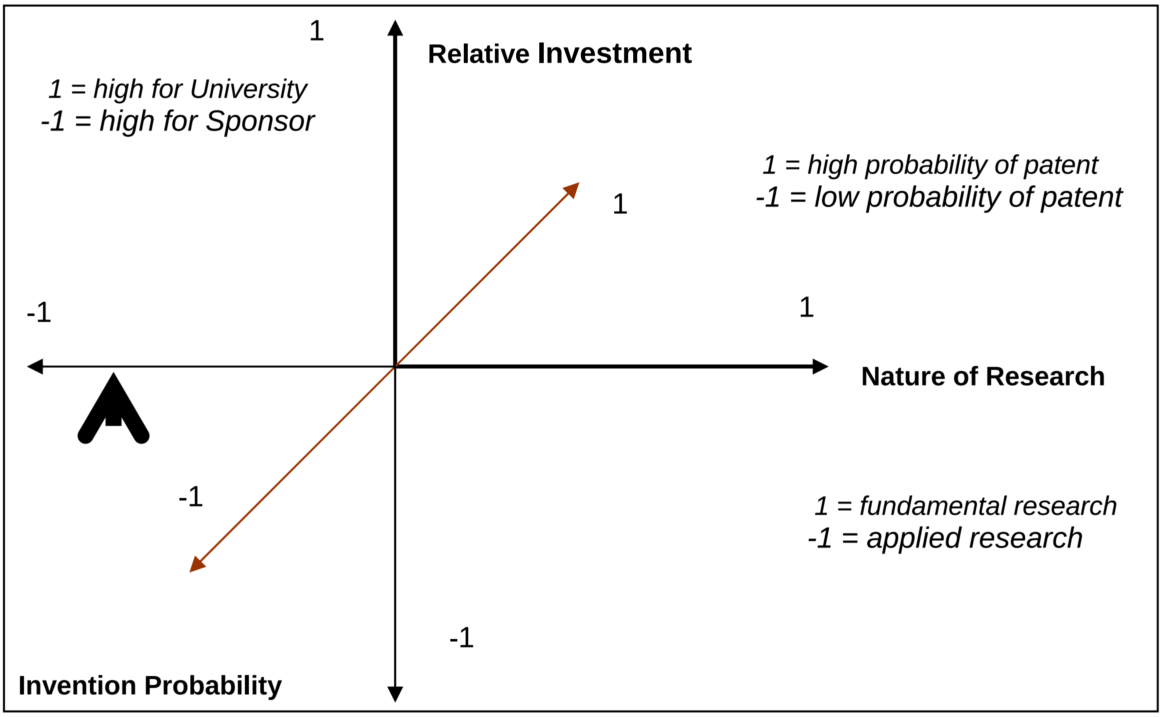


Figure 29: example of TurboNegotiator Project Space

Once both parties have agreed on the coordinates of their project in the Invention Probability (IP) space, tools will expose the likelihood of valuable IP. For example, a costly project for a company with direct impact on its current business, but with a little chance of patentable inventions would be given by (-1,-1,-1,).

In this case, TurboNegotiator would suggest the following options:

ALTERNATIVE 1: The University shall grant the Company a commercial license on fair and reasonable terms for an up-front payment at the time of execution of the licence.

ALTERNATIVE 2: Company agrees to fully pay or reimburse patent application expenses for those inventions it wants. University shall grant Company on fair and reasonable terms an exclusive commercial license in return for consideration, to be mutually negotiated, but which may include milestone payments and/or a licensing fee.

TurboNegtiator is also designed to distinguish between situations where treatment of IP is important and where it is not (95-97% of research agreements produce no valuable patentees, but most are fought over nonetheless), forcing the discussion between parties to focus on whether the IP is worth fighting over and providing on-demand educational material to many individuals assigned to negotiate these agreements without having a deep knowledge of how to navigate them.

It also aims to start moving towards a national uniformity in approach; electronic time to agreement allows institutions to track reductions in processing time as result of using the tools and correlate processing time with characteristics of the project under consideration.

Nationwide adoption of the same tool would ultimately allow automated uploading/compilation of time to agreement data; permitting the tracking of national trends in IP negotiations.

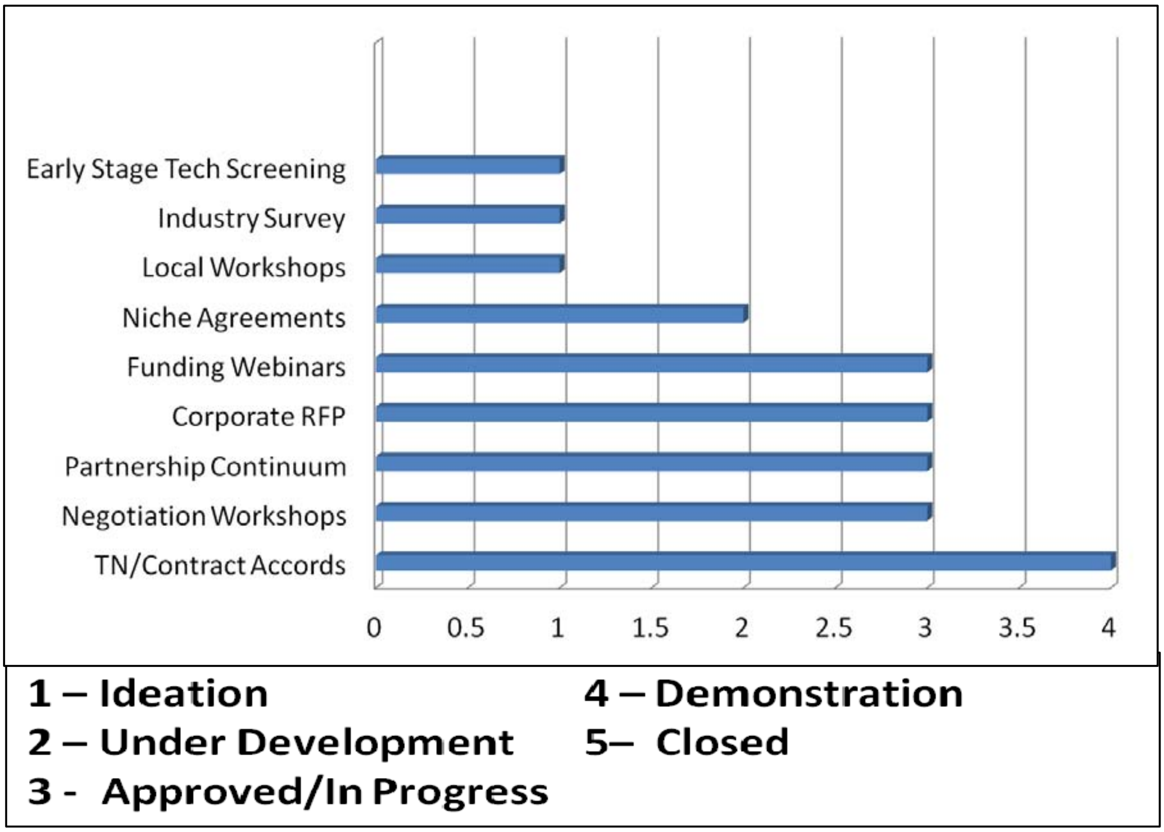


Figure 30: progress in several UIDP projects [38]

[39] The University – Industry Demonstration Partnership" – general information

Appendix 2

Siemens Group Profile

Siemens AG is a world leading company based in Munich, Germany. Founded in 1847 by Werner von Siemens and Johan Geog Halke with a unique groundbreaking and history of revolutionary innovations, such as the invention of the dynamo, the first commercial light bulb, the first electric street car, the construction of the first public power plant and the first image of the inside of the human body.

After 165 years, Siemens is one of the biggest players in the world, with almost 370,000 employees in more than 190 countries and consolidated revenue of €78.296 billion in the fiscal year 2012, with a net income of €4,590 billion[40].

It operates in more than 290 major production and manufacturing plants worldwide and in total, the group consists of approximately 1000 legal entities, including minority investments and participations in other companies.

From the financial point of view, Siemens has a primary listing on the Frankfurt Stock Exchange, as well as a secondary listing on the New York Stock Exchange.

Being an integrated technology company, Siemens is able to provide a complete services' package which covers everything, from planning and delivery to installation and commissioning, being very active in implementing the project from the very beginning.

"We make the investments of our customers better, though people, technology, processes and financial strength"[41]

As highlighted by the company's mission, Siemens is focused on quality of products and services, investing in people and technology, and focusing on building a long-term relationship with its customers.

As declared in its "Annual Report 2012", all Siemens business activities have the same ambitious goal, that is, to "capture No.1 or No. 2 position in all our markets" maintaining a constant growth world-wide. This is an ambition which has represented and still represents the key of business success for Siemens.

To achieve these goals, the company is constantly focused on portfolio development, adapting it to different regions and future challenges, from this point of view, Siemens' Environmental Portfolio represents a turning point in this strategy, set up to satisfy the increasing demand for eco-sustainability.
In 2012, Siemens generated a revenue of €33.2 billion (42% of total sales) and a further increase has been set, aiming to achieve revenue of €40 billion by fiscal year 2014.

[40] Siemens Annual Report 2012, (by 30 September 2012)
[41] Siemens' Mission

As a result, at the end of the fiscal year 2012, Siemens was named Supersector Leader in the Industrial Goods and Services category of the Down Jones Sustainable Index (DJSI) for the first time. It also won the top spot for sustainability in the Diversified Industrials category.

Company structure

Siemens is organized into four core businesses: **Energy, Healthcare, Industry, Infrastructures and Cities**.

Energy

The Energy Sector offers a wide spectrum of products, services and solutions for generation and transmission of power and extraction, conversion and transport of oil and gas. It primarily addresses the needs of energy providers, but also serves industrial companies particularly in the oil and gas industry.

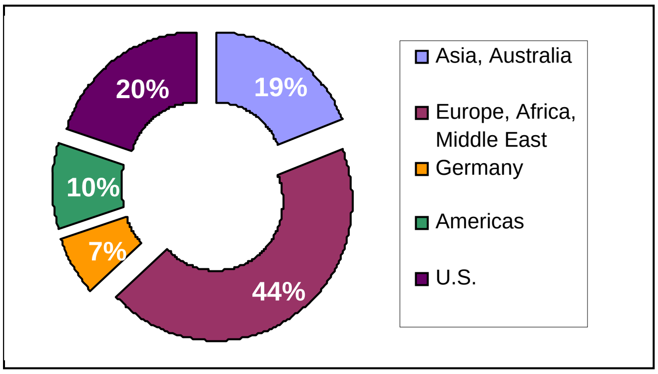


Figure 31: Revenue share in %

Revenue	€27.537 billion
Profit	€ 2.159 billion

This Sector is constituted by five principal Divisions:

Fossil Power Generation Division offers high-efficiency products and solutions for fossil-based power generation. It concentrates on gas and steam turbines and turbo generators, including control systems, with an emphasis on combined-cycle (gas and steam) power plants. It also develops solutions for instrumentation and control systems for all types of power plants and power generation, including information technology solutions.

Wind Power Division manufactures wind turbines with a rotor diameter spanning 82 to 154 meters for on- and off-shore applications.

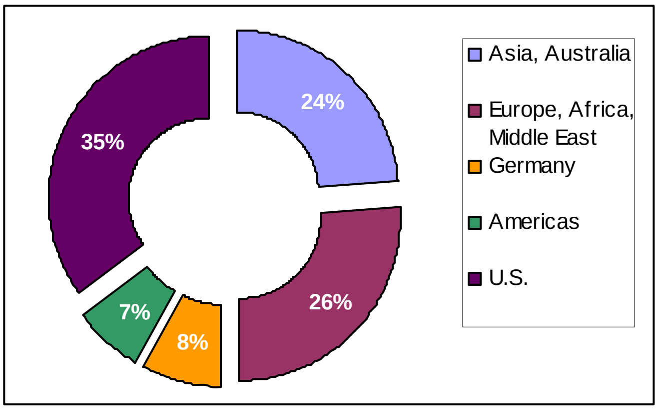
Oil & Gas Division supplies highly efficient small and medium gas and steam turbines for industrial power generation and mechanical drives as well as turbo compressors for a broad range of application to the oil and gas industries. It also offers a variety of automation and electrical product systems and solutions for fields, productions and management levels, enterprising intelligent solutions for safe reliable operations.

Energy Service Division offers several services, including parts and components for complete power plants including on and offshore wind farms as well as rotating machines such as gas steam turbines, generators and compressors. This Division also provides maintenance / operation services, as well as emission control services and systems.

Power Transmission Division covers high-voltage transmission solutions, power and distribution transformers, etc. The division is currently working with joint ventures in China and Germany to design, manufacture and sell high performance semiconductors. The main revenue comes from oil and gas activities in developing countries.

Healthcare

The Healthcare sector offers to its customers a comprehensive portfolio for medical solutions across the treatment-chain, ranging from medical imaging to in-vitro diagnostic, interventional systems and clinical information technology systems too, all from a single source. In addition, the Sector provides technical maintenance, professional and consulting services, together with financial services, to assist customers in purchasing the Sector's Products.



Revenue	€13.642billion
Profit	€1.815 billion

Figure 32: Revenues share in %

This Sector is constituted by three principal Divisions:

Imaging & Therapy Systems Division provides a broad range of medical devices for diagnostic imaging and for therapy solutions. Imaging equipment includes computer tomographs, magnetic resonance imaging equipment and position emission tomography.

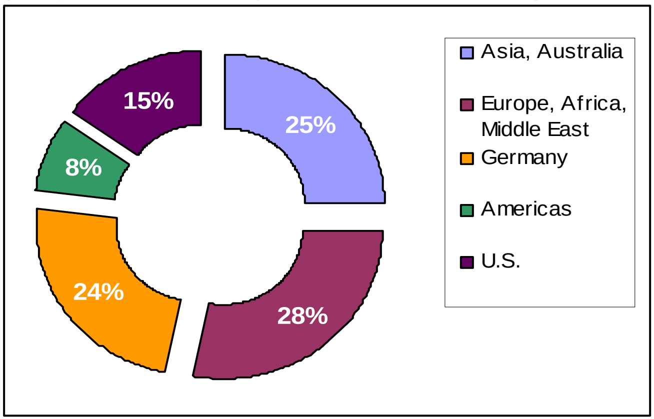
Clinical Products Division mainly comprises of the business with ultrasound and X-ray equipment, including mammography.

Diagnostic Division offers products and services in the area of in-vitro diagnostics. In-vitro diagnostics is based on the analysis of bodily fluids such as blood or urine, and supplies vital information for the detection and management of diseases, as well as individual patient's risk assessment. Customers of the Healthcare Sector include healthcare providers such as hospital groups and individual hospitals, group and individual medical practices, reference and physician office laboratories and outpatient clinics.

Industry

The Industry sector provides a broad range of products, services and solutions for the efficient use of resource, energy and improvements of productivity and flexibility in industry. Its integral technologies and holistic solutions address primarily industrial customers, such as process and manufacturing industries. The portfolio spans industry automation, industrial software and drives products and services, system integration and solutions for industrial plant businesses.
This Sector is constituted by three principal divisions:

Industry Automation Division offers automation systems such as programmable logic controllers and process control systems, sensors such as



Revenue	€ 20.508 billion
Profit	€ 2.467 billion

Figure 33: revenues share in %

process instrumentation, and industrial softwares. It also provides automation solutions for entire automobile production facilities and chemical plants.

Drive Technologies Division offers integrated technologies that cover a wide range of drive applications with electrical components such as standard motors and drives or conveyor belts, pumps, and compressors, heavy duty motors and drives for rolling steel mills, compressors for oil and gas pipelines as well as mechanical components such as gears for wind turbines and cement mills. With its e-Car business, the Division develops motors and inverters for electric cars and more in general, for the automotive industry.
It's able to provide automotive solutions especially for the marine and shipbuilding industries.

Customer Services Division provides a comprehensive portfolio of services and supports industrial customers in their efforts to increase their productivity. The portfolio includes product related services which seek to enhance reliability, profitability, efficiency and environmental compatibility of industrial plants.
The industry sector, also leads the Metals Technologies Business Unit which offers engineering and plant-building services for the iron and steel industry, as well as for the rolling sector of the aluminium and non-ferrous industries.

Infrastructures & Cities

This sector offers a wide range of sustainable technologies for metropolitan centres and urban infrastructures worldwide, such as integrated mobility solutions, building and security systems, power distribution equipment, smart grid application and low / medium voltage products.

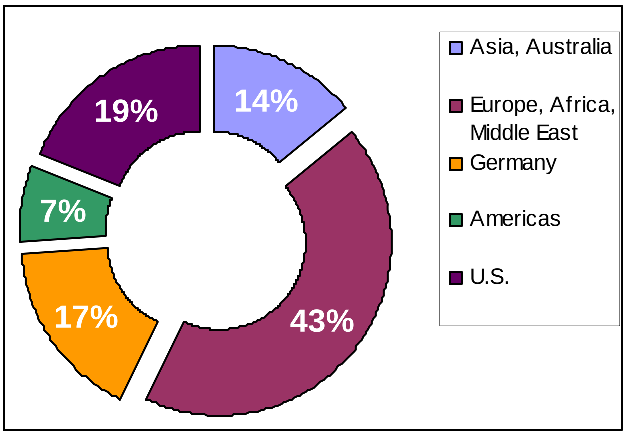


Figure 34: revenues share in %

Revenue	€ 17.585 billion
Profit	€ 1.102 billion

This Sector is constituted by five principal Divisions:

Rail System Division comprises Siemens' rail vehicle business. The division's activities consist of the business relating to rail vehicles for mass transit, regional and long-distance transportation and locomotives for passengers or rail freight.

Mobility and Logistic Division primarily provides products, solutions and services in operations systems for rail transportation such as central control systems, interlocking and automated train controls for road traffic, airport logistic services including cargo tracking and baggage handling, etc.

Low and Medium Voltage Division supplies electrical grid operators and large industrial electricity consumers with medium and low voltage equipment. Furthermore, it provides systems and services for the distribution of electrical power from high voltage transmission grid access to medium and low voltage grids.

Smart Grid Division provides energy automation solutions, smart grid applications, transmissions, and distributions services, applications for electro mobility solutions and rail infrastructure electrification solutions for mass transit.

Building Technologies Division offers products, services and solutions for commercial, industrial, public and residential buildings, including building automation, comfort, building safety and security, and building operations.

In the case of a large scale project, such as an airport, Siemens cross-Sector Key Account Management Program contributes to assist the customer on a 360 degrees basis, employing different Sectors competencies ensuring a complete and high qualified support all over the planet.

Strategy

Siemens vision is to be pioneer in four main areas:

- Energy efficiency
- Industrial productivity
- Affordable and personalized healthcare
- Intelligent infrastructure solutions

The company's goal is to become leader in all its markets, based on its values; responsibility, excellence, innovation. It has three strategic directions:

Focusing on innovation–driven growth markets, becoming a pioneer in technology driven markets. Siemens intends to concentrate on areas that are believed to have a future growth potential, for example in vertical IT and softwares.

Getting closer to our customers; that is, growing in emerging markets while maintaining a leadership position in already established areas, introducing more products, solutions and services for the rapidly growing entry-level segment, which are more price sensitive and mostly found in emerging markets.

Using the power of Siemens; investing continuously in expanding the expertise of its employees. Siemens aims to encourage lifelong learning and development of its people, creating a unique asset in its sustainable value development.

R&D in Siemens

Research and development (R&D) are the key driving forces behind the innovations that safeguard the future of a company. In 2011, Siemens invested in R&D a total of €3.925 billion; and €4.2 billion in 2012 equivalent to 5.3% of yearly revenues, holding approximately 53,300 patents worldwide and employing 29,500 people. Within R&D area, Corporate Technology (CT) and its worldwide network of experts is a powerful innovation partner for Siemens' business units.

The organization provides expertise regarding strategically important areas to ensure the company's technological future, to acquire patent rights that safeguard the company's business operations and achieve leadership in each market where Siemens operate.

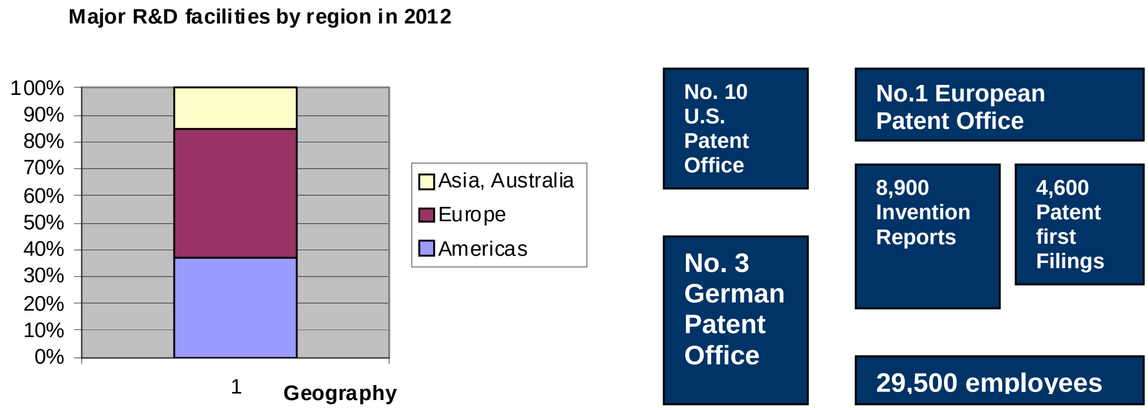


Figure 35: R&D facilities world-wide in 2012

Corporate Technology (CT)

The 7,000 men and women, who work within CT's global research network, focus primarily on key technologies that have strategic significance for more than one business unit. In its Global Technology Fields (GTF), CT brings together experts from globally operating research teams all over the world in order to pool their expertise and become a preferred innovation partner for the Siemens Units.

A large proportion of the budget of Corporate Research and Technologies is covered through project agreements with the business units, which serve as its customers. In 2008, CT was responsible for approximately 7.5% of Siemens' total expenditure in R&D.

Particularly important factors for CT are its close connections with its customers and top universities. These enable it to offer faster and more target–oriented solutions that are ideally adapted to local requirements, and are also perceived as an appealing employer for the brightest candidates.

In recent years CT has supplemented its locations in the US by opening research centres close to its business operations in Beijing, Moscow, Bangalore and Singapore, and has expanded its cooperation with top universities all over the world.

In all of these places, CT researchers are supporting Siemens business units with their product development, maintaining contacts with universities, analysing global trends and observing developments in their local markets.

Research is also pushed by the strong efforts made by the company to provide its R&D department several facilities world wide, giving Siemens the advantage of being able to incorporate crucial input customers and top universities into its research.

Appendix 3 [42]

Year	2000	2001	2002	2003	2004	2005	2006	2007
GDP	399.525	377.342	423.534	539.076	654.944	732.091	777.901	945.694
Year	2008	2009	2010	2011	2012	2013	2014	2015
GDP	1,053.86	992.244	1,244.41	1,486.91	1,542.06	1,598.07	1,638.93	1,679.66
Year	2016	2017						
GDP	1,731.68	1,787.46						

Appendix 4 [43]

Year	2000	2001	2002	2003	2004	2005	2006	2007
Unemployment rate	6.267	6.767	6.375	5.942	5.392	5.058	4.792	4.367
Year	2008	2009	2010	2011	2012	2013	2014	2015
Unemployment rate	4.275	5.592	5.225	5.083	5.217	5.333	5.208	5.133
Year	2016	2017						
Unemployment rate	5.133	5.133						

[42] Source: IMF database
[43] Source: IMF database

Appendix 5 [44]

Seven Priorities as set by the Department of Industry, Innovation Science, Research, and Tertiary Education:

1. **Public research funding supports high-quality research that addresses national challenges and opens up new opportunities.** The aim is to increase the number of research groups with high performance when compared to international benchmarks. The achievement of this priority is strictly linked to that of the four research priorities.
2. **Australia has a strong base of skilled researchers to support the national research effort in both the public and private sectors.** The objective is to significantly increase the number of students completing higher degrees by research over the next decade. This complements with the multicultural society that attracts students from neighbouring countries mainly in higher education.
3. **The innovation system fosters industries of the future, securing value from the commercialisation of Australian research and development.** Australia should always be a technology-maker and not taker, in the sense that it must continuously increase investment in R&D so to innovate and remain at the state of the art in technology.
4. **More effective dissemination of new technologies, processes, and ideas increases innovation across the economy, with a particular focus on small and medium-sized enterprises.** The goal is to achieve a 25% increase in the proportion of business engaging in innovation over the next decade. This is possible only if SMEs gain a relevant role and invest more in R&D becoming active innovation drivers.
5. **The innovation system encourages a culture of collaboration within the research sector and between researchers and industry.** The lack of coordination and collaboration between research and industry has been one of the main past pitfalls of the Australian innovation system. To close this gap, the Australian Government's goal is to double the level of the collaboration between Australian businesses, universities and publicly-funded research agencies over the next decade.
6. **Australian researchers and businesses are involved in more international collaborations on research and development.** To increase international collaboration in research by Australian universities it is crucial in the long run to consolidate Australia's role in formal research and to benefit from international spillovers.
7. **The public and community sectors work with others in the innovation system to improve policy development and service delivery.** Efficiency can boost national productivity to provide not only new and better services to individuals and families but also a positive business environment where new innovating clusters can form.

[44] Powering Ideas Report, see also:
http://www.innovation.gov.au/Innovation/Policy/Pages/PoweringIdeas.aspx
http://www.ausinnovation.org/articles/powering-ideas.html

Appendix 6

Key objective 1: RESEARCH

Funding research and research training through national competition across all disciplines with rigorous peer review processes is the means through which excellent research is supported and promoted. Key strategies are then:

- Enhance peer review;
- Simplify and standardize funding rules;
- Encourage international collaboration and mobility;
- Partner with other organizations to support research policy of strategic importance;
- Encourage researchers to make data arising from ARC-funded research publicly accessible.

Key objective 2: CAPACITY

Critical research infrastructure and research in areas of national need are the means planned to build Australia's research capacity and support researchers' careers. The key strategies are:

- Expand opportunities for research students and early career researchers;
- Retain the flexibility to respond to strategic research opportunities;
- Establish new initiatives to strengthen links between industry and the research community.

Key objective 3: POLICY AND EVALUATION

Participation in policy forums, Government reviews, informed consultations, evaluation and ongoing monitoring of performance are the elements through which informed high quality policy advice to the Government can be provided. The key strategies are:

- Ensure policy advice is evidence-based, innovative and strategic;
- Monitor international best practices;
- Monitor and evaluate ARC research funding schemes to maximize their effectiveness;
- Capture and quantify research activities in higher education;
- Use results from ERA to inform future development of policy and programs;
- Use results from the Linkage Projects scheme to inform the enhancement of ARC funding schemes.

Enabling Objective 1: ORGANIZATION

To continue to improve organizational performance through these key strategies:

- Ensure governance arrangements support sound decision-making and accountability;
- Ensure delivery of the NCGP[45] and ERA[46] continues to reflect the ARC's guiding principles;
- Sustainable ICT services and resources;

[45] The ARC funds research and researchers under the National Competitive Grants Program (NCGP). As part of its commitment to nurturing the creative abilities and skills of Australia's most promising researchers

[46] Excellence in Research for Australia (ERA) assesses research quality within Australia's higher education institutions using a combination of indicators and expert review by committees comprising experienced, internationally – recognised experts.

- Promote internal communication at all levels to ensure sound decision making and an informed and engaged workplace.

Enabling Objective 2: COMMUNICATION
To be a key advocate for the benefits of Australia's research efforts and maintain productive relationships with stakeholders through the following key strategies:

- Disseminate information about ARC-funded research and its outcomes to the general community through media releases, events and interviews;

Communicate the accomplishments of Australian research and researchers in the national and international arenas.