Innovation Ecosystems

Eunika Mercier-Laurent

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Foreword

Eunika Mercier-Laurent highlights the notion of *e-co-innovation* in order to emphasize the collaborative dimension presiding over it nowadays, as well as the increasing necessity to take into account in any innovation its end purpose (ecological, economic, educational and ethical).

Personally, I would like to put the emphasis on the meaning of progress.

We are in the habit of saying (and this is a true saying) that new information and communication technologies contain as many opportunities as they do threats. Indeed, they can be implemented without any environmental consideration and can cause individualistic behaviors, but on the contrary, they can also strengthen social networks, whilst harmoniously fitting into their ecosystem.

Creativity and innovation are also ambivalent. Some people do not lack the creativity to overturn legislations. Innovative products in finance such as subprimes, which escape the control of their creators, have led the world economy to the brink of collapse.

We therefore need to be careful not to be naïve or fascinated in the face of technological progress, creativity and innovation as such. Like everything else, they must be used wisely. They are only useful to mankind if they are to be used for higher purposes, such as those defined by the UN in the eight development goals of the millennium.

If it is true that technological progress allowed by innovation is only meaningful for political goals of promoting the common good, it is equally true that political actors are the first amongst others who must create a favorable environment enabling innovation to competitively develop itself. Indeed, as stressed by Eunika Mercier-Laurent, the tricky stage in any innovating process is the transformation of a good idea into products or services creating added value. This book may help us to

become aware of the decisive role that innovation plays to create a favorable environment; an environment that innovation modifies in return.

In *Innovation Ecosystems*, Eunika Mercier-Laurent not only presents innovation levers factually, whether a technical, social or economic innovation, she gets involved, formulates propositions and criticizes devices. I hope that, in the same vein, this book will encourage many readers to move on from merely reflecting on nourishing innovation, to action which indeed transforms the world.

Edith Cresson
Former French Prime Minister
President of Fondation des Ecoles de la 2e chance
September 2011

Introduction

For several years, innovation has been omnipresent and part of strategic matters. The word "innovation" is in the headlines of reports, articles and business media, and is also the subject of events, projects, think-tanks, clubs and blogs. Several forums on social networks are devoted to its various facets. This is a global phenomenon.

In the 20th Century, innovation was a subject for research centers of large companies and public laboratories. Now, it is no longer a confidential matter: we innovate politics, organization, management, business models, the way of managing intellectual capital, training, services, gastronomy and even DIY and gardening. From innovation emerges the vision of development that generates lasting values, ensuring a high level of income and a thriving economy. Innovation has all these virtues and is also likely to change tastes and mentalities.

The 1990s began with *knowledge-based business* (sale of publications, services and tools for knowledge management); nowadays *innovation-based business* flourishes. Many firms offer a plethora of approaches to creativity and innovation, some use games and information and communication technologies (ICT), there is also an abundance of institutional or private seminars and symposia. A variety of approaches are proposed. Most of them apply to product innovation resulting from research. Following the environmental awakening, innovation has become "eco", and is coming out of its favorite fields to infiltrate almost all other fields.

European and national policies have been developed, but the people in charge do not seem to be interested in feedback from practice. Nowadays, we rely on innovation to revitalize territories, to modernize industry, to create businesses, and to generate new activities. But how can we innovate to achieve the expected impact? What is the alternative to *faster, cheaper, better* logic? According to Peter Drucker, "the greatest danger in times of turbulence is not the turbulence. It is to act with

yesterday's logic". Which logic can we hold on to? How can we go from theory to practice in order to build a sustainable knowledge society? What are the prospects for all populations? What are the skills necessary to innovate and turn innovation into a sustainable success? Where can we find them? Peter Drucker mentions only one essential skill: "Every organization – not just businesses – needs one core competence: innovation. And every organization needs a way to record and appraise its innovative performance"[1].

Which indicators can measure the impact of innovation on the economy? How can technologies – ICT, Web 2.0 or artificial intelligence – help to innovate? Which stakeholders should we involve in the process? How can we innovate without destroying the planet? This book attempts to answer some of these questions.

The motivation behind this book is to introduce a global and systemic overview of the subject, to present the various aspects of innovation under different angles and perspectives to finally bring the reader to an understanding of all ecosystem components, their metamorphoses, cross-influences and possible impacts on the balanced development of people, businesses, regions and countries.

It is difficult to present such a topic – this is a set of ecosystems including individuals, their environments, products and services, technologies, activities, society, institutions, companies, schools, universities and research centers, as well as machines and the environment.

The other difficulty is to freeze a reality of the moment, knowing that this really is a question of dynamics. This book is a still picture because we are unable to give our readers a real-time video on paper. The seven chapters which follow are an attempt to paint a global overview of the subject. They can be read separately depending on the reader's interest.

Thus, Chapter 1 provides a landscape of innovation throughout the world. The resulting picture is static, but gives some references to follow. It introduces the main rankings and attempts to paint an image of innovation in selected countries. It demonstrates the bias of the ranking and the lack of suitable indicators for the knowledge economy measuring the impact of various actions, which are essential for a real-time control.

Chapter 2 presents the different aspects of innovation. This can be closed and open, incremental and disruptive (radical), organizational and cognitive. Products and services, business models, the ways of working and getting assistance from computers are part of this chapter's concerns. This list is not exhaustive and we

1. HBR, January-February 1995.

thank our readers for reporting other aspects which have been omitted by ignorance, on http://innovation3d.fr.

Chapter 3 describes the two main components of the innovation process, which are the creativity and the transformation of ideas into values. It focuses on the evolution from the closed process, which is still practiced in a large number of businesses and institutions, to the global "knowledge e-co-innovation" through approaches such as participative innovation addressing the clients' needs and open innovation.

Chapter 4 lists the knowledge and skills essential for the successful transformation of an idea into values for all stakeholders. This chapter suggests a method of measuring the innovation capacity of individuals, companies and organizations. Designed for the knowledge economy, it introduces the indicators of the intangible values, which make it possible to measure the impact of actions on balanced development.

Chapter 5 highlights the importance of "knowing how" to involve computers in all their forms and to use suitable approaches and techniques, so they can boost their own innovative capacity along with that of individuals and groups. The organization and management of knowledge increases the chances of successful innovation.

Chapter 6 focuses on innovating technological innovation. It suggests some ideas for improving the existing system, in order to accelerate the generation of the values from the research results. Fostering and enhancement of applied research is a prerequisite for the survival of ecosystems and a key to balanced development. This chapter describes French and European research systems, but the reader will find many similarities with other countries.

Finally, Chapter 7 highlights the importance of the right innovation management for the rapidity and quality of regional development.

In order to initialize the construction of the common language of knowledge innovation e-co-systems, a glossary has been compiled, in addition to the explanations in the footnotes. Each reader will then be able to enrich their vocabulary in their respective contexts.

This book aims to be a practical guide to the innovation "country" and help readers to become knowledge cultivators. Please feel free to send me your comments and keep me informed on your progress.

Eunika Mercier-Laurent,
eunika@innovation3d.fr
September 2011

Chapter 1

Global Landscape of Innovation

Les idées n'ont pas véritablement de patrie sur terre,
elles flottent dans l'air entre les peuples.

(Ideas have no real home on Earth,
they float in the air between people.)

Stefan Zweig

1.1. Innovation in the world

Innovation is fashionable, the word proliferates all around the world. Most businesses and organizations want to be considered to be innovative. The term is used with increasing frequency in communication, in advertising slogans, on product packaging, etc. A Google search gives 123 million references, Alexa more than 60 million, and Yippy more than 38 million. Blogs and interest groups on social networks are multiplying. Even if a lot of them are dedicated to technological innovation, all fields of activities are concerned.

Nowadays, innovation is part of governmental strategies; it is considered to be the means for building a strong and thriving economy. The European Union aspires to transform the member countries into an innovative knowledge society based on a knowledge economy[1]. The European Research Area was created for this purpose.

1. http://ec.europa.eu/enterprise/e_i/news/article_9129_fr.htm.

Following the idea of clusters[2], technology parks and *Pôle de compétitivité*[3] have appeared in France.

In the race for globalization, the competition has increased and the *faster*, *cheaper*, *better* logic has driven businesses to decentralize and outsource, leading to the weakening of industrialized countries and the development of countries where the workforce is cheaper. Decentralizing also generates knowledge losses and shifting *leadership* towards countries, which often imitate without actually having the know-how. In the face of these difficulties, many businesses have reduced or stopped their investments in the research and development sector. The collapse of the Soviet system and the opening of the borders have also contributed to a change in the economic landscape and to the brain drain. The end of the 1980s marked an awakening: in a changing world, we need to act differently to survive. Innovation would be the only solution. Considered as a magic wand, it would be able to create jobs and contribute to economic growth.

In Europe, countries are grouping to be stronger and more intelligent together. In 1981, Bull created a common research center with ICL and Siemens–ECRC (European Computer-Industry Research Centre) in Munich. This center is dedicated to artificial intelligence and to research in computer architecture, intelligent machines, new generations of databases and new programming languages. Since the 1990s, European research programs, such as Esprit 1 and 2, and the sixth and seventh Framework Program (FP) have contributed to the development of collaborative research, even if their contribution to economic development has not been channeled or measured. Besides the dissemination, no return on investment is required from the beneficiaries of research subsidies. These programs have produced and continue to produce many inventions with a strong economic potential, whose results are not well-known, because the knowledge management principles are not implemented. Despite the existence of techniques for relevant storage and retrieval, access to the information in the Cordis[4] database remains sequential and based on keywords, and therefore has a low efficiency. Since 2006, a biannual event such as ICT[5] spanning three days has been a showcase of European research and a place for networking. The second event brought together more than 4,000 people in Lyon in November 2008[6] and a third event assembled over 4,500 participants in Brussels in September 2010.

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2. Grouping of universities and companies with an objective of economic development and of job creation in a given territory (for example, Silicon Valley or the Boston area).

3. Competitiveness clusters

4. http://cordis.europa.eu.

5. Information and Communication Technology (ICT).

6. http://ec.europa.eu/information_society/events/ict/2008.

The 2000-2010 strategy developed by the Lisbon European Council chose the goal of making the European Union the most competitive economy in the world and reaching full employment before 2010. This objective has not been reached and therefore, a new view by 2020[7] has been developed and put into practice in a *strategy for an intelligent, sustainable and inclusive growth*.

The USA want to regain their lost position as leader. Many scientific conferences take place in China, which influences the progress of research in this country. India, an American sub-contractor in information technologies, sees the ability of its engineers to contribute to the economic development of the country. Some companies have also realized that innovation is a prerequisite for their survival and for them to become the leader in their field.

It is fruitless to look for a world map of the innovation on the Internet. We quickly note a lack of global view, and even a lack of elements to constitute this overview. The available knowledge is divided into sectors, and is specialized and limited. The map in Figure 1.1, drawn by Viktor Rotanovs[8], gives a worldwide image of innovative businesses[9]. It is frequently updated by its author.

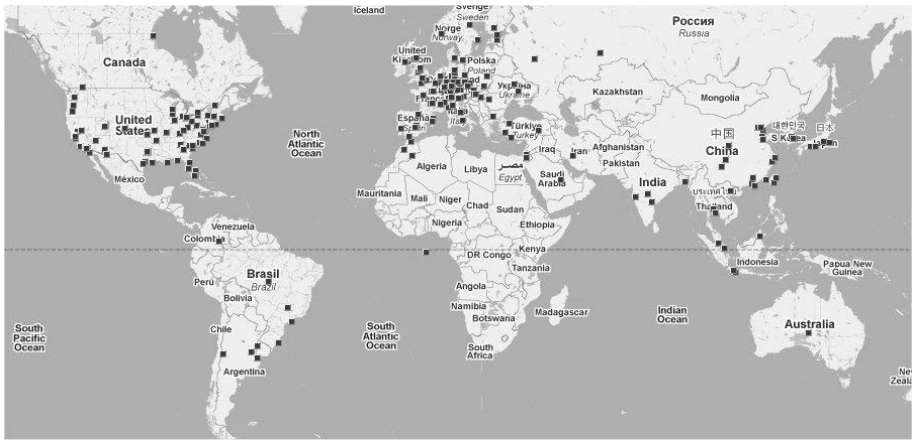

Figure 1.1. *Innovation in the world*

MBBnet[10] points out the technological innovation centers, which confirm the same groupings presented by Figure 1.1.

7. http://ec.europa.eu/eu2020.
8. http://rotanovs.com.
9. www.hitgeist.com/map.
10. http://mbbnet.umn.edu/scmap/digitalinnovationmap.gif.

1.1.1. *The United States of America*

The USA has long been considered to be the leader in the innovation sector. The Cold War and the competition with the Soviet Union have for a long time contributed to the dynamic innovation in the two countries. According to John Kao of the Harvard Business School, author of the book *Innovation Nation* [KAO 08], the USA are now 24th in terms of higher education, 17th in public funding and 11th in expenditures of GDP for research, although they invest more in the research sector than other countries, as is confirmed by the Booz Allen Hamilton report [JAR 08].

The 2008 Maastricht ranking [MAA 08] positions the USA 17th. The Forester Research [DEL 07] still counts them amongst the leaders after Finland, Ireland, Sweden and Switzerland. The report of the Boston Consulting Group and the National Association of Manufacturers' Manufacturing Institute [BCG 09] put the USA into 8th rank after Singapore, South Korea, Switzerland, Iceland, Ireland, Hong Kong and Finland. According to the Global Competitiveness Report 2008-2009 [POR 08], the USA still holds 1st rank for economy and is followed by Switzerland, Denmark and Sweden. This report defines 12 pillars of competitiveness by integrating innovation into it.

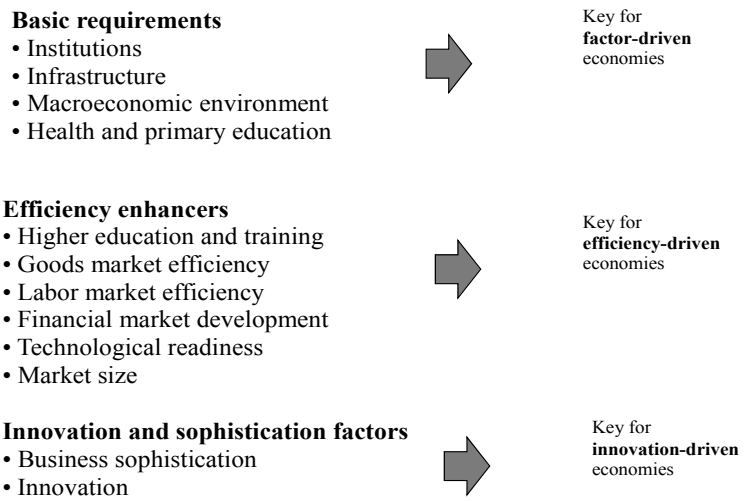

Figure 1.2. *The 12 competitiveness pillars (source: [POR 08] and [SCH 10])*

According to this report, the contribution of innovation to economic development strongly depends on the previous 11 pillars, including infrastructure and institution, which are the guardians of intellectual property, of intellectual capital and of the market.

The USA's rank is due to a set of factors, such as the rate of innovative businesses present in the world and the quality of the university system which is closely working with the businesses.

The difficulty of a world classification comes from the variety of objectives and criteria. Most of them take into account the number of publications and patents for the research classification, and the percentage of investment in R&D for the industrial classification.

In the most complete classification by Robert D. Atkinson and Scott M. Andes, "The Atlantic century II, benchmarking EU & US innovation and competitiveness" in July 2011 [ATK 11], the top ten countries are:

In this classification, France is ranked 14th, with a score of 54.4, the EU-15 is 18th, and the EU-25 19th.

The criteria used by Atkinson and Andes are as follows:

– intellectual capital or the percentage of the 25-34 year old age bracket out of 1,000 employees who have an higher education (5 points) and are involved in science and technology research (5 points);

– the capacity to innovate, in terms of private investment (9 points), of public investment (7 points) and the number of international scientific publications (4 points);

– entrepreneurship: investment in the venture capital (6 points) and in the creation of businesses (6 points);

– infrastructure of the information system in terms of e-government applications (3 points), telecommunication (5 points) and of the investment in ICT (12 points);

– economic policy: taxes favoring innovation (8 points), ease of development (5 points);

– economic performance: trade balance (6 points), direct foreign investments (3 points), the percentage of GDP per adult invested in R&D (6 points) and productivity (10 points).

Although very thorough, this classification does not take into account certain criteria, such as the existence of a national strategy for innovation, education and training, aiming to develop an innovation culture associating the ability to generate values from ideas.

Country	Overall Score	Rank
Singapore	74.2	1
Finland	68.0	2
Sweden	67.1	3
U.S.	**65.2**	**4**
S. Korea	62.6	5
UK	61.7	6
Canada	61.1	7
Denmark	60.5	8
NAFTA*	59.9	9
Netherlands	59.6	10
Japan	57.6	11
Australia	57.0	12
Belgium	55.4	13
France	54.4	14
Ireland	54.4	15
Germany	53.8	16
Austria	53.3	17
EU-15**	**53.0**	**18**
EU-25**	**50.9**	**19**
Czech Rep.	49.5	20
Estonia	48.3	21
Hungary	47.3	22

Table 1.1. *Benchmarking EU & US innovation and competitiveness [ATK 11]*

The annual Global Innovation Study 1,000 report by the Booz Allen Hamilton firm[11] is interested in innovation in large businesses. The 2008 edition [JAR 08] shows that amongst 1,000 studied companies amidst the largest investors in R&D, there is no direct relationship between investment and sales increase, profits and benefits for the stockholders. The Booz Allen firm has studied the whole innovation process of 1,000 companies, including Microsoft, which has respectively invested 600 and 220 million dollars in R&D in 2007. According to their last Global Innovation 1000 report [JAR 08], the economic success of innovation does not

11. www.boozallen.com.

depend on the innovation strategy itself, but on the way it is aligned with the company's global strategy. Secondly, the economic success is not proportional to the amount invested in R&D, but highly depends on the way the company includes the client in the chain of values. Booz Allen identified three distinct corporate innovation strategies:

– Need seekers actively engage current and potential customers to shape new products, services and processes, and strive to be first-to-market with those products.

– Market readers watch their markets carefully, but prefer to maintain a more cautious approach, focusing largely on driving value through incremental change.

– Technology drivers generate product ideas by deploying their technological skill and relying on unarticulated customer needs for product inspiration, rather than following the market or direct customer input to drive both breakthrough innovation and incremental change.

This report acknowledges that the studied companies need to better understand the connection between innovation and strategy and between strategy and the customer role across the innovation value chain. It also highlights that more than half of the studied companies innovate without any contribution from R&D, in organization and marketing.

President Obama has challenged his team to promote innovation[12], by using all the available tools and by cultivating the creative spirit of the American entrepreneur. He has set three objectives: accelerate entrepreneurship, give access to ICTs and use the creativity and expertise of Americans in order to stimulate the change. The role of education is essential – the emphasis is put on primary and secondary education – and more than 11,000 teachers and volunteers have been mobilized into introducing scientific discoveries into classes. To accelerate the technological transfer, a competition of six challenges has been proposed[13] and endowed with 12 million dollars.

1.1.2. *Japan*

The Atkinson report [ATK 09] puts Japan in 9th place, with Toyota ranking first in the top 20 in the *Global Innovation Study 1000* [JAR 08]. However, the Maastricht classification [MAA 09] puts them among the leaders.

12. www.whitehouse.gov/blog/2010/06/15/innovation-america-technology-economic-growth-and-empowering-americans.

13. www.eda.gov/i6.

In the study on the innovative capacity of the various countries in 2007 by the Economist Intelligence Unit (EIU), Japan comes 1st ahead of Switzerland and Finland. The indicators for this study are made up of the innovation rate of each country calculated according to the number of patents per inhabitant, the investment in research and development, and the technical skills of the country's workforce. The quantity of the patents filed in Japan from 2004 to 2008 is 1,274,533 per million inhabitants. To complete this study, the EIU has also followed 485 top executives throughout the world, in order to obtain their opinion on what innovation is and how to stimulate it. According to the EIU, the Japanese are the most efficient on the worldwide scale in neuroscience research.

According to the OECD, Japan is at the vanguard of the world scientific activity and is amongst the first countries of the OECD, in terms of the intensity of public and private research [OCD 08]. Since the 1980s, Japan has tried to restructure its economy in the high technology industries, which are based on the miniaturization, the computerization and the convergence of the various domains of communication, information and multimedia. It has realized its dependence on innovations produced elsewhere, notably in the domain of computer science [TAT 90]. Since the 1990s, investments in research have been combined with institutional reforms. These reforms favor the production and diffusion of knowledge. The Ministry of National Education has expanded, taking the form of a large ministry merging science, education and culture. The MITI was transformed in 2001 into the METI (Ministry of Economy Trade and Industry) and remains the key-ministry for articulation and coordination between public and private research, as well as for competitiveness watch, industrial policy and research. The latter is focused on society's needs. In 2004, universities became autonomous and evaluated according to their ability to carry out the syllabus found in the contract.

The political directions of the third basic plan (2006-10) and the long-term strategic directions Innovation 25 aim to take up challenges, such as the ageing population and climate change. Investing in human resources is a strategic priority. We can find amongst the government's initiatives the *Global COE Program*[14], supplying financial aid for the creation of learning and research centers, and the *World Premier International Research Centre Initiative*, whose aim is to create "research centers of worldwide reputation", designed to attract the world's best researchers.

The Prime Minister's website[15], in the pages related to the strategic Innovation program 25, specifies that the word innovation has been reformulated and in Japanese means technological renovation and reorganization of management, or

14. www.jsps.go.jp/english/e-globalcoe/index.html.

15. www.kantei.go.jp.

simply the renovation or renewal. This reformulation also includes the introduction of new technologies and of different ways of thinking, in order to create values from the existing patrimony and to thus contribute to the progress of society. To emphasize the importance of innovation for the future of Japan, an Innovation Ministry has been created. Its priority domains are medicine, engineering sciences and information technologies. They include life and environmental science, new materials, nanosciences and nanotechnologies, energy, process control, social infrastructures, space and oceans.

Moreover, measures have been taken to stimulate interdisciplinary exchanges, which are sources of innovation. After Sony CSL in Paris and the Toyota research center in Sophia Antipolis, the ELyT Lab laboratory[16] was created within this framework. On the French side of things, it is comprised of teams from the INSA and from the Lyon *Ecole Centrale* and eight laboratories in Rhône-Alpes. The Japanese side is made up of three institutes from the University of Tohoku. This multidisciplinary laboratory is one of the world's first platforms in engineering sciences and must answer to the significant stakes of the universities in the years to come, in terms of training and relationship with the economic world.

1.1.3. *Soviet Union and Russia*

The classifications of the 20th Century have too often forgotten the role played by the Soviet Union in the innovation field. Putting in common resources and introducing a common language in all the republics could be considered an innovation, if Russian, the official and mandatory language facilitating communication and knowledge sharing, was not also seen as a form of linguistic and cultural colonization. During its creation, the Soviet Union banked on free education for all and research. Entries to high schools and higher levels of study were subject to competitive examinations, which guaranteed high levels of applicants. This high level was then maintained by very demanding syllabi. Soviet researchers were excellent in theory and very ingenious in creativity and executing with limited resources.

The Soviets built tanks able reach 120 km/h on the highway in the 1930s [SUV 96]. They launched the first Sputnik and were the first to travel into space. The permanent exhibition of the achievement of the national economy in Moscow[17] was created in the 1950s to show the successes of the Soviet Union, to encourage the population to innovate and the youth to study sciences. Amongst the presented

16. www.elyt-lab.com/.

17. Выставка достижений народного хозяйства.

fields, was the quest for space, industry, nuclear power, building, agriculture, transport, culture and health.

Figure 1.3. *Tupolev TU 104 plane at the Moscow exhibition in 1959*

Used for military applications, innovation was first developed in the Western republics. This development was then found in the Urals and Siberia after the 1960s, when atomic defense was favored. After the breakup of the USSR, some centers (VPK[18]) were restructured [GLO 02] into civilian research centers. As an example,

18. Военно-Промышленный Комплекс, military-industrial complex.

we can quote the Research Institute of Perm, Uralinso[19], the Levada[20] sociology centers in Moscow or the Razumkov[21] center in Kiev.

The Cold War greatly stimulated innovation on both sides.

With the collapse of the Soviet Union and the division into independent republics, innovation activities have been in the grip of financial difficulties. Common resources have been divided by the "every man for himself" mentality. Some countries such as Estonia (now in Europe) are nowadays leading the pack of the former Soviet republics in the innovation field. In 2004, Tallinn airport already offered free Internet access using state-of-the-art keyboards and parking could be paid for using mobile phones [DEC 04].

It is however not easy to find exact information on the number of researchers, nor on the number of innovating business in Russia and in the former republics, due to the lack of suitable statistical methods, which have not always evolved with the change of government. Financial crises, the dilapidation of some equipment and the superiority of salaries in other sectors have led many researchers and technicians to give up on science or to go into exile [DEZ 05].

At the beginning of the 1990s, the permanent emigration of scientists from the Soviet Union as well as from the countries of the Warsaw Pact towards Germany, Israel, USA (28%) and Canada significantly increased. This "brain drain" has now slowed down and Russia still ranks as with some large countries of the OECD for the number of researchers in comparison to the working people. Nevertheless, the number of people working in the scientific and technological sectors is hardly equal to half of what it was in 1990 [MAL 2001]. Still, according to the OECD [OCD 08] Russia ranks 7th in the world for the number of scientific publications with about 3.5% of the total. The number of applications for patents has not stopped decreasing, independently of the liability caused by the communication language for the dissemination of the research results

On February 17th 2009, a new program was launched by the Senate: "New economy – portrait of the innovation in Russia". A report with the same title is published every year on the progress of the project[22]. A magazine is also devoted to this subject: www.mag.innov.ru/.

Publications only released in Russian do not facilitate global visibility either.

19. www.uralinso.ru.
20. http://levada.ru/education.html.
21. www.uceps.org/ukr/index.php.
22. www.centersp.ru.

Lev Bobrov, in his book *Na tropie sensacji* (on the path to exceptional discoveries) [BOB 68], deplores that in 1967 very few people were able to consult the 4 million patents found in the all-Russia patent and technical library of Moscow, scientific news reports or the 30 million books in the Lenin library, which was founded in 1862 by Roumiantsev. Most of these documents only exist on paper and are not digitized, even if they are important intellectual resources, which still remain to be used.

Other countries of the former Soviet Union which are now part of Europe are taken into account in the Maastricht classification (see Figure 1.4).

Ukraine is preparing its entry into Europe. There are very few visible actions, although economic innovation was a priority of the previous government[23]. According to Konstantin Golublev from the National Space Agency of Ukraine (NKAU), innovation is not taught and nobody seems to be in charge of the subject. And yet, this country does not lack potential. An "innovation breakthrough" competition[24] was launched in 2009. The list of experts is highly impressive. However, the official website does not publish any results. Ukraine is taking part in the Protect project[25] of the Tempus III program. Its objective is to improve university education and to introduce the theme of entrepreneurship.

1.1.4. *Poland*

Many important inventors and scientists such as Mikolaj Kopernik, Jan Heweliusz, Ignacy Łukasiewicz, Maria Skłodowska-Curie, Kazimierz Funk, Jedrzej Sniadecki and many others were born in Poland. This country, which has been subjected to successive invaders such as Mongolians, Teutonic knights, Tartars, Turks, Swedes, Prussians, Austrians and Russians, has developed an extraordinary ability to adapt by using knowledge. Poland, as part of the Eastern Bloc, banked on high level education, knowledge and sciences. Facing everyday problems, Poles have developed the ability to solve complex problems with limited resources.

A few similarities between Poland in the 1970s, France and certainly other developed countries of today are to be pointed out, such as environmental concerns, the lack of qualified workforce and too many graduates compared to the market needs. Environmental innovation was a consequence of badly controlled industrialization and poverty. Packaging was limited to the bare minimum, in order

23. According to the former minister of the Economy, Bohdan Danylyshyn, www.kmu.gov.ua.

24. www.ukrinnovation.com/.

25. www.project-protect.eu/.

to preserve the content as best as possible. A deposit was charged on glass and it was reused. Paper, as with clothing, was recycled and metals were collected. Household appliances and other pieces of equipment were designed to last and to be repaired if needed. The skilled workforce was the first to practice mobility, offering their services abroad; the famous Polish builder is an example of such mobility.

For more than 20 years, studies have lost their appeal in the face of fast business, which is possible in the current economic situation. In addition, higher education and research desperately lack resources. The *QS World University Ranking*[26] puts the Uniwersytet Jagiellonski at a rank of 302nd, and the University of Warsaw at the 349th.

Domestic production is almost non-existent. More and more companies resell foreign products, because the risk taking is less significant. Most of the technical solutions use technologies developed abroad, despite a high local potential, which is both rather unknown and badly managed. Polish companies are gradually being bought by foreign capitals – buyers who follow their own strategies.

Poland innovates in organization, economy and management. It has very quickly worked out how to exploit the wave of ICTs. Collaborative research is carried out within the framework of European programs and specific programs, such as Polonium 2011[27] for example, aiming to develop the French-Polish scientific and technological exchanges between the research laboratories of both countries and at the same time favoring new cooperations. There are some Polish-American funds for study and research such as the Kosciuszko Foundation[28] and others. Innovating companies are created and developing. We can observe an awakening, stating that innovation is the key-element of the future.

The innovation policy is in line with the European innovation policy. But the Polish government wishes to go further. The Poland 2030 report[29] mentions ten challenges – amongst them, the transition to a knowledge economy and the development of intellectual capital. In order to meet this challenge, nine strategies will be developed, including the innovation strategy and the efficient management of the country.

The Polish presidency of the European Union started on July 1st 2011. The logo of the Polish Presidency expresses dynamics, positive energy and solidarity[30] This

26. www.topuniversities.com/world-university-rankings.
27. www.egide.asso.fr/jahia/Jahia/site/egide/lang/fr/polonium.
28. www.thekf.org
29. http://polska2030.pl/.
30. http://en.poland.gov.pl.

logo shows "that we are capable of winning and facing new challenges" – said the Polish Prime Minister Donald Tusk.

1.1.5. *Israel*

Innovation in Israel is simply a story of survival – it was necessary to find food in an environment where rain is rare.

Agriculture and defense were the first triggers of innovation [SEN 09]. The most advanced irrigation systems, such as the drop-by-drop system[31] were invented there, in order to use water in the most efficient way. These systems have been officially recognized as national treasures [DVI 06].

The *kibbutz* system is a good example of social innovation. At first, their vocation was essentially agricultural, but with the change of society, this model became industrial, and then private, offering services such as tourist reception [SEN 09]. The villas in the *kibbutz* are much coveted.

Since its independence in 1948, the State of Israel has been involved in several armed conflicts with the neighboring Arab countries and remains involved in the Israeli-Palestinian conflict. As a consequence, a significant part of its technological development is linked to military strategy. The army is a laboratory for the best brains, who join after school to work on the resolution of complex problems. They are quickly entrusted with responsibilities and are offered the opportunity to following higher education at the same time. The Army also helps them to acquire the necessary qualities of a good entrepreneur, such as decision-making, responsible and an ability to improvise for problem solving [DVI 06].

In addition to the transfer of military applications to the civilian domain, notably in ICT, feats have been achieved concerning educational innovation, knowledge transfer and the preservation of memory and knowledge.

The profusion of researchers from the former Soviet Union has certainly contributed to providing knowledge and experience, and to the fast development of the innovation culture. This culture, added to the culture of entrepreneurship which has been developed for a very long time, is the drive of economic growth for this country. Its strong relationship with the American Diaspora, including prominent characters, have a certain influence on innovation.

31. www.netafim.com/.

The State of Israel joined the European programs very early on. It officially joined the Union for the Mediterranean in 2000. According to the OECD 2008 [OCD 08], Israel holds a remarkable position on a certain number of innovation indicators. With 4.65% of the GDP, its R&D intensity is the strongest in the world and represents more than double the OECD average (2.26%). The intensity of the R&D company spending is also the strongest amongst the OECD countries, with 3.64% of GDP in 2006. Israel is ranked 5th by the number of scientific articles per million inhabitants, after Switzerland, Sweden, Denmark and Finland. It has a solid ICT sector, which ensures about 20% of the total industrial production, 9% of the employment in the business sector and a significant share of the growth of Israeli industrial production.

The government has also played a major role in financing innovation, especially for small businesses and in implementing very efficient framework conditions for innovation, notably in terms of venture capital, incubators, close links between science and industry and good-quality higher education. Thus, Israel could count about 70 active venture capital funds, which mobilized €963 million in 2005 and €437 million in 2006. Out of 24 technological incubators, 16 are held by private interests [SEN 09]. Still according to the OECD, Israel is in 3rd position concerning the rate of graduates from the education service sector, after Russia and Canada. The ratio of graduates in science and engineering is 24.3%. This corresponds to the ratio generally observed in the advanced economies of the OECD[32]. Amongst the latest European initiatives, a common research program Sweden – Israel was launched in 2011 (http://www.eurostars-eureka.eu/).

Israelis also innovate in domains other than technology. For example, the little town of Holon, close to Tel Aviv, is organized for children, but also for creating meeting opportunities between the three generations: a technological museum, a garden of stories and a center for digital arts are, amongst other things, designed to teach and exchange in a playful way[33].

1.1.6. *China*

The opening up of China to the rest of the world and to outside capitals after the fall of Maoism was a major factor for the innovation boost. The trial opening of mixed economy areas since 1979 in Shenzhen, Zhuhai, Shantou and Xiamen played a pioneering role in promoting the reform, as well as in the expansion of economic exchanges with the outside.

32. www.israel21c.org.

33. http://holon.muni.il/OpenningEng.asp.

In 1985, the Central Committee of the Party launched the reform of the scientific and technical system, highlighting that it was the most dynamic vehicle of the economic development revival.

In 1999, some decisions were made to *vigorously promote technological innovation, the development of high technologies and the industrialization of the country*. Within the framework of this strategy, in 1999 the science and technology parks district of Zhongguancun was built in the north of Beijing, which was the first to be devoted to the industrial exploitation of high and new Chinese technologies, similarly to Silicon Valley[34].

This district is now made up of five parks: Zhongguancun Software Park[35], Zhongguancun Life Science Park[36], Yongfeng Hi-tech Industry Base[37], Peking University Science Park[38] and Tsinghua Science Park[39].

The 2008 Jean-Marie Rousseau mission[40] report [ROU 08] shows the effective situation of innovation in China and notably in the Yangtze valley. The aim of this mission was to compare the innovation capacities of the growth points lined along the Yangtze river, on the sites of Nanjing, Wuhan, Chongqing and Chengdu. The second part of its report, called "Innovation as a source of competitiveness", highlights the necessity of taking into account the intellectual capital, as well as the investment in R&D.

According to the *China Statistical Year Book*[41], in 2006 Chinese universities had about 18 million students (1.8% of the population). The universities now record a constant increase of about 10% per year. Thanks to a massive investment in the Academy of Sciences institutes and in the best Chinese universities, as well as to an overhaul of the evaluation system, scientific production has improved in number and in quality. These universities offer low cost accommodation and other associated infrastructures to lecturers and students on the campus.

With research and development expenditures of 300 billion Yuan ($38.3 billion) in 2006, China is ranked 3rd in the world for purchasing power parity after the USA and Japan. The R&D expenditures, which corresponded in 2006 to 1.42% of the

34. www.zpark.com.cn/.
35. www.zsp.com.cn/.
36. www.lifesciencepark.com.cn/.
37. www.yfcy.com.cn/.
38. www.pkusp.com.cn/.
39. www.thsp.com.cn/.
40. MEGALESE - Ile-de-France Technologies.
41. http://chinadatacenter.org/newcdc/yearbooks.htm.

gross domestic product (GDP), now increase by 0.1 point of the GDP per year (source: French embassy in Beijing, 2008).

The government is also using the slowed down new economy on a global scale to try to bring back several hundred thousand fellow-citizens, who left to study, work or live abroad in the past 25 years. With this aim, a project has been launched to transform 100 universities into world-class institutions. Businesses and technological parks are also offering competitive salaries and advantages.

According to the last edition of the OECD's *Science, Technology and Industry Outlook* [OCD 08], Chinese companies now seem to bank more on quality and innovation than on the quantitative asset. In 1999, 46,000 Chinese publications were included in the *Science Citation Index* (SCI), the *Engineering Index* (EI) and the *Index to Scientific and Technical Proceedings* (ISTP), i.e. a jump of 94% compared to 1992. The actions of filing a patent have quickly increased, even if their number is disproportionate compared to the number of foreign businesses; China is evidently collecting the fruits of the presence of foreign experts and workers.

Professor Jin Zhoujing, in her book *Global Technological Change. From Hard Technology to Soft Technology* [JIN 06] points out that the complex problems of economic development in the historical and cultural context of China can only be solved by a balance between yin-yang environments, between hard technology (machine-centered) and soft technology (human-centered). The success of investments in R&D cannot happen without a connection between strategy, management, ecology and human sciences.

For several years, many scientific conferences have taken place in Beijing, Shanghai or in other university cities. This has definitely had an influence on research. Organizers invite prominent scientists, including some Chinese people who have become well known in the USA or Australia. Following the example set by the Soviet Union, many scientific publications are in Chinese, which makes them less accessible to those not speaking this language. China also innovates in visibility. Many tradeshows are organized by its neighbor Hong-Kong, opposite Shenzhen (www.hktdc.com/).

Bilateral funding is now possible for common European and Chinese research projects via the access4eu program – http://www.access4.eu/China/.

1.1.7. *India*

Historically, India has been the computer science subcontractor of large American and European companies. But software developers have become aware of

their competences and some of them have left to make a career or a fortune in the USA, Switzerland or the UK. Technological companies are mainly based in Bangalore[42]. Other technology centers, such as those in Mumbai and Pune, are fast developing. The latter has banked on education[43] – Prime Minister Jawaharlal Nehru calls it the "Oxford of the East".

Open sources software, such as Zoho or Dimdim Wiki, have been developed by Indians and are widely used throughout the entire world. Dan Scheinman, Senior Vice President for corporate development at Cisco Systems Inc., summarizes his experience with this sentence: "We came to India for the costs, we stayed for the quality and we're now investing for the innovation"[44].

As with many developing countries, India has often replaced wealth with ingeniousness: with for example the Tata car or the position of Mittal Steel, which was started from nothing. According to Mark Dutz [DUT 07], India would gain by improving its education system and by organizing information. India is ranked 40th in the Atkinson and Andes classification.

1.2. Innovation in Europe

To meet the demand of the general direction of the businesses and industry of the European Commission, the 6th edition of the *European Innovation Scoreboard* [MAA 08], by the Maastricht Institute of Economic and Social Research Center on Innovation and Technology, shows that the European leaders of innovation are nowadays Sweden, Finland, Germany, Denmark, Switzerland and the UK. This report presents a comparative analysis of the performances of European countries, the USA and Japan, on the subject of innovation. The countries have been grouped together into four categories, according to their global result and their historical evolution in this field. The authors of this report have added what they refer to as the "follower countries" to the list of previously cited champions amongst which we surprisingly find the USA, France, Ireland, Belgium, the Netherlands, Luxemburg, Iceland and Austria. These are followed by the "catching-up countries", including Cyprus, Estonia, Slovenia, Czech Republic, Spain, Portugal, Greece and Italy. And then again we find the "lagging behind countries": Malta, Hungary, Slovakia, Poland, Lithuania, Romania, Latonia, Bulgaria, Croatia and Turkey.

42. www.bangalorebest.com/eposters/siliconvalley/silicon-2009.asp.

43. www.punesite.com/pune-education.

44. http://www.businessweek.com/magazine/content/05_34/b3948401.htm.

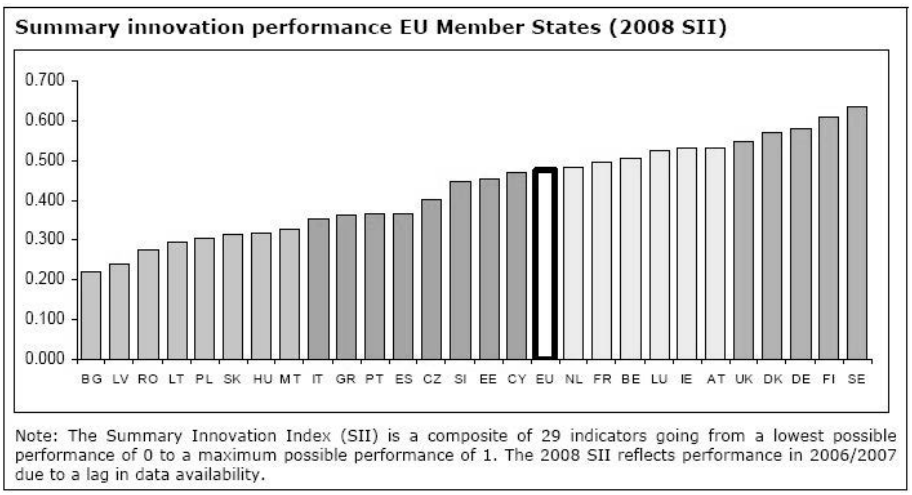

Figure 1.4. *Classification of the innovating countries according to the European scoreboard 2008*

Measured with 29 indicators – from education to ICT technologies, through the investments in research and development and the number of filed patents – this scoreboard highlights the superiority of the USA in terms of innovation in comparison to the European average. The American performances are better than the European performance on 11 indicators, even if the gap tends to decrease regularly for four years. This advantage is explained by three factors – which are also valid for the gap between the EU and Japan, who are also always ahead – the availability of the venture capital at an early stage in relation to innovation, the proportion of the population with a higher education (almost 40%, compared to 23% for the EU-25) and the number of filed patents. But in all these fields, the EU is progressing as a whole.

According to the evaluation of 26 nations carried out by the Forrester Research company [DEL 07] in 2007, Finland, Ireland, Sweden, Switzerland and the USA rank amongst the leader countries, in terms of global innovation capacity. This is a worldwide ecosystem of collaborative innovation, which is organized into innovation networks between countries, businesses, universities and other organizations (also see the definition of global innovation in Chapter 2). Michelle de Lussanet, the Vice President and Research Director of Forrester Research's business analysis team, asserts that "the biggest flaw of most innovation agendas is that they look at nations as closed systems, as if nations must have all innovation capabilities

in-house"[45]. Navi Radjou – Forrester Research Vice President 1999-2009 and advisor for senior executives on technology-enabled best practices to drive collaborative innovation – declared: "Nations must shed their inward-looking innovation attitudes to become successful in the end-to-end global innovation value network. They must play to their strengths and pair up with nations that complement these strengths"[46].

Published in 1995, the Green Paper on innovation by the European Commission [EC 95a] aimed to identify various elements of innovation in Europe and to propose actions in order to increase the EU's capability in this field. Amongst the proposals we find: to develop technology monitoring and foresight, to better direct research efforts towards innovation focus, to make training evolve, to favor the mobility of students and researchers, to improve innovation financing, to establish favorable taxation, to simplify administrative formalities, to encourage innovation in small companies and regions. A few task forces have been launched and some conclusions have been transformed into research programs. In 1992, the OECD published the first Oslo Manual [OCD 92], suggesting a statistical method for the collection and processing of data on technological innovation. This data has been obtained by surveys. Although limited, it provides a possibility of measuring innovation activities.

In spring 2000, the Heads of State and the Europe Union government gathered in Lisbon and voted in an ambitious strategic program: to, by 2010, make Europe "the worlds most competitive and dynamic knowledge economy, capable of sustainable economic growth accompanied by a quantitative and qualitative improvement in employment and greater social cohesion, in respect of the environment". The Lisbon strategy relies on three pillars: *economic, social and environmental*. The *economic* pillar must prepare the transition towards a competitive, dynamic economy, which is based on knowledge. Emphasis is put on the necessity to continuously adapt to the evolutions of information society and on the efforts to be made in terms of research and development. The *social* pillar must enable us to modernize the European social model, thanks to the investment in human resources and the fight against marginalization. The member states are called to invest in education and training, to pursue an active policy for employment in order to ease the transition to a knowledge economy. The *environmental* pillar was added during the European Council of Gothenburg in June 2001. It draws attention to the fact that economic growth must be separated from the use of natural resources.

The open method of coordination gives a cooperation framework to the state members, in order to bring together the national policies and to carry out the

45. http://www.forrester.com/ER/Press/Release/0,1769,1123,FF.html.
46. http://www.forrester.com/ER/Press/Release/0,1769,1123,FF.html.

common objectives, such as employment, social protection, social inclusion, education, youth and training. It is based on the identification and common definition of the objectives (objectives which have been adopted by the Council); jointly established measurement instruments defined in common (statistics, indicators and guidelines), as well as *benchmarking*, the comparison of performances between state members and the exchange of best practices (monitored by the Commission)[47].

The midway assessment in 2005 done by Wim Kok, former Prime Minister of the Netherlands, has shown that the indicators used in the OMC (open method of coordination) have made us lose sight of the hierarchical organization of objectives and the fact that the obtained results are mitigated. For this reason, the Council has approved a new partnership, aiming to concentrate all efforts on obtaining a stronger and more sustainable growth and towards the creation of more numerous and better jobs.

Concerning implementation, the coordination process has been simplified. The guidelines integrated for growth and employment are henceforth jointly presented with the guidelines devoted to macroeconomic and microeconomic policies for a three-year period. They are used as the basis for the Community program of Lisbon, as well as for the national reform programs. This programming simplification enables us to better follow the state of progress based on a single report.

Conforming to this strategy and with the emergence of new scientific and technological powers such as China and India, the European Research Area (ERA)[48] was created in 2000. Its aim is to contribute to the development of a European knowledge society, where research, education, training and innovation are fully mobilized for the economic, social and environmental objectives of the European Union and for citizen expectations [ERA 00]. This area groups together mobile and skilled researchers in their respective fields and research infrastructures on a worldwide scale, equipped with electronic communication systems. Research institutions are driven to take part in public-private partnerships on interdisciplinary themes and to create "virtual research communities", in order to mobilize a critical mass of human and financial resources. Knowledge sharing is encouraged between public research and businesses, as well as with the general public.

The ERA's vision is to modernize research, education and innovation systems by 2010. The interaction between education, research and innovation is called the knowledge triangle, which is linked to politics and other stakeholders.

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47. http://europa.eu/legislation_summaries/glossary/open_method_coordination_en.htm
48. http://ec.europa.eu/research/era/pdf/era_vision_2020_en.pdf.

The task is ambitious. For years, research has been increasingly divided up, in order to highlight the specificities. This division also results from research management and the way of evaluating researchers. European strategists still have to find out how to implement a tactic that takes into account the diversity of the cultures and how to measure the impact of these actions on the economy, society and environment, using (tangible and intangible) metrics and methods other than just statistics and benchmarking. One of the mandatory stages is to measure the capacity to innovate and use the results of this analysis, in order to organize and efficiently manage knowledge flows [MER 2007]. Although there is a database including numerous pieces of information, finding a relevant piece of data is a real assault course. The European Research Area needs to define and create a virtual knowledge space, including the knowledge and the experiments necessary to successfully carry out this fundamental issue.

To give an impulse to this global reflection, we have suggested a *networking session* for the ICT 2008, in order to define together the architecture of this flow. The main suggested topics for discussion could be:

– The main requirements and components of a knowledge sharing system.

– Knowledge models, techniques and tools for effective knowledge storage, retrieval and sharing.

– Tools for competency mapping and effective matching of supply and demand.

– Knowledge based on existing programs and results with highly relevant retrieval system best practices tips.

– Comprehensive communication and visibility system for industrial/enterprise actors.

– Collectively built state of the art in all covered fields – which organization?

– European base of scientific events and papers with easy and effective search.

– Easy guide on how to apply for the European program (games).

– IPR (intellectual property rights) – what innovation in patent system?

– Global security for a knowledge sharing assistant.

A portal is nowadays devoted to innovation in Europe[49]. ERA has just launched in turn a new portal[50]. There is no link between these two sites.

49. www.europe-innova.eu.

50. http://ec.europa.eu/research/era/index_en.htm.

1.2.1. *The Swiss model*

Switzerland is one of the most innovative countries in the world. It hosts very active private and public high level research institutions.

In 2008, the European Innovation Scoreboard (EIS) classification ranked Switzerland 2nd, after Sweden [MAA 08]. In the 2010 edition Switzerland is ranked 1st. In 2006, however, the OECD report [OCD 06a] mentions some gaps in the creation of businesses. This report quotes the following strengths: strong industrial structure, made up of large companies, but also small businesses with a high innovation capacity; industrial innovation of a very high level; strong academic research recognized in the world; professional education is focusing on applications and an intercultural environment. The shortcomings in education and the creation of businesses have been partially caught up since.

In 2009, according to the EIS[51], Switzerland was at the top of the innovating countries, with an annual average innovation performance growth of 3.3%, ahead of Germany (2.6%) and Finland (2.5%). The performance of Switzerland progressed by 0.5% in comparison to 2008, notably because the money available for financing innovation projects increased despite the economic crisis. Switzerland has carried out exceptional performances in the development of high tech products, in the research and intellectual property fields.

Contrary to the French, Swiss innovators prefer to be autonomous and do not expect any financing from the State to be able to create their company. They sell their products and services as soon as possible, in order to get the funds which will enable them to continue evolving. The Swiss tax system is globally less restrictive than the French system, which excessively tax businesses, and particularly small businesses [POR 08].

1.3. Innovation in France

France has always been an innovating country and French has long been the international language for scientific conferences. This is where the smart card and Minitel (pre-Internet phone-based information database), ADA and Prolog programming languages and constraint programming were invented. France took part in designing the supersonic jet Concorde, built the TGV (very high-speed train) and also jointly built the Channel Tunnel.

51. www.proinno-europe.eu.

However, a discrepancy between researchers and industrialists still remains: researchers do not have, or have very little interest in applied research and very few industrialists have the ability to anticipate the market and take risks to be innovators rather than followers. Some researchers create their businesses *ex-tempore* or driven by the ministerial aids or thanks to conditions limiting the risks (with the possibility of reintegrating their former laboratory in case of failure). Whatever the case, they consider themselves capable of selling their products themselves.

Therefore, they do not hire any sales and marketing people, because they would not be able to understand the impact of their products. Those who ask for grants from the Anvar should present a technical-economical file including a market study. Generally, the key features holding up the success of innovation in France are perfectionism and the lack of *business* culture.

Americans put products on the market during their development, whereas in France, they wait to design a perfect product without always checking the needs of the future clients. As for the entrepreneurship culture, very few schools teach it: amongst the schools that do, we find Paris Dauphine University, the University of Reims or the CERAM[52]. Some engineering schools propose MBAs[53], but not any entrepreneurship Master's programs.

Whereas there are training schemes for creating businesses, we have not found any efficient management methods proposed for starting up a company or for innovating small businesses. Piero Formica was amongst the first to introduce schools or training of this type in Bologna, Amsterdam, Tartu, Abu Dhabi and Jönköping [AFM 05].

At the request of Claude Allègre, a French Minister of National Education, Research and Technology, Dominique Strauss-Kahn, French Minister of Economy, Finances and the Industry and of Christian Pierret, French Secretary of State for Industry, a report was carried out by Henri Guillaume [GUI 98] and published in 1998. Its aim was to understand the main causes of France's lag in the ranking, compared to the USA and Japan, which were then considered to be leaders of global innovation. From statistics, studies and interviews with many innovation actors, this report lists a few of these causes:

– the barriers between higher education and research organizations and between research organizations, universities and engineering schools;

– the transfer and technology diffusion mechanism are too complex for small businesses;

52. Business School in Sophia Antipolis, France.

53. Master of Business Administration.

– investment shortfall in venture capital, which still do not cover the first stages of the creation of technology businesses really well;

– lack of a genuine governmental policy strategy in terms of coordination, monitoring and evaluation of the financing of industrial research;

– excessive concentration of public financing on a limited number of industrial groups and sectors.

To remedy to this, Henri Guillaume [GUI 98] emitted the following recommendations:

– create a technological research center, associating research laboratories by field;

– refocus public funds on three priorities: creation of innovating businesses, support to small businesses, strengthening the efficiency of the combination between public and private research;

– simplify technology transfer systems;

– launch national and regional seed funds;

– strengthen the research-industry partnership.

The State should have at its disposal a global view to be able to ensure real monitoring of the promotion of the organizations and institutions. The report recommends developing a certain number of systems, in order to drive the professors-researchers to better collaborations with businesses and to become entrepreneurs. It also suggests designating in each organization and institution, a person responsible for the identification of the companies needs, in order to place trainees and PhD students. Finally, it proposes defining and taking into account other academic criteria in the evaluation of researchers, such as the success of the interdisciplinary and industrial cooperation.

According to the OECD, the relative proportion of researchers present in businesses is, in France, the lowest of all the industrialized countries (except for Spain and Italy); it would thus be sound to consolidate all the different support procedures into only one, which would be managed by ANVAR[54] as a function of the specific needs of innovating businesses.

The organization of research around large organizations working separately is not adapted to the development of technological research. We should restructure the national system around competitiveness clusters combining research laboratories and businesses.

54. French Innovation Agency.

After the recommendations of this report, competitiveness clusters (*Pôle de compétitivité)* have been created. OSEO was born in 2005, by bringing together ANVAR (French innovation agency) and BDPME (SME development bank), around a mission of general interest supporting the regional and national policies. Its mission is to provide assistance and financial support to French SMEs; the ANR[55] was created to propose calls for projects and financial subsidies to the projects grouping together the actors of the research-industry. The CIADT[56] of July 12th 2005 approved 67 competitiveness clusters on 105 received applications; now there are 71 (Figure 1.5).

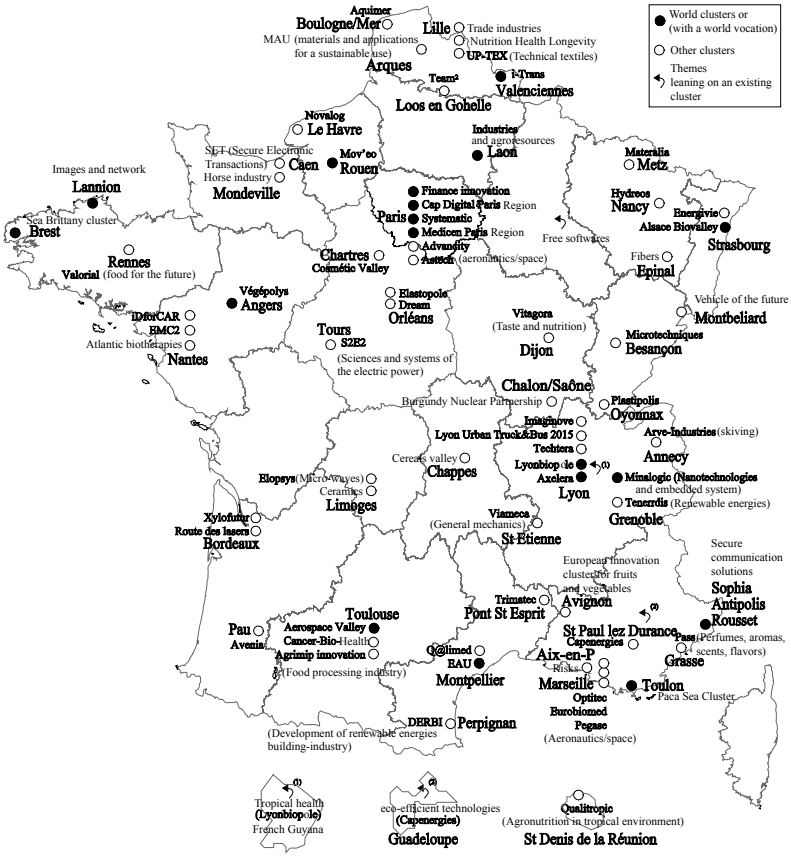

Figure 1.5. *Map of the competitiveness clusters (source: http://competitivite.gouv.fr)*

55. Agence nationale pour la recherche (French National Agency for Research).

56. Comité interministériel de l'aménagement et du développement du territoire (French interdepartemental committee for land settlement and development).

Recently, ANR has proposed common programs with ADEME[57] and the Fraunhofer Institute and carries out discussions on future cross-section programs. But it has few resources enabling it to finance only a small percentage of the research projects, even if these projects are for the most part interesting and promising.

Another report on innovation in France is by Michel Destot[58] [DES 00] which confirms the political interest for technological innovation; the issue here is to transform science and technology into growth and employment. It mentions the USA, Japan and Israel as examples of the transformation of innovation into economic success, which are to be followed.

Mostly devoted to financing, the report highlights the importance of the innovation culture, as well as its promotion, using the words of Edith Cresson (a former Prime Minister of France): "the innovative capacity of Europe constitutes a whole, from the education system to the "corporate culture".

Despite the reforms carried out, the education system does not really prepare youths for entrepreneurship; according to a survey published in March 2005 by IFOP (French Institute of Public Opinion), more than 75% of youths dream of becoming civil servants.

But education and training won, to then be combined with a tax policy favoring not only the creation of businesses, but also guaranteeing their sustainability.

Many institution managers parade the word innovation on their business cards, but there are not to our knowledge any State organizations concerned about the success of innovating businesses. A certain number of "pacts" have been proposed, including the small businesses pact of Oseo. The impact of these actions, with the aim of helping innovating businesses to durably succeed, is not evaluated by the main actors involved, i.e. the small businesses.

1.3.1. *Innovation and small businesses. Is small still beautiful?*

Eurostat, a Directorate-General on statistics for the European Communities, specifies that only 33% of French companies have innovating activities, whereas the EU average is 42%. For the period studied by Eurostat (2002 to 2004), Germany had

57. Agence de l'environnement et de la maîtrise de l'énergie (French agency for environment and energy management).

58. Report of the information filed by the Commission of finances, general economy and the plan, presented by the deputy Michel Destot to the French National Assembly on the 9 May 2000.

the best result: 65% of its companies had innovation activities, which were studied in terms of products (goods or services) and process. In France, we talk a lot about small businesses and their capacity to create jobs, but no one really seeks to reduce their failure rate. Bertrand Duchéneaut mentions a few origins of SME failure [DUC 96]. According to him, the personality, capacities and motivation of the leader plays a major role in success. Most founders of technological businesses believe that they are able to successively manage their companies. Other causes can be unpaid debts, a decrease in the orders in a given field or administrative difficulties. The Jospin Government carried out reforms on the taxation system, in order to simplify the procedures and to develop e-governement digital system. But we regret that companies, especially small businesses were not consulted. Consequently, the system has been simplified, but for the administration – the default amounts are generated on printed debit forms; the companies must correct them or pay these amounts, even if their income has decreased. They are then reimbursed of the debited surplus, but in most cases within a two-year period. Moreover, URSSAF (French organization for the payment of social security and family benefit contributions) keeps a part of it.

In a recent interview[59], Edith Cresson puts the emphasis on the fact that "the large groups build their accounts on the back of small businesses, and the administration has payment delays that are far too long . Small businesses need to be helped, because this is where there is a potential of employment, innovation and imagination. We talk a lot about small businesses in speeches. This is not only about giving money to small businesses, but about developing a cultural system which will take into account what small businesses do".

If a small business is not associated with a large group, it has no chance of receiving national subsidies, or European subsidies. The famous networked enterprises that everyone talks about, which are usually carried out by independent consultants and by small businesses, are not on the official European Commission list of possible legal companies; a consultant being part of a very large international network and a small business working with partners on the international level are considered to be isolated businesses.

The pact to support small businesses proposed by Oséo aims at associating large structures and small businesses with common projects. Since its official announcement, the proposed actions are meetings with purchase departments or large groups about a specific theme, such as the serious games used for training, i.e. air traffic controllers, police, nuclear plan. The employees of Oséo in charge of this program make the selection of the small businesses able to take part in these

59. www.lepost.fr/article/2009/01/26/1400274_les-freins-au-developpement-des-pme-par-edith-cresson.html.

meetings. This strategy deprives these businesses of the possibility of presenting their offers to inspire ideas in large groups.

The website proinno-europe.eu publishes a list of *Who's who* in innovation[60]. It includes 107 French innovation actors. They are for the most part institutional actors and small businesses are often ignored.

In the framework of the governmental reforms, a general direction of competitiveness, industry and services (DGCIS – in French) was created in January 2009. It includes a competitiveness and small businesses development department. We can find on the website a lot of information on the creation of businesses, but nothing on how to bring them to fruition. The DGCIS functions in information transmission – a small business does not have the possibility of sharing its feedback and is not asked about its needs or on the suggestions it could have.

To facilitate the participation of small businesses in community programs, a database of potential partners for the European programs has been created. But in a supply-demand system, it is not easy to find a company really corresponding to the demand. This gap is partially filled by Ubifrance and the DRIRE[61] which systematically send partnership requests on a mailing list. However, for more than 50 years artificial intelligence has invented the methods and tools enabling the relevant research; it is present in many community projects, but remains inefficiently used.

1.4. The future of innovation

With increasing frequency, the word innovation is used in close relation to the sustainable development expression and to the word environment. In the six work groups of the "Grenelle de l'environnement" (open multi-party debate in France about the environment), innovation does not appear clearly, as in the Grenelle 2, although it remains inseparable from the aims to be reached. The European Commission created a program called "eco-innovation". The year 2009 was declared a year of creativity and innovation, in order to instill dynamics about these systematic subjects. According to Forrester Research, innovation must be global to have a real impact on the economy.

A collective book *The Future of Innovation* [STA 09] has more than 300 contributions by world specialists, sharing their points of view from different angles depending on their fields and their cultures. It reflects the current dynamics and the

60. www.proinno-europe.eu/index.cfm?fuseaction=wiw.whoiswho&page=list&CO=5.

61. Regional Direction of the Ministry of Industry.

tendencies of innovation. According to most authors, innovation has a potential to generate tangible and intangible values, necessary for the prosperity of businesses and nations.

Here are a few quotes from this book:

> "We live in the global world, dealing with eco-systems, talking about Knowledge Society and still classifying things and working separately in the narrow domains considering technological innovation mainly. The most urgent is to innovate in the way of thinking"

> "Whether you are involved in teaching art and design or new product development for a blue chip consumer brand the priority is to provide services to citizens (…)"

> "Understanding innovation requires multiple perspectives for new products or services: from culture and mindset, social and commercial context, new ways of working…"

Chapter 2

A Multi-faceted Innovation

La réalité est à la fois multiple et une,
et dans sa division elle est toujours rassemblée.

(Reality is multiple and single,
and in its division, it is always joined.)

Plato

2.1. The pieces of the kaleidoscope

The word innovation is polysemous: there are as many points of view on innovation as there are fields covered by the word innovation. Many books have already discussed this subject, each limiting themselves most of the time to a specific point of view: innovation is either seen as a creativity process or as taking part in the technological field, in the design of a product, in marketing development, in political evolution, in organizational and social improvement or in cultural development; more recently, eco-innovation can be seen in the news. A group of people are linked to each type of innovation, who are most of the time specialized in their own fields. To innovate in textiles, for example, specialists of this sector get together: this results in an incremental innovation and rarely in a disruptive innovation. A multidisciplinary group could obtain infinitely better results. Technological innovation is probably the most known type of innovation, especially since it brings hope and is likely to contribute to economic development. The extent of its impact depends on the way it is associated with other types of innovation. It has the power to modify customs, culture, behaviors or values.

If the boundaries between innovation fields are still quite marked, they start to crumble in favor of cross-pollination.

This chapter presents the main facets and types of innovation and mentions some of the conditions encouraging innovation without borders.

2.2. From invention to innovation

What is the difference between an invention and an innovation? According to Daniel Scocco [SCO 06], an invention is the result of the individual work of a scientist or an amateur inventor, who proposes a new product, concept or method. Generally, a scientist files a patent and carries on researching to invent something else. This point of view is shared by Benoît Dubuis [DUB 07] and many others. In France, there are very few cases of scientists deciding to market their inventions themselves by creating their own businesses. The entrepreneurial spirit requires risk taking, which is not natural here. Governmental initiatives encourage researchers to create their own companies, but many prefer to continue their research in their respective laboratories. One of the reasons for this is the fact that technological transfer does not count in the evaluation of researchers. Only patent filing is given a value. Another reason is education, which also does not encourage students to become entrepreneurs and which considers research to be more noble activity than entrepreneurship. However, some research results are transformed in products, after a technological transfer by companies or by those wishing to become entrepreneurs.

An amateur inventor files a patent and seeks to market their invention. This is a painstaking task, which cannot be successful without perseverance and without associating a network of complementary skills with it (business intelligence, marketing, communication, sales, financing). The book *Réussites d'inventeurs* [CAL 07] discusses this aspect in 14 cases. According to the authors, an inventor has succeeded when their invention becomes a marketed finished product, i.e. a product which is manufactured and sold.

An invention has very little economic value if it is not transformed in an innovation addressing a specific market. We can quote many examples of transformations of inventions into successful innovations. When the scientists of AT&T invented the transistor in 1947, they patented it, but did not succeed in commercially exploiting this invention. In 1952, they sold licenses for $25,000 to Texas Instruments, Sony and IBM, who then accrued millions by exploiting it.

Xerox, in its two research centers of Palo Alto (Xerox PARC) and Grenoble (XRCE), is the origin of many inventions, of which the most memorable were not very lucrative for the inventors or for the company. The researchers of Xerox Parc

invented home computers long before Apple and IBM. But Apple and Microsoft are the ones who have commercially exploited Xerox's ideas [PIR 99].

The second personal workstation, after Xerox Star, was built in 1981 in France[1], in the framework of the Kayak project at the INRIA (National Research Institute in Computer Science and Automation). It was called Buroviseur (a multifunction workstation) [KAY 83]. It was equipped with a user-friendly and intuitive human-machine interface based on the windowing system (Xwindows[2]). It was also equipped with a mouse, a voice interface to make drawings and to control the phone, a phone interface inserted in the computer to monitor calls, an address book and a graphics tablet.The office automation integrated system developed in the framework of this project was built around a local network and included individual workstations (Buroviseurs) and shared-use specialized machines (print, files and mails servers, terminal concentrators and gateways to public networks). This architecture enabled us to implement the applications running in the workstation or allocated on several stations or servers. The print servers (printer and scanner), mail servers, a terminal concentrator and a Transpac gateway were developed from existing elements of the Buroviseur [ELL 87]. In 1981, the prototype was presented to French industrialists, who then noticed that this machine was too advanced.

It is not sufficient to have a good, practical and profitable idea, it must also be automatically applicable to achieve general approval. For example, the first copy of the Star machine from Xerox, Liza, did not bring any commercial success to Apple. Apple then asked Regis McKenna [MCK 85] for advice in marketing positioning. The latter proposed marketing it as a machine for printers. This is how Macintosh was born. It achieved very big commercial success. The iPhone is only a miniaturization of this machine and more precisely of the Star and the Buroviseur.

Andreas Pavel, the inventor of the Stereobelt, patented this technology, but Sony was the one to commercialize it as a Walkman. As a result of legal approaches, the Japanese firm granted him in 1986 an amount of $105,000. Apple also did not ask Pavel for a license to sell the iPod. In 1989, he filed a patent in the USA for another one of his inventions – a device combining the functions of a pocket audio player and a mobile phone. American authorities still granted him the patent.

This and other examples show that often the inventor is not the one benefiting from the exploitation results of its invention, but the "imitators" are. Sometimes, the invention occurs too early (for example, before Internet) for the industrialists to understand its impact. According to Avron Barr [BAR 94], there is generally a 20 year interval between the arrival of the concept and its application, as occurred for

1. http://www.digibarn.com/friends/curbow/star/retrospect/.

2. Later known on Unix systems under the name of X11.

expert systems. Indeed, they are just now becoming important when there is a massive retirement of experts and a requirement for knowledge capitalization.

As with Xerox, the Bull[3] computer company did not commercially exploit inventions such as the smart card and the Buroviseur, inherited in the framework of the technological transfer by the INRIA (Institut National de Recherche en Informatique et Automatique – National Institute for Research in Computer Sciences and Automation). They also did not know how to take advantage of the artificial intelligence tools developed at the CEDIAG[4], which was the pioneer on the market in the beginning of the 1990s; at this time, Bull's strategy was to sell computers and not software, let alone innovative applications.

We can also mention Netscape, which was the first to invent and commercialize a web browser, but did not succeed in maintaining its leader position. One of the causes was the use of anti-competitive means by Microsoft to thwart Netscape's browser.

2.3. A few definitions of innovation

Definitions are numerous and vary according to the person, considered field and professional group.

For Leonardo da Vinci, innovation concerns all fields. Jules Verne – another visionary – was passionate about technological innovation. Maria Sklodowska-Curie not only invented a new field, but also innovated by paving the way for women in scientific research.

According to *Encyclopædia Universalis* (French language general encyclopedia), the word innovation raises the terms of novelty, change and progress. It can be applied to any change introduced in the economy by an agent introducing a more efficient use of resources.

The Oslo Manual of the Organization for Economic Cooperation and Development [OCD 06], devoted to industrial innovation, means by technological innovation, the development/commercialization of a more efficient *product*, in order to supply consumers with services, which are objectively new or improved. By technological innovation of *processes*, we mean the development of new or notably

3. http://bull.com/.

4. Centre d'Etude de Développement en Intelligence Artificielle Groupe Bull (Center for the study and development of Artificial Intelligence, Bull Group).

improved production or distribution methods. It can involve changes affecting – separately or simultaneously – materials, human resources or work methods.

In the context of the European Union's Green Paper on innovation [EC 95b], "innovation consists of the successful production, assimilation and exploitation of novelty in economic and social spheres. It offers new solutions for the problems and thus makes it possible to address the needs of both individuals and society."

Amongst the most frequent definitions, we can find the following two. The first definition mentions a process beginning with an idea, which will then be transformed into a product. The second definition ("from the idea to the market") emphasizes the marketing of the result.

In his theory of economic evolution [SCH 12], Austrian economist Joseph Schumpeter specifies that innovation meets five main criteria: the manufacture of a new *good*, introduction of a new production method or of new *means of transportation*, implementation of a new *organization*, opening a new *market* and the conquest of a new *source of raw materials*. The latter is one of the most complete definitions since 1911.

For Jean-Pierre Waysse (Plastic Omnium), innovation is the result of a meeting between a dream or an idea and a need, as shown in Figure 2.1.

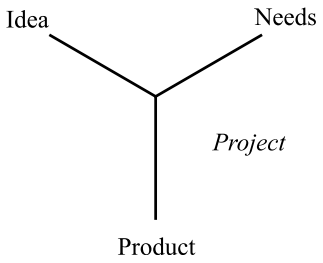

Figure 2.1. *Ynnovation*

This definition emphasizes the necessity of taking into account needs, because they represent a potential market. The authors of the book *Une France innovante*[5] [FRA 007], as elective representatives, associate innovation with the introduction of the Internet into the territories as a new means of communication.

According to Pierre-Yves Barreyre, innovation is a process. Its achievement is an original implementation, including attributes which are creators of values [BAR 80].

5. Innovative France.

His book is exhaustive concerning the different aspects of industrial innovation, with a product as the basis; this product is invented and manufactured using different materials and forms and it is then packaged and sold. He quotes Daltman, Duncan and Holbeck [DAL 73], who give the concept of innovation in three contexts:

– creative process combining at least two entities or concepts, in order to obtain a new configuration;

– social change with which a novelty becomes an integral part of the culture and of the behavior of the individual or of groups of individuals;

– new materials, new tools.

Therefore, Professor Barreyre [BAR 73] considers innovation as a problem to be solved. The solution consists of finding an original combination enabling the adequacy between three elements: a *need* to be satisfied (lightening the backpack of a mountaineer), the "concept" of an *object* satisfying this need (backpack with a pocket made of helium) and the *elements* (knowledge, materials, technologies) to make this concept operational. This definition is limited to product innovation.

However, he mentions four application categories: with a *technical*, *commercial*, *organizational* or *socio-institutional* dominant characteristic. In the first category, we can find new matters or products, new components such as the transistor, new finished products such as the ball point pen, new complex systems combining new or existing components such as computer aided logistics or packaging (tube-solvent) unknown up until then, use of new matters to carry out similar products (biofuel) or new methods (bonding to replace welding).

The second category is a new presentation of the product (a design or a packaging modifying its perception), a renewed esthetic-function combination (sportswear), another distribution mode (e-commerce), an original application of the same product, and an original means of promoting sales (Google), a still unknown commercial system (hypermarket).

The third category, *organizational* innovation, corresponds to new organization methods of work and companies aiming to improve their efficiency. It conveys the development or the adoption of a new organization of the work; it resembles procedure innovation, insofar as it contributes to modifying production and/or distribution methods. Scientific management, just-in-time logistics, the invention of department stores (in the 19th Century) and self-service restaurants are examples of this kind of innovation. Finally, the fourth category comprises socio-institutional innovation. It has an effect on the community organization. Kibbutz PGR[6] in Poland,

6. *Panstwowe Gospodarstwa Rolne*, Polish version of Kolhoz.

associations of producers directly selling their crops to consumers, or collective business systems, are examples of this type of innovation [FAV 08].

According to Debra M. Amidon, founder of the international network Entovation [AMI 03], innovation is a source of wealth and leads to the development of society. Its definition is as follows:

> "Creation, evolution, exchange and application of new ideas into marketable goods and services for the success of an enterprise, the vitality of a nation's economy and the advancement of society".

Her Knowledge Innovation holonomy[7] is presented in Figure 2.2. It starts with learning the "ongoing innovation" culture at an individual level. Individuals can be part of several organizations, such as professional associations, project groups or community of practices on the second level. At the same time, individuals can work for a company or an organization or study at university (level 3). In all these situations they innovate, because they are used to this, it becomes a reflex. Organizations represented by different levels from 2 to 5 thus acquire the capacity to innovate. John Kao defines innovation as the capacity of individuals, companies and nations to create the future they desire [KAO 08].

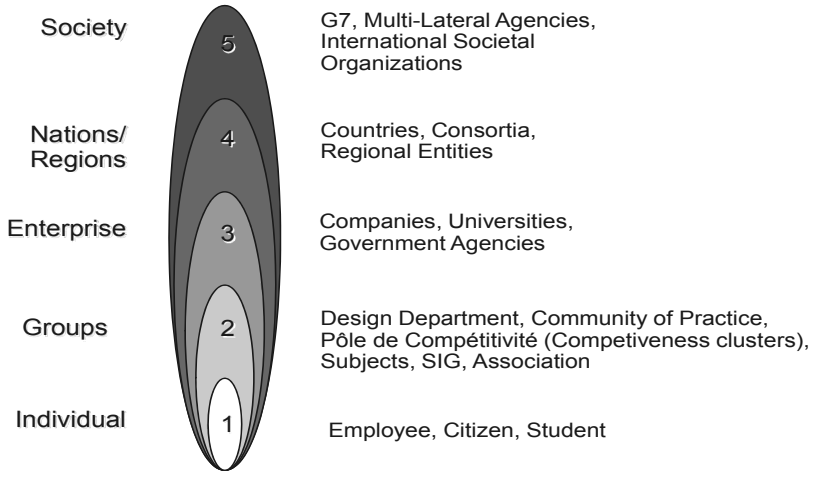

Figure 2.2. *Holonomy of innovation [AMI 97], adaptation [MER 07b]*

7. The word holonomy finds its origin in the Greek word *holon*, which means an autonomous unit with its own operating principles. In this meaning, it is complete and it is a whole. Holon can be part of several groups, such as professional groups, businesses, cities, countries – it brings its behavior into these environments [KOE 67].

In holistic logic, it is possible to develop another conception of innovation. This would be in line with the initial idea and leads to the success of all the ecosystems of the participants [MER 07b]. This process is to be seen in the context of dynamics, which should be lasting. From this point of view, innovation is also an attitude turned towards the learning process and daily practice. It is intimately a part of the culture of the knowledge society.

2.4. Innovation spectrum

Innovation can take various forms depending on the economic period, its role in society, on the way the process unfolds, the people supervising the process and participating in it, their organization, the managerial method, the organization of knowledge, the people talking about it, their ambitions or on trends. Technological innovation "can be high tech, low tech (uses of technology) or both at the same time" [GOD 10]. There are other classifications – this reveals a significant range of possibilities in its practice.

2.4.1. *Incremental and radical innovation*

Incremental innovation is the most frequent: it consists of improving or creating other variants to existing products, services or methods.

Generally, research and development management is in charge of innovation, whereas other managements will industrialize and market the results the R&D department's work. As an example of such an innovation, we can mention hybrid cars, the Airbus A380 plane, organic packaging, the addition of a functionality, and improvement of a service.

A *radical* or *disruptive* innovation provides a new technology, a new approach, a product or a service which does not yet exist or which creates new markets and new uses. Thus, Stereobelt (which then became Walkman) is a radical innovation, like Minitel or serious games (playing or learning in virtual environment with a civilian or military prospect).

According to Pierre Devalan, an engineer at the CETIM[8], disruptive innovation consists of marketing radically new products or services [DEV 06]. It is a key-element of competitiveness and a necessity for companies. Its implementation however is far from simple. Pierre Devalan notes that the strategic business models based on a continuous evolution turn out to be inadequate: a new culture is needed,

8. Centre Technique des Industries Mécaniques http://www.cetim.fr/.

which takes into account the intangible; the company must learn to change professions and to develop a long-term strategy based on innovation. There are many changes to be made simultaneously.

The expression "disruptive innovation" is used by many media – it is considered to be a magic wand able to help industrialized countries eradicate crisis. The consultation on the Internet of the future [INT 09], launched by Ministers Nathalie Kosciuszko-Morizet, Luc Chatel and Valérie Pécresse (closed on the 13th July 2009), also mentions it. One of the conditions for causing disruptive innovation is the development of a new culture; a knowledge society culture including the ability to think differently, which is not always easy.

When Bull decided in 1985 to create the CEDIAG to transform research results in the field of artificial intelligence (AI) into software products and services (innovative applications), this was indeed a radical innovation. Previously, Bull was designing and selling its own computers. Selling software and associated services was imposing an innovation in selling methods, in economic models and in the way of evaluating the efforts of commercial engineers.

Selling an IT solution with a large server and many computer stations and peripherals is not the same type of effort as selling software, solutions or tailored applications. Indeed, the interlocutors are not the same.

Whereas an IT solution is sold to the head of information systems, the sale of software and application programs requires more effort, insofar as it covers several categories of users in order to meet their needs. The Bull strategists decided to limit the sales of the software, solutions and services only to Bull computers, which considerably limited the market. The commissioning policy proposed to commercial engineers was not consequently modified, leading to a lack of motivation for selling artificial intelligence products and associated services, in which Bull excelled.

At the end of the 1980s, CEDIAG, which became the world pioneer in this field, decided to hire its own sales and marketing people. These software programs were used by Bull for the conquest of new accounts and markets. Unfortunately, the financial criteria were not changed to take into consideration the tangible and intangible profits which were generated thanks to artificial intelligence tools. The new executives stopped AI activities in 1994. The competitor of CEDIAG, Ilog[9] has just joined IBM, notably for its software programs of knowledge capitalization and of constraint programming invented by Bull.

9. www-01.ibm.com/software/websphere/ilog-migration/.

Another disruptive innovation example is the economic model of open source software. The term "open" is not synonymous with free, but assumes the four following freedoms[10]:

– The freedom to run the program for any purpose.

– The freedom to study how the program works, and change it to make it do what you wish. Access to the source code is a precondition for this.

– The freedom to redistribute copies so you can help your neighbor.

– The freedom to distribute copies of your modified versions to others. By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

The open source software editors make profits by offering training and other associated services, such as help for the development of specific applications.

It is in this breakthrough spirit that the University of Innovation was created[11] in 2003, to introduce students to the best actors of innovation. The other goal of the event was to improve knowledge and visibility of this Master of Innovation. The University of Innovation has turned its back on the previous logic – in this context, students were choosing "innovation leaders" and invited them to explain their approach over a morning within the school.

Lunch and the afternoon agora, in the presence of local businesses, had the objective of creating synergies between the three groups. Instead of traditional résumés, students prepared posters graphically explaining their ambitions and skills.

Amongst other radical innovation examples, we can mention Netscape, inventor of the web browser, or Archimex[12], which developed its activities around the idea of food-industry waste recovery to transform it, amongst other things, into active cosmetics components. In addition, the introduction of beauty creams by Helena Rubinstein was also a radical innovation.

The *Funtheory*[13] aims at educating citizens by surprising them – steps transformed into a piano attracting more people than an escalator, a glass collector becoming a game box and we win by putting glass into it…

10. http://www.gnu.org/philosophy/free-sw.html.

11. By Eunika Mercier-Laurent and Régis Lecoeuvre for the MSCI Master of Innovation ENSAM (Ecole Nationale Supérieure d'Arts et Métiers).

12. http://archimex.com/.

13. www.thefuntheory.com/.

In 2001-2003, the team of Disrupt-it, a European project [DVI 04] focused on the barriers and enablers of disruptive innovation. Participants analyzed several cases and deduced some conditions "to make it happen". Amongst them we can find a holistic understanding of innovation, opportunity recognition ability, the work of co-creation, an inspiring environment, the art of choosing adapted tools and methods and skills as well as resources (access to knowledge).

2.4.2. *Closed innovation*

This is a classical model of innovation, still very much set in many companies – only the R&D department can innovate. This kind of innovation requires a lot of effort and can thus produce products which are very little or not at all accepted by customers. There are many examples of this type of innovation in the food industry, where the introduction of a new or improved product on the market requires effort, notably on the advertising level.

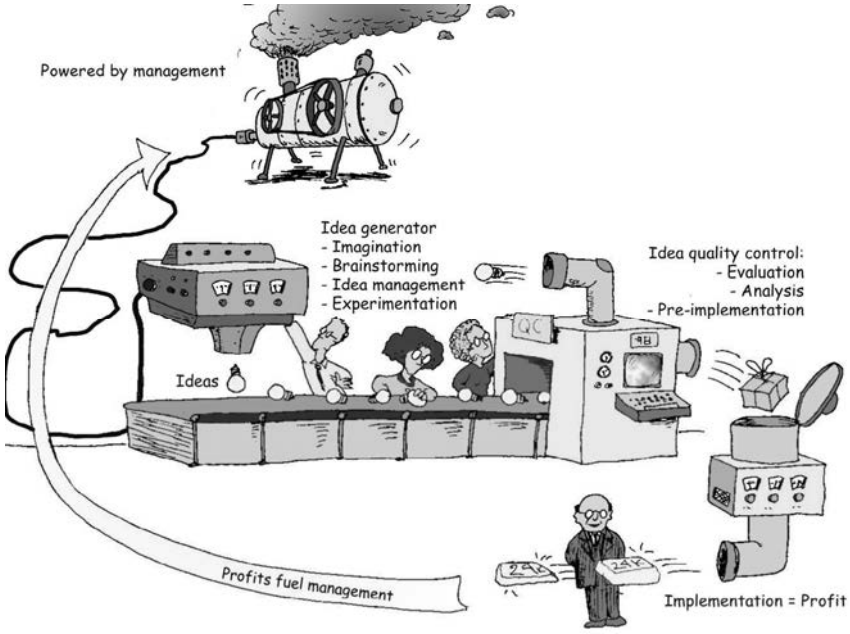

Figure 2.3. *Closed innovation (source: www.jpb.com/ [BAU 09])*

A Danone booklet designed for subscribing customers explains for example that to release the new Volvic water "touch of fruit", two years of research were needed,

whereas other simpler solutions could have been used if the R&D team had thought about them.

This type of innovation, notably in the industrial sector, can lead to a productivity paradox [AMI 97]: R&D spent a lot of time inventing and manufacturing a product that did not sell, because it was not meeting the needs of the market or it was invented too early. Figure 2.3 illustrates the closed innovation process.

2.4.2.1. *Participative innovation*

This consists of involving other internal sectors in the creativity process in addition to the R&D sector – management, managers and employees are mobilized to come up with good ideas. DGA[14] groups together under the term of participative innovation, the innovative projects are initiated, carried out and validated by employees with no assignment in the field concerned with innovation. Participative innovation is practiced by other major groups such as Safran, Renault, Solvay, Société Générale, EDF or l'Aéroport de Paris (Paris Airports). A participative innovation approach must be decentralized and facilitated. To have an innovation facilitator is then essential. In most cases, companies name a Chief Innovation Officer (CIO)[15]. This function is not always full-time. The facilitators evaluate the suggested ideas and supervise their implementation. They can call upon spontaneous propositions or ideas on a given subject. To motivate participants, it is important to value them. This recognition can be monetary, honorary (award ceremony in presence of the peers and hierarchy) or professional. In this spirit, some companies organize innovation competitions on a regional level, and then on a national and international level.

There are clubs or associations such as "Innovactors" or the "Chief Innovation Officers Club", which organize events enabling participants coming from member companies to talk about their innovation practices. The second club is strictly reserved for Chief Innovation officers, and it is not open to outsiders.

2.4.3. *Open innovation*

The feedback, within the company, coming from those in contact with customers, such as sales, customer service and marketing people, can lead to the improvement of a product or a service. But the involvement of customers and partners can also lead to the creation of new offers.

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14. French General directorate for armament.

15. Expression suggested by Debra Amidon, who named Leif Edvinsson the first CIO in 1996.

The Users' Club of Artificial Intelligence Tools was created following this logic in 1987. At the beginning, it brought together education and research partners and later it included all the interlocutors. Club meetings helped to improve and to refine the software, as well as to design new more adequate software applicable to the real needs of the users.

Texas Instrument (TI) was amongst the first to involve customers in their innovation process via specific services. They created a laboratory in 1985, where customers could design their boards and carry out tests, while benefitting from the surrounding know-how. These exchanges were fruitful – some applications were transformed into new TI products.

Michael O'Leary, CEO of Ryanair, asked his customers about their ideas on the next charged services on board. He rewards customers with ideas that have been carried out with €1,000.

BMW and Volkswagen also practice this type of innovation – they try to make new ideas emerge, while taking into account the desires of the users (drivers and passengers).

Since 1989, Debra Amidon has recommended involving customers in the innovation process [AMI 89]. According to Hanne Schou-Rode, Vice President of Novo Nordisk, 80% of good ideas come from outside the company/organization [QUA 07]. According to this principle, Novo Nordisk launched several programs to involve patients and partners in their innovation process. The *Youth Panel* program associates young patients with their family circle, to improve their knowledge of diabetes and to rethink the future of the patients. The DAWN program aims to provide access to care[16] to the largest number of people and to better integrate the psychosocial aspect during the initial educational management of type 1 diabetic patients and their family circle in the hospital [SKO 04].

Orange is looking for ideas in innovative small businesses, which are invited to present their products once a month in the Cantine[17]; but its own customers do not have the possibility to contribute to their innovation processes, by visiting for example the Orange website or the customer service webpage.

Amongst automobile manufacturers, Peugeot launched a design competition[18] in 2000. "Budding designers" were invited to draw the 2020 Peugeot car. In the same spirit, the Polish chocolate manufacturer Wedel organizes a packaging competition

16. Program of change of the global access to medical services, www.novonordisk.fr.

17. *Mobile Monday*. http://www.mobilemondayfrance.org

18. www.peugeot.com/fr/design/concours-de-design.aspx/.

Wedel Vintage – Timeless Inspirations. It is a shame that it is limited only to young people, because older people have memories about the products from the time of the Eastern Bloc, when this manufacturer was nationalized and despite the provision difficulties was still producing excellent chocolates and confectionary.

However, many companies do not yet involve – or do not wish to involve – their customers in this process. At SNCF (France's national state-owned railway company), where participatory innovation is a must, only employee ideas count, customers do not have the opportunity to submit their ideas. At Nestlé, innovation is the exclusive domain of R&D employees. Danone organizes product tastings for parents, in order to convince them to buy the products. Although considered to be an innovative company, Google innovates on its own. Most of the professionals, notably in the automobile sector, consider that customers do not know anything about their job and thus cannot take part in their innovation process.

Although known as an innovative business and one of the first companies to sell online, Amazon only does *pushing* ("those who buy this, have also bought that").

Customers are a source of knowledge and they know what they want. The majority of e-commerce websites is tracking exactly what visitors do when they are on their website. They do not seek the customer's opinion, most notably why they did not buy the considered product. Suggestions on products and services customers desire are not encouraged and companies do not take an interest in their knowledge of the competitors' offers. Evidently, discussions in specialized forums are tracked, but it requires a significant analysis effort; for now, it is entirely automatic.

2.4.4. *Collaborative innovation or co-innovation*

Several companies and/or organizations sometimes join forces to innovate together. In 1981, Bull created ECRC[19], a collaborative research center with ICL and Siemens in Munich. It is in this center that the first constraint programming language and the deductive database were invented. European research programs and more recently ANR[20] programs are led according to this principle. European programs group together researchers and companies from several countries to work on a given subject. Generally, ANR programs involve French researchers and companies, except for the French-German research program, PICF[21].

19. European Computer-Industry Research Center.
20. National Research Agency.
21. Inter Carnot-Fraunhofer program.

Although this type of innovation is more productive and economical, it can raise intellectual property problems, if the principles are not defined at the beginning. Usually a consortium agreement is defined and signed by all participants. Generally, the project results are the property of all participants, who can create their own variants from this common work.

2.4.5. *Product innovation and service innovation*

Product innovation consists of introducing a new product or incorporating novelty into an existing product. Just selling the product is bringing an income, whereas selling a product with associated services enables us to accrue even more money and to secure the loyalty of the customers. Some categories of products, notably complex and knowledge intensive products, cannot be sold without associated services, such as installation, training, customer service or maintenance. Thus, computer manufacturers had only begun to offer relative services at the end of the 1980s, whereas they already had the know-how in these fields. The automotive industry, in partnership with car repair shops, proposed an integrated offer of "car and maintenance". Some car dealers add to this associated bank loans and insurance, others offer significant reductions on the sale of cars, only if the paying maintenance is made in determined garages.

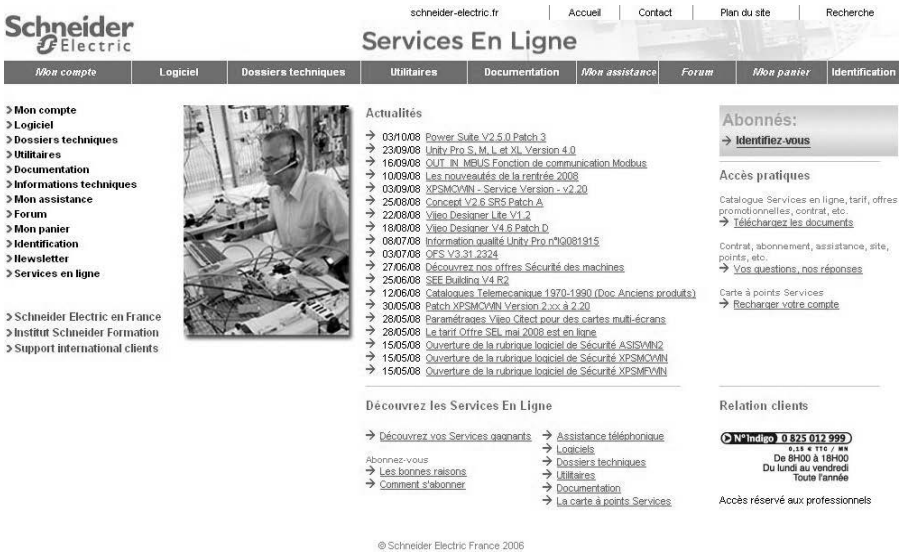

Figure 2.4. *Online technical support system of Schneider Electric [SCH 08]*

The Internet has brought new online sale opportunities, notably expert services on subscription. Thus, in 1995, the Schneider group proposed an online technical support service to selected customers. Figure 2.4 shows the homepage of this service.

Such a sale represents an incremental innovation allowing us to generate income from the existing expertise. The latter is innate to a support system for technical and logistical problem solving. Nowadays there is a plethora of services available on Internet, such as e-commerce, engine searches for the best price, travel optimizer or advice via forums connecting users of the same product, equipment or service. Artisans create a common website offering service proposals related to their know-how, while farmers group together to sell their products directly to consumers.

In 1999, ANRT[22] organized the first conference on innovation in services. It was presented as a means of combating unemployment and as an asset for the development of jobs and territories: it associates the existing knowledge with the skills in waiting[23], thus encouraging a dynamics of value creation. This is a step towards a knowledge economy. At the beginning of the 2000s, the Accor group invented the corporate concierge, at first within the group, to make the staff more available and focused on their work. Then, this concept became a commercial offer proposed to companies. Metalsa, a Mexican firm, go even further by introducing a concept of employee "well-being".

Amongst the current tendencies, we find home care services, such as finding a plumber, grocery shopping, baby-sitters, taking care of the elderly, etc. These services are not innovative, because they already existed before the concept of "home care services". But the act of creating a company to group them together or to propose them to companies is an innovation. In the knowledge society, the needs for services based on the exploitation of knowledge will increase – find the person or the machine able to solve a problem with the available resources, use the traditional know-how to fight insects instead of destructive chemical products, find a natural conservant and much more.

The ecological tendency has in addition created opportunities for new services such as an energy optimizer combining traditional and renewable energies and skills or research for new solutions minimizing the impact on ecosystems. For most of these services, ICTs have a major part to play, notably in remote services.

22. French national agency for technical research.

23. Leif Edvinsson, Capital in waiting, Critical eye, June-August 2005.

2.4.6. *Organizational innovation*

Organizational innovation refers to the new ways work can be organized, and accomplished within an organization, in order to encourage and promote competitive advantage. It encompasses how organizations and individuals specifically manage work processes in areas such as customer relationships, employee performance and retention, and knowledge management. An example of such innovation could consist of giving more autonomy to the employees, on the decision-making level and encouraging them to contribute to the innovation process [RAV 08].

Various innovations in the organization of the working space have also been tested. Amongst those, we find the adaptation of the workstation making it more ergonomic – proximity of tools and of information, comfortable seats, etc. In southern countries (e.g. south of France, Portugal, Spain, Greece, Latin America, North Africa, etc.), people take a short nap, whereas in Japan and China there is a mandatory exercises break. Amongst the companies displaying their code of ethics on their websites, Metalsa[24] is the only one to our knowledge to really put it into practice. Their *Modelo Metalsa* defines an enterprise culture assuming that to be able to design, manufacture and supply customers with good quality products, employees must have a good quality of life.

The elements of this model are presented in Figure 2.5, where:

– TPQ: total personal quality; its components are the respect of principles and values, friendly work environment, personal development and contribution to the company productivity – have the objective of continuously improving;

– QWL: quality of working life is a lifestyle.

The role of the leaders is to encourage the personal development of their teams and to favor the sustainable development of the business, while respecting the environment.

Since the beginning of the world, human enterprises have had to overcome all the experimental stages, always aiming to improve efficiency and growth. Nowadays industrial societies are no exception to the rule. They tested the methods proposed by F.W. Taylor, *Strategic Business Units* of Alfred Sloan, TQM[25], QSE[26], EBN[27] or the networked enterprise, also called learning organization. One of the

24. www.metalsa.com.mx/modelo_metalsa.html.

25. Total Quality Management.

26. Quality, safety, environment.

27. Extended Business Network.

new tendencies is the organization in ecosystems, launched by Intel. This model consists of involving students and stakeholders in the spreading of Intel standards. In Europe, this model is used by SAP [PEL 02]. It was introduced to Bull in 1987 without introducing the word "ecosystem".

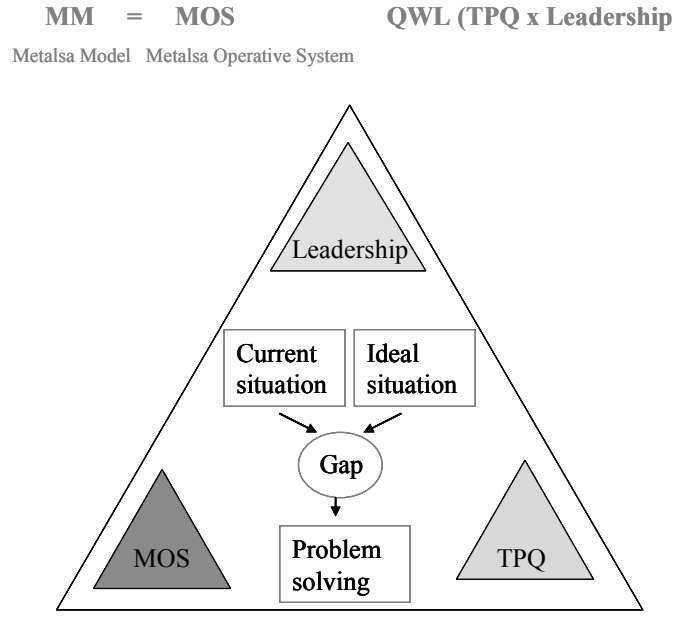

Figure 2.5. *Metalsa model*

Nathalie Ravidat [ESC 08] mentions three types of organizational innovations: organization of manufacturing (Taylorism, Fordism), organization of the company (Fayolism, autonomous teams, socio-technique, group technology) and skills organization in virtual and networked companies. According to *Encyclopaedia Universalis*, an enterprise can be simple, hybrid, mechanistic, based on skills or on results. Its architecture and operation have an economic and social influence on its environment [DHE 06].

Globalization and the Internet have shaken up the existing forms, without however making legitimate networked organizations inside and outside the company. A small business which is part of a major international network is always considered to be a SME by national and European institutions, and is thus less credible according to them. ICTs are also at the origin of virtual and mobile organizations. According to the OECD, technology has become a strategic tool:

"Technological advances and the diffusion and use of ICT have boosted economic change over the past decade. ICT has become a strategic enabler of companies' organisational and technological innovation" [OCD 07]. The new tendency of promoting and valuing technological innovation has led to new organization forms, such as incubators and clusters. The principle of the latter, known in France under the term of *pôles de compétitivité* (competitiveness clusters), is the private-public partnership. Amongst these concepts related to the ICT use in companies, we find the Enterprise 2.0. This is a *buzzword*, which was introduced with the arrival of the Web 2.0 in 2006.

Andrew McAfee, from the Harvard Business School, defines Enterprise 2.0 as "the use of emergent social software platforms (ESSPs) within companies or between companies and their partners or customers" [MCA 09]. It is thus about allowing the access and the sharing of information within the extended business network via tools of the Web 2.0, such as wikis, blogs, social networks, RSS, Facebook and Twitter [NEW 09]. However the business impact of emergent social software platforms (ESSPs) cannot really be measured.

Figure 2.6 presents an overview of five generations of managerial methods. The 5th method corresponds to the knowledge society. Debra Amidon [AMI 97] introduced the term of *Knowledge Innovation*®[28].

These methods successively manage the product, project, company, customer and knowledge assets. The core strategy of the 5th generation company is a participative innovation system. Customers and partners are part of the company learning network. Skills are vital for its success. They have an influence on the dynamic strategy of the company/organization. Computers equipped with capacities of intelligent knowledge processing work in symbiosis with their users. This fact leads to a fundamental change: thinking differently about the way to organize the whole system.

During the time of industrial economy, organizational innovation deals with optimization of processes, in the knowledge economy, it must manage skills and knowledge organization [EDV 02, SAV 96]. An innovative organization of the company combines the hierarchical structure and the internal and external networks of knowledge cultivators, which are mobile for the most part. They are equipped with "intelligent e-assistants" able to process not only information, but also knowledge. This type of organization is only efficient if it relies on an organized and optimized knowledge flow [MER 08].

28. Recorded by Entovation Intl.

	1st Technology as the Asset	*2nd Project as the Asset*	*3rd Enterprise as the Asset*	*4th Customer as the Asset*	*5th Knowledge as the Asset*
Core Strategy	• R&D in Isolation	• Link to Business	• Technology/ Business Integration	• Integration With Customer R&D	• Collaborative Innovation System
Change Factors	• Unpredictable Serendipity	• Inter-dependence	• Systematic R&D Management	• Accelerated Discontinuous Global Change	• Kaleidoscopic Dynamics
Performance	• R&D as Overhead	• Cost-Sharing	• Balancing Risk/Reward	• 'Productivity Paradox'	• Intellectual Capacity/ Impact
Structure	• Hierarchical; Functionally-Driven	• Matrix	• Distributed Coordination	• Multi-Dimensional 'Communities of Practice'	• Symbiotic Networks
People	• We/They Competition	• Proactive Cooperation	• Structured Collaboration	• Focus on Values and Capability	• Self-Managing Knowledge Workers
Process	• Minimal Communication	• Project-to-Project Basis	• Purposeful R&D/Portfolio	• Feedback Loops and 'information persistence'	• Cross-Boundary Learning and Knowledge Flow
Technology	• Embryonic	• Data-Based	• Information-Based	• IT as a Competitive Weapon	• Intelligent Knowledge Processors

Customer *Retention* → Customer *Satisfaction* → Customer *Success*

Figure 2.6. *Five generations of management methods (source: D. Amidon The Innovation Strategy for the Knowledge Economy, Butherworth Heineman, 1997)*

2.4.7. *Cultural innovation*

Two points of view are possible regarding this type of innovation. One can simply be the innovation related to cultural activities, such as music, painting, theater, cultural heritage. Art can be introduced into companies to motivate and increase imagination and creativity or to better communicate, as is advocated by *The Banff Centre*[29].

The other perspective is broader: it introduces a change in the working methods, in values or behaviors. As an example, we can mention organic farming, the search for the well-being of the employees or the introduction of the ethical code into companies' practices. It is not limited to the cultural sector, despite what we could believe by browsing the French-speaking web.

For example, the transformation of Barcelona in the 1980s was designed as a social and identity project with the emergence of the democratic and post-Franco city. The emphasis was put on the redevelopment of the industrial city into a city of services. The current issue is to introduce an innovation culture into companies[30] [MER 09a] and into all social layers. The knowledge society implies *the innovation of attitudes*. Knowledge cultivators learn to share knowledge and experiences, to learn, to innovate, to use individual and collective knowledge in order to preserve ecosystems, to think differently, to work in collaboration, to capture opportunities, to create and manage the collective intelligence and to work in synergy with the connected computers assisting them.

2.4.8. *Social innovation*

Social innovation introduces a new behavior. The invention of the phone enabled us to communicate at a distance. Social networks facilitate the connection between people, research at distance for a specialist or a friend. But the introduction of a novelty in society is not easy: Parmentier proposed reserving potatoes for the aristocracy, in order to arouse interest in their consumption in France. Helena Rubinstein first proposed her cosmetics to fashion addicts, before popularizing them by selling them in supermarkets. Recent movements such as de-growth, slow food or slow down also illustrate a cultural change by adopting different habits, in opposition to those previously practiced.

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29. www.banffcentre.ca/.

30. www.eds.com/news/features/4279/.

2.4.9. *Cognitive innovation*

Cognitive innovation modifies the way of thinking and using mental models. This refers to the famous "thinking outside the box", about the ability to choose a mental model which is applied in a given situation. Whereas most computer science training teaches how to think "data", artificial intelligence enables us to learn how to think "knowledge". Figure 2.7 represents these two ways of thinking. Playing with the same box of Meccano® we can:

– classify the objects: bars with four holes, bars with six holes, screws by sizes and wheels; this corresponds to the "data" approach; or

– imagine the toys we can build with the available pieces by using the "knowledge" or problem solving approach.

Figure 2.7c represents instructions to follow for the construction of a toy – this corresponds to the know-how.

In this spirit, Allen Newell [NEW 82] has proposed a new way of modeling knowledge to make it "comprehensible" with computers: conceptual modeling independent of the implementation.

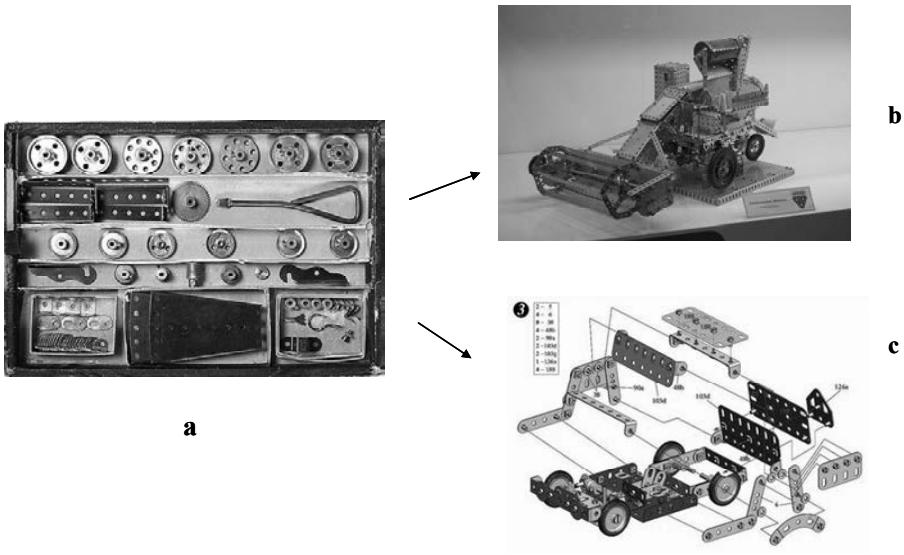

Figure 2.7. *"Data" and "knowledge" thinking (source: www.girders-and-gears.com and http://sizygie.free.fr/)*

In the 1960s, Edward de Bono developed the concept of lateral thinking [DEB 67]. The main objective of his method is to get new, unexpected ideas. For this, the "lateral thinker" must be able to modify his/her perception of the world. This way of thinking is not natural – we need to make an effort to find alternative points of view. His six hats method [DEB 99] is used to solve problems in creativity sessions. Each hat represents a different way of thinking and participants can play several hats during one session.

Some Russian scientists have also worked on the "thinking differently"; amongst them, the most well known in France is Heinrich Altschuler, the co-creator of the TRIZ method[31]. This method is mainly used for industrial design. TRIZ principles are at the basis of a patent analysis software amongst other things.

Complex problem solving could rely on a combination of global, systematic and holistic approaches [MER 07b].

Cognitive innovation is at the basis of mental flexibility. Switching from the *faster*, *cheaper*, *better* logic to knowledge economy, from the employee status to an entrepreneur status, working in a complementary logic and not in a competition one, are also examples of cognitive innovation.

2.4.10. *Economic innovation*

Economic innovation proposes new ways and models for value generation. Amongst them, we can find microcredit, invented by the Bangladeshi banker and economist Muhammad Yunus. Since this invention he has been considered the banker to the poor and was awarded the Nobel Peace Prize in 2006. Microcredit generally consists of allocating small-amount loans to entrepreneurs or artisans who cannot access classic bank loans. It has mainly developed in emergent countries and enables the fulfillment of micro-projects favoring the activity and the creation of wealth.

With the development of Internet services and start-up companies several economic models have been created and experimented with. One of them is the Google business model. Their Google Adwords are the main income source. Using its search platform, search and partner network, Google is monetizing web traffic by pay per click. The open source model enables incomes to be generated from services related to the software, such as training or specific application development. Selling product functionalities is another economic innovation example concerned with the

31. Теория решения изобретательских задач.

environment. It consists of making people pay for a service or for the use of goods, instead of buying equipment that will only be used occasionally [BUC 05].

The pull economy, introduced by John Seelly Brown, John Hagel and Lang Davisson [SEE 10], recommends conversing with customers and observing them via Web 2.0 tools in search for the new tendencies a company can turn into products. This consists of innovating with customers [AMI 89], but also completing this relation using discoveries made with the help of ICTs. This approach facilitates the connection of company or research center talents with new needs, such as for example, finding the name of an unknown object of which we have just taken a picture.

2.4.11. *Educational innovation*

The introduction of ICTs has changed the way of learning and teacher-student interaction. New and more adequate pedagogies have been developed through e-learning experiments carried out in universities and other schools. This new pedagogy puts the learner at the center of the system. E-learning platforms have also evolved to adapt to the needs of the actors. Tools for collaborative work, such as wiki, facilitate the work in groups at a distance and asynchronously – students can contribute at any time and any place. Smartphone capacities have contributed to the development of m-learning (mobile). Currently, electronic and serious games are making their entrance into 3W education[32]. Training in immersion in a virtual environment is already practiced in some companies.

Marc Giget, a professor at the CNAM of Paris, invites outsiders to intervene in his course on innovation. Most of the time, this is about product or technological innovation, but this approach gives students a broad spectrum of innovative activities in the enterprise world and in competitiveness clusters.

2.4.12. *Innovation centered on the needs of the customer*

This is the *outcome-driven innovation* proposed by Tony Ulwick, founder of Stategyn [ULW 07]. It is centered on the needs of the customer buying a product they require to do their jobs better.

Another way of taking into account the needs of the customer is to involve them in the innovation process [MER 07a].

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32. What you want, where you want, when you want.

2.4.13. *Eco-innovation*

After the alarm having been raised several times by astronauts, Captain Cousteau, the Earth Charter Association[33], Al Gore, Nicolas Hulot and Yann Arthus-Bertrand, protection of the Earth has become a priority. The career of the last two shows how to become a leader, starting from the job of traveller or photographer. The European Commission has launched an eco-innovation program[34]. This is considered to be an "eco-innovation", which is any form of innovation leading to the improvement of environment protection. We take into account new production processes, new products and services, new management methods, as well as all uses or implementations able to prevent and reduce environmental risks: pollution and other negative impacts due to the use of resources in the lifecycle of human activities. Priorities are transportation, recycling, use of sustainable building techniques and materials, cleaner production and packaging techniques for food and drinks and the recognition of environmental criteria for purchases, and adoption of a rational use of resources by companies. At the same time, the evolution of the quality approach to QSE introduces the notion of the "eco-reponsible" product. On the national level, ADEME has been created and a common research program has been launched with ANR, to promote and finance innovation while taking into account the previously mentioned criteria.

However, these innovation approaches are still restrictive, because any innovation must take into account environmental aspects [MER 07b].

2.4.14. *Global innovation*

According to Forrester Research [DEL 07], it consists of a world ecosystem of collaborative innovation, which is organized in innovation networks between countries, companies, universities and other organizations. According to Forrester Research, nations do not all have innovation capacities. Within the world innovation network, they tally up their strengths and join forces with nations with complementary assets.

The innovation process plays the role of an integrator of all enterprise processes [MER 07a]. Innovation thus comes down to an attitude of "knowledge cultivation", practicing it daily in all its related environments, such as the company, the city, the region, or the professional association. Global innovation is collaborative and does not have any field boundaries. It integrates the environmental aspects and enables us to produce tangible and intangible values for the success of all the participants of the

33. www.earthcharterinaction.org.
34. http://ec.europa.eu/environment/eco-innovation.

process. It relies on individual and collective knowledge and on present and past knowledge as well. It cannot exist without a vision of the future shared by all the actors involved.

2.5. Innovation paradoxes

As previously mentioned, innovation is considered to be the driving force of the economy. However, a few paradoxes due to human nature should be pointed out and avoided.

2.5.1. *Paradox of novelty*

In chemical, cosmetic, food, DIY industries and many others, producers of goods follow a logic that opposes "what the customer wants". Customers are not even consulted. When the sale of a given product starts to decrease, they seek to extend the market addressing new customers with a new product and they stop producing the previous one. This "innovation" causes the frustration of former customers who were satisfied with the previous product. In the chemical industry and especially in the beauty products field, the fashion factor plays a predominant role. A customer used to a product or, for example, a color of lipstick is frustrated to not be able to buy it anymore.

This is exactly the same in the food industry, in building or in the simple DIY. Sellers of construction equipment – doors, windows, fences, locking systems, etc. – often change standards, making it impossible to repair or replace components.

Innovation consists here of proposing a better product and not necessarily a new one.

2.5.2. *Productivity paradox*

This symptom is characteristic of the 4th generation of management methods (Figure 2.6). The company has invested in the development of a new product, but they did not reap the expected return on investment. This is caused by the lack of knowledge of the market, of customers and their needs.

2.5.3. *Organizational paradox*

An organizational innovation does not always lead to the expected profits and can have serious consequences on the quality of customer service, on the

development of activities and on the territorial development. In order to absorb a competitor or do economies of scale, companies merge, which leads to lay-offs. A delocalization motivated by the fast reduction of expenses and the fast increase of profits generally leads to lay-offs and to the devitalization of territories.

An innovation leading to a bad organization could disturb the functioning of the production-customer supply chain. An example of such an experience is given with the new organization of the energy industry in Poland.

The Energy Ministry has been absorbed by the Economy Ministry: energy is no longer visible on the first page of the governmental website, www.mg.gov.pl/. Production, distribution and energy services have been placed in separated and independent organizations. The "production-distribution-services" knowledge flow has thus been destroyed, like the visibility of the Polish energy industry, which is however amongst the pioneers in the use of renewable energies.

2.5.4. *Innovate, yes, but not too much*

While everyone seems to be dreaming about disruptive innovation, frequently the fear of disturbing, making waves or overdoing it, remain major obstacles. During competitions between innovative companies, it is more frequent to see 1st place given to a mode of transport for the elderly or to a manufacturer of industrial fans, whose objectives are immediately understood by all members of the jury. The expansion of the market by exportation is also considered to be an innovation. Even within the most concerned communities, incremental innovation is preferred instead of disruptive innovation. Project/proposal evaluation committees are choosing an application representing a moderate innovation; breakthroughs are seen with suspicion and little accounted for by selectors. It is the same case for different competitions – those in charge prefer to only take into consideration the "politically innovative" in tune with the times, rather than disruptive innovations, which are considered more risky.

2.5.5. *Innovation and small businesses*

It is obvious that a small business is much more reactive to the innovation process, because its subsistence relies on it. Answering a national or European call for proposals requires at least one month of intensive work. Which small business could afford to work for one month for free without being sure of being selected for funding?

2.5.6. *Multidisciplinary paradox*

While transforming ideas into innovative products and services requires more and more multidisciplinary knowledge, the evaluation of projects filed in European and national programs is successively carried out by several experts in one field. This sometimes causes disastrous results for very good multidisciplinary projects, because each expert is looking for excellence in their own field.

The innovation process must thus evolve to adapt to this new context: this assumes an understanding of the knowledge economy, as well as a deep change in mentalities. The next chapter tackles the first aspect, while the second aspect will be discussed in Chapters 4 and 5.

Chapter 3

From Innovation to E-co-innovation

True wisdom consists of not departing from nature and of molding our conduct according to its laws and models.

Seneca

3.1. Awakening consciousness

When we mention the word innovation, most people and more particularly those involved in research and development immediately think about creativity. Companies spend a lot of money and energy on actions with an objective of finding "fresh" ideas. This process generally remains internal; and this is often for confidentiality reasons. Thus, Toyota does not employ any interns in its research center in Sophia Antipolis. At Nestlé, only the R&D employees are in charge of innovation.

Some companies are starting to realize that other employees are also likely to have good ideas. The closed process is thus evolving towards participatory innovation – at SNCF all professionals are involved.

Very few companies include the stakeholders in their innovation process. They begin by inviting partners and sub-contractors, as PSA does: an extranet enables them to exchange experiences and knowledge. It seems obvious that the participation of customers would bring better knowledge of the true needs and a more realistic vision of the market. They know what they want and they have an overview of the competition that is sometimes better than that of their suppliers. Moreover, they have experience in the use of products/services and as a

consequence know their weaknesses and strengths. Major groups, such as Unilever and its off-brands, state that innovation is part of their strategy, but however remain far away from the true customers.

Danone, Nestlé, Henkel and some others have created consumers clubs, giving the impression of caring about customers. But in reality, they only spread advertisement information and share a bit of knowledge through recipes and tricks. Many offer contests or invitations to follow them on Facebook and feed their databases with participants' email addresses. Surveys are made on a small sample of "representative" consumers. The questioned customers must make do with answering questions, generally in the form of a multiple-choice questionnaire. Retail is starting to perform *data mining*[1] on its databases to discover consumer profiles. This enables them to only innovate in the store organization and to classify customers for statistical purposes. The e-commerce sites are for the most part built on the same model, i.e. the model of mail order selling. They send advertisement emails, but do not seek to know their customers. Most of the websites do not have any contact form to offer customers the opportunity to submit ideas.

The usual reference marks are out of place in the context of the global market and the excessive competition. Companies must permanently innovate to survive and contribute to the "sustainable development". This expression is an oxymoron[2] – is it possible to reconcile development consuming limited resources with the sustainability initiated by innovation? Or is it simply a balanced development[3] ?

The integrated approach "quality, security, environment and sustainable development" seems to be the only way to integrate environmental aspects into products and services. Designed for the industrial economy, is it adjustable to the knowledge economy? The design of "eco-responsible" products is from now on part of a CSR approach[4]. This is a "concept in which companies include social, environmental and economic concerns in their activities and in their interactions with their stakeholders on a voluntary basis" [EC 06a]. But is this a sufficient condition to ensure development and limit pollution, climate change and the extinction of the species?

In public research centers, innovation comes from knowledge, experience, passion and sometimes from chance. Ideas can be found in conferences, online or

1. A technique of knowledge discovery in the database, associating statistical analysis with artificial intelligence.

2. A combination of two incompatible words. Example of the "Obscure clarity" by Corneille.

3. The Polish equivalent of *sustainable development* is *zrównoważony rozwój*, literally "balanced development" in English. This expression corresponds better to the system logic.

4. Corporate social responsibility.

can be born from a collaborative work on European or national projects. We observe trends, an interest, a fad, but rarely an inspiration coming from enterprises, whose complex problems are real challenges for research. Researchers often consider them as too far from their concerns. The industrial world imposes constraints, such as time or profitability. A step towards a better connection between two populations in France has been made with SAIC[5] – societies of expertise transfer from universities to companies. But expertise transfer does not come within the competence of research and does not really interest researchers.

This situation is still evolving with the recommendation of including small businesses in projects financed by the State and the European Commission. The organization in competitiveness cluster facilitates company/research exchanges, but the synergy still needs to be strengthened. While we propose for researchers to work on real and complex industrial problem solving, some find them too difficult. Some industrialists who could test original techniques resulting from research, prefer industrialization to be carried out before using these techniques.

Decision-makers wish to see more disruptive innovations, but how can we get there? What could be the contribution of scientific research?

In the context of the knowledge economy, the success of innovation depends on the recognition of all the elements of the process, which influence one another. This relies on the participants' imagination, their ability to create a collective intelligence, the relevance of the knowledge involved, the efficiency in spotting opportunities and the operation rapidity. This chapter briefly describes the creativity part before concentrating on the transformation of ideas into values, while always associating all the system components of the innovation process: technological, economic, social, cultural and environmental.

3.2. The traditional innovation process

Figure 2.3 of Chapter 2 represents the innovation process as it is carried out in most companies. It unfolds under the control of the management in charge of the strategic plan and the budget allocated to innovation. Ideas can be the result of individual and collective imagination during creativity sessions, the result of experiments or coming out of an innovation support system. After an evaluation, the best ideas will be transformed into products or services to be sold. Part of the profit thus generated can be invested in research activities for ideas and transformation of these ideas into products or services to be sold.

5. University services of industrial and commercial activities, www.amue.fr.

This process is thus made up of two distinct stages: *creativity* and *transformation* of the selected ideas into products or into services and values.

3.2.1. *Creativity*

Creativity is a mental process helping to generate new ideas or concepts, or else to make associations between ideas and already known concepts. This is the ability of an individual or of a group of individuals to imagine and to carry out something concrete, to solve a problem in an original way, to address a need, to generate needs for a new product/service or to invent a new research field.

Neurobiology or neuropsychiatry researchers, amongst others, study the role of the brain in creativity. Kenneth Heilman [HEI 05] defines it as the ability to understand and express new relations. He puts the hypothesis according to which creativity implies the ability to connect regions of the brain that are usually not connected. This consists of developing the ability to produce meaning and to simultaneously use the two hemispheres of the brain. In the search for the sources of creativity, Einstein's brain was cut out and analyzed a long time after his death to find the origin of his creative ability[6].

According to Tony Buzan[7] everybody has the potential to be creative on the condition of training themselves to use both parts of the brain, rapidity and originality of thinking, flexibility of thought, imagination and association between elements (making links).

There is a plethora of creativity methods and tools. Amongst them, we can find two main tendencies: those concerning *problem solving* and those trying to improve the idea creation process, for advertisement, for example, by generally relying on various psychological approaches.

Here are a few creativity methods, starting with the methods of the first category:

– Case-based reasoning [MAH 97] is an artificial intelligence technique. It is inspired by our way of solving new problems by analogy with those that we have already solved. Implemented in tools such as Kaidara[8] and essentially used for technical diagnosis, it helps to quickly create a range of new products, inspired by

6. www.larecherche.fr/content/impression/article?id=15167.

7. http://www.videojug.com/film/how-to-improve-your-creative-thinking.

8. http://kaidara.com.

those that are already available. Other artificial intelligence techniques also have the ability to increase human creativity[9].

– The TRIZ method[10] by Genrich Altshouller [ALT 89, ALT 04], developed from the analysis of two million patents to extract from them 40 inventive principles, which are useful for problem solving and can be applied to fields that are technologically different. The main advantage of this method is its universality. Often, specialists do not know that there are solutions to their problem in another field which is sometimes very different technologically. A TRIZ tool can propose a solution from another field. This method, encapsulated in tools such as the TechOrganizer of Invention Machine, is mostly used for the design and improvement of products.

– The six hats method by Edward de Bono[11] [DEB 99], psychologist, Doctor of medicine and knowledge engineer, relies mainly on creativity techniques coming from neurosciences. These lateral thinking techniques enable us to pull out of our usual mental diagrams by relying on exaggeration, inversion, change of usage (provocation), etc. Each of the six hats corresponds to one mode of thinking. Bono's method consists of making six people work together to solve a given problem. The participants each play the role corresponding to a hat color. The blue hat leads the group, and must think globally and channel ideas and exchanges. The white hat reports numbers, information and facts, whereas the red hat collects information tinged with emotions and intuitions; it represents passion. The black hat embodies caution; it lists the risks threatening the development of an idea. The yellow hat symbolizes imagination, dreams and crazy ideas – its role is to put into action the ideas suggested by other members of the group. The person wearing the green hat must find alternative solutions. He/she is inspired by lateral thinking, about the different ways of considering a problem and must think outside the box to suggest new ideas. The six hats facilitate the concentration of the team's creative energy on a common objective, team work and the learning of different thinking modes. In order to stimulate strategic creativity, Edward de Bono also uses strategy games such as the L game[12].

– The concept of bissociation was provided by Artur Koestler (Artúr Kösztler) [KOE 60]. It consists of connecting two elements or fields usually separated to create a new element including the components of both. Any successful integration is a creation, when all fields are taken together. Innovation is sometimes an association of several technologies, as IT solutions associating in some cases several techniques during the resolution of a complex problem. Works by Ludwig von

9. www.aaai.org/AITopics/pmwiki/pmwiki.php/AITopics/Creativity#swale.

10. теория решения изобретательских задач – theory for solving innovative problems.

11. www.edwarddebono.com.

12. www.edwdebono.com/debono/lgame.htm.

Bertalanffy and Herbert Simon on complex systems have contributed to bissociation. In his book, *Ghost in the Machine* [KOE 67] Koestler introduces the term of "holon", probably borrowed from Jan Christiaan Smuts (1926) and coming from the Greek term. Holon is at the basis of the holistic approach, helping to conciliate innovation and nature.

– The heuristic map or mind mapping by Tony Buzan[13] starts from the principle that our brain works by visualizations and associations. Heuristic maps underline the hierarchical links between the various elements, as well as semantic connections. This is a tool used to think, but also to take notes. By simply looking at the map, ideas can come out of new associations or original concepts that will be added to the previous ones. An example of the cartography can be found in Figure 3.1.

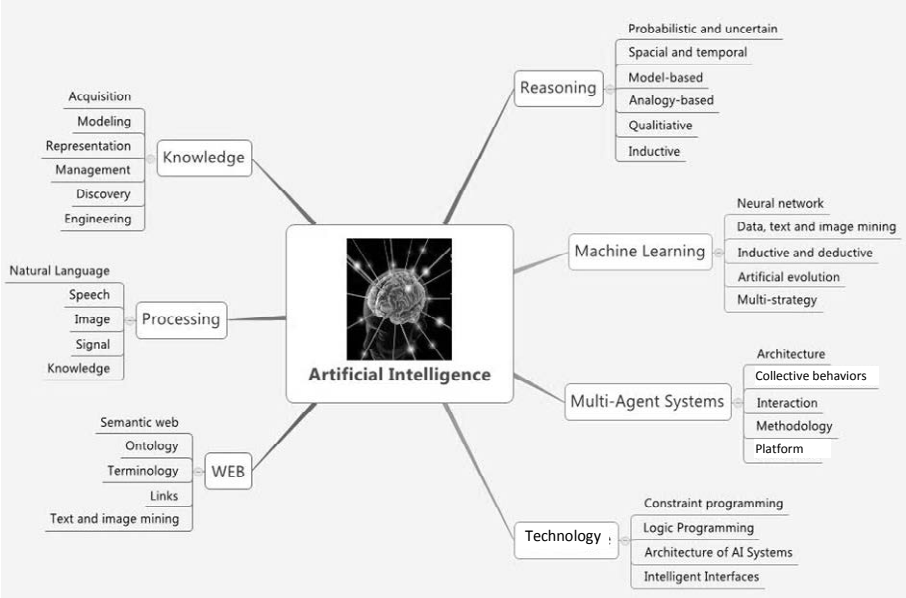

Figure 3.1. *Cartography of the artificial intelligence fields*[14]

– The ontology knowledge modeling tool allows us to graphically represent, via computer, the concepts organized in hierarchy and the relations between concepts for a given problem or field. Their role in creativity is similar to their role in heuristic maps [DAM 03].

13. www.creativite.net/mind-mapping-mind-map-tony-buzan-12/.
14. www.afia-france.org/tiki-index.php?page=AFIA.

– Brainstorming, designed for advertising by Alex Osborn in 1935, is described in his book *Your Creative Power*, 1948 [OSB 48]. A brainstorming session is carried out in small groups and must be led by someone. It has three phases: presentation of the subject, production of ideas by the participants and exploitation to select the most relevant ideas.

– Synectics by William Gordon is a psychological approach (metaphorical thought) consisting of combining several elements which are apparently heterogeneous, aiming for the conscious use of unconscious psychological mechanisms. This is carried out for example by the Synecticsworld company[15]. The resolution of a problem or search for ideas is carried out via the cognitive series: problem, paradox, analogy, single activity, equivalence, new idea.

– Challenge-storming is done in eight stages and was proposed by Jean-Louis Swiners (HEC) and Jean-Michel Briet (publicist). It takes into account the various creativities of the company, such as innovation, design, strategy and leadership [SWI 05]. The succession of the stages is as follows: locate the (controversial) problem, make a clean sweep, research for existing solutions, define and hierarchically organize the selection criteria, introduce creative tension (and motivation), find three good solutions, choose the best one, implementation of the idea with creativity (agility, resiliency, pugnacity, acceptance of the change).

– "PAPSA" of Hubert Jaoui [JAO 98] is an approach in five stages consisting of:

- appreciating opportunities and risks,

- analyzing,

- producing ideas,

- selecting those corresponding to the objectives,

- applying or putting into action selected ideas while avoiding logical, cultural and sensory traps.

French industrial product theoretician Abraham Moles, writes about a "variational creativity" in which designers will be confronting the current fundamental concept of "initial form plus variations", a theory that recognizes an often methodical variation of possible forms with respect to given parameters [MOL 70].

We can also mention "inventique" by Michel Fustier [FUS 70], detour techniques by Guy Aznar [AZN 05], creatics by Michel Demarest [DEM 70], the four characters by Roger von Oech [VON 87] and many others. Roger von Oech

15. www.synecticsworld.com.

offers his Creative Whack Pack on iPhone with 84 creativity strategies to stimulate creative thinking.

Very few consultants courses choose from amongst these existing methods during their training. Often, they recommend only one method – theirs – according to the principle "to a man with a hammer everything looks like a nail".

The Blue Ocean strategy was introduced at INSEAD by Chan Kim and Renée Mauborgne [KIM 07]. Its objective is to direct the business activity on an uncompetitive segment, in order to better use resources and to make more significant margins. This is instead of fighting with the competition on the same criteria (price, quality, etc.), which is called "red ocean"; it consists of creating our own free space (the blue ocean) by innovating and using completely unusual criteria in comparison to what already exists as a basis.

Creativity methods such as the Innovation Cafés practiced by the Entovation Intl network or creative intermediation [DHE 06] are well adapted to innovation systems in the knowledge economy. The first is inspired from creative discussions in Parisian and Viennese coffee shops of the "Belle époque", adopted by Elisabeth Lank in the 1990s and popularized by Charles Savage under the name of DynamicTeaming and World Café. The participants (20-50) are gathered around tables. Each table discusses a specific subject, which is a part of the considered themes, which have been chosen by the main leader. Each table has its own leader.

After a presentation of the principles, the participants work on each subject for about 20 minutes. Then, the leaders of each table successively recount the results to all participants. The main leader can then decide to move a few people and to run a second session generally using another way of thinking. The session is closed with a final conclusion.

Creative intermediation is a tool for facilitating the emergence of collective projects. A session lasts two or three days. It starts with a reciprocal spotting of affinities and complementarities between the actors present and is followed by a constitution of project groups. The different projects which have emerged are improved with the help of a questioning grid resulting from theories and practices of sustainable development and of innovation management. Each project group can refine its strategies and partnerships; then the third day is devoted to formalization of the innovation project and its implementation strategy.

Electronic games and other ICTs[16] can play a significant role in the stimulation of creativity and in the management of the global innovation process.

16. Imagination and creativity technologies [MER 06].

3.2.2. *The lifecycle of an idea*

The lifecycle of an idea is limited in most companies to the one shown in Figure 3.2.

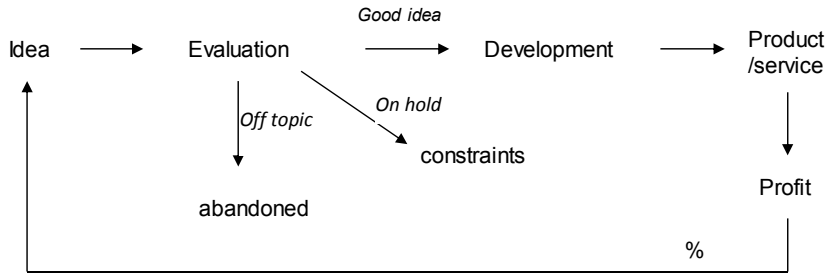

Figure 3.2. *Lifecycle of an idea*

Ideas resulting from creativity sessions or those proposed by the actors of the company are evaluated in the prospect of their transformation into products or services to be commercialized. In the case of a closed innovation, new ideas must come from the R&D team, whereas in participatory innovation, they can come from all the units involved in the process.

In some companies, only one person is in charge of evaluation. In others, such as Air Liquide for example, ideas are evaluated by a committee composed of R&D representatives to validate the feasibility of the idea, of marketing/sales representatives bringing knowledge of the potential market and a person in charge of human resources, whose role it is to schedule the skill resources which are necessary for the implementation of an idea. This is important in the 2nd management generation in Figure 2.6 – with the project as an asset. Some ideas can be prototyped to check their technological feasibility. Connected to the market, this type of evaluation represents progress compared to the usual evaluation practices.

An idea can be frozen while waiting for better development conditions, or can be rejected. The rejected idea is not necessarily bad, but can be out of the enterprise strategy context. It is sometimes interesting to carry out this idea outside the company, in the framework of the spin-off process. The new process could be called upon to become a partner of the original company.

An idea transformed into a product or a service must generate a profit for the company. Part of it is generally reinvested in research. Most of the companies only focus on the tangible profit, whereas it could also be intangible. Very few companies

account for this possibility. The probability of obtaining disruptive innovation in such a context is very low.

This approach, because of the lack of internal connections, as well as outside connections, sometimes leads to what Debra Amidon [AMI 97] calls the productivity paradox – the investment in R&D has not produced the expected financial results. Some projects are therefore stopped, when the management realizes during the development that there is no market for this product or that the desired market is already saturated, that technology has evolved or that the competition has been faster. Another cause for this failure may be also due to the lack of connection with the perspective of corporate strategy.

3.2.3. *Conditions of success*

In most cases, innovation, whether it is closed or participative, does not focus on market requirements. They are supposed to be known. In the recent survey on the TGV (French high speed train) of the future, all the questions are closed and customers do not have the possibility of giving their opinion or adding comments. They are invited to give a mark to the proposals without any further elaboration. This lack of open questions is often explained by the difficulty of collating the results. However, there are techniques which can easily carry out this task, notably those used by the Semantic Web[17].

This situation is even more absurd in technological companies where a product, considered as essential by its creator, will certainly be bought. The latter address a specific professional category, such as information system managers, human resources managers, corporate marketing, maintenance and process managers, or even the whole worldwide population (Microsoft).

Service innovation generally answers to an identified gap, such as the developmental accompaniment of specific IT applications, ground services for airlines and passengers, installation of a PC, research for a plumber, help for the elderly, etc. It can also answer to a governmental requirement, such as the reduction of CO_2 by carpool or bike rental in cities.

The time to market is an important element of success. This rapidity often corresponds to the prevailing culture of the innovator. Thus, Bill Gates has announced Windows, whereas Microsoft was just beginning its development. However, this announcement enabled him to prepare the market for the idea of a

17. Associating techniques of statistical analysis, of language processing, of knowledge modeling and of automatic learning.

windowing system which already existed long before [ELL 87], but was not marketed on a large scale. In order to make customers want to buy the forthcoming SharePoint Portal, he has written the book *Business @ The Speed of Thought* [GAT 99]. He explains in it the necessity of managing information inside and outside a company. Other companies do not hesitate in proposing unfinished products, just to take some advance on the market. On the contrary, in France, a lot of time is spent refining the product and when it is perfectly finalized, the market is already taken. The Bull group has thus lost many opportunities of becoming leaders in the market for smartcards, home computers and artificial intelligence. Small businesses are more reactive, but often managers of technological startups think they know the market, and they invest more in development leaving investment in marketing and sales until much too late.

This attitude is cultural: Americans, English or Swiss do not have the same business sense or the same relation to money. In France, engineering schools and universities do not teach students how to be entrepreneurs and business and management schools do not sufficiently prepare future executives to sell innovating products and services.

Once again, this field is becoming complex and it is necessary to innovate in innovation, i.e. to take into account new needs, the knowledge of a world market, competition but also to find potential allies and to consider the different aspects of the balanced development. Aspiring to the role of leader depends on it.

3.3. Why and when innovate?

In the search for the ideal organization, many companies have invested in quality approaches, in reengineering and in change management, without obtaining the expected results. Currently, in the CSR[18] investments are made in creativity and in closed innovation, or better in participatory innovation. These investments are due to a fad or are engaged to avoid the decline of the company. Charles Handy [HAN 89] recommends innovating when the company is still thriving, i.e. at point A in Figure 3.3, whereas most of companies start innovating when they are already at point B and that it is already too late. Only innovation dynamics can make the prosperity of the company possible over time.

Figure 3.3 shows a version of the curve by Charles Handy, adapted by Debra Amidon [AMI 97] to the knowledge economy. This adaptation draws the attention to the condition of efficient innovation – an organization and a management of internal and external knowledge. These two aspects of knowledge are now the assets

18. Corporate social responsibility.

of the company. A 6th level in Figure 3.3 could be the "Future as Asset", because innovation dynamics, part of the vision and part of the corporate strategy, enables us to build a prosperous future.

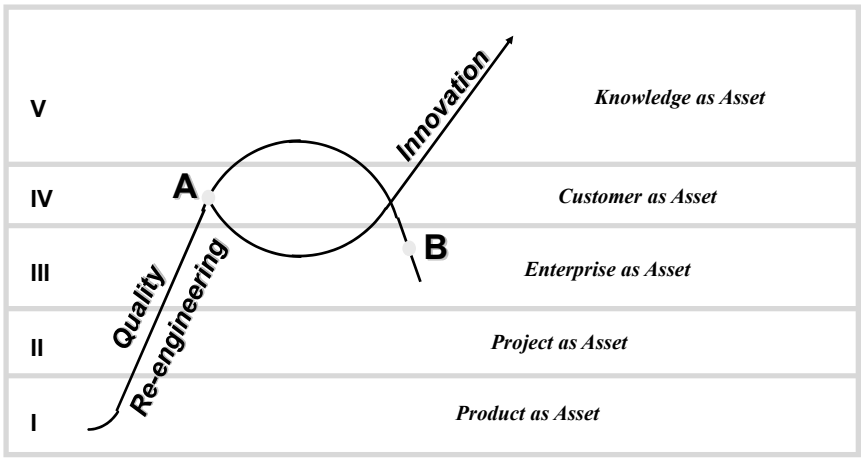

Figure 3.3. *Charles Handy curve of life*

When most of the companies are still dealing with assets such as products, projects or customers, the Enterprise 2.0 movement proposes dealing with another capital – the capital of the connections in social networks.

3.4. Role of the customer in the innovation process

Customers knowledge is used very little, or not at all, in the conventional innovation process. Customers are only solicited to buy and to answer marketing questionnaires, if they are part of the studied samples. Integrating customers into the innovation process enables us to satisfy them, but also to better target the market. We can also suggest to them to refine their needs, aiming to discover together unexpected needs. This approach goes beyond project management, which deals with a series of elements, such as the expression of the needs and their analysis in order to establish customer requirements.

3.4.1. *Need engineering*

To illustrate the mentioned comments, let us examine the case of computer and software designers. In principle, they should take into account the way users will

communicate with their machine (ergonomics) and their own needs in the individual, professional and society context (holonomy) [MER 07b].

In general, users are never asked about this subject by computer and software designers. They just have to choose amongst the market offerings. The marketing service of the manufacturers is slowly taking an interest in the use made by customers of their machines. This is the same for most designers of application systems and specific applications. Some software editors use success stories to trigger reasoning by analogy and to thus inspire future customers. Most of them imagine the customers' needs, because their software is often the result of a technological transfer and is proposed on the market in a push mode.

Nowadays, with the supremacy of Microsoft, the role of the customer is limited to the purchase of software and their updates. Purchasing departments in major French companies obey the following logic: request for proposal including customer requirements > selection of received proposals (solution specifications, negotiation, and selection of the provider). In this context, a startup company proposing a relevant offer to the demand and sometimes a much cheaper offer has difficulty winning.

3.4.1.1. *A few approaches*

According to the marketing specialist from Silicon Valley, Regis McKenna [MCK 85], we need to determine who needs a given product or an innovative service, to come into contact with the target users, in order to know them better (*go to the badge number*) and to design a product corresponding to their needs. To extend the market the product thus developed will then be proposed to users with similar activities.

The offer thus designed can later on be extended to other professional groups with needs close to those of the target users. This approach has been successfully carried out for the marketing of artificial intelligence tools: case-based reasoning software has thus been proposed in priority to maintenance professionals, in order to help them build collective experience in problem solving [BAU 95].

Research-wise, several approaches are possible according to the field considered. The engineering of needs [ROL 03] aims at the designers of information systems and suggests implementing systems supplying the services expected by the users and compatible with their work environment. The engineering of needs is exerted all along the cycle of life of the system and comprises several stages of the initial vision, from designing to development and validation. The engineering of needs and of knowledge are complementary [TOR 00].

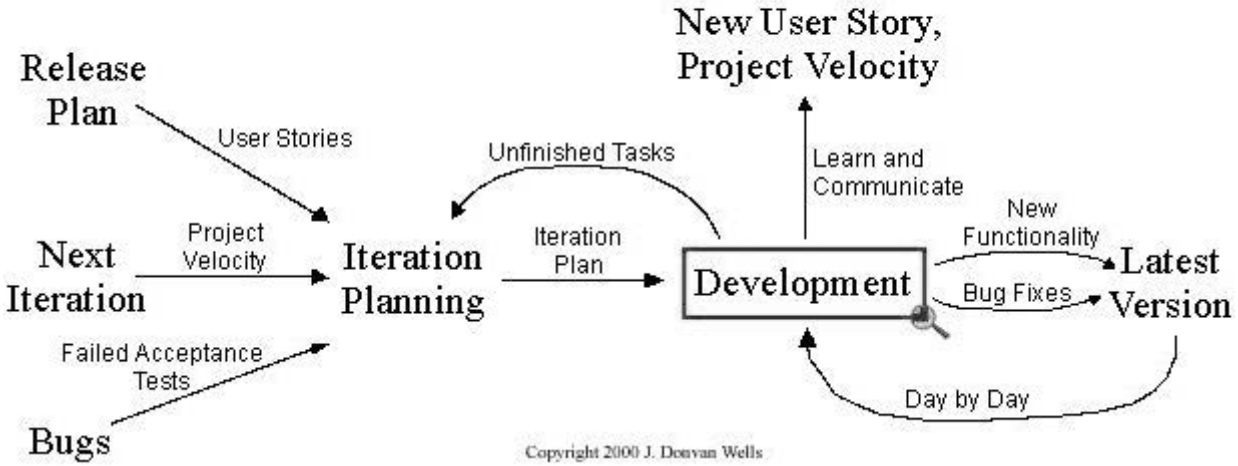

Figure 3.4. *Diagram of interaction with the user in Extreme Programming (source: http://www.extremeprogramming.org/: Extreme_programming.png?uselang=fr, original source Donovan Wells)*

Maryse Sales, in her approach, [SAL 02] takes an interest in the needs of the business intelligence actors and tries to model the cognitive processes of the decision maker. She takes into account the emotional action. The MEDESIE project introduces a method for need analysis of the companies in the field of business intelligence. It is elaborated from results of surveys carried out in selected companies. The engineering of requirements only targets complex products. It considers a product as an optimized system in its environment [FAN 02].

An interesting approach, recommended for the management of a research and development project from known needs, is *Extreme Programming*[19]. It is part of the "agile" methodologies. Users are involved in the development process (see Figure 3.4.)

Users describe representative cases of their needs. They will be used as the basis for developing simple programs meeting the needs deduced from the cases. Validated by users, these programs will be assembled in a solution, which is incrementally built during interaction with users. They can add new scenarios to improve the software. They transmit their feedback on the bugs back to developers, which will then be corrected in the next version.

3.4.1.2. *Collaborative discovery of needs*

Customer requirements rarely mention all the needs. Questioned users cannot express these needs either, because most of the time they do not know all the possibilities of advanced computer technologies. Ideally, we should integrate it from the beginning in the design cycle, in order to discover during the application definition, functionalities able to do services for them. The opportunity matrix by Gary Hamel and C.K. Prahalad [HAM 94] can be used to illustrate this fact. This adaptation is presented in Figure 3.5.

A better observation of users when they work and of the exchanges with the designer enables us to discover the real needs for interface and functionalities. Thanks to an optimization between the expressed needs, the needs detected during a common work session and those offered by technology, this approach helps to propose new functionalities and to anticipate the next stages [MER 03a] (see Figure 3.6). This method being generic, it can be applied to all fields.

This work of discovery is part of the innovation with customers [ARB 88, AMI 97, MER 95b]. A users' club is a privileged place for collaborative innovation, for experience and trick sharing. The activities take place there in a "win-win" logic – customers contribute to the improvement of the products and influence the addition of new functionalities, corresponding to their needs or even to the design of

19. www.extremeprogramming.org/.

new products. EDEN[20], an intuitive environment for the development of diagnosis systems is born from such exchanges. It allows a specialist in diagnosis to graphically build, without any programming, their cause-effect graph [MER 92]. Ideas resulting from a collective intelligence which occurred there, have been integrated into a CGO (Cediag Graphic Objects) interface generator.

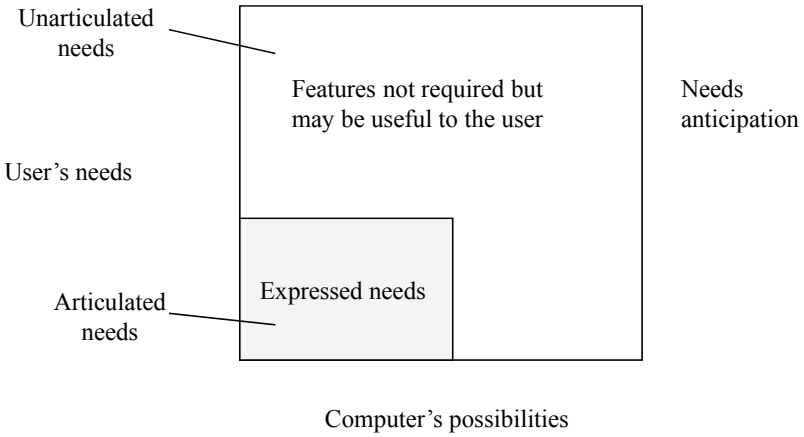

Figure 3.5. *Spectrum of the users' needs*

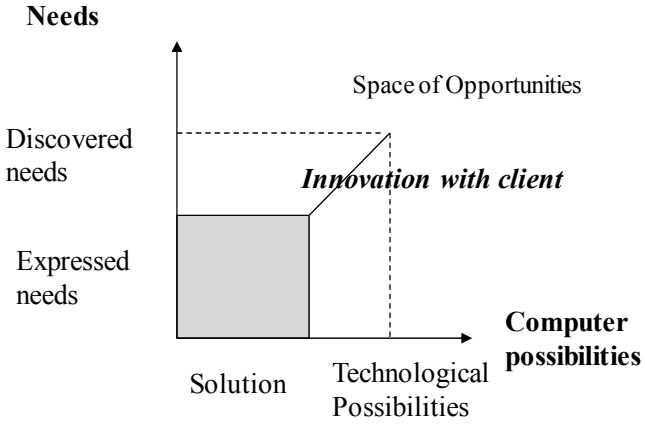

Figure 3.6. *Collaborative discovery of the users' needs*

20. Expert Diagnosis ENvironment.

3.4.2. *Inventing new needs*

In the matrix of Gary Hamel and C.K. Prahalad, the space beyond the first square is a field of opportunities. This is a playground for disruptive innovation. To extend it even more, we need to be visionaries, like the German inventor Andreas Pavel, who patented the "StereoBelt", or Marc Andreessen, designer of Mosaic, the first web browser, which became *Netscape Navigator* in 1994. Inventing new needs requires imagination, intuition and an ability to predict the future.

Amongst the current useful products, we can mention the instantaneous automatic translator on mobile phones, which is able to translate at the speed of speech and to verbally restitute what was said in the target language; an intelligent anti-spam able to learn from keywords and expressions what needs to be blocked; an intelligent search engine helping to find what is relevant from images, speech, sentences and others.

The art of exploring the opportunities space facilitates the invention of new ways of learning, working, entertaining and of making the largest number of people dream.

The dog Aibo is the only robot able to swim, have fun and make children and adults play. Humanoid robots can help the elderly or be guides for exhibitions. Those designed jointly by LEGO[21] and Storming Robots[22] facilitate learning by playing – the payers can learn the principles of robot building, but also different ways of thinking, or mathematics and robot's programming.

Serious games were first introduced in the training of the army[23] to learn how to act immersed in a virtual environment. They became a tool for creativity, education [SAI 05], corporate and sportive training. The IGEL project of ICT[24] proposes a learning environment integrating artificial intelligence techniques and an intelligent tutoring system to guide learners working in immersion in the simulated environment, which is very close to their working environment. Eurocontrol uses this technique when training air-traffic controllers.

Monitoring wristbands and other support equipment were introduced to help the ageing population to live more comfortably, to supervise their medical treatment or just to get real-time information on their state. It could also be interesting to capitalize on this knowledge. Knowledge transfer has various effects, such as

21. http://mindstorms.lego.com.
22. www.stormingrobots.com.
23. http://ict.usc.edu/projects/learning_sciences.
24. Institute for Creative Technology, University of Southern California, http://gl.ict.usc.edu/.

recognition of the knowing person, but also brain stimulation. Ancient knowledge can bring simple solutions to the complex problems we have to face today.

3.5. Integrating environmental aspects

For over a century, innovation and intense industrialization have given us the possibility of traveling fast in the world, communicating at a distance and at a low cost, to learn and work in any place. Thanks to scientific progress, we can now treat many serious illnesses, produce more food and pieces of equipment making our lives easier. These developments have sometimes been carried out without taking into account their impact on ecosystems.

We are immersed in ubiquitous electromagnetic fields, the number of antennas increases with the demand, which is not without an influence on our health. Researchers are investigating the consequences of high voltage lines on neighborhoods or the possible damages mobile phones may cause to brain function. The changes resulting from this new environment are not immediately detectable and the conclusion of their works does not lead to the overcoming of the simple precautionary principle [KOS 06]. The situation is similar in the field of bio- and nanotechnologies. In France, a ECRIN[25] work group is discussing the possible consequences of nanotechnologies for human beings.

Some physicians and environmental researchers already pointed out in the years 1960-1970 the consequences of intense industrial development on the environment [ECK 76, FAL 71, LEN 69, SZE 69]. Very few industrialists paid attention to these alarm signals, favoring business at the risk of causing ecological damages that we are noticing today. Pollution is galloping, global warming is causing climate change and serious illnesses are intensifying after the massive use of insecticides and pesticides [BEL 04]. The world is experiencing ecosystem disorder. In the recent movie *Home* [ART 09], photographer Yann Arthus-Bertrand gives some alarming statistics, notably on the increase in the rate of extinction of species, which is 1,000 times higher than the natural cycle.

Although environmental aspects have been taken into account for a long time, the main economic actors do not respect them and favor “fast business”. All is good to sell to the “appearance” and “disposable” generation. The business of fashion and the clothing industry are flourishing in China. Technological progress and the race for novelty make us change mobile phones and computers every two years on average. We do not repair anything [URB 09], we throw away almost everything

25. Exchange and research-industry coordination.

and waste is piling up. Product obsolescence is also planned[26]. In French hospitals alone, the production of waste is estimated from 2 to 6 kg/bed/day. At the national scale care activities produce about 155,000 tons of waste with infection risks [ADE 00]. "Innovation" in the food industry makes us feed animals with granules and humans with processed and chemically improved food. This has a regrettable impact on the health of animals and humans and on ecosystems.

After a brutal awakening in the world, actions have been launched to reduce the "ecological footprint". Amongst those, we will mention the world summit of the UN on sustainable development initiated in Rio in 1992. The declaration of Rio aims for a world partnership on a new and fair basis by creating new levels of cooperation between the States, the key-sectors of society and populations [RIO 92].

At the European level, there is the ERA NET program[27], which has the objective of favoring the emergence of transnational research and the program devoted to eco-innovation, which emphasizes recycling, eco-packaging, green building and the rational use of resources. An *eco* aspect is also present in the seventh *Framework Programme*. The European Commission has launched a public consultation in order to prepare new strategies for the information society[28]. The questions tackle reducing the carbon footprint and innovation.

For the president of the USA, Barack Obama, ecology is a strategic lever for the revival of the economy and a return to economic growth[29].

The objective of Group 6 of the Grenelle Environment Project was to promote ecological development modes. How to develop them without innovating? ADEME emphasizes eco-innovation and eco-technologies [ADE 06]. Eco-innovation, like eco-technologies, seems to be limited to biotechnologies, the economy of energy and renewable energies, climate impact and the management of soils and groundwater.

The development of eco-technologies is at the heart of calls for projects in the PRECODD research program[30] launched in 2005. This program covers downstream procedures for pollution control, but also for hybrid technologies reducing the emissions of pollutants, the methods of economical production in energy and resources, optimization systems for the monitoring of emissions and resources. The

26. http://www.youtube.com/watch?v=QKymAL1zCc&feature=related.

27. http://cordis.europa.eu/fp7/coordination/eranet_en.html.

28. http://tinyurl.com/i2010.

29. http://ecology.com/ecology-today/2009/09/23/us-president-obama-speaks-on-climate-change-at-the-un/.

30. French program for eco-technologies and sustainable development.

challenge is to contribute to the preservation of resources and the reduction of pollutant emissions with curative and preventive approaches, as well as mastering the environmental risks. Eco-technologies notably have the objective of improving economic growth, insofar as they reduce the costs of environment protection compared to the current norms and practices [ANR 05].

The eco-industries strategic committee was established in 2008, after the Grenelle Environment Project. The governmental plan Ecotech 2012[31], launched at the end of 2008, has the objective of ensuring the development of the eco-industries sector, on the basis of a public-private partnership. According to the ministers in charge of this program[32], the latter must play a major part in the emergence of green growth: eco-industries are an accelerator to come out of the crisis and an accelerator for green growth. "If we are the best in waste and water treatment, we must work on the sector of the vehicles of the future, for example. The idea is to reach prototypes as soon as possible. We also want to favor the export of new technologies and promote the emergence of new know-how[33]. Green growth must be a diversification opportunity for small businesses, some of them have gold hands without knowing it. We will work with 100 to 200 companies at first, in order to evolve their activity towards innovative products" [MIN 08]. The call for Ecotech[34] projects, launched in February 2009, covers environment technologies centered on the reduction at the origin, the treatment and the measurement of the industrial and urban pollutant emissions. This program takes over from the previous program called PRECODD.

Eco-innovation gathers an increasing number of actors concerned about the future of the planet. Nevertheless, at the company level, the situation is not brilliant. Amongst those getting involved, most of them only seek to obtain a QSE certification (ISO 14001). They thus make an effort to reduce the energy consumption, the emission of CO_2 or to decrease the volume of paper used in switching to "all digital". Decreasing the use of paper is often limited to a shifting of the problem towards customers: for example electronic tickets of airlines are printed by customers to show it when boarding. A cosmetics manufacturer announces an economy of 30 tons of paper if all customers accept to receive advertisement and do their shopping online. Electronic invoices make savings for companies proposing them, but customers are then not protected from an error or from hacking.

31. http://www.agence-nationale-recherche.fr/documents/aap/2010/ANRCall-ecotech-2010.pdf.

32. Christian Estrosi, French Minister of the Industry and Chantal Jouanno, Secretary of State in charge of Ecology.

33. He means the collective know-how resulting from collaborative work of the specialists from different domains, working separately.

34. Sustainable production and environmental technologies.

ICTs are also on the track to become green. The 16th edition of the *Guide to Greener Electronics from Greenpeace* [GRE 10] reveals good and bad examples (see Figure 3.7). This guide has been developed from three main criteria: the presence of toxic materials, recycling and the assumed impact on climate change.

Nokia keeps its first place in providing greener electronics, followed by Samsung and Sony Ericsson. The first step is asking customers to give back their technologically out of date phones – "if only each customer could drop off their old phones, we could get back 80,000 tons of raw materials". Amongst the "worst" examples, we can find Microsoft, Nintendo, Toshiba, Lenovo and LGE.

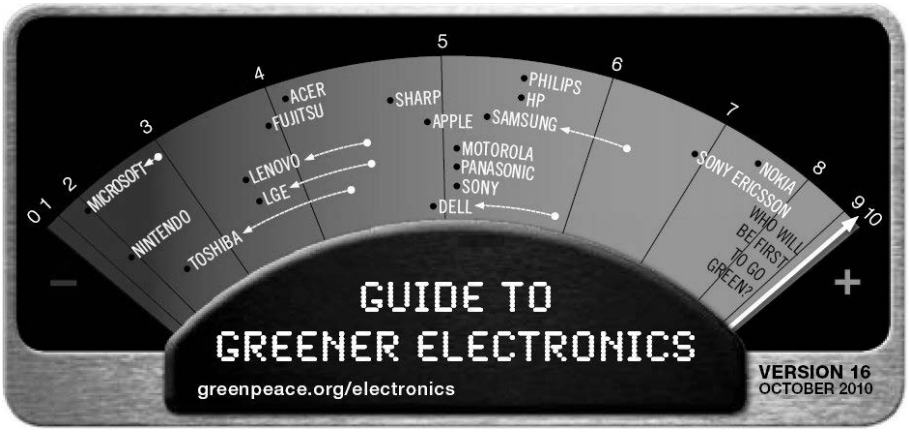

Figure 3.7. *Ranking of the electronic companies according to the Greenpeace Guide to Greener Electronics 2010*

In this context, any innovation and not only eco-technologies, should take into account the environmental aspects of the whole life-cycle of the products or services and by all the participants. This perspective strongly depends on the vision, the commitment and the ethics of the company. It also has an influence on strategy dynamics, in order to facilitate its adaptation to the current opportunities.

3.5.1. *Innovating in eco-activities*

Despite decisions made on a global level and the significant efforts made, the impact of these actions on the state of the planet is not perceptible. Developed countries reason as if they were still in a situation of abundance, while their economic situation has evolved; they should without a doubt change their logic. Significant sums have been spent organizing the selective sorting of waste, whereas

it would be better to focus on reducing them at the design, production and distribution stage and with "intelligent" purchases. This is the same for recycling, which has now become a necessity.

Worldwide, too many objects of bad quality are produced and quickly thrown away, because they no longer work and nobody is repairing them, because repairing is not profitable or because spare parts are no longer manufactured or are too expensive compared to the price of new equipment. The lifespan of household appliances has gone from 20 years in 1980 to five years in 2008 and is continuing to decrease. Recycling is energy-consuming, emits toxic gases, contributes to global warming and to the deterioration of our health. Only one positive point needs however to be pointed out: this activity generates short-term employment. Recycling can be reduced with two factors: decisions taken during the design process concerning the choice of materials, dimensions and the shape of the object and political decisions, encouraging design quality and repairable products.

Production relocation does not guarantee the quality of the products, nor their composition: materials imposed by the designer are often replaced by recycled materials, which are locally produced at a low cost. Some copied products sometimes use toxic materials, which are not in accordance with the European legislation.

The process of eco-design [REY 08] however recommends verifying environmental constraints before launching a development, which allows us to choose less polluting and easier to recycle elements and materials. Designers could also find a bit more inspiration in nature, supplying elements and materials with sometimes unsuspected ecological quality.

Price remains an important criterion, because companies, prisoners of the *faster, cheaper, better* logic of the industrial era, always seek to reduce costs. Innovation also consists of changing attitudes to adopt those corresponding to a way of thinking that is compatible with the knowledge society.

3.5.2. *Thinking differently*

Mankind has a tendency to perpetuate the same mental diagrams and to cling on to known reference marks. This is one of the main barriers of disruptive innovation. Conquistadors – in their haste to seek gold – missed out on the very large Peruvian wealth, the guano, one of the most efficient natural fertilizers.

While we are expending significant energy encouraging customers to give back their appliances and recycle where possible, waste continues to pile up… Part of this

energy could be devoted to discovering how to minimize the ecological impact of the product from the beginning of its design, in order decrease waste and thus recycling [REY 08].

"Thinking differently" also applies to the economy of energy, the development of alternative energies and to transport uses. In 2005 in Languedoc Roussillon, with a total consumption of 4,829 Ktoe[35], 1,279 Ktoe were covered by electric energy (26%) and only 11 Ktoe by renewable energies [INS 08], whereas at a national level (in France), this proportion is 23%. It has certainly evolved to the benefit of solar or wind power, but it is not easy to find exact data. It is surprising that in the south of France, solar panels are installed to heat up water, while in Greece, water containers are directly heated up by the sun.

The biggest challenge of the automotive industry is to reduce CO_2 emissions. Technological exploits are made to carry out this challenge [BEA 09]. Hybrid and "clean" cars are proposed, operating with biofuel, which is produced from food wastes [PER 09]. But the innovation will be in changing the concept of "car" to a new way of traveling. This challenge could be taken up with the invention of another means of transportation, but also with the relevance of the trip. Could designers of transportation devices find inspiration in migratory birds? Or from monarch butterflies covering 4,000 km in their fall migration? Monarch's travel this distance in about 2½ months, covering 80 to 120 km a day. We always ignore how monarch's control their energy, how they find their way to go from one point to another, how they transmit information and their flight plans from one generation to the next.

ICTs and multimedia offer possibilities to communicate, learn and work at a distance in synchronous or asynchronous mode and to thus limit the trips.

We have gone back to tramways. There are other non-polluting public or individual means of transportation waiting to be developed or industrialized. The main barrier to this development lie in mentalities.

Concerning goods transport, here is an extract from the blog of a truck driver: "How many times did I transport melons from Murcia to Chateaurenard, waiting for labels to be changed and take them up to Rungis; or taken up tank acid to store it in Rotterdam in PACTANK, while waiting for prices to rise and then go and pick them up. If we stopped having potatoes washed 3,000 km away... then weighing them at 2,000 km and putting them in bags at 2,000 km before selling them 5 km from the cropping place, there would be less trucks on the road". Other similar testimonies show that the reduction in CO_2 requires better organization "from the producer to the

35. Kilotons of oil equivalent.

consumer", favoring local producers and seasonal products. The solution is certainly not in enlarging the A9 highway, was proposed by territorial authorities, but in another transportation policy. Is the pavlovian solution, consisting of taxing pollution, the only possible way to educate society? Once again, so-called intelligent technologies, such as constraint programming, are in the services of planning or route optimization (the famous problem of the travelling salesman). Concerning attitudes, it is urgent to educate people, by finding part of the inspiration from good practices and even from the past.

Different thinking is at the basis of disruptive innovation. An abstraction of the problem solving field is implemented in the TRIZ method. It integrates the universal mechanism of thinking, independent from the application field – solutions used in one field can be applied to another. This way of thinking, conditioned by the capacity of abstraction is infrequently or not taught in schools.

The conditions minimizing the impact of innovation on ecosystems require knowledge of the latter and the ability to choose the suitable mental schema. Although mental flexibility can be acquired, a single person cannot possess the entire knowledge of the ecosystems. Collaborative innovation is imperative. The ability to think global, system and holistic [MER 07b] is also important to succeed in the knowledge economy. Global thinking allows us to know the context, system thinking allows us to know inter-influences and holistic thinking enables us to work in an incremental way.

3.6. E-co-innovation or innovating differently

In order to innovate differently, we need to think differently and relevantly use individual and collective knowledge and skills. The classic diagram of sustainable development, presented in Figure 3.8, illustrates the necessity to group together three ingredients to reach the expected result: social, economic and environmental.

From the point of view of the knowledge economy, the three pillars are not sufficient to ensure a balanced development by innovation [SAV 09, WII 04, JIN 06]. The technological and cultural components are part of the necessary ingredients for success. The role of technology, and especially of intelligent computer science, is to efficiently assist knowledge cultivators in all the stages of the innovation process, leading from creativity to a satisfying result (success). It is able to take the best from the cultures, thanks to collective experience including "best practices" and the permanent contribution of the participants to the process. Figure 3.9 presents the relationship between the five system components.

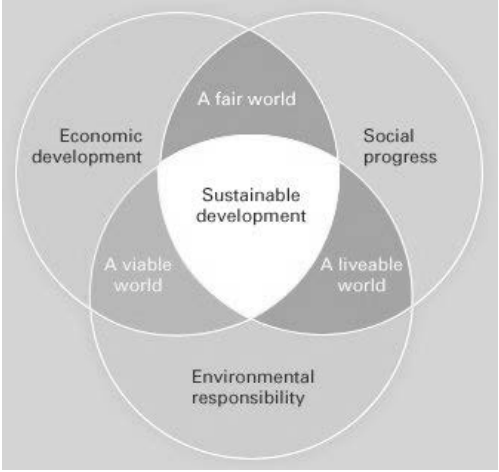

Figure 3.8. *The three pillars of sustainable development, source http://www.dragageshk.com*

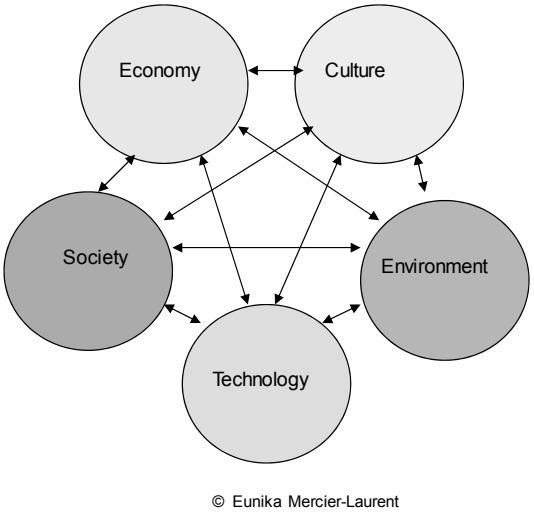

Figure 3.9. *System components of the balanced development (5D Innovation)*

Culture is present in the way of managing, transmitting knowledge, educating society, cultivating creativity and imagination, living with nature and respecting it and of innovating together or individually.

In this context, we propose another way of practicing innovation and eco-innovation. The latter becomes e-co-innovation, with an e- as ecological, respecting ecosystems and as economical, educational, ethical and electronic; and a co- as collaborative, based on current knowledge ("co-naissance" in French) but also on old knowledge, facilitating a convergence of intelligence, which is concrete, commercializable and enabling the creation of new companies from ideas born in this environment. This is the result of a collective intelligence which can also be exerted at a distance using technology. The process of e-co-innovation is presented in Figure 3.10.

Conformity to our definition of innovation, "from an idea to a sustainable success", the e-co-innovation process starts with an idea, which can have its foundation in a need, an observation or even a dream. All the participants, including stakeholders, are proactive actors. Ideas can be new, transformed from existing ideas or coming from the past – some ideas of Leonardo da Vinci or the dreams of Jules Verne, of Stanislaw Lem or Issac Assimov have become realities or have inspired other creators a long time after their original conception.

An idea can be improved or transformed by the participants of the process to become their idea [AMI 05]. Everyone adds their points of view and knowledge – iinnovation becomes co-innovation. The initial idea is validated by the stakeholders, including technological experts for its feasibility, marketing experts for market estimation, as well as by the manager of intellectual capital in order to plan the resources for its development. In the case of the idea coming from a customer, part of the market is already ensured, but it can open to other markets, thanks to the partners involved in the process. The inventor of the PAX system – Michelin – has joined forces with Pirelli and Goodyear to ensure a second supply source to its customer Renault, but also to take together the largest market [MER 03b].

Constraint verification partially concerns the market, technology and available resources. Any innovation activity generates an impact on the environment – it must be estimated at the beginning and throughout the process. At this stage, the impact of the product or service to come will be checked on ecosystems. This is where artificial intelligence technologies, such as constraint programming, multi-agent systems or case-based reasoning, associated with techniques of image processing (graphic simulation), can be of significant help. Business intelligence tools will also be useful for an initial study of the competition. The technological and economic watch will continue, with the help of all the participants, all along this recursive process. An estimate of the expected profits made at this stage will supply a decision element for the development to come.

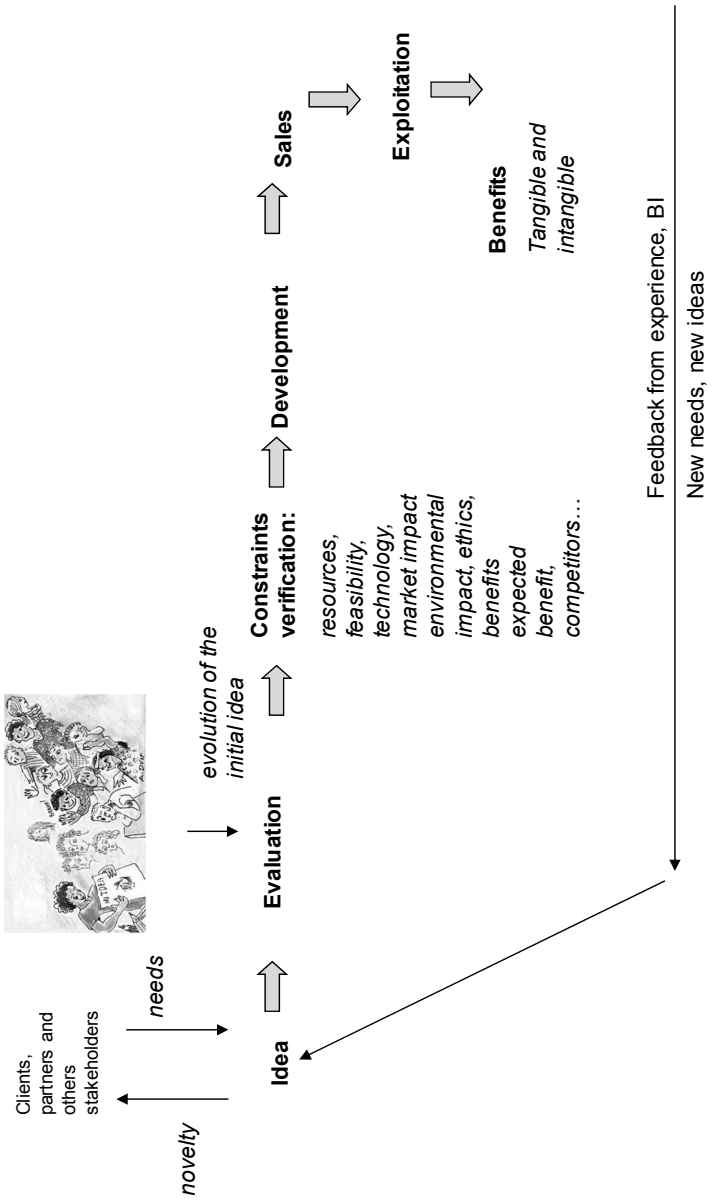

Figure 3.10. *Recursive process of global e-co-innovation from knowledge*

As a function of the subject of the innovation, the development will use more or less complex knowledge. Technologies of knowledge processing can be significantly helpful during design, planning and project management.

Feedback from experience is taken into account all along the process and more particularly during distribution and exploitation, where any remark from the field will contribute to the improvement and the evolution of the innovation subject.

The profits are the measurement of the success of the innovation. Tangible profits are quite easy to estimate, but the result of their estimate depends on the strategy of the company. They are the economic values shared between the participants and bring their contribution to the development of the participating companies and through this, to territorial development. However, as a function of the strategy, most of the companies only count income coming from the sale of products/services and forget to take into account the propagation effect. For example, the constraint programming language Charme was the first product from the Bull group sold on the Japanese market at a time where this manufacturer counted only the sale of computers. The sale of thousands of licenses brought in less than the sale of a large system and thus went unnoticed by financials, whereas the real success was to conquer this market. A dynamic strategy would know how to take into account the evolutions generated by innovation and evolve in order to promote the contributors of this success.

Few companies have integrated the intangible profits into their measurement of the success, such as the image of the company, its reputation, its leader position, its taking of market shares or the conquest of new markets, the emergence of new ideas, the improvement of the ability to innovate and other individual and collective skills, the creation of companies coming from the dynamic setting of the initial idea. Leif Edvinsson proposed considering skills as intellectual capital. This can be found next to financial capital on the annual report of his company, Skandia [SKA 96]. This was the first step towards the knowledge society.

In this context, success also takes into account the impact on the ecosystems, which should be as minimal as possible. This is indeed about the success (the survival) of the planet. It strongly depends on the organization of collection, the sharing and processing of knowledge inside and outside a company or an organization. The feedback from experience of the sale can induce an innovation in the sale methods or in economic model, in order to generate more values for all the participants of the process.

The process of e-co-innovation is multidimensional. It consists of open, global, system and holistic innovation at the same time. This process requires and produces knowledge and skills all along its course, “from an idea to a sustainable success”.

3.7. Innovating in a knowledge economy

"About 80% of a company value resides in its intangible assets, 80% of the new ideas come from the outside (mainly customers), 70% of the new products are developed from their ideas, at least 60% of what a company needs to know is located outside" [SCH 07]. This statement puts the knowledge capital as an essential condition for innovation. Eco-responsibly innovating is only one aspect. Innovating practically, efficiently and in a biodegradable way must gather multidisciplinary knowledge, coming from various actors and sometimes from other sources of knowledge. No inspiration source must be neglected – knowledge and experiments of the past, nature and practices from other cultures will only increase our individual and collective imagination. Our future depends on our capacity to detect opportunities and to gather necessary skills and knowledge and to transform them into economic values, in balance with ecosystems. It also depends on the rapidity of our decision making, on our risk taking ability in a dynamic environment, and on our ability to use the computer, regardless of its form, as an intelligent assistant. The latter facilitates an innovation without boundaries.

Chapter 4

Knowledge and Skills to E-co-innovate

The success of the economy will be determined by knowledge, skills and education.

Tony Blair

4.1. Information or knowledge?

The European document Innovate for a Competitive Europe [EC 04] recommends the stimulation, diffusion and absorption of technological knowledge. The authors of Post Crisis: e-Skills Are Needed to Drive Europe's Innovation Society reiterate this recommendation and specify that Europe lacks ICT specialists [KOL 09]. Another document, Skills for Innovation [PRO 07] specifies that the development of skills for innovation and creativity must be a priority, in order to accelerate the economic development and thus increase the competitiveness of Europe. Technological knowledge, creativity and mobility are mentioned in the text, but can they really be sufficient to achieve the above goals?

Organizations, caught in the whirlwind of the innovation trend, produce documents on this matter, which are widely available on the Internet. Just the European Community search engine, Cordis[1], lists 3,200, as well as 187 programs,

1. http://cordis.europa.eu.

12,948 projects, 17,147 web pages and 2,139 events, including 98 in 2009, with the word "innovation" in the title.

The different countries and regions produce reports discussing innovation from various angles. Following the governmental innovation strategy, institutional actors belonging to numerous structures have been appointed responsible for this theme. They are in charge of the production and diffusion of information, event organization, specialized advice or of financing.

The employees of the companies and research centers absorb knowledge, via training courses, conferences and meetings. They are part of professional groups and make study visits to discover the "best practices" in the countries considered to be innovation leaders. The trend of social networks and the proliferation of interest groups and forums even bring an "overflow of information", without supplying a relevant research tool.

Patents are also a mine of knowledge. They can inspire ideas, help to position someone's work in relation to the existing inventions or encourage partnership solicitation. An "automatic" exploitation of patents by specialized software can be helpful in finding a solution that can be applied to a specific case.

Facing the affluence of information and solicitations, a new skill is required – the innovation know-how (*savoir-innover* in French). This is the art of finding and exploiting strategic information and of gathering momentum and developing the knowledge and skills essential to the success of this enterprise, which is innovation in its entirety.

These skills are numerous – from the management of ideas and people to the implementation and commercialization. Existing training courses prepare specialists of atomic components of this process; very few of them consider the whole process.

This chapter lists some elements of knowledge and skills to be mobilized in e-co-innovation logic.

4.2. The knowledge necessary to innovate

Three types of knowledge are often mentioned: knowledge, know-how and behavioral skills (*savoir, savoir-faire, savoir-être* in French). According to the French Larousse dictionary, knowledge (*savoir)* is the set of knowledge acquired for a given activity. The know-how *(savoir-faire)* is defined as the ability to succeed in what we undertake. This is also a professional skill. Behavioral skills (*savoir-être*) are the art of using the given knowledge in different situations. We can also mention

savoir-vivre (living a good life while remaining elegant and well mannered), whose codes are sometimes radically transformed.

The *know-how to innovate* implies mobilization of the knowledge necessary to initialize the innovation process and bring it to success, without forgetting the environmental aspects (see Figure 3.10 in the previous chapter). To achieve this, we need to combine strategic knowledge, knowledge of management, of the market, of customers, of their needs and motivations, of opportunities, of competitors, of possible alliances, of creativity methods, of environmental knowledge, as well as problem solving knowledge, professional knowledge, the knowledge necessary for product design, the knowledge of materials and of production, of sales, distribution, export, legislations, knowledge of intellectual property, of psychology, of organization and management of the feedback, of maintenance, etc.

All these types of knowledge are possessed by the different actors of the company and by the stakeholders. They are found in electronic and paper documents, on the web, in different computers and other mobile devices in design, decision and diagnostics support systems as well. To ensure the instantaneous and relevant access to all the participants, it is preferable to organize them into a knowledge flow, intelligently assisted by computers in all its forms [MER 07b].

At the beginning, there is an individual or collective vision. It can be the result of a creativity session, of the technological and economical watch, of the analysis of the market and of its evolution on short-, mid- and long-term. It can also be a result of the observation of trends and gaps, or simply of the imagination of an inventor. The triggering factors favoring this vision are imagination, intelligence, intuition, knowledge of mankind, of mankind's activities in individual contexts, in company/organization and social contexts, of behaviors and motivations. An ability to envision the future allows us to anticipate the needs and the market trends, but also the technologies to come. Difficulties, shortages and limited resources amplify imagination and creativity.

4.2.1. *Knowledge of the context – watch and business intelligence*

"In today's fast changing environment large companies need to be fast and flexible to compete successfully against smaller, more agile competitors. Strategic Foresight encompasses a set of tools, processes and organization forms that enable large companies to identify, assess, and act upon opportunities and threats, that have been identified by weak signals in the periphery. Companies using Strategic Foresight aim to enhance their innovation capacity, manage disruptions, and shape

the future by creating trends favourable to their business model or to their expansion strategy." Deutsche Telecom[2].

Knowledge of the innovation context plays a major role in the success of the future product or service to be commercialized. This context is economic and technological, but also political, social [AST 05] and environmental. It is a mine of opportunities. It may give birth to ideas or help to discover similar products and competitors on the world scale, to choose a suitable time to launch a product, to obtain funds, to make an alliance with a partner bringing a value-added to the product or service to come. Contextual information and knowledge provide elements on constraints to consider and particularly those associated with the operating environment. Some constraints can sometimes be removed by a consultation of future customers. During the development phase of the Airbus A380, the services in charge of marketing consulted specialists looking for an idea of communication slogan able to comprehend the fear (imagined by communicators) of boarding a jumbo jet. An air bridge concept was proposed, but Airbus never communicated on this subject. Showing the plane in flight and offering discounts for the first long-distance flights were sufficient incentives to overcome this fear. However, the problem of efficient ground services remains: boarding and unboarding more than 800 passengers, whereas nowadays boarding 250 passengers can take more than two hours in some large airports. In a global approach, this problem could have been considered during the design.

In France, there is a long tradition of intelligence services. Major companies generally have a department in charge of the strategic, technologic and economic watch. It collects and dispatches to professionals, summaries of information gathered in the papers, in specialized magazines, on the web or received from subsidiaries abroad. Is this enough? In the knowledge society, all participants are in charge of business intelligence and share the information learnt in various contexts with the concerned actors. The knowledge of organization strategy guides this sharing of information and knowledge thus gleaned. Search engines such as Google, Yahoo, Alexa, Yippi and others are basic tools for business intelligence. However, engines like Google, using keyword searches and the business model of paid advertisements, are not really effective. There is other specialized search software, including the invisible web, the selection, storage and sharing of information relevant for a company in a flow of data and information. Some use techniques of text mining or knowledge discovery in the text. The most efficient software combines several techniques such as statistics, neural networks, language processing or multi-strategy machine learning [MIC 98]. Nevertheless, there are not – to our knowledge – any engines able to check the consistency of the information gathered on a given subject, which would help to detect false information. Indeed, evil-

2. http://ideas.repec.org/p/pra/mprapa/5701.html.

minded rivals can spread malicious rumors, fake pictures and falsified information on the web, in order to win an important market.

How do small businesses fare? They generally do not have a business intelligence unit. Those for whom ICTs do not have any secrets use search engines, social networks, blogs, specialized RSS, magazines, electronic publications of ADIT[3] or other country or embassy relative services. Those concerned about the subject register on the mailing lists they are interested in, and initialize a discussion group on one or several social networks. They can also use collaborative watch software such as a simple wiki with an integrated social network or, for example, Yoolink[4]. To our knowledge, there is no business intelligence unit in incubators.

Other small businesses do not do much watching and make timely use of the services of chambers of commerce or consultants. Most of them operate in the short-term and have difficulty innovating efficiently. A recent study on the integration of environmental aspects into the products during the design, demonstrates that generally small businesses either need incentives for the integration of all these aspects or need to be compelled to it by law [REY 07].

Since the publishing of the Martre [MAR 94a, b] and Carayon [CAR 03] reports, business intelligence (BI) has become a trend. Globalization has turned it into a necessity. Some short-duration training courses produce specialists in this domain, but few of them know a range of tools based on the artificial intelligence techniques, which are able to make the watch more efficient and above all to integrate it into a knowledge flow of the extended enterprise[5] [JAK 09, MER 07b]. Many books are devoted to it[6]: Amongst them, we can mention the collective book *Benchmark européen de pratiques en intelligence économique* [LAR 08], which lists the European practices in this field, and the book by Jean-Louis Levet, which gathers the BI practices at EADS, Renault, L'Oreal and in a few small businesses [LEV 08]. Given the importance allocated to the watch, a governmental website[7] lists the training courses in France and the reference documents, as well as a few research projects.

BI also interests IT researchers. It is an opportunity for them to implement knowledge discovery techniques, known since the 1980s [MIC 83]. Many work

3. French national agency for the diffusion of technological information.

4. www.yoolinkpro.com.

5. Including the stakeholders.

6. http://www.businessintelligencebooks.com/.

7. www.intelligence-economique.gouv.fr/rubrique.php3?id_rubrique=33.

groups[8] and scientific conferences are devoted to it, such as EGC[9] in France [EGC 09] which includes all the research works on data, text and more recently image mining techniques. According to Maryse Sales, it is a need analysis method, which should be applied in order to properly target the business intelligence projects [SAL 06].

There are many opportunities to create a relevant BI tool, adapted to the need of the extended enterprise; it can be carried out either through national research programs, such as ANR, those of competitiveness clusters or in the European framework.

BI practiced daily by all the participants enables them to better understand the trends, to capture in time the opportunities and knowledge useful for the company, as well as to know the studies concerning its activities, such as the price of raw materials, the exchange rate, the influence on health, etc.

4.2.2. *Knowledge of customers and of future customers*

In the majority of cases, the marketing department is in charge of customer relationship management. Depending on the activity of the company, it can have a consumer or customer service. Customers generally contact them for complaints and rarely for suggestions. The after sales services deal with failure problems in warranty periods. Marketing, sales people and distributors also have an opportunity to get information on the needs and wishes of the customers, as well as their knowledge of the competition. It would be beneficial for the company to share the gleaned information and knowledge with the actors and services involved.

Customer services are increasingly automated and outsourced. Computer programs, wrongly called "robots", answer letters or emails from the customers. But answers are sometimes irrelevant, because the "automatic answer machine" does not have the ability to "understand" the content. Here is an example of the misunderstandings that can result:

Advertisement mailed to customers:

> *Subject: Your beauty solutions for this summer!*
>
> *Melt from pleasure with your summer basics: 4 products at sunny prices to make the beneficial effects of holidays last even longer!*

8. Including the business intelligence group of the F.R. Bull Institute, led by the admiral (reserve leader) Pierre Lacoste www.institutbull.com.fr/publication/groupes/intelligence_m.htm.

9. French association of extraction and management of the knowledge.

And receive a GIFT, a necklace with iridescent reflections.

Maintain your summer figure with Sveltadraineur Red fruits. Maintain your summer figure with Sveltadraineur Mint. Show a smooth and tanned body with the brightening and moisturizing product. Keep a glowing complexion with Océasolaire.

Receive your GIFT with any €35 purchase: the Sensual Oil valued at €30! Your GIFT: the Lagoon Necklace.

Customer sent by email:

I did not have any problems. Moreover, you have never taken an interest in my needs.

Reply of the company:

Following your request, we are cancelling your subscription to our newsletter.

Several lessons can be learned from this exchange.

This company claims to be innovative, but did not innovate in its marketing mode. It considers immediately all the customers to be interested in the gifts, without seeking to know their own needs. This is a typical example of transposition of the old model of mail order selling to e-commerce. The possibilities of ICTs are not used at all, except maybe the .log file to track the website visitors and to then send them "targeted" advertising via Google Ads. The email is not even read, which is disappointing for the customer. An automatic system of reading/answer based on natural language processing techniques could "read" the message and answer it while taking into account the request of the customer.

Technological companies selling computers and peripherals are no better. For example, if we point out to HP a *bug* in their software product, we receive guidelines for a procedure to try, followed by a standard satisfaction survey contracted out by a partner. The sub-contractor does not try to capture and share knowledge with its customer, but only to supply an analysis of the answers to "typical" questions.

Customers of more expensive equipment, such as purchasers of cars are not treated any better. There is no possible contact between the final customer and the manufacturer sought after by the manufacturer. The car manufacturer PSA[10] uses an

10. www.psa-peugeot-citroen.com.

extranet to communicate with the partners. Customers do not have the possibility to directly contact them, without going through at least one intermediary. Generally, they are directed to a marketing service, which has an objective of selling them a new car. In this situation, the feedback and above all suggestions of the customers can be distorted or considered as not interesting by the distributor and thus not dispatched to the suitable service.

The attention paid to customers is conversely proportional to the size of the company: the larger they are, the less, customers are solicited.

Many software providers propose support for customer relationship management (CRM). Amongst those, many of them claim knowledge management of customers, but in reality they only take into account data. In some cases and particularly in retail, data coming from the recordings of checkout counters are processed by statistical analysis, and sometimes data mining tools are used to discover the customers purchase behavior in a given store. Loyalty cards also help them to collect data. Consumption surveys do no ask open questions and thus do not help to know the customer wishes. If customers require the provision of a product which is not in the database of the central purchasing, the store customer service answers them that this product is not in the purchase habits of the given region!

Small businesses are paying more attention to their customers, because they are the ones ensuring the success of the company. Their relationships are mainly based on dialog. Nevertheless, it can happen that a company does not want to change the packaging of a product suggested by a customer. Here is an example in the pharmaceutical industry. It concerns a medicine sold in the form of a cream in two different packages: tube with applicator and single dose. A customer points out a quality problem of the applicator and suggests an improvement. As an answer, the company suggests them to buy the other packaging, but it is more expensive and generates more waste. This company has not taken this remark to improve the packaging seriously, therefore overlooking the comfort and satisfaction of customers, as well as the opportunity to reduce the ecological footprint.

Software editors prefer to sell training courses and services, so that customers fit their software, rather than profiting from their feedback to improve their ergonomics or functionalities.

Another typical situation is to frequently offer a novelty to customers, while they want to buy a product maybe older but that suits them. Here is an example of reply to a request about a product which is no longer in the catalog: “With the concept of Club XX being innovation, we try to be closer to the needs of our customers by proposing new products through our promotional offers. However, this innovation imposes a constant renewal of our products and we have to do a selection on several

items. We are however conscious that such a selection does not satisfy everybody and we deeply regret it".

It would be better to ask customers how many of them are interested in the renewing of this product before sending a negative reply.

Another interesting case is this reaction to a suggestion of a customer:

"We think that accepting ideas from customers can cause many problems, because these ideas can be similar to those developed by our services, especially if they are protected by patents".

Concerning IT products, the concept of user clubs remains an excellent facilitator of knowledge exchanges with the customers and a generator of ideas, on the condition that we also invite designers and other involved persons.

Electronic commerce gives an opportunity to hold a dialogue with customers, but a large majority of online shops only use typical functionalities. Some of them do not even enable customers to contact the company by email sent from the website. They are still far from the "innovating together" concept.

4.2.3. *Knowledge for creativity*

Creativity requires stimulation and permanent questioning [VOG 03]. What knowledge is necessary to be more creative? Ignorance, curiosity and shortages are the best creativity stimulators. Too much specialization in a given field can sometimes prevent people from coming out of usual reasoning models, by thus limiting their capacity to innovate. We then need to learn mental flexibility, how to undo connections and how to conceptualize.

According to most brain specialists, creative people use the right hemisphere, while current syllabi force us to mainly develop the left side. Ned Hermann recommends using the brain in its entirety to combine the four usual ways of thinking: analytical, sequential, interpersonal and imaginative [HER 96]. Waldemar di Gregori proposes a concept of social cybernetics gathering the three worlds of knowledge in a system of three brains [DEG 84, DEG 02]. World 1 comprises the knowledge inherent in the natural physical and biological processes making the universe machine work. World 2 gathers the beliefs, preferences, perspicacity and personal facts that cannot be evaluated, checked and controlled from the outside. Finally, world 3 comprises knowledge of scientific laws, knowledge made up of theories and experiences that can be evaluated, confirmed, falsified or replaced by

new discoveries. Learning how to use this tricerebral[11] system enables us to be more creative, because we can utilize our brains better.

4.2.4. *Knowledge in problem solving*

A product or a service addresses, in most cases, a specific problem. The design of a solution thus requires a gathering together of all the knowledge inherent in this problem [HUO 05]. Thus, the plane has been built to carry out the old human dream of being able to fly, but also to quickly cover long distances. The product design requires knowledge of its functionalities, structure and behavior in an environment. The plane which must transport people and goods has been designed with the knowledge of the lift principle and other physical and aerodynamic laws. The more complex the product is, the more knowledge is required to design and explore it. Sometimes, we need to gather the knowledge of several fields. If we are also trying to eco-design a product, we need to include the knowledge relative to the possible consequences of the choice of materials, of its form, color, of the way it is manufactured and packaged if that is the case, and used in various environments. The choice of material is important for manufacturing and recycling. Its form must not only be attractive, but also ergonomic for customers.

There are many methods of problem solving. We can mention Socrates' maieutics, the methods by Descartes [DES 37] or George Polya [POL 57], the exploration of the cause-effect graph, by analogy, TRIZ, heuristic methods or those based on propagation constraints [FRO 94, GOR 80].

In order to solve a given problem, we need first to understand it. This requires the use of associated knowledge. This is the first step of the method proposed by Polya [POL 57]. It is then that we can choose an adapted method.

Artificial intelligence is interesting in computer problem solving. "Solvers" can turn out to be very useful in the case of complex problems, involving knowledge from several fields and a large number of parameters. The *General Problem Solver*, designed by Allen Newell and Herbert Simon in 1957, uses methods from mathematics applied to knowledge processing [NEW 72].

Allen Newell then worked on the representation of several levels in computers – from the components to the programs – and proposed a new level: the knowledge level [NEW 82]. His work focuses on another way of modeling knowledge – on the conceptual level. The models thus developed are independent of the implementation – the same conceptual model can be shared by several applications.

11. www.globaltriunity.net.

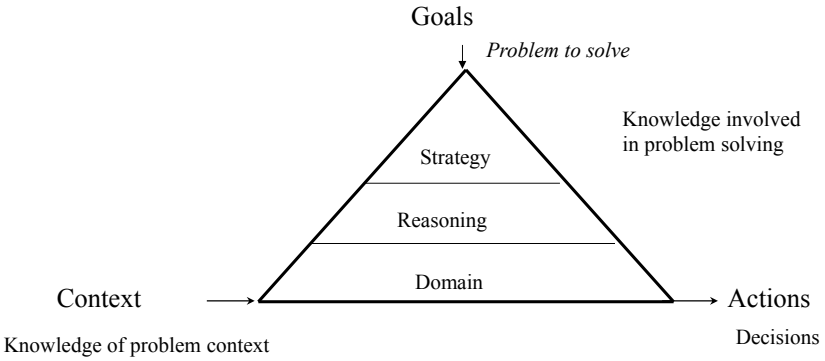

Figure 4.1. *KADS method adapted to problem solving*

This work inspired the development of the KADS[12] method [SCH 93] and knowledge modeling tools, such as Open KADS (Bull) [MER 95b] and KADS Tools (Ilog). The inherent philosophy can be applied to the analysis of a problem from the point of view of knowledge participating in the resolution. As shown in Figure 4.1, to solve a problem, we need to define an objective. The knowledge inside the triangle will be solicited by the reasoning mechanism during problem solving. The problem context, like the trends, legislation and environmental knowledge, influences the choices made during the process of resolution.

To solve a given problem, we will use a resolution strategy and appropriate modes of reasoning (inference layer). The reasoning mechanism will use the knowledge relative to the field. The resulting actions are the proposals of decisions to be made.

4.2.5. *Professional knowledge*

No problem can be solved without business knowledge. This knowledge is necessary to answer questions at the design stage, during the development phase and to cope with difficulties related to the exploitation of a product, its deployment, for the after sale services or during the maintenance.

General and specific knowledge can be found in design support systems, which are specific to the field, such as KATIA, Autocad, TurboCAD, etc. Complex knowledge intensive products, which involve several teams sometimes working at a distance, require knowledge in the co-design management [COD 09]. The objective

12. *Knowledge Acquisition Design Systems*, European project Esprit 2.

is to organize and manage teams and knowledge for successful development in the allocated time. In the case of the design of the A380, it was necessary to gather skills and knowledge necessary for the success of the final product – the knowledge of physicians, mechanics, engine specialists, electronics engineers, computer scientists and material specialists, amongst others.

Innovative services are born from the knowledge of the needs we wish to address. They can be associated with the use of a product. For example, in the field of computer design, expert knowledge will be used to develop specific solutions for the customer from generic software. In the 1980s, the strategy of computer manufacturers was to sell computers equipped only with the operating system and some basic software to make them run. Services, such as the installation of networks, peripherals or application software, were supplied by the partners. However, machine and software designers knew them as no one else did, but the sale of services was not part of the company strategy. At the beginning of the 1990s, they realized that such services can be a source of considerable income, some manufacturers added them to their catalog. Using the designer knowledge to sell associated services is something common in the case of open source software.

New services can be proposed from unexploited skills and contextual knowledge, such as trends, information on the growth and activities of the aging population, on lays-off or on the introduction of new laws. Proximity services have, for example, a first objective to reduce unemployment, but this would not be possible without the associated professional knowledge [DIA 05].

Taking into account the feedback [MER 03a], information and knowledge in real-time, at all the levels of the innovation process, can influence the evolution of skills, or even the creation of new skills that will be involved in new projects, born from gleaned opportunities and from the imagination of the participants.

4.2.6. *Knowledge of ICTs*

Computers, equipped with artificial intelligence techniques have the ability to efficiently support innovation activities at all stages, under the condition of knowing these possibilities. Besides software specific to an activity, most organizations use basics such as Microsoft Word and Microsoft Excel, a minimum of web and Google, as the only search engine. Consequently, they do not have the time or the curiosity to discover and explore suitable tools able to improve their innovative capacity. Generally, the Information Systems Department decides on the purchase of software. This situation changes with open source software and with the arrival of the new generation, which is a daily consumer of ICTs. Nevertheless, most of these people do not know technologies for knowledge processing.

4.2.7. *Environmental knowledge*

Knowledge of the influence of asbestos, aluminum and heavy metal, electromagnetic fields, pesticides and chemical fertilizers, chemical releases or hot water in rivers, toxic smoke and CO_2 into the atmosphere and the absorption of polluted or "chemically" improved food on the living and the planet, relies on knowledge in physics, electrotechnology, biology, chemistry, medicine and many other fields and their cross-influences. Those involved in a specific field cannot know everything, hence the importance of multi-disciplinary collaborations. Knowledge of ecosystems allows us to determine the influence of our activity all along the life-cycle of a product.

All these types of knowledge previously mentioned exist, but they are infrequently or not used at all, because many companies favor a short-term profitability. Some of these companies show good will by asking scientists for particular studies. Generally these studies are conducted in a single domain and time. This time is too short to expose all of the consequences. For example, to see a tumor on a microscope, 10^9 cancerous cells are needed. A tumor can sometimes take ten years to be visible on a microscope while studies commissioned by companies are shorter, because they are source of expenses. Some companies hide behind ignorance and the conclusions of scientific studies to say that it is too early to evaluate the possible consequences. Reports proving the danger of an activity are classified highly confidential, in order not to kill the business. In the case of high voltage lines close to housings or mobile phone antenna relays on buildings, we apply the precautionary principle, but it is not always respected, because business prevails. These influences are calculable, however, because there is a certain knowledge about them. One of the conditions is to bring them together and to think differently with respect to ethics. We can also, if it has not been already done, introduce this knowledge into a computer and run stimulations enabling us to see the consequences as a function of the values of different influential parameters.

It is not reasonable to say that there is no visible influence of our activities on the ecosystems, as is said by some irresponsible companies. Since the beginning of the world, different types of knowledge have been accumulated. Egyptians, Aztecs and other ancestors were cultivating multidisciplinary knowledge. Some have been transmitted, others not. The organization of sciences into fields scatters knowledge into "boxes" that we have forgotten to connect. This is about making connections between these boxes. In the 1960s, many books were written to increase the awareness of the world's population to the destruction of the planet by human activities. These books are not all on the Internet but they are far from being obsolete.

Artificial intelligence approaches and tools facilitate the building of systems based on multidisciplinary knowledge [BON 86]. Integrated in a knowledge flow of the extended enterprise, they are able to intelligently assist the e-co-innovation process, from the idea through simulation, to development and manufacturing, distribution and recycling.

4.2.8. *Managerial knowledge*

In addition to knowledge in project management, management of the innovation process and particularly of e-co-innovation requires knowledge in psychology, in communication, knowledge of humans, of their talents, motivations and increasingly of their culture. Environmental knowledge, from the point of view of what is required by the QSE approach, remains necessary, because companies still have not changed their logic. To the previous types of knowledge, we can add knowledge of the "holon", i.e. of the responsible citizen. The knowledge of managerial methods and in particular those for the knowledge economy are to be favored.

HEC Montreal (a business school) in collaboration with the University of Barcelona has recently organized a conference on creativity management [HEC 09]. It is unfortunate that there are no conferences on managerial knowledge, despite a significant interest and the innovative character of this event.

4.2.9. *Knowledge of intellectual property protection*

Patents are sources of knowledge on the state-of-the-art in a field, but the embedded knowledge can also be a source of inspiration. If we wish to protect an invention, we need knowledge on patent systems in the considered countries and we also need legal knowledge to properly write a patent, communicate with a patent office, and then defend and exploit it. Major companies generally have an Intellectual Property Department. One of their objectives is to "translate" an invention into legal patent language. Small businesses have to work with specialized lawyers and with relative services such as the INPI[13] in France. Regarding researchers, they rarely think to protect their invention, which is compounded by the fact that sometimes ideas and some software are considered non-patentable by lawyers and the relative services.

Collaborative research and the e-co-innovation process impart the knowledge of intellectual co-property management and of the new rules of the knowledge

13. French national institute of industrial property.

economy. The problem is raised in European programs. Generally, each project decides on the terms of result sharing and protection.

4.2.10. *Knowledge in project funding*

In France, there are numerous possibilities for applying for financing, as a function of the organization asking for funding and as a function of the characteristics of the innovative project. It is important to know all the possibilities to be able to choose the best fit.

Knowledge of the existing opportunities and know-how in preparing an application document are necessary to apply for funding. Application forms are relatively complex and it is better to target specific financing and to devote time to it, in order to make the most of the opportunity. The hardest work consists of finding and gathering rightful and trusted partners. Knowledge of the selection criteria, of the structure of the documents to be filed and how to correctly answer a call for projects is essential. Those in charge of some research programs, and particularly of multidisciplinary programs, ask for the names of experts able to correctly evaluate the potentialities of a given proposal.

In Chapter 1, we mentioned a few national and European programs. Amongst them were the ANR and the ADEME, the common programs of Precodd and Ecotech and the calls for projects coming from various ministries and institutions, such as the regional council of Ile-de-France[14].

It is vital to know that applicants generally do not have much time to prepare a substantial file. A permanent collaborative watch by all the actors willing to get involved is then preferable, in order to know the call availability and its updates as quickly as possible.

The list of calls for projects and information on European programs are available on the Cordis website[15]. This information is relayed by national representatives in all the member countries.

Applied research projects involving small businesses have several opportunities to apply for financing on the national and European level. But, as previously mentioned, it is very difficult for a small business to find time to consolidate a proposal, especially if they are not sure to win. The best solution is thus to ask Oseo

14. www.iledefrance.fr/appels-a-projets/.

15. http://cordis.europa.eu/fp7/dc/index.cfm ?fuseaction=UserSite.FP7CallsPage.

(in France only) or another sponsoring organization for funds or to make enough money to finance innovative projects on their own.

4.3. Which skills are essential to e-co-innovate?

Although Europe has a long innovation tradition since the industrial era, globalization has changed the odds. Factors such as the slowing down or even the mortality of some sectors and the emergence of others, as well as the transfer of activities, influence active knowledge and skills. The lack of interest expressed by youths in scientific studies will lead to a shortage of engineers. Some skills are disappearing with retirements, which are sometimes accelerated by the economic crisis. Knowledge capitalization approaches are saving a part of the strategic and "sensible" skills, but these initiatives are quite rare and are often initialized too late.

The European document *Putting Knowledge into Practice* [EC 06b] specifies that the lack of skills, notably in the fields of sciences, engineering and ICT, is a challenge for European education. Another publication, *Innovate for a Competitive Europe* [EC 04] advises companies to absorb knowledge, to be able to transform it into action. This is innovation dynamics, combining the knowledge and skills in value creation. A few details on these skills are given in *Skills for Innovation* [PRO 07] and are summarized in Table 4.1.

Skills for innovation	
R&D related innovation	**Non-R&D related innovation**
Knowledge transfer skills and R&D management	Entrepreneurial skills and innovation management
Scientific and technological skills	Workers' skills and competences
Basic skills (mathematics, natural sciences, etc.)	General education
Innovation Culture and environment (e.g. creativity flexibility, adaptability, migration)	

Table 4.1. *Knowledge and skills for innovation (source: [PRO 07])*

The authors of this book separate R&D innovation from other types of innovation. Scientific and technological skills are found in the first category. Surprisingly, we do not find any managerial skills in this category, instead only

technological transfer capacities – this reminds us of the first generation of management presented in Figure 2.6. The two populations are assumed to have, or to acquire, a culture of innovation. This includes creativity, flexibility, adaptability and mobility: creativity to have more ideas, flexibility to be ready to change profession if necessary and adaptability to integrate another environment, company or culture. According to the authors, one of the conditions of territorial development is the migration of researchers or of companies to this specific place, hence the mobility. They notice that an improvement in intellectual property management would encourage open innovation. However, the capacity and rapidity of the transformation of ideas into products or services is not mentioned.

This table is certainly valid for the industrial economy, whereas globalization and knowledge economy are changing our reference marks, activities and habits. They have an influence on our ambitions, objectives, values and our way of learning and working. Table 4.2 shows a few of these induced changes.

Industrial economy	**Knowledge economy**
Industrial company	Extended and learning enterprise
Financial capital	Capitals: financial, intellectual, customer patents, products, connections
Planning by project	Research of opportunities, reactivity
Risk management	Risk taking
Value of the company	Value of the connections
Work inside a company	Mobility
Processes of the company	Collaborative innovation
Training	Continuous education, e- and m-learning
"Customer – supplier" business model	New business models
Employee	Entrepreneur
Integration of environmental aspects	Environment as a source of business

Table 4.2. *Some changes induced by the knowledge economy*

The mentioned changes have an impact on the activities and behaviors of enterprise managers and employees. Currently, CEOs mostly manage the short-term,

restructuring, mergers/acquisitions and lays-off caused by the search for operational savings. Employees are overloaded and stressed. This context is not favorable for innovation and yet it is the only alternative able to ensure prosperity. The course "from an idea to success" requires different efforts. According to Peter Drucker, "the greatest danger in times of turbulence is not the turbulence; it is to act with yesterday's logic". Which logic should we choose? Learning the innovation culture adapted to the knowledge economy is part of this logic.

4.3.1. *The innovation culture*

Regardless of their position in the company, a knowledge cultivator progressively learns by performing the attitudes, which are part of the innovation culture. Some are presented in Figure 4.2.

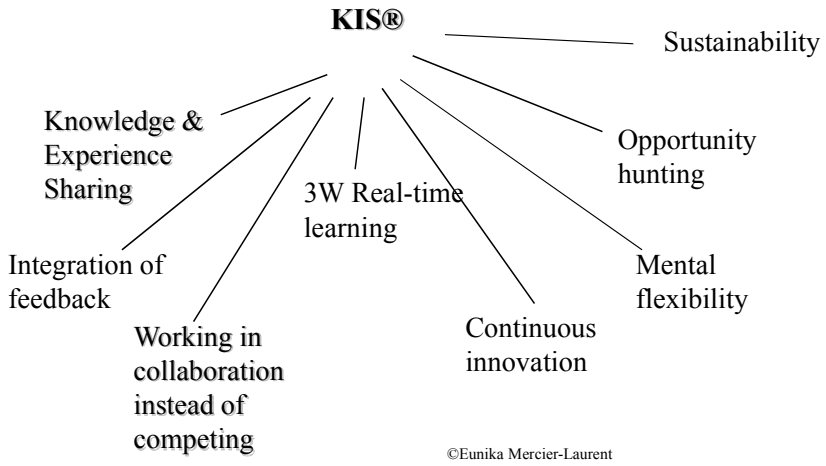

Figure 4.2. *Some attitudes relative to the knowledge innovation strategy (KIS) to be acquired*

Strategic, technological and economic watches are part of these attitudes. Observing, collecting and sharing information and knowledge with those who need it is much more efficient than waiting for the results of reports of a person devoted to this task or reading press reviews. It is a condition for opportunity "hunting".

Experience sharing and feedback facilitate training, the improvement of products or services and help people to take inspiration from a solution, in order to reuse it in another context and it can sometimes give birth to new ideas.

Working in collaboration is often difficult, because the evaluation of people in most cultures is individual. This requires listening to others, recognizing their abilities and their contribution to the group results. Finding complementarities and making connections between people and abilities implies a different logic to the "know-it-all" and the push logic practiced in social networks. Although European programs have introduced this collaborative research, there is still much to do to really practice it on the level of competitiveness clusters, national projects, in enterprise and on the regional level.

Learning how to learn efficiently (what we can immediately put into practice) and in any situation is also important to progress and become flexible. ICTs have extended the range of possibilities with the creation of e-learning and mobile-learning environments. We can now learn 3W[16]. Nevertheless, an adapted pedagogy is necessary for the relevance and efficiency of this learning process.

The reflex of constantly innovating in the individual and collective context certainly gives better results than occasional creativity sessions. Learning to "think differently" is useful for finding solutions that respect the given constraints, especially in an environment with limited resources. This skill is particularly helpful in the case of a presumed technological dead end.

Adopting the attitude of an eco-responsible citizen in all the actions and in the context of the innovation holonomy is much more efficient than waste sorting, the reduction of CO_2 emissions or recycling.

To this, we can add the urge to become an entrepreneur and to succeed individually and collectively.

4.3.2. *For a successful e-co-innovation*

The new European policy[17] is clear: "Very often, innovation and skills are only associated with science, technology and engineering. Although these skills are extremely important to European innovation, they are not the only skills required to compete in a global knowledge economy. The successful commercialization of innovative products and services also requires know-how in areas such as management, design, organization, marketing and finances, to bring together technological and non-technological innovation". "Equally important are the so-called 'soft skills', including attitudes, willingness to learn, social skills and a sense of entrepreneurship."

16. *When you want, what you want, where you want*.

17. http://ec.europa.eu/enterprise/policies/innovation/policy/skills/index_en.htm.

Industrial Economy		Knowledge Economy
Functional title	**Focus on**	**New role**
Enterprise Manager	Planning, organizing, staffing, leading or directing, and controlling an organization (a group of people or entities) or effort for the purpose of accomplishing a goal	Leader, visionary and strategist, Focus on dynamic governance, sustainable success manager, stakeholders, strategic alliances
R&D	Managing research and development projects	Manager of the e-co-innovation dynamics
Human Resource Manager	Managing human resources, training and laying-off	Talent miner and optimizer, Manager of the Intellectual Capital
Marketing Manager	Market study and customer relation	Opportunity hunter Risk taker
Communication Manager	Image	Image, Links maker
Corporate Social Responsibilty Manager	Image, environmental impact, recycling, CO_2 emission	E-co-innovation, minimizing the impact and packaging, nature inspired design
Project Manager	Managing tasks and people, reporting	Facilitator of the collective intelligence and creativity able to motivate and evaluate
Practitioner of the *faster, cheaper, better*	Manager of delocalization, finder of cheaper workers	Practitioner of the e-co-innovation culture
Financial	Estimation of ROI (return on investment)	Measuring the capacity to innovate and the tangible and intangible benefits and values
Computer user	Planning, reporting, scoring	Master of ICT (intelligent and creative technology), able to take the best in technologies

Table 4.3. *Contrast in managerial roles*

The know-how to innovate, at the CEO level includes an ability to develop a vision and the corresponding strategy and to translate it into tactics, by mobilizing the knowledge and skills of the participants. This strategy, communicated to all the participants, is dynamic and adaptable as a function of the feedback and the opportunities of the moment. On the one side, it reflects a projection into the future, the market needs and the opportunities and on the other side, the capacities and capitals of the company. The visionary talent and intuition are necessary to hypothesize on the long-term evolutions of the market and technologies.

Some challenges for the 21st Century managers are presented on the right-hand side of Table 4.3.

At the level of the participants in the innovation process, the know-how to innovate is expressed by the ability to have ideas and to transform them into eco-responsible products and services.

The e-co-innovation process does not necessarily need an innovation director, rather it needs a facilitator and a driving force able to instigate dynamics and to motivate all actors and knowledge, to regularly measure the organizational capacity to innovate and the tangible and intangible benefits brought by innovation. These measures help them to stay on course (vision), while integrating the dynamic elements which could influence the company strategy.

The scientific research sector also needs a vision and the resulting strategy. The latter enables them to concentrate the talents on the priority topics at national and European levels. The Lisbon strategy is a good start, but a lot remains to be done, notably concerning the collective business intelligence and the visibility of research results and talents in the European research area (ERA).

The Danish pharmaceutical company Novo Nordisk, is exemplary in the practice of e-co-innovation [QUA 07].

Another example of innovation management could be the Henkel company[18]. Its offer includes cleaning products, cosmetics, adhesives and surface treatment products. Henkel considers itself to be the market leader in trademarks and technologies "facilitating, improving and embellishing everyone's life". This vision can only be carried out through innovation, which is now part of the company's corporate values. This is about understanding the innovation occurring in all sectors and functions. For them, innovating means finding and applying new, better and even revolutionary solutions. Consumers and customers determine the success. The acceptance by the market is its measurement. Henkel considers that innovation must

18. www.henkel.com.

be strategically and long-term managed. On the one hand, this implies a targeted observation in the long-term of the trends which could be useful, such as the desires of the consumers and the technologies of the future. On the other hand, regular visits by product managers help to sustain good relations with the customers, distribution, industry and professionals and consumers. Admittedly, their approach is still far from that of Novo Nordisk on the integration of the final customer, but they are making progress.

4.4. Measuring the organizational capacity to innovate

The method proposed by Debra M. Amidon in 1997 [AMI 97] to accompany the *Knowledge Innovation*®[19] process is generic. It starts with an analysis of the organizational capacity to innovate in the knowledge economy. Able to be carried out in half a day, it does however require a preliminary adaptation, in order to obtain the results corresponding to the nature and ambition of the organization to be evaluated. This evaluation is generally led by the executives and aims to guide the participants in building a shared vision of the future. Figure 4.3 presents the generic modules on which this method relies.

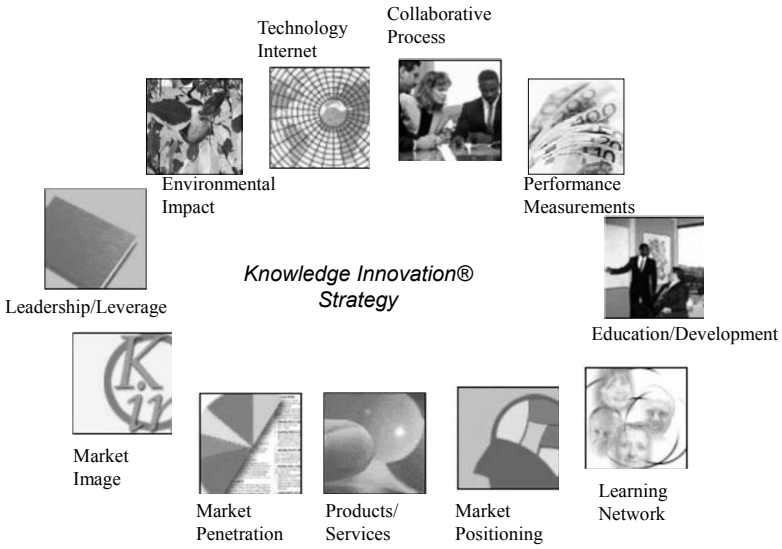

Figure 4.3. *The 10 modules of the Entovation method + environmental influence*

19. *Knowledge Innovation* is the trademark registered of Entovation International Ltd.

As previously specified, the e-co-innovation process is the integrator of all the enterprise processes. The modules follow ecosystem logic – each has an influence on the others, as well as on the innovation success.

The organization and management of this process bringing together all the inside and outside actors, as well as the relative knowledge sources, plays a crucial role in the success of the extended business network [CAR 08]. A person or a committee should be chosen to lead these dynamics. Although this work is not full-time, it is essential for the success of the process. The facilitator must have many talents to comprehend the whole system. The "know-how to facilitate" and motivate the participants, demonstrate mental flexibility, know-how to estimate the intangible values, are part of these abilities.

In order to regularly measure the benefits and the impact of such an organization, we should define suitable *performance indicators*. They should take into account the financial and intangible aspects as well as the market image, the level of the intellectual capital, the number of new products and services per year, the capital of links, the leader position, the creation of new companies and the impact on the environment.

Long-life training is not mandatory, but is a reflex to continuously learn from exchanges with colleagues, customers, partners, researchers, the *Web* and by following online lectures. However, this training should be channeled and re-centered on the elements immediately applicable in the trainee activity conforming to the strategy of the company and also to the personal vision of the participants (career management).

A company or an organization is part of a *learning network* (learning organization), including stakeholders. Compared to social networks, a learning network is built selectively, with care for the real contribution to the lasting success of all participants and in trust. Its composition influences the leadership position. The benefits from having a learning network are measured (measurement module).

This network is significant for the quality and the relevance of the strategic, economic and technological *watch*. The efficiency of BI can be measured amongst other things in a number of opportunities. More people are involved and more targeted information is arriving into the knowledge flow.

Some opportunities, including collaborative innovation, will be at the origin of *new products and services*. Their percentage is also measured and is part of the capacity to innovate. In the case of fundamental research, "products" are new techniques; in the case of applied research, they are new solutions found for a given problem. Expertise or training provided by academia are considered to be a service.

Sometimes, a partnership with a competitor can be strategic, for *collaborative market penetration*. In Chapter 3, we gave the example of such an association, which was initialized by Michelin for the PAX system. When considering this module, the facilitator asks questions about similar initiatives within the analyzed company.

The image of the company/organization plays a significant part in the success of the innovation and its leader position in the market. It depends, among other things, on the choice of the logo and advertising slogans, on the way the company communicates with the outside, on the subjects of this communication, on its visibility on the web, on the Alexa search engine and on firm ethics.

If it is well-managed, the e-co-innovation process should lead to company leadership. There are several ways to become a leader, notably by being visible at the worldwide level, by invitation to prestigious events, by distinction with prices and other honors. A partnership with a leader with complementary activities, such as research for example, facilitates access to the desired position.

Information and communication *technologies*, as well as imagination, intelligence and creativity help knowledge cultivators in their e-co-innovation activities and amplify their capacities. They play a major role in the efficiency of the whole process, including the "time-to-market".

The *environment* module, which was not present in the original method [AMI 97], is systematically added [MER 08]. The group will have to answer questions concerning the estimation of the environmental impact and the use of simulators and decision support systems, amongst other things.

The participants of an evaluation session of the capacity to innovate answer the questions asked by the facilitator and give a mark on the radar chart presented in Figure 4.4. The small surface corresponds here to the current situation and the large one to the objectives for the future.

Depending on the nature of the organization (major company, small business, governmental organization, research center, association) and on the number of participants, we can split the groups, in order to integrate the technological, economic, social, cultural and environmental points of view, depending on the interest. During the final assessment, the point of views, if different, are discussed to reach a consensus, which will form the collective vision of the group.

The vision thus developed is then translated into a strategy and a tactic – actions are suggested, such as a function of priorities and objectives to achieve. Progress towards the targeted situation is measured regularly using the appropriate indicators.

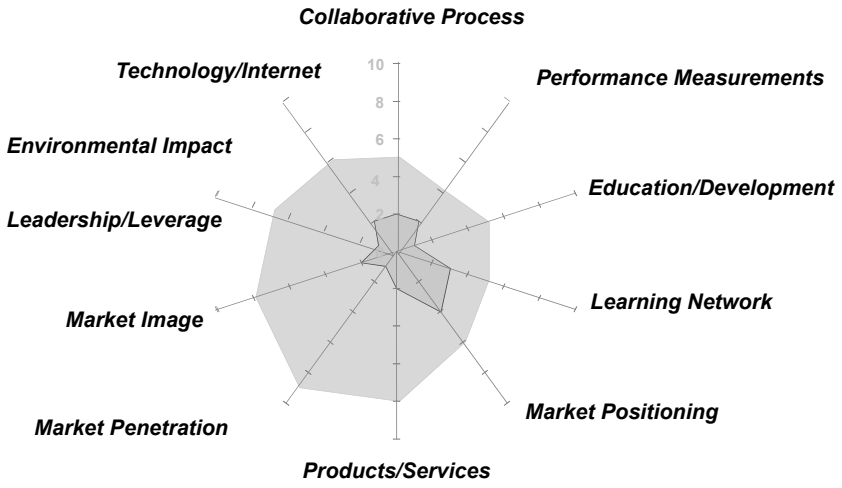

Figure 4.4. *Evaluation results of the capacity to eco-innovate*

A free test (minimum version) is available on the website of the Entovation network[20].

This approach provides the basics for the definition and the building of a knowledge flow connecting the participants and other sources of information and knowledge, which will accompany the e-co-innovation activities of the extended enterprise.

4.5. Mobilizing imagination, collective intelligence and technology

The results of the innovation process strongly depend on the organization and on the management of knowledge and participants. The role of the facilitator includes several aspects – they have demonstrated vision and imagination, intelligence and boldness, but they also know how to mobilize the talents of the participants, to create a collective intelligence and to take the best from technologies. Boldness is one of the key-factors of success. However, unavoidable in the knowledge economy, it sometimes leads to risks, which can be mitigated by the right technologies in a flow of knowledge.

There are several ways to initialize the construction of such a flow. Amongst them, we find the strategic top-down approach following the previously described

20. www.entovation.com/assessment/flitmus.htm.

analysis (or the bottom-up approach) consisting of progressively building a flow, beginning from a problem to solve. Some details on these two methods are given in Chapter 5.

Chapter 5

Knowledge Management – Collective Human-Machine Intelligence

Computers are incredibly fast, accurate, and stupid. Human beings are incredibly slow, inaccurate, and brilliant. Together they are powerful beyond imagination.

Albert Einstein

5.1. Amplifying intelligence

The impact of innovation is proportional to the speed of opportunity detection and to the speed of ambient information and knowledge exploitation. In all their guises, computers are able to store and process what is asked but they can do much more.

Since 1956, artificial intelligence researchers and practitioners have invented methods and techniques of knowledge processing by computers. Most of them have been experimented and successfully used in robots and in decision support systems, in order to learn, predict, plan, simulate, innovate and play.

The introduction of tools for collaborative work (groupware) at the beginning of the 1990s, and then of the intranet and extranet, was a progression in the organization and sharing of information and documents inside and outside enterprises. The Internet is an inexhaustible source of information, but finding relevant and reliable information is almost like finding a needle in a haystack.

The concept of knowledge management (KM) was born in the 1980s, as a new managerial method, but its introduction into companies began with the organization of databases and the introduction of ICTs. Some of the collaborative work tools, now known under the name wiki, are excellent to start co-innovation. Moreover, the Web 2.0 has brought other services, such as social networks and RSS; it is evolving and integrating more intelligence. We should add to this, specific tools for creativity, design, customer relationship management, e-learning, e-commerce and others.

How can we organize the knowledge and put all kinds of computers to the service of innovation? This chapter discusses the topic of automated knowledge processing and methods for knowledge organization and management (KM), with the aim to boost the innovative capacity of all participants: humans and computers. Documents, as a third source of knowledge, indeed have their place in this approach.

5.2. The role of computers in the e-co-innovation process

Since von Neumann, the architecture of the personal computer has not changed much. It has just become more powerful and smaller. It is connected to the Internet, wireless or not. Personal assistants (PDA) have merged with mobile phones, which have now become real computers with the addition of high resolution cameras, movie cameras and GPS. Computers may take several appearances: robot, agent or digital object.

As a holon, personal computers can be part of the extended organization – of the information system or of a "cloud"[1]. In this case, they must meet, in addition to their own rules, those of the system to which they belong.

In the sixth management generation, methods which we can now add to the table in Figure 2.6 and which would have the future as an asset (*future as asset*), computers are able to work in symbiosis with their users.

This collaboration, using at best the abilities of both humans and computers, generates a human-computer collective intelligence. This consists of harnessing computers and making them work for our success.

The challenge is particularly important in the current context, where the information overload and a lot of non-targeted push make us lose time, which has become a valuable asset. It would be extremely useful to eliminate unsolicited mail at the source before it arrives in our email box, or influence other ethics.

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1. Cloud computing: information processing service on remote servers, accessible via the Internet.

Originally, computers were built to imitate and outstrip human beings. They have not yet surpassed human intelligence, but they are able to help in human activities. This is particularly useful in situations where the possibilities of the computer outstrip those of humans: such as storing a large amount of information, simultaneously taking into account a large number of parameters; researching solutions respecting the given constraints set by exploitation, in a huge space of possibilities; searching for relevant information within an immense quantity of data and information; and knowledge discovery in databases, texts and images.

They are able to check the coherence of information from multiple sources, "read" documents and make a summary of them as a function of the current user interests, to report information, articles, events or books that are of interest.

Able to learn by discovery, analogy, observation (tacit knowledge), computers can help in complex system diagnosis, translate simple and well-structured texts, help to capitalize knowledge, to design documents, products or to gather know-how in a given field.

Within an organization, in an embedded system or in a "cloud", computers can collaborate with other machines, aiming to increase knowledge and amplify the participant abilities inside and outside the company.

The human-machine synergy, or even symbiosis, strongly depends on the last architecture, interfaces and on programming, which is preferably user-centered [MER 94]. The ability of computers to communicate, learn and anticipate the users' actions also contributes to it. A disruptive innovation in computer design could improve the efficiency of both humans and computers; the challenge being to largely exceed the usually exploited 10% of the brain and of the computer as well.

5.2.1. *Amplifying the capacity to innovate*

Computers, which are programmed to use the "knowledge approach", can play several roles in the innovation process: that of a facilitator of the collective intelligence; a generator of ideas, able to check if a new idea has already been carried out somewhere in the world; a business intelligence specialist; a consistency and constraint controller; a simulator "to see before doing"; a design assistant; an adviser and a box of ideas.

Equipped with artificial intelligence techniques, computers can "think", solve problems, become experts, and accumulate a collective experience, under the condition that we transfer to them the relative knowledge and the necessary reasoning and learning techniques.

Suitable organization and management of knowledge flow generated by innovation activities remains a *sine qua non* condition of the success. In this logic, SolidWorks, editor of the design support software have launched a 2011 version, integrating tools for the creation, simulation, validation, documentation, design management and analysis of the impact on the environment. This last aspect classifies SolidWorks as a tool for e-co-innovation.

5.2.2. *Knowledge processing via computer*

The first industrial knowledge-based systems were designed in the 1980s, in order to provide the people involved with the best expert knowledge [BAR 82], to gather the necessary elements facilitating the decision making process, to assist the operator in the industrial process control [DOL 96] or to help a marketing and sales person in the configuration of complex equipment [MER 07b].

Another category of applications includes systems able to solve combinatorial constraint problems: such as scheduling, planning, resource allocation, logistics (business traveller), allocation of frequencies for radio, television and cell phones, air traffic management[2] and cathering [RIV 06].

At the end of the 1980s, these systems were tested in almost all the fields [RAU 86]. The initial techniques evolved with feedback from experience with an aim to adapt them to various problems and to make an application design that is easy for professionals. Henceforth, a diagnosis specialist can build a cause-effect graph corresponding to the equipment to be diagnosed [MER 92], or contribute to the co-construction of a conceptual model of their area of expertise [DOL 96].

Other techniques, such as reasoning by analogy, have provided significant help in building support systems for diagnosis, combining theoretical knowledge and practice in the field in a collective experience [BAU 95, MAN 94, MER 03b]. In the early 1990s, a new approach, the "corporate memory" was born.

It was applied to the development of "memory" of knowledge intensive projects [COR 99, EMM 08].

This same approach was used to build a flow of knowledge starting with a multi-domain support system assisting in the preparation of proposals for tenders [MNE 93]. It was then enriched with the skills management module and with a system for the collaborative design of products or documents. The principles of the latter are described by [COD 09, HUO 05].

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2. See for example http://www.lockheedmartin.com/capabilities/attm/index.html.

Three main tasks are to be considered for the development of knowledge-based systems which are components of flow: knowledge transfer and modeling, the choice of processing techniques and the development of interfaces for the acquisition of and the access to knowledge.

5.2.2.1. *Knowledge transfer*

So that computers can process knowledge, it is necessary to transfer this knowledge to them in a form that they can "understand" and use for future processing and for their own learning. In a connected human-computer relationship, three types of transfer can be considered:

– from human to computer (capitalization, collectivization, strategies, tactics, reasoning);

– from computer to computer, M2M[3] (file or application transfers, knowledge transfer between applications, ways of communicating);

– from computer to human (training, search for solutions, discovery).

The interface between humans and computers plays a predominant role in the bidirectional transfer process and in the way of learning for both. It must be intuitive and developed preferably with the users or able to adapt to them.

Knowledge is human. According to Nonaka [NON 91], tacit knowledge (know-how) represents over 80% of our knowledge and resides in our heads. The contribution of human and cognitive sciences is thus essential for any knowledge acquisition and transfer activities between humans and machines.

The experience of the first generation of expert systems has demonstrated that the quality of the system depends on the ability of the knowledge engineer to ask the right questions, to listen, to apprehend new fields and to refrain from interpreting what has been said, during the "translation" of this knowledge into objects and rules, which the machine can "understand".

The second generation uses a conceptual modeling workshop, whose principles are briefly presented in Chapter 4 (Figure 4.1). It is designed from the results of the European project KADS[4], taking into account the experience from the first period and the works of Allen Newell at the knowledge level [NEW 82]. It accompanies experts and knowledge engineers in the co-construction of a conceptual model of knowledge in the relative field.

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3. Machine to machine.

4. *A Methodology for the Development of Knowledge-Based Systems*.

The Open KADS workshop, designed for collaborative modeling by several experts in the framework of the Sachem project [DOL 96], includes an automatic consistency control. Based on the principles of modularity, genericity and reusability, it facilitates the co-construction of a library of knowledge model.

The current trend is to communicate with "intelligent" assistants by voice, gestures or image and maybe soon by thought [IDI 09, VAN 08]. Therefore, we can describe [DUC 08] or show an object to them [BER 09, BIS 06].

A support system for the inventory of knowledge on the historical heritage [DUC 08] illustrates the first case. A vocal description of a work done in the field is transmitted to the computer, which automatically translates this recording into text. A knowledge model, extracted from this text, will be used both to index the objects and for future applications.

Here is an example of the vocal description of Figure 5.1:

> "Town of Aniane, Saint-Sauveur Church. The painting represents Saint-Benoît of Aniane and Saint-Benoît of Nursie offering to God Almighty the new abbey of Aniane. This picture is located in the chancel and placed 3.50 m from the floor. This is an oil painting on canvas, which is framed in gilded wood. Its height is 420 cm and its width is 250 cm. This is 17th Century painting. It is signed down in the bottom-right corner by Antoine Ranc. It is in a bad state of preservation. A network of craquelures is spreading over the whole paint layer."

The "automated" translation gives the following text:

> "Town of Aniane, Saint Saveur Church. The painting represents Saint Benoît of Aniane and Saint Benoît of *Nursy* offering to God Almighty the new abbey of Aniane. This picture is located in the chancel and placed 3.50 m from the floor. This is an oil painting on canvas, *witch* is framed in gilded wood. Its height is 420 cm and its width is 250 cm. This is 17th Century painting. It is signed down in the bottom-*write* corner by Antoine Ranc. It is in a bad state of preservation. A network of *crack lures* is spreading over the whole paint layer."

Figure 5.1. *The described object*

After the correction of minor errors (in italics), the system will automatically extract the concepts and hierarchically organize them into an ontology[5], shown in Figure 5.2. Associated with other ontologies of historical objects, it will facilitate the relevant search in a large cultural heritage database. In addition to this description, we can "show" the computer the image of the object.

5. From the greek *ontologos*, ontology is a structured set of concepts and relations in a given field [GRU 93, VIS 96].

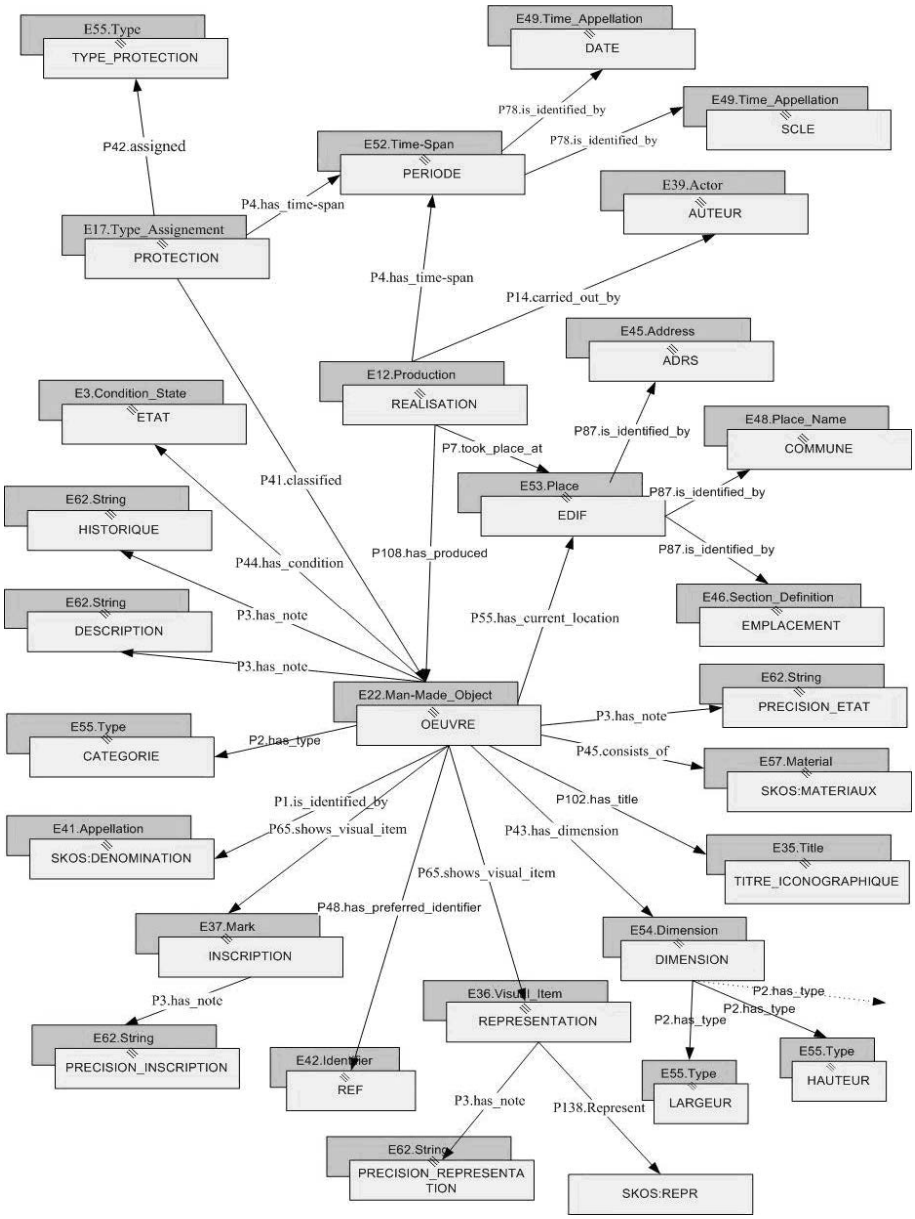

Figure 5.2. *Ontologies generated from the vocal description of the object. French words in white boxes correspond to the inventory descriptive system, which is imposed by the existing information system. The text obtained from voice is used to: a) generate information for a historical database using the words in white boxes; b) generate a knowledge model (ontology) from the existing general model (gray boxes)*

The knowledge thus modeled could be exploited by other applications, using the various concepts and techniques of reasoning. The choice of the acquisition method depends on the situation, on the nature of knowledge and processing which we wish to carry out later on.

5.2.2.2. *Knowledge modeling*

From the beginning of artificial intelligence, different representations of knowledge have been proposed and experimented upon. Figure 5.3 illustrates a few of them. This is about finding one that will be the closest to the concepts used by humans that will be *understandable* for computers.

Amongst these models, we can find three main types enabling the modeling of:

– static knowledge, i.e. objects or hierarchy organized concepts and relations between them;

– dynamic knowledge or reasoning models;

– dynamic and static knowledge in one hybrid model.

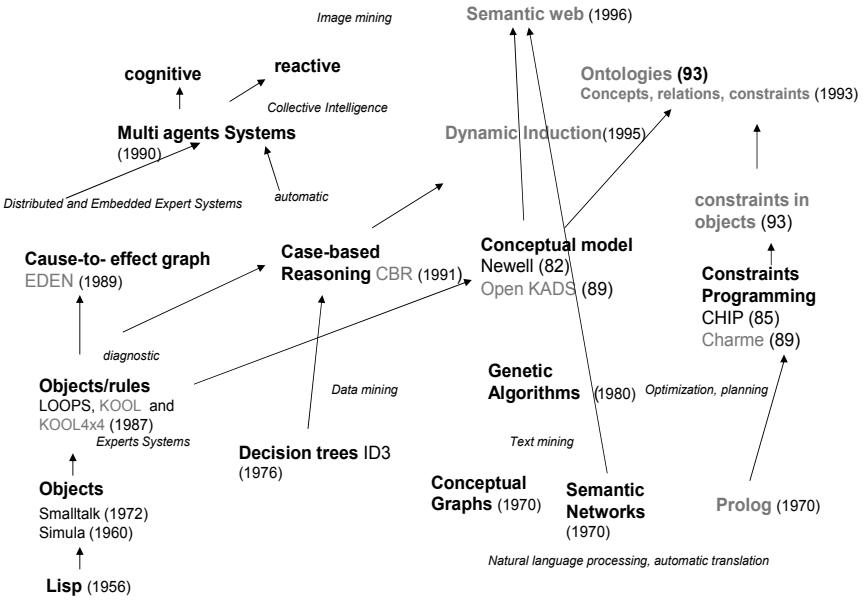

Figure 5.3. *Evolution of knowledge models*

Thus, to model *static* knowledge, we will use taxonomies, semantic networks, conceptual graphs, reflexive and hierarchically organized objects, concepts/

relationships, ontologies[6] [DOU 06, GRU 93], constraints on the variables, tables, concepts and objects.

To model *dynamic* knowledge (reasoning), we can use the *if... then* rules, the analogy engine or generic reasoning models, such as those of evaluation, diagnosis or design. A collaboratively built models library will facilitate reusing existing models and consequently will enable quicker design.

Hybrid models, such as causal graphs, decision trees (induction algorithms) or multi-agent systems [BES 97, BON 04, JFS 09] encapsulate static knowledge and reasoning.

Researchers in knowledge engineering have been working on knowledge representation in computers for about 50 years. Modeling techniques have evolved thanks to their imagination and to the feedback coming from application designers and users. Figure 5.3 represents a point of view on the evolution of knowledge modeling throughout time. To complete this presentation we should add the various forms of logic necessary to deal with fuzzy, uncertain and changing with time knowledge and beliefs [FER 93, SAN 98].

Experiments with expert systems have evolved the way of modeling knowledge as their designers, who were at this time also mostly experts, were looking for representations getting close to the concepts they used daily. For portability questions, KOOL[7], designed in Le_LISP as a reflexive language, has evolved towards KOOL4x4[8]. It enabled the design of expert systems with the help of the graphic interface. The application thus conceived has then been "translated" into a C language, in order to facilitate quick porting on heterogeneous machines.

EDEN[9] was designed for the fast development of diagnosis support, where knowledge was modeled by the cause-effect graph.

Multi-agent systems were born from experiments carried out in the building of embedded and distributed applications [BRU 92, FER 95]. At first, multi-agent systems borrowed the principle of the blackboard, used in automatics [LAA 89]. This is why we can find them at the beginning of the 1990s. Readers can also refer

6. A set of terms and definitions specific to the given field and organized in the form of a system. The properties of this system depend on the properties of the ontology in terms of consistency, consensus, sharing and formalization (definition from C. Roche, www-lgis.univ-savoie.fr/condillac/fr/activites/recherche/ontologie/definitions.html).

7. Knowledge representation object oriented language.

8. Running on all machines.

9. Expert Diagnosis ENvironment.

to [BES 97, MER 98]. The blackboard principle is no longer mentioned in recent works.

Modeling by case[10], associated with reasoning by analogy, has appeared as a result of evolution and simplification of diagnosis tools. On the theoretical side, it has been influenced by the works of Ross Quinlan [QUI 83] on the automated generation of decision trees from cases and by the works of Roger Shank on the efficient organization of the dynamic memory [SHA 82]. Describing a case is simple and open to any professional. The collected cases are then exploited by an analogy engine. This technique is very helpful in building a collective experience.

The conceptual modeling approach – KADS, based on the work of Newell [NEW 82], Chandrasekeran [CHA 83] and Clancey [CLA 85] – was a breakthrough in the way of transferring knowledge from expert to computer. Conceptual models are built in collaboration with experts, which makes experts more trusting and considerably improves the quality of the model, following the direct transfer of knowledge. The time necessary for the design and validation of the system is shorter and therefore makes the system cheaper.

The Open KADS workshop, developed at the CEDIAG, includes a method to support system design and allows automatic generation of the program from a correct conceptual model. *Collaborative modeling* carried out by several remote teams was made possible in 1989. It has been used, amongst other methods, to model the knowledge on blast furnaces for the SACHEM project [SAN 98, DOL 96].

In the framework of the MNEMOS project [MER 99, MNE 93], we proposed a simple model of the semantic network with constraints. It includes entities and relations, grouped into classes of concepts, which are hierarchically organized and on which we can define constraints.

The Idéliance tool [ROH 03], the precursor of social networks, enables knowledge modeling in the form of hierarchically organized concepts and the bi-directional connections between them, without any programming.

The Internet has created the need for efficient search engines. To anticipate and face the information overloads, we proposed using KADS principles in building websites, in order to be able to efficiently explore knowledge models [VER 96]. The current engines use the results of works on natural language processing and machine learning (classification, knowledge discovery). The *semantic Web* is the result of the

10. Case-based reasoning (CBR).

hybridization of the already known forms of modeling, such as semantic networks, conceptual classification, ontologies or multi-agent systems.

For example, the hybrid search engine developed in the Mediaworks project [GOL 00] integrates ontologies, multi-agent systems, neural networks and natural language processing. It supports semi-automatic indexing and effective searches for elements in images, videos and texts.

5.2.2.3. *Knowledge processing techniques*

Solving complex problems begins with understanding the problem in context, the discovery of real needs, analysis of the nature of knowledge to be exploited and the decision-making mechanisms. The choice of a technique will be made as a function of all these elements. Very often, several techniques are necessary. Amongst them, we can mention:

– the *expert system*, where the reasoning is based on rules. In reality, there are few situations where the rules are used to solve a given problem. This technique is effective in the areas where the rules are well-defined and there are few exceptions, such as the allocation of taxes at customs, equipment configuration, process control or in administration;

– the *cause-effect graph*, is useful for finding a solution from an observable symptom and by exploring the branches. This technique is used for diagnosis and to model the correct operation state. Building a graph for a complex system is time and energy consuming;

– the *decision tree* or static induction, used for diagnosis and in data mining. The tree is automatically generated from examples [QUI 83];

– *analogy* [BER 03, SHA 82] is very useful to learn and get inspiration from already known solutions, to build a collective experience and for any matching of the supply and demand, such as job-, travel- or house-hunting. *This technique can be used to build an idea generator*;

– *dynamic induction* [AUR 95, MAN 94] including the advantages of induction and analogy. The decision tree is built while the user is answering the questions asked by the system. The processing of unknown values is taken into account by the analogy engine, which proposes the best choice amongst the possibilities;

– *constraint programming* [DIN 88] integrating a constraint propagation engine and algorithms of optimization and generation of solutions, which respect the given constraints. This enables us to solve combinatory problems, such as scheduling, planning, resource allocation and management, optimization and routes or frequency allocation;

– *natural language processing* techniques, based on semantic networks, conceptual graphs, ontologies and grammatical analysis are helpful to communicate with computers, for database queries, web searching, for knowledge discovery in texts, confirmation or discovery of experts from texts they have written, as well as for automated translation;

– *multi-agent systems* [FER 95] are programmed to perform various distributed and collaborative tasks. Their organization copies that of humans – there are agents, tasks managers using different forms of reasoning. There are even agents preventing the others from working, what enables the simulation of dynamic constraints. They can organize themselves to "create" a collective intelligence, inspired from insects [QUI 06];

– *neural networks* are generally applied to form recognition in image processing, in data mining in association with other techniques, or in design. They are equipped with automated learning "ability" [CAR 00].

The current trends and works of the researchers are mainly focused on ontologies and multi-agent systems [RUS 02] (http://aima.cs.berkeley.edu/).

The usefulness of "knowledge thinking" and of the aforementioned techniques in creativity and in the innovation process lifecycle is undeniable. However their choice should be made as a function of the problem to be solved and the objectives and processing to consider (constraint verification, simulation, computation), the way of working with stakeholders and the expected results.

5.2.3. *From artificial intelligence to KM*

Artificial intelligence has made people dream, has made some hopeful and has disappointed others, those who were a little too ambitious about the technological possibilities of the time and maybe too ignorant of the complexity of human nature. These experiments were helpful for understanding the mechanisms of knowledge transfer and allowed them to improve the approaches and tools for knowledge modeling and processing and to invent new techniques.

Unfortunately, this feedback has not – or has only marginally – been taken into account in KM approaches and tools, which were massively introduced from 1996, thanks to the Internet wave.

Nowadays, we do not talk much about artificial intelligence, because it is "embedded" in computer applications, in various decision and design support systems, in robots and electronic games.

5.3. Knowledge management

The expression KM appeared at the end of the 1980s and was first introduced into companies and organizations as a new managerial method [AMI 89, DRU 92]. We find it again in artificial intelligence [MAE 94]. It is then found in fields, such as business intelligence, human resources management, training, information officers and computer science, which has been propelled by the Internet.

The translation of "KM" into various languages is not simple. For example, some French specialists translate it as *capitalisation des connaissances*, [BAR 99] or knowledge administration (*gestion de connaissances*) [ERM 08] or assimilate it with organizational memory [GAN 00, KUN 98, STE 95, WAL 91]. In Spanish we find *Gestion del Conocimiento*, in Russian *Управление знаниями*. The Polish translation is the closest to the English meaning *Zarządzanie wiedzą*,

A translation has to express the holistic aspects, dynamics and multi-disciplinarity of this movement, as well as the significant phases which are the identification and discovery of needs, involvement of participants in the process and organization of knowledge shared by various communicating applications.

The KM movement was born from practical experiences, trying to organize companies, in order to maximize profit and improve the design, customer services, training, human resource management, business intelligence market penetration, image and information searching and sharing.

Theories such as cybernetics [WIE 50], system [VON 68, LAP 93, LEM 84, PEN 93], chaos (Poincaré) [GLE 87, PRI 98] and holistic approach [KOE 67], have certainly contributed and influenced the knowledge cultivators' way of thinking.

In its initial period, two main trends focus on the new management and on technology, in which we distinguish two ways: artificial intelligence and traditional information processing. Proponents of the latter talk about two generations of KM, wedged onto the Internet generations.

Whereas the practitioners of the first generation create and manage the databases and sometimes use the intranet, those of the second generation are becoming followers of social networks, which are the basis of Enterprise 2.0 [ROU 07].

Visionaries such as Charles Savage, Peter Drucker or Debra Amidon, consider KM as a global approach and the managerial method for knowledge society. The success of this approach is conditioned by the ability to take into account all its dimensions: technological, economic, social, cultural and environmental [MER 09b].

5.3.1. *A few definitions*

To better understand what we are talking about, here are some definitions.

Data: a set of symbols, which are easy to codify and transfer from one machine to the other.

Information: data with a meaning. A lot of information is within our reach. It can become knowledge on the condition that we appropriate it (including the context, which is generally personal).

Knowledge: information with meaning in a given context. Three basic types: know, know-how and abilities to use one's knowledge in a given situation (*savoir être*). The latter introduces behavioral aspects. Knowledge transfer requires learning. Transmitting knowledge to a computer implies the use of knowledge engineering methods and techniques.

Wisdom: is knowledge and insight, knowing how to intelligently use knowledge in a given context; the art of making decisions. Here Jacques Pitrat could use the term *meta-knowledge* [PIT 90]. The wisdom of the computer could be understood as the ability to make a choice, as a function of a given situation.

Figure 5.4 illustrates the aforementioned definitions. It shows a rupture of the paradigm [CHA 93, PRA 97] between data/information and knowledge/wisdom. Whereas it is quite easy for a computer to store and process data and information, "learning" and processing knowledge or using "wisdom" involves the implementation of other techniques.

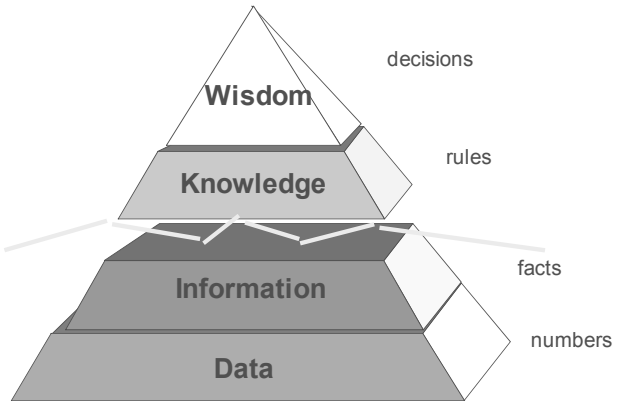

Figure 5.4. *Data, information, knowledge and wisdom*

Knowledge management: there are as many definitions as there are fields. Here are two of them:

– "KM is nothing more than managing information flow, getting the right information to the people who need it so that they can act on it quickly", Bill Gates [GAT 99];

– "An integrated system of initiatives, methods and tools designed to create an optimal flow of knowledge within and throughout an extended enterprise to ensure stakeholders success", Debra Amidon and Eunika Mercier-Laurent [MER 97].

The first definition corresponds to the two first levels of the pyramid above. It introduces the SharePoint Portal, a Microsoft tool designed to store and exchange information within an organization.

Knowledge flow: creation, collection, processing and sharing of information and knowledge in an organized and optimized way[11], taking into account the different activities of the extended enterprise as well as the needs, individual and collective motivations of all the participants [MER 97].

In order to understand the role played by a flow of knowledge, we need to review the contributions of the various fields, which separately took an interest in KM.

5.3.2. *KM and management*

Management specialists, theoreticians and practitioners have tried several approaches, such as the Taylor method [TAY 11], the strategic business units (SBU) of Alfred Sloan at MIT in 1953[12] and business process reengineering (BPR) proposed by Michael Hammer and James Champy [HAM 93]. BPR aims to radically review the organization processes, rethink how they work in order to dramatically improve customer service, cut operational costs, and become world-class competitors. All workstations (personal computers) are organized into networks and connected with the databases, in order to facilitate the information flow. The way of managing tangible and human resources changes, with a motivation for teamwork. BPR is an interesting approach, but it highlights too much

11. The optimization of thea flow of knowledge cannot be made without a global view and an in-depth understanding of the needs and activities of the stakeholders. The different types of knowledge have to be modeled (conceptual modeling) allowing further incrementation. This modeling takes into account three aspects, modularity, genericity and reutilizability for future implementations. The search for information and knowledge will use this model for optimal efficiency.

12. Massachusetts Institute of Technology.

traditional computer science with its complexities and the data approach. It lacks a global approach to designing an information flow adapted to the users. The organization strategy and human aspects are not taken into account.

On the contrary, the *total quality* approach brings a reflection on the importance and the understanding of the business strategy on all firm levels [HER 89]. The quality strongly depends on an understanding of the business strategy by all the actors and on integrating it to their working methods. Nevertheless, the total quality is not interested in the management of the humans + computers set. Some negative effects of this approach need to be pointed out, such as the restriction of the strategy in the short-term and consequently a reduction of product lines, of research topics and staff. The recent awakening to the state of our environment has caused this approach to evolve towards QSE[13] and more recently towards CSR[14]. The latter includes a sustainable development approach [QUA 10].

Facing the globalization of the economy, hyper-competition [DAV 94] and financial difficulties, companies reorganize or merge. These modifications are leading to *change management* (since 1992) to justify a new situation. Two variants are common in organizations: managerial, to explain the mergers and lays-offs to come and associated with the virtualization by introduction of the ICTs. To these is added a change induced by the sustainable development trend.

Another method associating management and knowledge is storytelling, inspired by the work of John Seely-Brown from Xerox PARC [SEE 91, SEE 94]. It has common points with knowledge transfer. Its objective on the management level is to motivate employees, through experience or storytelling, to give the best of themselves. The Danone group uses this approach to share the experiences of its affiliates worldwide.

The awareness to the changes on all the levels and the reflections on the knowledge economy influence the managerial approaches [AMI 89, DRU 92, KOZ 97, SAV 90, SEE 04]. John Seelly Brown introduces a pull economy [SEE 10] (see Chapter 2). This is a new corporate behavior associating direct relations and e-observations with the objective of discovering the knowledge which will be used to propose a new offer.

In this context, approaches such as business intelligence [MAR 94a, b], intellectual capital [EDV 97] or the learning enterprise [NON 95], are the components of a global approach [AMI 97, MER 08].

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13. Quality, safety, environment (ISO 14000).

14. Corporate social responsibility (corresponding to the ISO 26000).

5.3.3. *KM and information processing*

Computer science has invented databases, networks and Internet. Software editors provided tools, methods and activity or profession oriented solutions, such as *electronic document management, workflow, data warehouse, computer-aided design, maintenance decision support systems, enterprise resource planning*, *supply chain*, *customer relation management*, *enterprise asset management*, *advanced planning and scheduling, manufacturing execution systems* and so on. These solutions are generally proposed by different software vendors and are *ad hoc* limited and costly. Moreover, only some software programs consider company needs with a global view; very often the users have to adapt to what the software offers. Each solution uses its own database, which results in multiple databases with recordings containing the same elements, but in different formats.

Internet has facilitated connections between individuals and has opened access to a large quantity of information on a global level. It has contributed to the globalization of the economy and is changing behaviors. It has also reevaluated the technologies "in waiting", such as collaborative work, ICAES[15], some artificial intelligence techniques and has created new needs. Although there is now a plethora of e-applications, such as e-commerce, e-publishing, e-learning and others, they rarely share the same knowledge resources. Each module evolves separately, generating complementary costs for companies, which leads to outsourcing aimed at reducing these costs.

Therefore, a website, in its simplest form, provides information on the company, its products and services. All or almost all electronic commerce systems use the same catalog model, which is organized in arborescence. This compels customers to follow arborescence logic: they cannot directly search for an object, but have to follow successive steps and select from the list menu. However, the addition of a "supply and demand" matching mechanism would make the search more relevant [MER 95a] and the FAQs[16] smarter.

By using the "data" approach for storing, the Internet has made a big contribution to the "information overflow". In order to effectively find and receive only relevant information, we need to use more AI: knowledge models for the design of websites, blogs and others web applications. Conceptual knowledge modeling and artificial intelligence techniques are already used and combined in the concept of semantic web [AFI 03]. Web 2.0 brought new services, but the storage principles and access to information have not really evolved. It has influenced the technological trend of KM, which is wrongly named since it is only concerned with

15. Intelligent computer-aided education system.

16. Frequently asked questions.

data and information. Books on the enterprise 2.0 promoting the benefits of social networking for business have been published. None to our knowledge explain how to involve generate economic values from social networks.

Information systems in businesses are made up of these various elements, but, in most cases, without a global approach. The urbanization tendency of the information system [CIG 03, LON 01] is a step towards a global approach, which is applied to an extended organization. It consists of defining the various components of an information system and the ways they can be connected.

Another tendency is cloud computing. Companies no longer need to buy servers and computer applications, but they can access many services online, without having to manage the underlying infrastructure. Applications and data are no longer on the local computer, but are in a cloud made up of a number of remote interconnected servers. The access to the service is achieved mostly through a web browser. Enterprises only pay the service (use of servers and applications).

Miniaturization and ubiquitous radio networks facilitate the remote activities, but the problem of instant access to the relevant information remains unsolved. However, mobile equipment and games are an excellent means of influencing the learning of new ways of thinking and new attitudes.

5.3.4. *KM and skills*

Organization by project, savings on all company levels and the global context have modified the way of forming teams – it involves finding the skills essential for the success of the project, minimizing their costs and optimizing their use. A human resources manager (HRM) must know the skills available and where to find them. Some skills may be needed only in defined periods and part-time. Human resources (HR) databases do not generally contain "real-time" information on the skill level of the employees. Often, data are coded (business code). Therefore, it does not give sufficient accuracy for finding an exact skill, or the closest to the required profile. New technologies and the economic context are constantly creating new professions, which are not taken into account by national classifications.

Artificial intelligence techniques allow greater flexibility in the description, research and planning of skills in time [AMI 05, GER 90, LED 99]. It is possible to describe them in a natural language or as cases (each person is a case). To find the right skills, we can use the analogy engine of "supply-demand" matching [MER 95a]. The business references can be represented by one or several ontologies [MIL 03]. Constraint programming [CAI 01] provides assistance in planning the resources and skills.

Michel Autier and Pierre Lévy propose an approach consisting of visualizing the individual and collective knowledge and skills as a tree [AUT 92]. Figure 5.5 illustrates the skills of 10 people: the trunk represents common knowledge, branches the specialties, and leaves the unique skills. Such an image provides information on everyone's ability and helps to decide if the unique skills represented by the leaves are strategic.

The part to the far right of the trunk, as well as the triple branch, indicate the position of a person in a group. Such visualization facilitates the identification of skills and helps to detect the lacks in relation to a required profile, which can be filled by training.

Thus, we can build the competency tree of a company or a region and reason backwards: what projects can we achieve with such intellectual capital? We then need to search for the skills in a neighboring region or "rent" them to a partner.

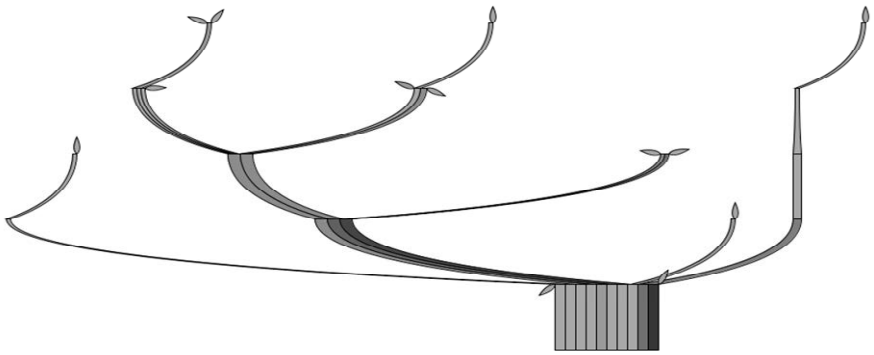

Figure 5.5. *An example of a knowledge tree created with the Ligamen software*[17]

In the international context and within a networked enterprise, it would be better to manage skills on the regional, national and international levels. They constitute a capital [EDV 97, OCD 96], which can grow through continuous learning from interaction with the environment. The organizational strategy must take into account this intangible wealth.

Managing skills is a complex problem, foremost requiring a good reflection on the way to describe and display these skills in relation to a clearly defined strategy. Who is fitter to define their skills than the people themselves, on the condition that they do not under- or over-estimate their abilities? What are the essential skills for

17. http://ligamen.fr.

companies nowadays and in the future? What role can they play in the organizational strategy?

The training department is also involved, because it is in charge of making this capital grow. It is involved for now, because in the global KM approach all knowledge cultivators are constantly learning. The training department could be a guardian for the transmission and preservation of the essential knowledge and know-how of those retiring, especially when this is the knowledge of a long-life and is a strategic product for the company [ERM 08]. Collaboration between several professionals is vital for optimized managing of the skills.

The management of intellectual capital is essential for the development of companies, regions and countries. It could influence the evolution of education.

Activities such as design – particularly that of complex systems – and the management of documentation or of feedback have also contributed to the debate on the global KM approach [MER 07b].

5.3.5. *KM and innovation*

The main objective of a KM process is to lead the participants' ideas to success. This first consists of creating innovation dynamics able to ensure a sustainable development of the companies, regions and countries [AMI 97]. It will rely on both current and past knowledge, which can play an important role in an organization and for tools able to amplify the innovation capacity of humans and machines involved in knowledge flow. Such an organization will enable disruptive innovation and facilitate the management of risks associated with such an innovation.

5.3.6. *KM and risk management*

The current economic situation requires daily risk taking. In addition, we are exposed to natural risks and to risks arising from human activity. The collection, sharing and exploitation of "best practices" and errors help to prevent and anticipate where possible. Various simulators play a significant role in prevention.

Small businesses are particularly exposed to risks [ALT 11], [TOR 99]. These risks are related to the economic situation, loss of customers, evolution of professions and of their offers. Practice of the KM culture brings elements enabling anticipation and changing of course, if necessary.

5.4. Building knowledge flow

The organization and management of knowledge relative to people, computers and documents is essential for the success of a company through the continuous innovation process [MER 08]. Several approaches are possible. The choice depends on the initial situation and on the hierarchical position of the initiator of the process in a given organization. The two main methods are the strategic and applicative beginning of problem solving.

5.4.1. *Strategic approach*

Chapter 4 introduced the analysis of the capacity to innovate. Carried out on the top-management level, this is a cornerstone for the construction of knowledge flow, which will accompany e-co-innovation activities of an extended business network. The results of this analysis define the objectives. The main objective is to initiate or re-launch innovation dynamics. Each action will use knowledge and skills organized in knowledge flow. Measurements of progress are a compass for innovation.

The advantage of this approach is indisputable – the KM approach becomes global and is now part of the company's strategy. It involves all the internal participants of the process and the stakeholders as well. The rules are clearly defined and the objective is to succeed together. The three laws of knowledge dynamics [AMI 05] will be mandatory:

– knowledge multiplies when shared;

– values are created when knowledge moves from its point of origin to the point of requirement or opportunity;

– mutual leverage (complementarity principle) provides an optimal use of resources – both tangible and intangible.

The success of this approach is conditioned by the involvement of the top-management and their ability to stimulate learning of the attitudes for the knowledge economy. However, this process is long and sometimes does not immediately give spectacular results, which may discourage some decision makers, who are used to working in the short-term.

5.4.2. *Corporate knowledge: a global approach*

This approach, called corporate knowledge, aims to build knowledge flow by taking into account the knowledge lifecycle. Invented at Cediag at the beginning of

the 1990s, it can take into account the knowledge inherent in the innovation process. This cycle is presented in Figure 5.6.

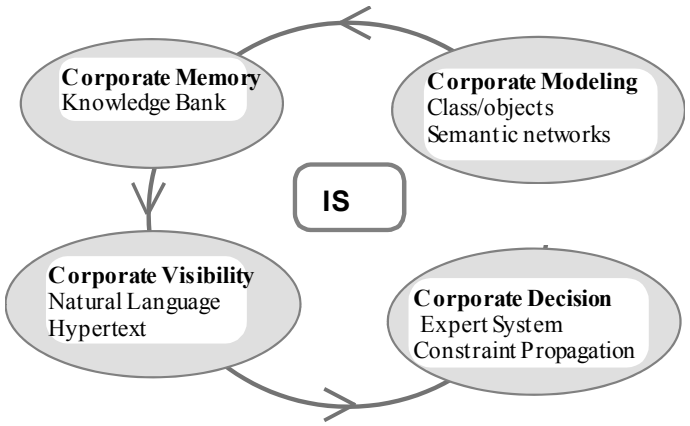

Figure 5.6. *Knowledge production and exploitation cycle (source: CEDIAG© 1991)*

The knowledge to be explored is first modeled in the computer using one or several models to ensure effective sharing between the different applications. Conceptual modeling is preferred in the case where several applications have to share the same knowledge.

Knowledge models guide the collection and are a bank in which all the participants of the flow can record and look for relevant elements using hypertext navigation or semantic browsing.

Various decisions, design and diagnosis support systems, simulators, etc., will use the knowledge to wisely assist the players of the innovation process. In this context "IS" means the traditional information system of the company.

5.4.3. *Application approach*

This type of approach is generally initiated at the middle management level. The flow begins with the organization of knowledge involved in solving a specific problem, preferably the most urgent, whose resolution may be exemplary. If the result is valid, other components are then integrated into the flow.

However, the progressive construction of the flow requires an overview, collaboration with those working on relative problems, rigor and patience. If the results are not quickly perceptible, some participants may have a tendency to try

traditional tools, such as databases with the aim of demonstrating a quick but isolated and basic "solution".

This is not used by all the actors, because the others may have experimented with other tools. Karl Eric Sweiby describes this phenomenon as *middle-up-down* [SVE 97]. The initiatives of the middle management fail to get approval from the top-management to include them into the corporate strategy. They remain limited and thus have little impact on the whole process.

An example of incremental construction of a flow of knowledge is described below. It is designed to facilitate the management of the innovation process within the R&D department of a large international company. The initial task was to identify and organize knowledge relative to the innovation process with an aim to build an innovation support system. After an in-depth analysis of the activities of research teams in France and in the USA, and their connections with other company activities, three components have been selected: technology watch, industrial property protection and ideas' management. Figure 5.7 illustrates the relationships between them.

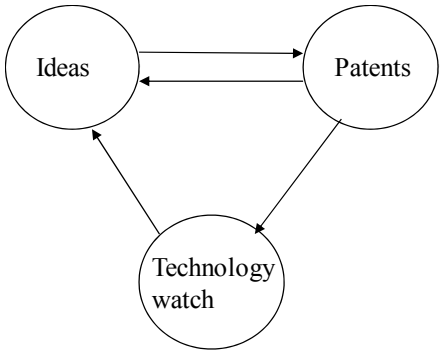

Figure 5.7. *Innovation systems: ideas, patents, technology watch*

Initially, an analysis of all the previously mentioned innovation elements was carried out, in order to understand the nature of information and formal and informal knowledge, how they circulate, identify actors and their roles and relationships with other activities.

At this stage, only one person was in charge of the technology watch, whereas it would be much more relevant to involve all the stakeholders and organize sharing of the information learnt.

The company activities in industrial property consist of analyzing a large number of patents, in order to find a new angle to patent inventions. Related activities are drafting and filing patents. These should be written in the legal language, which is not the usual language for researchers. An industrial property specialist sometimes has difficulty understanding the scientific language of researchers. It would be wise to design a system able to help the two populations.

Analyzing patents can generate new ideas. At the same time, we can find in these patents useful elements for the technology watch. The information found while doing the watch can also bring ideas. These new ideas can be transformed in procedures, processes or devices to be patented.

Concerning creativity and idea management, there has already been an attempt to create a base in which researchers could register their ideas. The initial database included hundreds of ideas, but was not available on the intranet. Very few people used it.

Given the initial situation, the applicative approach was more relevant. At first, it was decided to build an online "idea generator" [MER 07b], which was then associated with patent and watch modules.

Although this work was initialized within the R&D department, marketing people and HRMs have been involved in the technological and economic evaluation of ideas. It was a perfect excuse, inviting people in contact with the customers, to then extend this participation to any individual in the company.

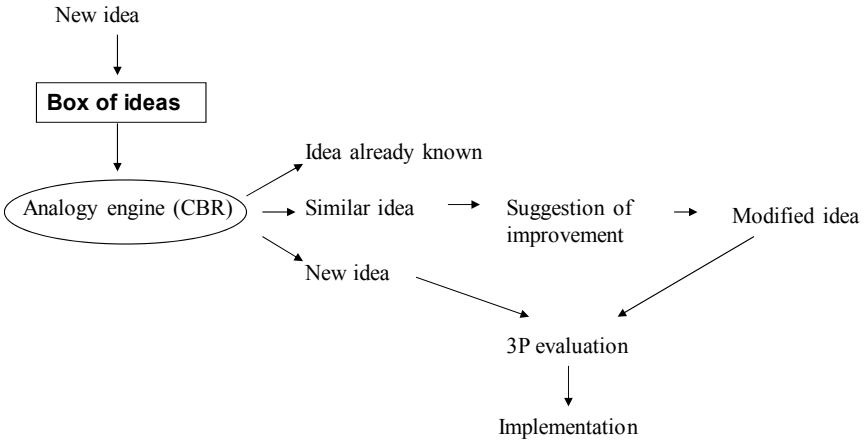

Figure 5.8. *Generator of ideas*

This first flow module called "generator of ideas" is programmed to collect, evaluate and manage registered ideas. Its function is presented in Figure 5.8.

The innovator fills a "birth of idea" e-certificate. This registered idea will be submitted to a "three-professionals" evaluation.

We have chosen case-based reasoning software to model ideas as cases. An example of a case description is as follows:

Idea N° XXX

Innovator: Name, First Name, Department

Date of birth of the idea:

Description: in almost natural language, in a structure imposed to ease analogy search)

Presumed finality: product, process, device, service

Technologic evaluation result: dated mark

Economic evaluation result: dated mark

Human Ressources evaluation result: dated mark

Research program: name of the project

The system immediately compares the new idea with the existing case, to check for similar ideas. If they exist, they can be consulted and sometimes help to evolve the initial idea or give birth to other ideas (generator effect). The system builds a "family tree" of the idea in case of modification, merger or transfer. If similar ideas are not found, the idea is registered in the system to be evaluated. Anyone in the company can view and provide additional information to the base of ideas. Ideas can be discussed in groups, directly, by mail or on a private wiki. The discussion also has a brainstorming effect and can modify the initial idea or generate others. The evaluation committee is made up of the R&D representative to validate the feasibility of the idea, marketing/sales to bring knowledge elements regarding the potential market and a HRM to allocate the skills, necessary for the transformation of the idea into a product or service, and then into an income. An idea considered interesting by the committee then goes into a research program. It can be put on hold, to be taken charge of by a specific program if one of the blocking characteristics changes with time. It can be rejected if it is considered to be irrelevant to the company strategy. Sometimes it could be interesting to develop this

idea outside the company. An idea can hide another idea – the simple act of consulting the idea database can generate others by improvement, modification or inspiration. But it can also lead to an organizational change or a different way of working.

The main difficulties encountered during this implementation were of a human nature. They regarded motivating the participants to enter their ideas into the system and to making it clear to managers that bringing together people belonging to different departments was not a threat to their power. Other difficulties are however worth noting: reusing the existing database and completing it *a posteriori* is not easy if the time between registering the idea in the case-base and its update is relatively long.

This idea generator was the first module of a flow of knowledge, which was then completed by a support system for analysis and drafting patents, using linguistic and knowledge discovery techniques.

5.4.4. *What to choose?*

Whatever the approach, the objective is the same: generate tangible and intangible values for all the participants, while preserving a balance of participating ecosystems. A vision of "where are we going?" is vital to building a flow of knowledge, as is the base of innovation and amplifying the capacities of the actors. The two main approaches will be guided by this vision. Whenever possible, it is better to start with a shared vision to define the strategy and translate it into actions. If the flow starts with solving a problem, the "think global do small" mentality is essential for its incremental construction in alignment with the participants' needs.

Techniques for knowledge processing by computers have existed for over 50 years. They have been successfully used for industrial applications and in other areas. For over 30 years, the science of machine learning has also made some progress. Experiments and techniques at the service of innovation will certainly contribute to the best use of the computer's abilities in all forms and will strengthen the human-machine symbiosis. Experiments on this symbiosis in "life-size" environments will offer more challenges, contributing to the advancement of applied research.

The global system and holistic way of thinking is becoming more focused on knowledge and objectives and will certainly favor disruptive innovations.

"Global thinking" allows us to see and take into account the full context of knowledge, strategy, participants, current processes and feedback from the construction (or re-construction) of a flow of knowledge adapted to the needs of all.

"System thinking" is also essential because the extended enterprise is a set of communicating ecosystems, which exert an influence on each other [INT 09].

The "holistic" approach is also helpful in understanding (and influencing if needed) the various environments of an individual, such as an organization – regardless of size and activity – and a society.

The facilitator of this dynamic is not necessarily the CIO (Chief Innovation Officer). He/she is a knowledge cultivator, who knows how to associate the 3IA (intuition, imagination, intelligence, audacity). Endowed with multiple talents, he/she is able to bring together skills, tangible and intangible capitals and opportunities into a value creation dynamics. Knowing the participants and their motivations, he/she encourages experimentation, the lessons learned from any failure and asks the right questions.

Chapter 6

Innovating Technological Innovation

To accelerate innovation, the parallel existence of the two distinct worlds (public and private research) has to end… numerous obstacles are still slowing down the cooperation… Academic laboratories will have the opportunity to collaborate with large companies, as well as with small businesses, with which they almost never work.

Valérie Pécresse, French Minister of Research

6.1. Researchers, R&D and innovation

Innovation has always been considered to be a full-time activity of public research laboratories and of R&D departments of companies. The two populations do not have the same objectives and do not work at the same speed. CNRS[1] (French national center for scientific research) has 1,100 research units (95% are joint university and industry research laboratories). Some laboratories seem outdated while those essential for the future are lacking and are not included in eco-bio-tech and info-nano-bio fields or in the recently created sections [CNR 08].

Research has always been considered costly, for both the State and businesses. Therefore, researchers working in public labs are poorly paid and require other motivations. The beginning of the 1990s saw the acceleration of the reduction or even the suppression of R&D in large companies. As for small businesses, they can be distinguished based on technological transfer, those whose activity is based on technological innovation (some industries, sport equipment, building,

1. http://www.cnrs.fr/en.

entertainment), SMEs in services related to technology or not and others. The first cannot exist without R&D. We sometimes find them in ANR[2] and European projects. The percentage of French small businesses in the latter is rather low. In the others, innovation depends on the owners' motivations, many of which focus on short-term incomes, saying they do not to have the time or means to innovate.

Since its beginnings, the European Union, probably inspired by MITI, has invested a lot in technological innovation by setting successive framework programs, such as Esprit 1 and 2 followed by 6 and 7 FP[3] and others. The strategy guiding these programs was first the strengthening of Europe's position by collaborative research. Nevertheless, an estimate of the return on investment is still not required from the participants of the financed projects. The Commission is not *a priori* interested in what these projects and their partners have become. It just requires the dissemination and presentation of results in conferences, books, workshops or at events, such as ICT[4].

The Lisbon strategy[5] developed in March 2000 was considered insufficient [BER 07, KOK 04]. In November 2009, the European Commission launched a public consultation, in order to develop a new strategy by 2020.

Like the Silicon Valley, technology parks and competitiveness clusters have emerged, as well as other groups such as the Latin, Transalpine or Mediterranean Arcs and recently Euromed.

Launched in 2004, the policy of competitiveness clusters aims to bring together into the same territory, companies, training centers and research units of the same sector of activity, in order to generate synergies and lead to innovative projects. Its objective is to facilitate "public-private" partnerships (PPP) and to open access to research for small businesses via collaborative projects. Its instigators had the ambition to create a technology transfer flow from laboratories towards companies and to create new companies and therefore new jobs.

The objective announced in 2004 remains topical: "strengthening the specialization of French industry, creating favorable conditions for the emergence of new activities with a high international visibility and therefore improving the attractiveness of territories and fighting against relocations"[6]. Initially focused on the public-private partnership and on the creation of synergies between populations

2. French National Agency for Research http://www.agence-nationale-recherche.fr/en/project-based-funding-to-advance-french-research/.

3. Framework Program http://cordis.europa.eu/fp7.

4. http://ec.europa.eu/information_society/events/ict/2008.

5. http://europa.eu/scadplus/glossary/lisbon_strategy_fr.htm et http://europa.eu/lisbon_treaty.

6. www.industrie.gouv.fr/poles-competitivite/brochure.pdf.

working together sporadically, the authorities have not defined the right indicators to measure the impact of this initiative. The authors of the recent French Senate report[7] are very optimistic about the five year assessment. However, they consider success according to the mobilized budget, the number of submitted projects and the involvement of the actors, including small businesses and territorial collectivities. To our knowledge, only ANR is checking during the project reviews, if the partners are really doing collaborative work.

According to the authors of the above report, more effort has to be put into *training*, integration of *environmental* aspects, and participation in the clusters of private actors of innovation *financing*. The authors noted that measuring the impact on job creation is difficult to achieve with statistical methods. However, they do not ask questions about the existence of alternative methods, adapted to the knowledge economy, such as those coming from artificial intelligence (knowledge discovery in databases and texts) or practiced by specialists in the measurements of intangible values [EDV 02, MER 00, SKY 98]. Although some words specific to the industrial vocabulary, such as "roadmap", were introduced to the CNRS vocabulary, it still lacks the expression "return on investment".

Most institutional researchers only consider companies to be useful for funding work on the topics of their choice. Organizations, founders of innovative projects, are putting emphasis on the impact of research on economic development, job creation and on the prevention of relocation, but do not propose appropriate indicators to measure this impact. We can observe a scattering of the means, which complicates the process of applying for funds and a proliferation of institutional actors, whose role is not always justified.

The 3,851 funding possibilities are listed by the "Institut pour le financement de la recherche"[8] and are giving France the status of a financing paradise. Closely monitored, the access to these subsidies remains difficult, even impossible to obtain for small businesses, who become lost while facing a variety of possibilities, the cumbersome procedures and the low probability of being elected. The small size and fragility of these organizations greatly reduces the chance of access to these funds, even those that are networked; all for the simple reason that such a structure is not recognized from the administrative point of view. All project evaluations only take into account the financial situation of the company and not its talents, its ability to succeed and its connections.

Applied and even fundamental research has the potential to create economic values but it is poorly governed and underexploited. A periodic or permanent

7. www.senat.fr/rap/r09-040/r09-0401.html.
8. www.ifr-finance.com. French Institute for research financing.

evaluation of the regional and national level would detect and put in motion this value-, activity- and job-creating potential[9]. The creation of AERES[10] is a step closer to an evaluation that is more focused on capacities. However, it remains to be innovative in the choice of evaluators, in the implementation approaches and the criteria.

Technological innovation is an indisputable capital and remains full of hope. Governmental reforms have established a national strategy aiming to create a dynamic between innovation and economic development. However, the efforts are carried out on all levels and by various actors, without checking the understanding of this strategy, without a global, visible and governed synchronization, without progress measurements adapted to knowledge economy and without a continuous feedback from the field; these efforts thus remain scattered and their impact seems insufficient compared to the stated ambitions.

The previously described productivity paradox persists. Its consequences are well-known: a lack of connection with the market, lack of long-term vision and an associated strategy, lack of market visibility, marketing weaknesses, little innovation in business models and lack of marketing and commercial talents, particularly in the high-tech areas. There is also a lack of connections between researchers and "customers", resulting, amongst other things, from evaluation criteria of the French (and not only French) researchers, whose only result obligation is publications on scientific projects. Few researchers take an interest in the available industrial solutions. Their technological watch is limited to scientific conferences in their respective fields.

The above situation is a consequence of the education system, which is still unsuitable for the knowledge economy, and of a depreciation of "mar-com" professions in comparison to the "noble" professions of scientific researchers. The Juppé-Rocard report [JUP 09] recommends a significant investment in higher education – an associated strategy could correct this phenomenon.

For more than ten years, the French government has experimented with several ways to motivate researchers for the creation of businesses, but the results of these actions are far from spectacular. Creating a company when we have a guaranteed salary for life is a risk that few tenured researchers are willing to take. In 1999, the "Ministère de l'Enseignement Supérieur et de la Recherche – MESR (French Ministry of Higher Education and Research) launched the first call for creating innovative companies. More than 14,000 projects were submitted in 10 years. There

9. Estimating the capacity to innovate, Chapter 5.

10. "Agence d'évaluation de la recherche et de l'enseignement supérieur", French agency for the evaluation of research and higher education.

have been 2,049 winners and 1,031 businesses have been created. Winners are invited to join incubators (29 public) and they are offered entrepreneurship training at the EM[11] Lyon (2 weeks) and HEC[12] (26 days). These training courses are limited to industrial era management. According to the document by the DGRI, *Research and Development, Innovation and Partnership* of September 2009 [DGR 09], assessing the actions carried out by MESR in 2007, 16% of the companies hosted in incubators have stopped their activities. The mentioned causes are only of a financial nature.

The measurements of the effects of these expensive actions on the national and European economy are difficult to find.

Most governmental and European actors consider technological innovation as a key drive for regional, national and sectorial development. Nevertheless, other types of innovation are necessary for balanced development. Amongst them, we need to mention innovation in the approach and governance, in the system of values, in education, in social success models, in the ways of managing intangible capital, which are too often ignored by rankings, cognitive innovation, mentality innovation, those in the management of the capacity to innovate, in the estimate of the return on investment or innovation guided by the citizen's needs, and finally innovation of creative industries, which is essential to increase the attractiveness of technological objects.

Education and training play a predominant role in the preparation and motivation of young people, as well as older people, for creativity, innovation and entrepreneurship. They could influence the change of paradigm, to the condition of anticipating future needs, in synergy with a national and European strategy. Although engineering schools are opening MBA training courses, in most cases they teach the traditional management methods of industrial companies. There are still not enough entrepreneurship schools teaching how to be visionaries, to manage and succeed in the dynamics of the knowledge economy [FOR 09, TAT 09]. Medias have a tremendous potential, but this potential is not used to influence change.

The Observatory of Educational Practices in Entrepreneurship was created in 2001 by public authorities and by APCE[13]. Its mission is to identify, share and promote initiatives favoring the development of entrepreneurship. Is this sufficient to succeed in the knowledge economy?

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11. Ecole de Management (Management School).
12. Famous French "Grande école", http://www.hec.edu/.
13. Agence pour la création d'entreprises (Agency for business creation), www.apce.com/.

This chapter provides an overview of the current initiatives, as well as the available elements of the assessment. It suggests a few ideas which could favor technological innovation at the service of tangible and intangible prosperity.

6.2. Technological innovation actors

According to the brochure by the Ministry of Higher Education and Research [MES 10], "public research is mainly conducted within 83 universities, hundreds of 'Grandes écoles' and higher education institutions, about 30 research organizations with an interdisciplinary (CNRS) or finalized (INSERM[14], INRA[15], INRIA[16], CEA[17], CNES[18], IFREMER[19], etc.) purpose, and two foundations (Pasteur and Curie Institutes)". The public research sector employs full-time 160,000 people, including 96,000 researchers, who are considered to be the key players of technological innovation in France.

Private research employs 200,000 people. It is focused on four industrial branches: electronic, automotive, computer services and pharmaceuticals: all of which are part of private actor departments R&D of public services, large groups, and technological SMEs, as well as research centers of major international companies established in Ile-de-France (Paris suburbs), Sophia Antipolis (near Nice, French Riviera) and then in other places, following opportunities offered by regions wishing to develop. Some of these actors were gathered at the end of the 1990s in seven research and technological innovation networks, which were created in order to intensify, diversify and increase the flexibility of the relationship between science and industry, to promote the participation of small or young innovative technological companies and increase the efficiency of existing public incentives for private R&D [OCD 04].

In these considerations, there are some forgotten actors such as those innovating in services in relation to the use of technologies, or individual inventors, who often struggle to sell their inventions transformed into products, because of their isolation, the ignorance of the 3,851 financing arrangements, cumbersome procedures and

14. Institut National de la Santé et de la Recherche Médicale (health sciences), http://english.inserm.fr/.

15. Institut National de la Recherche Agricole (agriculture), http://www.international.inra.fr/.

16. Institut National de Recherche en Informatique et Automatique, http://www.inria.fr/en.

17. Centre d'Etudes Atomiques, http://www.cea.fr/english_portal.

18. Centre National d'Etudes Spatiales, http://www.cnes.fr/web/CNES-en/3773-about-cnes.php.

19. Institut Français de Recherche pour l'exploitation de la mer (sea), http://wwz.ifremer.fr/institut_eng.

skepticism concerning the eligibility. There are also employees in contact with customers and partners, who do not know to whom they should present their ideas and all those, whose ideas are not exploited, because of a lack of organization of the innovation process as a whole. The new generation is intensely consuming of technologies and could bring many ideas, but it is not integrated in the mentioned initiatives. Let us also note that Bill Gates and Paul Allen created Traf-O-Data, to sell computers dedicated to traffic control in Seattle, when they were teenagers and Microsoft at the age of 20.

So many institutional individuals have the word innovation on their business cards that we can wonder what the ratio of innovators is. Some of them even kill the creativity and entrepreneurship with the complexity of the procedures.

6.3. Contexts and ambitions

The current economic context – globalization and the resulting mix of cultures and talents, hyper-competition, relocation in order to have cheaper workforce and resources, the crisis, the decline of some industries caused by a lack of innovation and the resulting lay-offs – have produced an environment imposing a radical change of strategy, method and behaviors, to survive and succeed. This environment is also favorable to innovation.

The Juppé-Rocard[20] report [JUP 09] describes a worrying context, which is imposing the transition towards another model: “The crisis has impoverished us. The ageing will reduce the active population and the growth. International competition is extending to new fields, such as higher education and research. In industry, new actors are appearing, including in the sectors where Europe has positions of excellence, such as aerospace. Our development model will come up against the supply problems in fossil resources and is threatened by the consequences of climate change. Nowadays, we need to start the transition towards a new model, less dependent on fossil energies and more focused on knowledge”.

The innovation combining research and industry, has lost its usual reference points. The tendency to protect environment and to reduce the impact of human activities is leading to other paths and activities, but they are not the only opportunities.

The power of computers, the evolution of smart phones and the impact of the Internet, of networks and of ubiquitous waves are imposing other ways of thinking and working. At the same time, the knowledge of technological possibilities and

20. Co-chairs of the commission to propose priorities for future national debt.

imagination can expand our capabilities and help us to better capture and exploit opportunities.

Trend and tendencies produce "waves", which, when they are uncontrolled or poorly exploited, due to misunderstanding all the phenomena including the impact, can sometimes become devastating economically, socially and environmentally.

In this context, there is no choice other than to innovate with the knowledge of these ecosystems and their cross-influences. European authorities wish to have an innovative, strong and prosperous Europe. The same ambitions can be seen on the national level.

6.3.1. *European policies*

After the failure of the Lisbon strategy, the "EU now needs to make a stronger effort to work together to make a successful exit from the crisis and to shape the next generation of public policies in a very different set of circumstances" [EC 09]. The European Commission has launched a public consultation, in order to collect the opinions of companies and citizens. The new strategy was published in March 2010 [EC 10a]. It relies on three mutually reinforcing priorities:

– *Smart growth*: developing an economy based on knowledge and innovation.

– *Sustainable growth*: promoting a more efficient and greener resource, and more competitive economy.

– *Inclusive growth*: fostering a high-employment economy delivering social and territorial cohesion.

Progress will be measured by aiming at following objectives:

– 75% of the population aged 20-64 should be employed.

– 3% of the EU's GDP should be invested in R&D.

– The "20/20/20" climate/energy targets should be met (including an increase to 30% of the emissions reduction if the conditions are right).

– The ratio of dropping-out students should be under 10%, and at least 40% of the younger generation should have a tertiary degree.

– 20 million less people should be at risk of poverty.

To ensure that each Member State tailors the Europe 2020 strategy to its particular situation, the Commission proposes that EU goals should be translated into national targets and trajectories.

To achieve these objectives, the Commission is putting forward seven flagship initiatives:

– *Innovation Union* in order to improve the framework conditions and access funding for research and innovation, so as to ensure that innovative ideas can be turned into products and services that would create growth and jobs;

– *youth on the move* to enhance the performance of education systems and to facilitate the entry of young people into the labor market;

– *a digital agenda for Europe* to speed up the roll-out of high-speed internet and reap the benefits of a digital single market for households and firms;

– *resource efficient Europe* to help decouple economic growth from the use of resources, support the shift towards a low carbon economy, increase the use of renewable energy sources, modernize the transport sector and promote energy efficiency;

– *an industrial policy for the globalization era* to improve the business environment, notably for SMEs, and to support the development of a strong and sustainable industrial base able to compete globally;

– *an agenda for new skills and jobs* to modernize labor markets and empower people by developing their skills throughout the lifecycle, with a view to increase labor participation and better match labor supply and demand, including through labor mobility;

– *European platform against poverty* to ensure social and territorial cohesion so that the benefits of growth and jobs are widely shared and so that people experiencing poverty and social exclusion are able to live in dignity and take an active part in society.

Concerning the Innovation Union, the EU will develop a strategic research agenda. The aim is to re-focus R&D and innovation policy on the challenges that our society faces, such as climate change, energy and resource efficiency, health and demographic change. They also plan to improve and modernize the intellectual property protection system. Community patents could thus save French companies €289 million each year.

A European Innovation Partnership between the EU and national levels (each of the E25) will be launched to speed up the development and deployment of the technologies required to meet the challenges identified. The first will include: building the bio-economy by 2020, the key enabling technologies to shape Europe's industrial future and technologies to allow older people to live independently and be active in society. The procedures will be simplified to facilitate access to funding, particularly for SMEs. The EU will also work on promoting knowledge partnerships

and strengthen links between education, business, research and innovation and on promoting entrepreneurship by supporting Young Innovative Companies.

These guidelines are made to help Europe rise out of the crisis. The flagship initiatives are all the subjects of innovation. Some elements are emerging, such as the systemic aspect of innovation, the necessity to organize the relative knowledge and to innovate in measurements of the efficiency and the impact of innovation on economy and the European leadership.

As an example, our joint contribution with Charles Savage (*Knowledge Era Enterprizing*) to this consultation was as follows:

> Energizing the Knowledge Economy
>
> Our vision: A strong and prosperous Europe – building upon individual competencies at all levels, instead of social position.
>
> Suggested strategy: Develop and master the New Rules for **Energizing the Knowledge Economy**, including education, research and synergy with companies and territories. As a starter, the reader can refer to the *Three Laws of Knowledge Economics* [AFM 05].
>
> This helps us move in a systemic, holistic and global direction and certainly supports the impulses towards a "Green" economy.
>
> Set the **Energizing** program (not programs) with these principles (not words) embedded.
>
> Some points:
>
> – to be inventive, we do not need necessarily a lot of money, but different thinking;
>
> – with the right measures of innovation capacity based on knowledge economy principles (collective results, capacity of addressing and discovering the needs and the capability of generating value through dynamics linkages), we can build momentum;
>
> – by involving "forward thinkers" instead of the traditional reputable institutions, we can harvest new innovations;
>
> – our research system must be need-based, with ROI measures, so that we can more efficiently transform ideas and research projects into

value generating activities. In other words, we need more business thinking in our research centers;

– a stronger collaboration between companies, including SMEs and research, will bring multiple benefits;

– by awakening the entrepreneurial spirit within younger students, we will be able to move people from "button-pushers" to economic "idea-generators" who are whole-brain in their thinking;

– by learning to mimic nature, we will likely find cheaper and more endurable long- term solutions;

– we are not starting anew, but building upon amazing ideas and exciting concepts, already worked out in Europe. By creating a common virtual space of knowledge (not data), we will be able to share experiences and results and to find the right partners;

– more ICT (intelligent and creative technology instead of information and communication technology).

Some elements of this proposal are visible in the new 2020 strategy.

6.3.2. *Policies in France*

The reforms undertaken by the government since 2005 aim to associate innovation, research and economic development [RGP 08]. Their objective is to make French research "more effective and more visible"[21]. This consists of "improving the global efficiency of the system and its interaction with society, in terms of the economic and social dimensions, while clarifying the function of each institution". In the text of these reforms, we can find a vocabulary close to that of businesses, which is a step towards a common language to practice in the knowledge society.

The new organization seems complex: "the mission of monitoring and strategic direction of the research system is conducted by the Ministry of Higher Education and Research, which through its General Directorate for Research and Innovation (DGRI), endowed with a Directorate of Strategy which has a central role alongside other ministries in the development of national research policy.

Moreover, the French High Council for Science and Technology, established in September 2006 and attached to the President of the Republic, reinforces the

21. www.enseignementsup-recherche.gouv.fr/pid20003/politique-et-administration-de-la-recherche.html.

legitimacy of government policy choices. In terms of research, DGRI gives the role assigned to the Ministry of Coordination of the Inter-ministerial Mission of Research and Higher Education (MIRES); the general director of research and innovation being the program director for three programs: multidisciplinary scientific and technological research, research on resource and natural environment management and space research".

The external actors have no opportunity to provide the authors with feedback on the field implementation of the above reforms.

The National Agency for Research[22] (ANR) was established by the French government in 2005 to fund research projects, in addition to the means provided by the European Commission through the 7th Framework Program. ANRs thematic calls for projects are directing research teams towards governmental priorities – biomedical, sustainable development and sciences of information and communication technologies. Despite efforts towards multi-disciplinarity, the partitioning is only now beginning to crumble. Nevertheless, the evaluation of multidisciplinary projects is raising some problems, because there are very few experts able to properly evaluate such projects.

Experts, highly specialized in a specific area have the tendency to seek excellence in each field separately, which is not in accordance with the Bellman theorem of optimal control. Experts are not paid and some may not take enough time to conduct meticulous work. Funds are very limited and it thus remains difficult to obtain them, even for very promising projects.

Major groups which are part of competitiveness clusters are all displaying innovation as a strategic priority. They are considered by authorities to be an innovation drive, able to involve small businesses, which is not always the case.

6.4. Motivations, evaluations and promotion

Motivations to innovate can be personal (inventor), triggered by a fad, by the want for recognition of a sector considered as not serious from a scientific point of view (as were electronic games for a long time), by needs (care services for the elderly) or by a financing opportunity. The motivations of the researchers are directly related to the evaluation criteria.

22. http://www.agence-nationale-recherche.fr/en/project-based-funding-to-advance-french-research/.

6.4.1. *Evaluation criteria of the researchers*

CNRS is 5th and INRIA is 12th in the world ranking of CINDOC's Top 2000[23]. Its objective is to provide extra motivation for researchers worldwide for publishing more and improved scientific content on the Web, making it available to colleagues and people wherever they are located. The "Ranking Web of World Research Centers" was officially launched in 2008, and it is updated every 6 months. The Web indicators used are based on and correlated with traditional scientometric and bibliometric indicators. Research Center activity is multi-dimensional and this is reflected in its web presence. Therefore, the best way to build the ranking is to combine a group of indicators that measures these different aspects. The four indicators were obtained from the quantitative results provided by the main search engines as follows:

Size (S) – Number of pages recovered from four engines: Google, Yahoo, Live Search and Exalead.

Visibility (V) – The total number of unique external links received (inlinks) by a site.

Rich Files (R) – Selected formats: Adobe Acrobat (.pdf), Adobe PostScript (.ps), Microsoft Word (.doc) and Microsoft Powerpoint (.ppt).

Scholar (Sc). Google Scholar provides the number of papers and citations for each academic domain.

Table 6.1 shows the significance of each indicator.

WEBOMETRICS RANK	
VISIBILITY	SIZE (web pages) **20%**
(external links)	RICH FILES **15%**
50%	SCHOLAR **15%**

Table 6.1. *Criteria of the CINDOC ranking*

Putting the salary aside, the researchers' motivations are directly related to evaluation and promotion criteria. Despite the AERES creation, the CNRS criteria[24] have not evolved much – they are not taking into account the influence on economic

23. http://research.webometrics.info.
24. Section 7 groups Information Science and Technology, http://www.cnrs.fr/comitenational/english.

development, nor efficiency measurements, nor the real collaboration (applied research) with the business world, which are mentioned in the reforms.

A researchers' activity is evaluated every two years. They have to write an activity report including a list of publications. A large number of aspects of the researcher's professional activities are taken into account and includes scientific references, mobility, opening up to industry, teaching activity and dissemination of the scientific culture. The sections establish the evaluation report from these elements. They also provide an opinion throughout the career of researchers, on requests for promotion and reallocation.

As an example, the criteria for section 7[25] are given.

Common criteria for all researchers are as follows:

– Scientific contribution: publications, prototypes, software, originality of work, risk taking, national or international collaborative projects, national or international recognitions (awards, honors, etc.).

– Valuation: technological and/or economic impact of activities relative to a research or consultancy contract, patenting, participation in start-ups.

– PhD supervision and teaching: coaching and follow up of PhD students, diffusion of scientific culture, participation in teaching.

– Mobility and international relations: geographic mobility, international collaboration, area or functional mobility.

There are four ranks from the lowest to the highest: CR2, CR1, DR2, DR1. The CR1 (researcher rank 1) is evaluated on the capacity to set a personal research project. The CR2 has to take responsibility in the national or international scientific community (scientific committees, advisory bodies, congresses, etc.). They must demonstrate dynamism and leadership.

The DR2 (Director of Research) has to be a team leader, able to manage research projects and scientific reputation, as well as take responsibility in the national and international scientific community (scientific committees, advisory bodies, congresses, etc.).

The DR1 has to perform even better than the previous rank.

The aforementioned criteria are also specific criteria for getting ranked or being promoted.

25. www.cnrs.fr/comitenational/sections/critere/section27.htm.

Promotion to CR1:

– dynamics of the publication activity;

– progress of the works since recruitment;

– insertion into a research team and/or program;

– national and international audience;

– involvement in teaching, training and supervision of students;

– research promotion (contracts, patents, licenses) and knowledge dissemination.

Promotion to DR1:

– excellence of the publications;

– international diffusion of the work (expertise, editorial activity, invitations to conferences, organization of conferences, awards, honors);

– capacities to manage a team and/or research;

– local, national or international collective responsibilities;

– administration and contract management;

– supervision of young researchers;

– participation in teaching (higher education);

– geographical mobility;

– thematic evolution;

– knowledge dissemination;

– research promotion (patents, licenses, transfers).

Promotion to exceptional class DRCE (in addition to the qualities required for the DR1):

– founding and structuring action for a given discipline;

– outstanding scientific qualities and exceptional national and international scientific influence.

Generally, the review of the researcher activities will not be limited to the accounting of publications, but will also include all the activities inherent in the practice of research (promotion, teaching, scientific culture diffusion, administrative responsibilities). The quality of publications and productions will considered to the

same extent as their assumed impact. Moreover, (reasonable) risk-taking will be encouraged, with its implications of success or difficulties (or even failures).

Let us note that these criteria are not making a distinction between fundamental and applied research. Research valorization is the last item on the list and is very succinct. Next to "patents, licenses and transfers", we do not find the word "entrepreneurship", instead we just find "participating in business creation". Filing a patent in universities is not so simple, because it requires a specific approach and is quite costly. Some universities and public research centers have a valorization unit, which is, in principle, in charge of this task. For example, Aquitaine Valo's[26] objective is to promote Bordeaux research, patents drafting is a part of their concerns. The Bordeaux laboratory of research in computer science[27] has its own transfer unit. Moreover, few transfer specialists are able to formulate a patent document [BRE] for intellectual inventions and it is always difficult to patent a software and impossible to patent an idea.

Software can only be protected by copyright, which requires legal skills and the ability to sell licenses. Concerning selling licenses, to our knowledge, it remains marginal, because this point is also marginal in the evaluation process. The license sales process remains complex and it can be only initiated by a person in charge of industrial relations in the research center [LOR 09]. "A company wishing to exploit the patent of an academic researcher should get in touch with the organization that filed the patent and for which the researcher works. Concerning services, a company can directly contact a laboratory, but for contract management, it will often have to go through the valorization service of the organization hosting the laboratory. Depending on the offered service, the contract negotiations can be complex. This situation is slowly evolving through the competitiveness clusters and academic valorization services", Marc Chevalier, http://blog.innovageek.com.

The above mentioned evaluation criteria include "reasonable" risk taking; we do not have any specifics in the available documents on the nature of the risks to take nor on the degree of "reasonable" risks. Nothing in this list encourages collaborative and multidisciplinary projects and we also cannot find any criteria related to the consideration of environmental impact. Amongst Lisbon criteria, only mobility is mentioned several times, without however giving the objectives or conditions to this mobility. Generally, this is the "visiting professor" status. Let us note that frequent mobility is contrary to the principles of sustainable development. On this level, these criteria are not encouraging the use of ICT for distance work.

26. www.aquitaine-valo.fr/.

27. www.labri.fr/.

No criterion verifies updating the researchers knowledge, notably the knowledge of industrial solutions (business intelligence) or of similar works carried out in other fields. Consequently, most conferences and publications remain limited to the "community".

In accordance with ministerial directives, the Agency for evaluation of research and higher education[28] (AERES) was established in March 2007, "in order to provide research stakeholders, ministries and funding agencies with evaluation data, to enable them to improve the global performance of the system and to decide organizational reconfigurations and allocations of more relevant means." AERES simultaneously evaluates the units of the same site, whether they depend on universities, research organizations or whether they are mixed. Four evaluation criteria help to assess the current state of the unit, its strategy and projects:

– *Scientific quality and production*: this consists of estimating the relevance and value of research, the quality of the results and their originality, scientific advances, their impact on international level and risk taking. The quality and quantity of publications in international journals, of communications in conferences, of books, the number and quality of supervised and obtained PhD and habilitations[29] and, when it is relevant, the quality and quantity of developed software, of maintained collections, observations, patents, knowledge dissemination documents and scientific and technological culture documents, as well as the societal benefits and impact and those in the field of clinical research (translational research, implementation of procedures, clinical protocol, etc.). In the domain of applied research, obtaining contracts, especially with businesses and in relation to ongoing scientific programs rather than simple services, is also a significant aspect of evaluation.

– *Influence and attractiveness, integration into the environment*: this rating system takes into account the reputation, visibility and attractiveness of the laboratory or of the team and its members. We are taking into account the international relations, guest talks in conferences or abroad, received awards or honors, participation in national and European projects, successful transfer and valorization actions, relations with the socio-economic, industrial or cultural world, organization of conferences, participation of laboratory members in editorial boards and international and national evaluation of teaching or research, hosting of foreign researchers and post-doctorals and capacity of the laboratory to attract good researchers and leading lecturers-researchers.

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28. www.aeres-evaluation.fr.

29. HDR – habilitation to supervise research can be obtained after several years of research. The applicant has to provide a report on his/her work to the jury, who decides whether to accord the HDR title. It is the step before applying for the title of Professor.

– *Strategy, governance and life of the laboratory*: this consists of assessing the organization, coherence, vitality of the unit, the existence and effects of a policy of scientific activities, of emergence of transversal structures or young teams, of incentive of exchanges within the laboratory, the existence and effects of a recruitment policy open to the outside, the involvement in ambient higher education and in doctoral training, insertion into the regional environment, internal and external communication capacities.

– *Evaluation of the project*: the assessment committee actually observes a four-year project quality, relevance and consistency, in relation to the means and feasibility: defining lines, strength of the human potential, renewing and incentive to the emergence of innovative subjects, evolution of the organization, allocation of means, projected recruitment policy and positioning in appropriate networks.

Out of the four notation criteria, the first two examine the current state of the unit and the other two are interested in its management and strategy, as well as in the quality of the project, the opportunity to develop research in the field concerned and the ability of the unit to achieve its ambitions. The results of this evaluation will provide advice for the unit actors and will inform funders, financing agencies, supervisors and other stakeholders in the field about the development potential of the evaluated unit [AER 08].

It is important to note that AERES expert teams, which are made up of prominent personalities, do not include any marketing, commercial or SME actors able to evaluate the market relevance and the capacity to generate market values from research results. This is the same for strategists and knowledge economy management specialists, which would help in planning the training of the skills that the economy needs to thrive. The logic of technological transfer is not from needs, but is in push mode – researchers are deciding the research topics. The aspect 1 also mentions risk taking, but it is unclear how we are to know to what this risk is related.

The creation of AERES represents progress in the evaluation of research. The business vocabulary, with words such as strategy, management, project, resource allocation, road map begins to merge with the research vocabulary. This will certainly facilitate closer relations between the two populations. The choice of the evaluators and the real opening to the outside for recruitment remains to be innovated – no outside applicants was accepted during the competition exam CNRS 2010. Some of the mentioned criteria are just desired now, but changing mentalities takes time and it is not always possible to leap frog, in particular in an environment with a long research tradition.

6.4.2. *Other motivations*

Since 1954, CNRS has been awarding with the gold medal, the work of a scientific personality, who has made an outstanding contribution to the dynamism and influence of French research. The silver medal distinguishes researchers for originality, quality and importance of their work, recognized on the national and international level; the bronze medal awards the first work of a researcher, which makes them a talented specialist in their field. This award is an encouragement from the CNRS to continue this well-underway and already fruitful research.

Another award, the CNRS Crystal, which was created in 1992, each year values engineers, technicians and officials, who with their creativity, technical mastery and their sense of innovation, are contributing alongside researchers to the advancement of knowledge and to the excellence of French research.

There is no award for applied research or for the most successful technology transfer.

6.4.3. *Ambitions of the CNRS*

Following the engaged governmental reforms, the CNRS is expressing the ambition to be a driving force behind the adaptation of national research and innovation system to global competition [CNR 08]. According to the authors of the 2020 strategic plan[30], "this global competition of intelligence requires consequent financial resources and an optimized organization". They are not specifying how to find these resources and how to use them to compete.

The strategic plan "CNRS Horizon 2020", published in July 2008 [CNR 08] is at the origin of a series of actions; the first was the change of logo! The target contract with the State [CNR 09] shows the ambition to "overcome knowledge boundaries and technological obstacles, but also to go beyond the geographical and disciplinary borders, whether they are within the European research space or between continents". The CNRS must rely on "the values that have shaped its competences, credibility and international reputation: the elitism of recruitment, freedom and autonomy at the service of the researcher creativity, risk taking in terms of research, combination between competition and collaboration to carry out a scientific project, opening to new disciplines and the implementation of multidisciplinarity on the field."

30. www.cnrs.fr/fr/organisme/docs/Plan_Strategique_CNRS_CA_080701.pdf.

The mentioned recruitment elitism is leaving no room to a brilliant mind coming from outside. The notion of scientific excellence deserves to be more precisely defined.

The contract with the State is supposed to be in a model that is common to all the major industrialized countries:

– "The State is setting the major priorities of Research, but research organizations are involved in the definition of the national research strategy. They are structuring the research policy on the national level and ensuring a balance between collaboration and competition; they are preferably structured into networks and can form an alliance; they are strengthening their role of means agency and are preserving their research operator function, especially for long-term research;

– research is carried out in laboratories, which are mainly located on the sites of universities on their way to become autonomous. These sites are research and higher education clusters (known in France as PRES) in a triangle structure 'teaching-research-innovation';

– funding agencies, such as the ANR, are encouraging research on middle-short term projects, which are selected by peers;

– the evaluation of research organizations and activities of the units is performed by an independent agency, the AERES".

Three scientific challenges are presented in Table 6.2.

Advancing on the knowledge front	Mathematics and digital sciences From the infinitely large to the infinitely small Matter and waves Development and complexity of the living beings Knowledge of mankind and societies	Pooling of s research instruments
Taking up major global challenges	Environment and climate Sustainable development, resources, biodiversity Energy Medicine, treatments, handicap Significant social change, new vulnerabilities, safety	Methods and tools
Making new advanced technologies emerge	Nano-science and nanotechnologies Information, communication Molecules, materials, procedures and structures Developing advanced instrumentation	Technological platforms and large instruments

Table 6.2. *Scientific overview of the 2009-2013 CNRS contract with the State*

Multidisciplinarity trends are: sustainable development at the service of mankind, origin and control of matter, nano-sciences, nano-technologies and networked society. We can notice that artificial intelligence which has invented methods of knowledge processing is not very present and is enclosed within other digital sciences, whereas it is multidisciplinary. The word *company* is mentioned several times in this 143 page document, but as a research receiver and not as an initiator or stakeholder. This document, however, reveals a deficiency in the consideration of the knowledge economy principles.

Amongst European countries, Great Britain is reviewing its research promotion system. The department of education and skills has announced the replacement of the RAE[31] by the *Research Excellence Framework* (REF), in which evaluation should essentially be carried out on bibliometric indicators and contract resources indicators (volume of public and private contracts obtained by a department).

In the new formula, they propose to measure not only the quantity of research, but also its economic and social impact, as well as the participation of stakeholders in development, research project management and in the deployment of the results. The research environment will also be assessed to take into account the facilities, resources, organization, strategy and human resources management. They wish to add to this, measurements of the progress of diversity.

In Baltic countries, the creation of businesses at the end of training, or even during studies, is encouraged. This trend was known in France for 40 years under the name of "Junior Enterprise". Nowadays, the French national confederation of junior enterprises[32] gathers 140 together.

But when students have completed their studies, it is difficult to know if they kept the entrepreneurship spirit or what they have become, because this association does not practice the knowledge management principles. Associations of graduates of "Grandes écoles" make an effort to keep connections. Social networks are completing these connections, but the objectives of each initiative are different.

6.5. What is the role of education?

"Out of the €32 billion State investment in the future, half of it will support higher education, research and innovation" [JUP 09]. John Kao, in his book *Innovation Nation* [KAO 09], emphasizes the importance of higher education for value generative innovation. Why only higher education, whereas in the United

31. Research Assessment Exercise.

32. www.junior-entreprises.com/.

States, being an entrepreneur is almost genetic? How should we conduct reforms in France and Europe, to move from research to economic success?

According to Sheridan Tatsuno [TAT 09], "most universities teach old knowledge with courses that are more economic and technology history than state-of-the-art thinking. So students turn off from this stale knowledge. And governments focus mostly on proven knowledge, much less on imagination, daring and breakthroughs. That is why they prefer PhDs to college dropouts like Steve Jobs, Bill Gates, Larry Ellison or Jim Clark. They focus on proven, conservative people and technologies, not wild cards which often create totally new industries. In Silicon Valley, Google, Yahoo!, Apple, Netscape etc. were created by young people who were not and would never have been subsidized by the government or VCs in their early years."

The capacity to innovate is a skill that must be taught and practiced at the youngest age by games and individual and collective projects of students, who succeed from their idea. Medias could also play a significant role in this education process. In the movie by Blair Treu, *The Brainiacs.com*[33], the main characters are 10 years old. They have to find a business idea to present at school. One of them has decided to buy the toys company off his father, a workaholic, to spend more time with him. His "associate" uses Internet subscription to raise money. They buy shares in the company and become a majority. During the first staff videoconference meeting, the new CEO is represented by his avatar. He radically modifies work habits – the employees must play with the toys they manufacture and they must modify their schedules, to spend more time with their children. New leaders are innovating toys from the opportunities arising, including the introduction of a neural "chip". The latter has been developed by the sister of the new CEO – a teenager passionate about artificial intelligence. French (and other) schools and medias could draw inspiration from this example.

6.5.1. *University ranking*

The ranking criteria of Shanghai Jiao Tong University is the most well-known and is quite conventional[34]: quality of teaching, quality of the staff (Nobel prize and citations), research results in number of publications and greatness of institutions in number of students.

The European U-Multirank classification[35] "under development" is more sophisticated. The objective of this project, funded by the European Commission, is

33. http://www.youtube.com/watch?v=-_vS06Va9iw.

34. http://www.universityrankings.ch/en/methodology/shanghai_jiao_tong.

35. www.u-multirank.eu.

to develop an instrument that can contribute to enhance the transparency of institutional and programmatic diversity of European higher education in a global context and can test its feasibility. The general intention is to create a transparency instrument that will have a global outreach, potentially covering higher education institutions of all continents.

It covers five dimensions: research, education, professional inclusion, innovation, internationalization and regional engagement. It also includes the performances of universities by discipline. Indicators have been set and the *consortium* has carried out a pre-test to ten establishments. On this basis, a larger test has been carried out for 150 institutions inside and outside Europe in the second phase of the project. Results of the first phase are published in two reports and can be found on the project website. A decision about whether U-Multirank will enter a second phase and who will carry out this phase is expected in early 2012. We have to hope that this classification will take into account the key-indicators of the knowledge economy, such as the capacity to innovate, to create connections, to seek for opportunities and so on.

6.6. Some initiatives to transform technological innovation in economic values

Many initiatives have been and still are experimented, such as "incubators", various contests to encourage public and private research actors, as well as any project holder to create their own businesses. Many reports have been written. Amongst them, we can find that of SETTAR [DGR 09], which is a good summary of the actions carried out. It draws a report of these actions at the end of 2009.

6.6.1. *Creation of companies by researchers*

The national contest for the creation of innovative technology companies has been held every year in February since 1999, by the Ministry of Research[36]. The candidates can apply to one of two categories:

– "emerging" projects, still requiring a phase of maturation and technical, economic and legal validation may receive a grant of up to about €45,000 in order to finance the services necessary for the projects maturation;

– "creation-development" projects, whose concept proof is already established and which led or will lead shortly to a business creation. They can benefit from a

36. www.enseignementsup-recherche.gouv.fr/cid22991/concours-national-aide-creation-entrepriseentreprises-technologies-innovantes-2009.html.

subsidy of up to about €450,000, intended to help them finance their innovation agenda.

The "Tremplin d'entreprise" ("springboard of enterprise") [37] is organized by the Senate in favor of innovative projects that can compete in four categories: services, software, life sciences, material-components. The prize is €15,000 by category. Winners are offered the opportunity to meet investors. Almost 150 contests are held each year in France by public and private actors aimed at entrepreneurs. Some details can be found in the next chapter, because most of these competitions have regional development as the main objective.

6.6.2. *Business breeding-grounds and incubators*

In France, two business incubation structures exist: one is known as an "incubator", aiming to identify and assist innovative business start-up projects and the other is known as "pépinière d'entreprises" (business breeding-grounds), which offers shared premises and services for young businesses or companies in the process of being created. Finally, high-tech regional hubs, known as "technopôles" in French, group together companies, research centers, prestigious French universities and professional organizations and aim for the economic development of a territory via innovation[38].

Business breeding-grounds have been proposed by the Ministry of Research and have been progressively implemented since the beginning of the 1980s, first within the structures of research valorization. They then spread via local collectives, in order to favor creation of activities and jobs. They offer temporary accommodation and common resources to newly created businesses, as well as methodological support and coaching to enhance the chances of successful business. An incubator helps to break with the usual isolation of business creators and can facilitate information sharing via conferences or other events and exchanges with other creators. Legal, accounting, tax, commercial or technological development and management advice can be suggested in partnership with outside organizations.

As an example, Cap Alpha, close to Montpellier, hosts about 20 innovative companies, specialized in fields such as agricultural decision-making support systems, embedded mobile solutions, hearing aids or polyphenols, amongst other things. Other business breeding-grounds, Cap Omega, hotels and business houses

37. www.tremplinentreprises.com.

38. http://www.france.fr/en/knowing/research-and-innovation/competitiveness-clusters/article/business-incubation-and-high-tech-regional-hubs.

are also established there[39]. The return on investment and the impact of these initiatives are difficult to estimate – statistics published in regional communication media are always optimistic.

Incubators are the support structures for business creation projects. In 1999, ministries in charge of Research, Economy and Industry launched a call for project incubation and seed capital for technological companies, in order to encourage the creation of innovative companies from the results of public research. Following this action, 31 incubator projects were selected and became operational between 2000 and 2002: there are currently 29 of them. Other incubators such as those of schools, economic development agencies, competitiveness clusters, public or private companies, are now a part of the landscape.

6.6.3. *Technology parks and competitiveness clusters*

Technology parks appeared in France in the 1950s, either to promote a place by attracting companies with a significant job creation capacity or to involve an existing university and research potential in an economic development perspective. The technology parks of Vélizy (near Paris), Sophia Antipolis (Nice), Meylan (Grenoble), Futuroscope (Poitiers) and Compiègne were amongst the first to be created. About 20 technology parks are listed on www.zones-activites.net /technopole-technoparc-a-20.html.

Since their inception in 2002, the objective of the 71 competitiveness clusters is to connect researchers and companies located on a geographical area through collaborative projects, thus influencing the development of the territories by creating jobs. In other words, they must "strengthen the specializations of French industry, creating favorable conditions for the emergence of new activities with high international visibility and thus improving the attractiveness of the territories and fight against relocations" [BLA 04].

In most cases, they are using an association or an economic interest group. CESE[40] consider them both as essential tools for competitiveness, as well as levers for territorial development. The Council is placing emphasis on the necessity to carry on with the initiated policy and is suggesting ideas to improve efficiency. The DATAR[41] report [DAT 08] is proposing a set of fact sheets relating to: the involvement of major groups and small businesses and inter-enterprises synergies; connection between research and companies; governance assessment; project

39. www.montpellier.cci.fr.

40. Economic, Social and Environmental Council http://www.lecese.fr/.

41. Town and country planning http://territoires.gouv.fr/la-datar.

financing; the issue of training; business internationalization; the impact of the clusters on the dynamics of the settlement territory and capacity to create added-value. In reality, connecting research actors and companies is an arduous task, given the objectives, concerns and motivations differ for each population. Joint projects can create synergies if we take into account the specificities of each of them. From 2008, the policy of clusters was renewed over three years and endowed with an envelope of €1.5 billion.

6.6.4. *Grouping of technology parks – Archs and Euromed*

Clusters are beginning to spread across the borders. Lyon, Grenoble, Geneva, Lausanne, Turin are part of the transalpine arch. This initiative is a partnership policy launched by the Rhône-Alpes region in collaboration with the "Suisse Romande" (French-speaking part of Switzerland) and Piedmont. It involves training and research in health sciences, sport and ecology areas [SIB 09, KOH 09]. "Arco Latino[42] is a cooperation space between territorial collectivities within which integrated actions are implemented in several strategic fields for the social and economic cohesion of the territory comprised in it. The objective of this is to strengthen competitiveness and social integration, to improve the respect of the natural and cultural environment and to take into account the realities and traditions of the member regions. The Arco Latino observatory is equipped with an interactive platform for exchanges of skills, practices and information between its participants. The synergy with the researchers of the involved territories is scarcely visible on their website".

6.6.4.1. *Euromed*

In February 2009, President Nicolas Sarkozy put the senator Pierre Laffite in charge of a mission to create an innovation development network in Euroméditerranée with members of the Union for the Mediterranean[43]. Its objectives are defining and implementing an extended innovation strategy, federating the existing strategies, developing interaction between excellence zones and clusters around the Mediterranean and developing new partnerships and the exchanges of best practices between clusters and small businesses, in order to reinforce economic and social development. Priorities are motorways of the sea, detoxification of the Mediterranean and the Mediterranean solar plan. This will consist of helping to create new clusters around the priority axes of the Mediterranean, by favoring for example training for careers in cluster management. In order to succeed in such a venture, a Knowledge Management approach is vital. Our suggestion of creating a

42. www.arcolatino.org/.

43. http://ec.europa.eu/external_relations/euromed/index_fr.htm.

virtual knowledge space for Euromed was presented during the Global Forum 2009[44].

6.6.5. *European Research Area*

As specified in Chapter 1, the objective of the European Research Area is to provide European research with new perspectives – in order to allow the mobility of researchers; sharing, teaching, promoting and efficiently using knowledge for social, commercial and political purposes, optimizing and opening European, national and regional research programs, in order to support the best research through Europe and coordinating these programs to meet all key challenges; developing connections with partners all over the world, so that Europe profits from the global progresses of knowledge, contributes to global development and takes a leading role in international initiatives aiming to solve issues of global importance [EC 07]. The ERA-Net program[45] finances networking actions, its objective is to develop and strengthen the coordination of national and regional research programs within the European research area. Two types of actions are supported: the preparation and implementation of joint activities (ERA-Net) and the organization of joint national and regional calls, with resource pooling (ERA-Net plus). Some examples of financed actions can be found on the Cordis website, http://cordis.europa.eu /coordination/projects.htm.

The 2020 vision[46] wishes to promote the mobility of researchers, knowledge and technologies through public and private funding. Except for European programs, and country reports, there are no specific initiatives helping to create a common knowledge space, using innovative technologies, invented in the framework of collaborative projects, nor to transform these researches into values.

According to the long-term vision, "the scientific community, business and citizens need should have the following features:

– an adequate flow of competent researchers with high levels of mobility between institutions, disciplines, sectors and countries;

– world-class research infrastructures, integrated, networked and accessible to research teams from across Europe and the world, notably thanks to new generations of electronic communication infrastructures;

– excellent research institutions engaged in effective public-private cooperation and partnerships, forming the core of research and innovation 'clusters' including

44. www.items.fr/spip.php?rubrique102, session 10.

45. NETworking the European Research Area.

46. http://ec.europa.eu/research/era/pdf/era_vision_2020_fr.pdf.

'virtual research communities', mostly specialized in interdisciplinary areas and attracting a critical mass of human and financial resources;

– effective knowledge-sharing notably between public research and industry, as well as with the public at large;

– well-coordinated research programs and priorities, including a significant volume of jointly-programmed public research investment at the European level involving common priorities, coordinated implementation and joint evaluation; and

– a wide opening of the European Research Area to the world with special emphasis on neighboring countries and a strong commitment to address global challenges with Europe's partners" (*Green Paper The European Research Area: New Perspectives* [EC 07]).

All the initiatives mentioned are starting from the aforementioned vision, which is not yet that of the involved actors. For instance, it is rarely collective and shared. It is sometimes associated with a national strategy, such as governmental reforms. The positioning is clearly that of the knowledge economy, the transition from the industrial era is expected to be done by actions. Some objectives mentioned are mobility, collaboration, the knowledge space, experience sharing, unifying projects, public-private partnership and small businesses. Whatever the approach, the key issues are the economic development, territory revitalization and the regaining of the leadership position.

As in a strategic knowledge management approach, the conditions for the success of such initiatives are not gears, but appropriate management, the involvement of the stakeholders in the ongoing innovation process, the creation of a common knowledge, skill and experience space using the techniques equipped with intelligence, many of them are the results of various projects financed by national and European funds, but not well-known and not sufficiently exploited.

6.6.6. *Education: training of future entrepreneurs*

The observatory of educational practices in entrepreneurship (OPPE) was born in 2001. Created by ministries respectively in charge of research, education and industry, by the French agency for business creation (APCE) and by the Entrepreneurship Academy, it aims to identify the "best practices" and the educational initiatives and to disseminate them to students, lecturers and collectivities. It should also evaluate the impact of the initiatives, in terms of educational methods, in order to help lecturers and collectivities in their choice. A database available on www.entrepreneuriat.net provides Internet users with action sheets, bibliographical references, Internet links, testimonies on an action, case studies and the list of all the competitions for students and pupils. The OPPE

website[47] also offers to register teachers for more than 30 educational tools, most of which are for higher education. If you try to make a request for "entrepreneurship courses" on the search engine of this website, the answer is not really satisfactory. This website would certainly be more valuable, if it was using modern computer tools, at least those of Web 2.0.

Every year, OPPE organizes a seminar bringing together those involved in entrepreneurship, students, lecturers and those who wish to start a business. The seminar of 2008 gathered 170 participants. The impact of this initiative, which is however mobilizing lots of actors, seems negligible in relation to what it could be if the technological possibilities were fully used.

Entrepreneurship houses in universities were launched in 2004. Their objective is to develop inter-institutional projects and to promote the entrepreneurship spirit, to help students who wish to create an activity during their studies, to be accompanied by an advisor and make contact with support structures adapted to their project and to conceive projects between institutions. "This awareness entrepreneurship campaign can also be a reorientation of students in early courses and also for PhD students who do not want to or cannot become researchers"[48]. A bad corporate manager instead of a bad PhD student? Counseling advice could certainly offer more than this binary choice as a function of the students capacities, skills and wishes. There is, however, no link with junior enterprises, which has 40 years of experience to share.

6.6.7. *KIZ*

Knowledge Innovation Zone[49] is a new concept, adapted to the knowledge economy and introduced by Entovation Intl. – the international network of experts in Knowledge Innovation®. It has been implemented on a global scale since 2003. "KIZ are enabling new forms of enterprise, collaboration, cooperation, research and development, knowledge sharing and commercialization of ideas between the private sector, government, and academia. As with any new endeavor, there are successes, failures and lots in between. Our studies have distilled the key elements of KIZ and linked them to outcomes. Understanding and applying the dynamics for success will separate the investment successes from the failures."

47. http://www.apce.com/pid11493/qu-est-que-oppe.html.

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

49. www.inthekzone.com/KIZ_Introduction.htm.

Focusing on sustainable knowledge creation and application, and directed towards economic and social development, they are rapidly expanding worldwide. As with all new investments, risks are high, rewards great.

A KIZ approach must be properly planned, supported and implemented. This involves new performance indicators, which take into account knowledge and skills, networking organizations, community of practices, innovation processes and the use of collaborative and intelligent technologies" [AMI 06].

Other initiatives are successfully carried out by members of the Entovation Intl network, such as the entrepreneurship schools of Piero Formica in Bologna (Italy), Tartu (Estonia), Abu Dhabi and Jönköping (Sweden). The New Club of Paris[50], founded in 2006, aims to share its experience in developing intellectual capital and setting up projects at a global level. Management classes in knowledge economy are given by Charles Savage (Knowledge Era Enterprizing) in several developing countries. The concept of the Future Center has been tested in the framework of a European project and is being transformed into the Virtual Future Center[51]. The certified training, "Innovation Leaders", have been co-developed by Innovation3D, Innovatika[52] and Knowledge Era Enterprizing (KEE) in order to educate the innovation culture by action.

6.7. Financing and return on investment

The DGRI document [DGR 09] lists financing systems and assesses the initiatives aiming to develop innovation and business creation activities. It exposes the measures implemented by the Higher Education and Research Ministry and by other public actors, in order to develop research and innovation activities in companies, to support innovative business creators and to favor knowledge exchange between companies, organizations and research centers.

Amongst these systems, we can find "credit impôt recherche" – the French R&D tax credit (CIR). Between 1994 and 2003, the average annual amount of business debt was €465 million. In 2007, it reached €1.7 billion and the reform in 2008 made this tax expenditure double to about €4 billion in 2008 and 2009. The R&D tax credit has thus become another crucial measure of the R&D promotion policy in France. The evaluation process established in 2005 is only interested in the impact of the R&D tax credit on R&D expenditures and employment of researchers by companies. The document mentioned above presents the various analyses of

50. www.new-club-of-paris.org/.

51. www.educore.nl/2009/01/future-center-alliance/.

52. http://innovatika.com/.

accumulation of aids by companies and the balance of expenses relative to the R&D tax credit.

Thus, companies are still spending more for R&D, are doing more long-term projects, but they are not taking many risks, are only relatively working with the actors of university research and are scarcely hiring PhD graduates. This impact analysis on economic development is quite limited.

Other support measures for the creation and development of innovative businesses include systems such as Eureka, Oseo, awareness campaign of students to entrepreneurship, incentive for researchers to create companies, incubators, contests, financing in capital of the innovative companies and aids for young innovative and university enterprises.

Concerning incubators, Table 6.3 is presents the 2000-2008 assessment.

Total Companies (2000-2007) (number given)	1,204	100%
Companies in activity at the end of 2008	1,010	83.9
Terminated companies at the end of 2008	194	16.1
Terminations because:		
Deregistration	105	54.1
Closing for insufficient assets	12	6.2
Dissolution	8	4.1
Legally active company but no noticeable economic activity	5	2.6
Compulsory liquidation	63	32.5
Disposal plan	1	0.5

Table 6.3. *Incubators: situation at the end of 2007 for companies created between 2000 and 2008 (source: [DGR 09])*

EUREKA[53] aims to strengthen the European competitiveness by supporting international innovative projects coming from technological companies. France finances two types of projects: collaborative projects led by companies which have primarily been funded by Oseo since 2008 and strategic initiatives, called clusters, which are major programs piloted and financed by the French general directorate for

53. www.eurekanetwork.org/.

competitiveness; industry and services (DGCIS) of the Ministry of Economy, Industry and Employment, through the competitiveness fund of the companies; SMEs, particularly high technology ones, represent an average of 40% in number and about 15% in amount of companies assisted through projects clusters together with major European groups. The amount of funding allocated to French partners in 2008 has risen to €8 million for 21 projects.

EUROSTARS[54] is a cooperative program involving EUREKA and the EU, in the program "Capacities" of the seventh FP. Jointly funded by the State members (€300 million) and the European Commission (€100 million), it is intended to support high-tech SMEs (at least 10% of the revenue spent on R&D). After the first two calls for EUROSTARS projects, more than 50 French small businesses benefited from funding.

In 2008, Oseo accompanied more than 5,000 innovative companies with €459 million of aid, €120 million of loans and €700 million of guaranteed bank financing.

Amongst the support measures for technological transfer mentioned by the DGRI document [DGR 09], we can also find competitiveness clusters, Carnot institutes[55], ANR and the CIFRE grant.

Concerning competitiveness clusters, territorial collectivities have co-financed the projects selected in the framework of the "Fonds unique interministériel" (FUI, French inter-ministerial single fund) up to €125 million against €239 million for the FUI[56].

From 2005 to 2008, clusters represented financing from the State of more than €1.5 billion for 1,400 projects of collaborative R&D. The renewal of the competitivity clusters which was announced in June 2008, was accompanied by a new financing of €1.5 billion up to 2010. 17 clusters are already asking for an additional budget of more than €900 million. In comparison, during the same period, Oseo invested a State budget of more than €500 million for 8,000 R&D projects (partly collaborative and mainly non-collaborative), in all regions, with the support of regional councils for more than €80 million (source: Oseo).

According to the Senate report of April 2009[57], "all the representatives of the work group have highlighted that it was nowadays impossible to evaluate the impact

54. www.eurekanetwork.org/activities/eurostars.

55. http://www.instituts-carnot.eu/en.

56. http://www.oseo.fr/a_la_une/actualites/resultats_du_10e_appel_a_projets_du_fui.

57. www.senat.fr/rap/r09-040/r09-0401.html.

of competitiveness clusters in terms of job creation. It is still too early to evaluate the impact of the system on innovation and employment. According to APEC[58], the impact on employment of any R&D action is premature. It is always difficult to measure and it requires several years of statistical collections".

The Carnot brand was created in 2006 to promote the conduct of public research in partnership with socio-economic actors, notably with companies. Research organizations branded as Carnot institutes receive funding from the State, which is managed by ANR and is calculated on the basis of the volume of contracts concluded with the socio-economic partners and the licensing revenues. The Carnot brand is awarded by the Ministry of Research, on a proposal of ANR, for a renewable period of four years. The financial envelope devoted by ANR to the Carnot system was €35.3 million in 2006 and €62.1 million in 2007.

It amounted to €60 million in 2008. The 33 Carnot institutes (2008) are organized into four thematic networks: electronics, micro and nanotechnologies, optics; the living and ecosystems; mechanics, materials, chemistry, energy; transport, aeronautics and space.

In 2008, allocations given by ANR to businesses in partnership projects (i.e. with at least one company partner and one research laboratory) were €127,511,094.

Figure 6.1 shows the financing system of the technological transfer in 2008 and Figure 6.2 shows the possible allocations for starts-up.

The CIFRE (Convention industrielle de formation par la recherche en entreprise – Industrial agreement of training by research in companies) system was created in 1981[59] in order to favor exchanges between public research laboratories and socio-economic environments, but also to favor the employment of PhDs in companies. It associates a company entrusting a PhD student with research work, a laboratory outside the company which is ensuring the scientific supervision of the student, and a PhD student, receiving financing during their thesis.

In reality, the approach is rather reversed – a PhD student looking for financing is contacting companies likely to be interested in their thesis subject. The company offering a CIFRE grant takes the commitment to hire students at the end of their thesis. This condition has not evolved since the creation of this grant and is certainly a constraint for businesses and sometimes for students wishing to have a scientific career.

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58. Agence pour Emploi des Cadres – Agency for Employement of Executives http://www.apec.fr.

59. www.anrt.asso.fr/fr/espace_cifre.

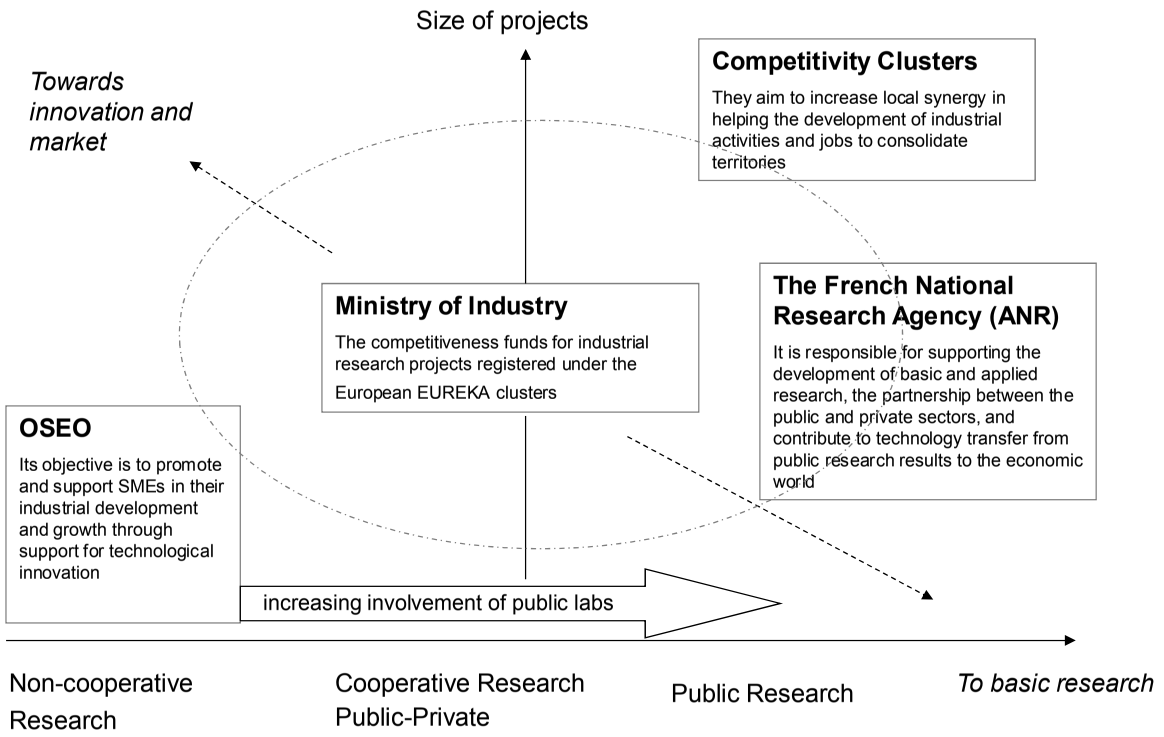

Figure 6.1. *Positioning of the actors of public funding . For updates visit http://www.industrie.gouv.fr/*

Since 1981, 12,000 PhD students have benefited from this system. For CIFRE grants finished in 2008, 14% of the companies declared that they received no fallout from the thesis. The rate of occupational integration of CIFRE doctors in the private sector is 72%. Half the CIFRE doctors are employed by a company other than the one which hired them during their thesis.

In 2008, the Ministry of Higher Education and Research subsidized six chosen *entrepreneurship houses* with up to €101,000 euros. Benefits announced for students included training in the form of conferences, seminars and optional modules in entrepreneurship. Benefits for lecturers included establishment of a network of interested lecturers via meetings. A project to develop an educational kit is being planned in order to gather their experiences, but we do not as yet know the form it is going to take.

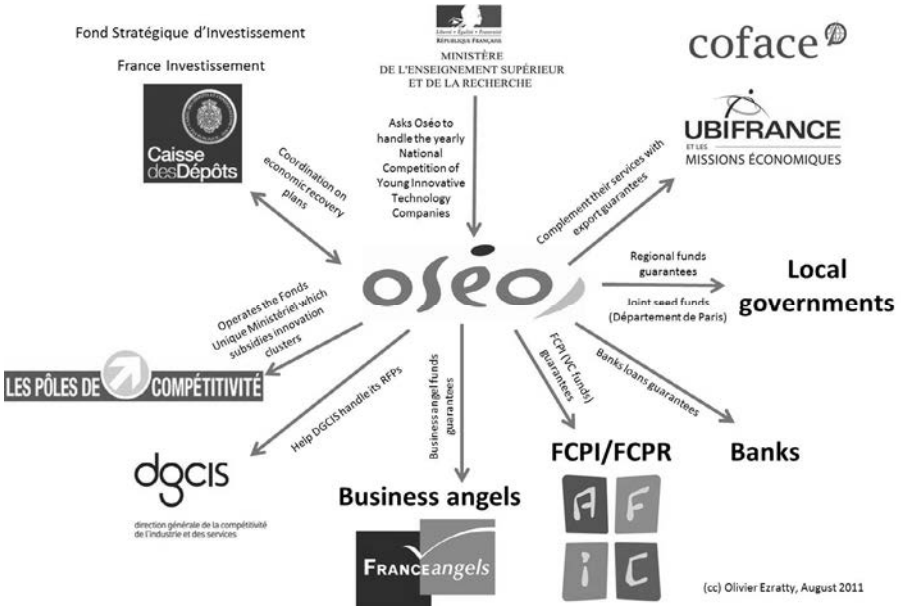

Figure 6.2. *Possible financing of starts-up (source: Olivier Ezratty, 2009)*

Given the scattering of the means and a diversity of views and objectives of the various available reports, it is difficult to estimate the return on investment of these actions. According to Jean-Michel Drevet, the Chief of Staff of the Minister of Industry, 7 innovative companies out of 10 are encountering failures. Possible causes could be: inadequate for the market (50%), cash flow problems (25%), management (25%) and financing (25%). According to the Billon report [BIL 05], one third of the winning companies of the national competition are not making any

turnover and half of them have a turnover of less than €500,000. The survival rate of these companies is 66% after four years, but they are in difficult financial conditions since 37% of them only have outside financing. Most of them have small seed funding and are only surviving thanks to the national competition subsidy. Frequently, they are encountering three major difficulties: insufficient human resources and an often inadequate profile of the entrepreneur for the management functions, a frequent immaturity of the projects when launching the company, insufficient seed funding and late occurrence in the creative process.

The vast majority of owners of SMEs, created after a technological transfer, have no preparation for managing a company. In 76% of the cases, the scientist behind the project is the CEO, manager or president of the created company, whereas in only 17.5% of the cases, scientists are associates and in 3.4% of the cases, they are technical or scientific advisers.

Following the analysis of the French situation by 200 experts and from 300 written contributions, the large loan ("Grand Emprunt") [JUP 09] will finance innovation according to 7 axes:

– supporting higher education, research and innovation – €16 billion;

– favoring the development of innovative small businesses – €2 billion;

– accelerating the development of life sciences – €2 billion;

– developing carbon-free energies and efficiency in resource management – €3.5 billion;

– making the city of tomorrow emerge – €4.5 billion;

– inventing the mobility of the future – €3 billion;

– investing in the digital society – €4 billion.

The authors of the report specify: "France is a large country of industry and knowledge. To take up the challenges of the future, it must (financially) invest". However, they also point out that it is necessary to find new drives and sources of development, such as knowledge economy and green economy.

To conclude, this report proposes allocating half of the amount to higher education, research and innovation, including €10 billion to favor the emergence of the campuses. It does not however give any suggestion of the professions needed in the future. This amount seems disproportionate in comparison to the other axes, such as for example encouraging the creation of innovative companies and social innovation (€0.5 billion) or facilitating the access to financing for innovative small businesses (€1.5 billion). We already have a lot of campuses. What is cruelly lacking is the means to reflect on skills and professions, enabling people to individually and

collectively succeed in the future, on how to produce quality rather than quantity and to reform universities functions and areas according to these aspects. Authors are not proposing any return on investment measure for an efficient campus. They are also not specifying the desired impact in exchange of this investment.

6.8. Proposal: technological innovation in the knowledge economy

The knowledge economy imposes a new perspective. It cannot rely only on the sectors and technologies, where France and other countries have (for now) strong positions. New sectors and technologies should be invented from a vision, the existing capacities and from those able to produce and put the imagination to work. Multiple and interconnected crises are creating an environment propitious to experiments.

Success is conditioned by the rapidity of evolution of the reference marks from the industrial era, in order to meet new stakes. Changing perspective in a country where for centuries we "were dividing to conquer" – the number of clusters and campuses proves this fact – requires a suitable strategy, perseverance, permanent feedback from the field and appropriate progress measurements. Humans with their habits, individual ambitions and weaknesses are influencing the final result. This evolution of attitudes can be generated by actions, such as joint projects, which are carried out with a holistic approach to knowledge management.

The triptych education-research-business appears in many mentioned texts, as a *sine qua non* condition to boost the economic development. Knowledge is playing the leading role, but only innovation dynamics can facilitate their transformation into economic values [AMI 05, MER 07b, UTT 96]. The know-how to detect and generate opportunities is part of it.

Obtaining meaningful results from the support of technological innovation for purposes of growth and competitiveness of the national economy requires new rules. They impose a change of the current logic – a logic where researchers are innovating, valorization units are filing patents and selling licenses to businesses and where an entrepreneur is first seeking the financing – to the logic where researchers are also working on solving company problems and where they are recognized for it.

One of the objectives of the reforms is to make research evolve towards being human-oriented, dealing with the problems to solve and address the needs of today and tomorrow. This type of research will know how to combine the natural and the artificial, as well as ancient knowledge in the production of new ones, while preserving the balance of ecosystems. Key subjects such as environment, transport and energy could be viewed with new logic: transportation and energy production

exert a strong impact on our environment and health. Current research is seeking new possibilities to fuel the same means of transportation – cars and trucks – but they are not focusing on the research of other transportation. What if we reduce the unnecessary transportation or if we moved differently? Do we need to produce that much energy or should we change our habits?

The problems of the 21st Century are complex and difficult enough to provide exciting challenges for both – applied and fundamental research. They need an organization other than organization by areas, or even grouped by concepts (e.g. cognitive sciences). New organization could combine the areas and issues addressed. Organizations in ecosystems are better suited to the challenges, because they take into consideration the multiple effects of actions and mutual impact. Figure 6.3 presents an example of such an organization of the stakeholders working in a collaborative logic, where everyone needs each other to succeed together.

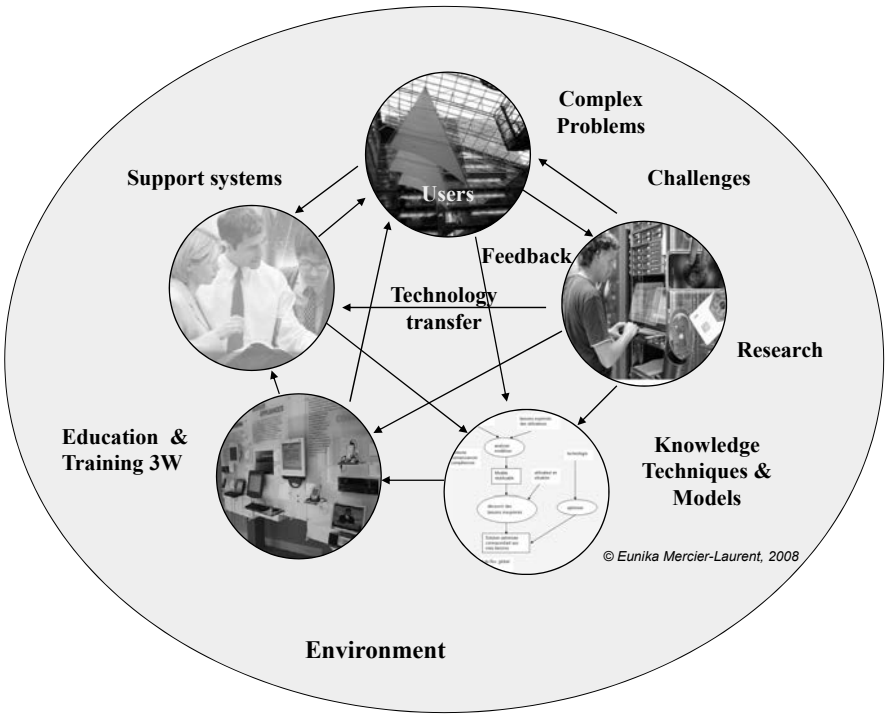

Figure 6.3. *Example of a technological innovation ecosystem*

The challenges and problems of businesses are feeding research programs. The latter make more use of knowledge technologies. Skills and knowledge are made

available to all stakeholders via a system facilitating continuous learning. The various decision-making support systems amplify the efficiency of participants. Users are involved in the innovation process and can be beneficiaries or initiators of a research program. The continuous feedback is organized and managed with the aim to improve solutions or to refocus research programs if necessary.

The required mobility is not geographical, but intellectual: the in-between domain thinking. The context is imposing abstract, conceptual and generic thinking, as well as collaboration and synergy onto the actions, instead of the current competition. This new research has the duty to contribute to the creation of intangible and tangible values for all stakeholders. It is unrealistic to carry on thinking that innovation is an elite matter and that research alone can save the world, that innovation cannot be done outside clusters or that the future lies in salaried jobs. The challenge of new education is the recognition of all these aspects, on all levels and not only by higher education.

6.8.1. *Which approach?*

Although CNRS claims a global and multidisciplinary vision of research [CNR 08], its interpretation and implementation on the field do not escape old habits. It is the same on the governmental level. A multitude of actors, levels and hierarchical layers prevent visibility of the results and generate the wasting of means.

A holistic, systemic and global approach to innovation based on strategic knowledge management [MER 07b] is certainly better adapted to the current context. Stakeholders are acting in a "win-win" logic and the triptych "vision-organization-action" is supervised by feedback from the field. An ongoing synergy "education-research-innovation-businesses" has a place here and could be improved by the participation of citizens 3G[60], connecting imagination, perseverance and experience. It is operating a change of values and an evolution of culture towards those of knowledge cultivators.

This process relies on a virtual knowledge space, which is designed using intelligent approaches and technologies. We can efficiently find there implementations, projects and ongoing initiatives, space to exchange ideas, a challenge box, a bank of partners, experts, skills and experiences, classes and online, educational playground, 3G collaborative innovation school, observatories of

60. Three generations: youth for imagination, middle for perseverance and "silver" for experience.

opportunities, entrepreneur bistros[61], investors in the future, etc. This space is not organized in arborescence, or territories or areas, but ecosystems, avoiding the dispersion of energies and funding of projects for which solutions already exist. It would facilitate the rapprochement of inventors, researchers and customers, as well as specialists of various fields in a spirit of multidisciplinary research and continuous learning.

Just as a company is about to succeed, public research would have more impact on the economy if it could be empowered by a facilitator of global innovation and managed by a scientific and commercial binomial. It is not about having a valorization unit at each university, a relic of the 20th Century, but about a cross-valuation: an idea or a technology can be developed not only in one field where it is born, but in all the fields where it can create value (for example the laser).

6.8.2. *What funding?*

It is sufficient to inject money into the current system, which is inadequate for the economic reality, but it would be better to rethink it, so that it can foster innovation generating values, establish measurements to monitor the progress and require a tangible and intangible return on investment. Based on skills and requirements, in line with future needs, it will have every opportunity to succeed.

Some funds are necessary and impossible in the current system. An innovative inter-disciplinary project on a key issue for the new economy, and of excellent quality, sometimes has difficulty obtaining financing, due to a lack of an evaluation system, whose experts are mostly single domain; such an evaluation may lead to disappointing results, because each expert will seek excellence in their field. Experts are not all visionaries and therefore a breakthrough innovation can be misunderstood and rejected. Some of them, which are too solicited, may not take enough time to read a proposal carefully. Although selection criteria are generally quite clear, this transparency is not the same concerning the return to the team, which submitted a project and has not obtained financing. Preparing a proposal of the quality level required by the institutions takes one full-time month. Due to the dispersion of resources, many very good projects do not get any financing. Such projects would deserve a second chance – the opinion of a visionary on the importance of proposed works for the knowledge economy, European leadership and radical innovation.

Current selection criteria, notably those of the clusters, favors major groups with teams specialized in consortium building and proposal writing, leaving no chance

61. *Bistro* means “quick” in Russian. In this context, this is about the quick and collaborative transformation of ideas into values.

for SMEs, for which one month of preparation is a huge sacrifice. This is the same for small research teams, which are not part of the CNRS because of their size. Moreover, some calls for proposals are announced late compared to the deadline and the application documents are quite complex. There are excellent ideas outside clusters, but the current system does not give any chance for small businesses to succeed. This is the same for specialists.

An innovative small business, in order to grow, does not necessarily need funding, but rather it must be taken seriously in terms of confidence and its capabilities. Small businesses are rarely chosen as providers by institutions and major groups.

SMEs need financing for intelligent promotion and business intelligence actions, such as participation in a study mission, a speaker at an event that could lead to a leadership (trip, accommodation, registration fee), participation in strategic fairs (such as, for example, those organized by HKTC[62]), professional clubs or professional networks meetings abroad. This kind of financing is impossible in the current system, where most decision makers do not know how to estimate or measure the intangible.

The financing system under the form of a "one-stop service" with simplified tools and clear rules would be more efficient for applicants; an online expert system could guide them in the process. Pooling resources and reducing the number of actors and their selection as a function of their capacity to innovate in the knowledge economy would reduce the decision time for the allocation of funding, generate more budget for deserving projects and give a chance to disruptive innovation.

Evaluation at two levels: a brief presentation of the project followed by an interview for the chosen applicants would certainly be more attractive for small businesses. Selection criteria should favor innovation "from a problem" (Figure 6.4) or projects of applied research on key-themes of the new economy, including those presented by small businesses that are able to influence fundamental research.

Regarding the financing of education and particularly in the context of the university autonomy, it should be allocated to those who know how to innovate in the choice of the taught topics, in educational methods, in the ways of introducing entrepreneurship for the knowledge economy and in the way of managing leadership. Appropriate performances measurements and the recognition of feedback would ensure the proper use of these funds.

62. Hong Kong Trade Center.

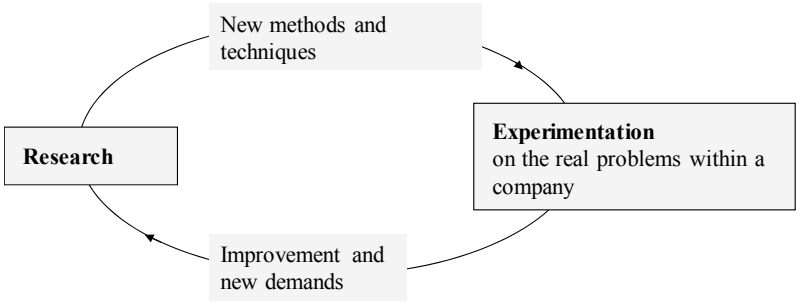

Figure 6.4. *Innovation from a problem*

Modern management training for university leaders would facilitate the transition from the "saving" logic to the logic of research of opportunities and contracts promoting the know-how of researchers.

6.8.3. *Innovating in evaluations and in measures of progress and impact*

The evaluation criteria of researchers has generated a multitude of scientific conferences, many of which are on the same or similar topics. To be well rated, everyone wants their own conference. Consequently, their quality and the number of participants are not always present. Moreover, the conference concept has not evolved for two centuries and, despite technological possibilities, is generating travel costs and results in an impact on the environment. Focusing on individual presentations, it does not facilitate the emergence of collective intelligence. Evaluation criteria could include these innovation aspects in conferences, such as their gathering around applicative subjects, new forms of lectures leaving more room for constructive discussion and creating a collective intelligence, as in innovation cafés or in the use of ICT (videoconference), in order to limit trips. However, a videoconference is more efficient if the participants already know each other (principle of trust).

Some assessors are not valuating invitations in prestigious conferences they do not know. Current evaluation criteria do not take into account the proposals of networking sessions for the European ICT event or the creation of synergies.

Other criteria could measure the imagination quotient (another IQ), creativity, adequacy of proposed projects to a strategy, relevance or articles written on strategic issues and prevail in the introduction of a disruptive innovation. To follow the logic of introduction of the corporate vocabulary, it would be interesting to initiate the teaching/research staff to individual and collective objective/performance

interviews, to the estimation of tangible and intangible ROI, to the business intelligence and to considering the feedback. The creation of a company by a researcher and its success should be part of the criteria.

Intellectual property protection (IPP) by filing a patent and the sale of licenses is changing. More and more patents are becoming collaborative – filing a patent just to have one point more in the evaluation does not contribute to the value-added if the patent is not immediately exploited. On the contrary, it leads to additional costs. The authors of the report [GOD 10] are recommending that "in some cases, to protect from copy, it is better not to file patents and to keep the secret of the procedure, as has been done by Coca-Cola".

Despite the efforts of valorization units, the sale of licenses remains marginal. Software is increasingly available in open sources[63] and valued by services, involving knowledge and skills. In this context, it would be more relevant to evaluate the number, the quality and the impact of the contracts obtained by researchers and linked to the use (or industrialization) of their software and their know-how.

6.8.4. *Using methods and techniques of knowledge processing*

In most cases, the capacities of computers are under-exploited. Professors, students and researchers should be aware of the existence of approaches and technologies for knowledge processing by computers, notably those of artificial intelligence and should learn to use them in their respective activities. In return, these techniques would evolve by adapting to requirements; new approaches may emerge. ICTs, amplified by the techniques of AI and embedded in an "intelligent assistant" would help researchers to be more inventive individually and collectively. The creation of a virtual knowledge space on the national, European and world level would facilitate creativity and connectivity, avoid wasting time reinventing that which already exists, would give an impetus to multi-disciplinary synergies and maximize the return on investment.

6.8.5. *Education and training*

In France, universities are preparing students to be researchers and not entrepreneurs. Given the fact that there are many universities in France, selective admission is minimal and the level of students is continuously decreasing. Moreover, some professors have not updated their lectures for a very long time.

63. http://sourceforge.net/.

Innovation in the system is imperative. The engaged reforms for the autonomy of universities comes under the autonomous business unit method of Alfred Sloan (1957); the staff is not prepared for this change. We are still far from the principles of the 5th generation, those of the knowledge society. More than ever, universities must learn to innovate and to teach this approach. One challenging option would be to make a leap frog and go directly towards the 5th generation, where exchanges between professors, students, researchers and companies and the intense use of ICT would replace the current functioning.

It would be wise to innovate, not only in universities but in the entire cycle of education – in the early detection of talents, replacing research for children with high potential[64] with research of children with high-potential, in the advice given to the youth for their future careers, in their education and in the training and recruitment of lecturers. There are some pioneers and exemplary efforts going on in the direction of a transformation of education, such as in the Baltic countries [DEC 05] and many others [FOR 09, INR 10, TAT 09]; these approaches could inspire others. Learning to think at the conceptual level, to work together rather than compete, in a win-win logic providing all participants with benefits and to complete push by pull [SEE 10], are only some aspects of a new education.

"Lifelong training" does not mean that teachers should constantly be in training. In the knowledge society, learning is a reflex – it has to be done in all circumstances, this consists of exchanges with their peers in other countries, with students, their parents, on the web, etc.

ICTs were introduced in e-learning in France in 2003 (University of Limoges, and then University of Paris 5) and plays a significant role in education and training. At the same time, they are the subject of research and innovation. Experiments carried out in artificial intelligence for computer supported education systems, on intelligent tutors and the introduction of immersion and serious games have increased the attractiveness of education [INR 10]. M-learning mixes various technologies and is from now on possible via smartphones. We still have to define the issues to be addressed by these tools in adequacy with the vision of the future society.

"Management knowledge economy" training for start-ups could be mandatory for the company creators following the technological transfer, in order to make them realize what are the skills needed to succeed and how to put them at the service of success, but it would be useful for all.

64. www.echa2010.eu/.

6.9. The future of research

In June 2008, the RETIS[65] network – federating all the technology parks, incubators and European centers of French innovative companies – published 10 proposals for the future of innovation:

– better detection of projects in laboratories;

– creating standard training "entrepreneur-studies" for students with the capacity to create new activities;

– creating a unique network with multiple-stop services, in order to favor the emergence of regional innovation networks, by federating on the territories all innovation actors and by encouraging them to enroll in a partnership approach;

– creating a brand enabling the recognition of the structures supporting innovative projects. Establishing a program of performance evaluation for the aforementioned structures;

– reinforcing the flexibility of accompanying structures;

– making private investment possible;

– opening up the worlds of research and business via a time-share contract;

– providing facilities for Business Angels;

– involving listed companies;

– developing the notion of corporate social responsibility of major accounts in relation to innovative small businesses.

This White Paper notes and suggests the improvement of the current organization. In order to better meet the challenges, pooling resources and simplifying current processes and organizations seem to be necessary stages. However, these are not the only conditions.

According to André Montaud, the director of CEEI[66], Thésame delegate for external relations [RET 08], "small businesses and laboratories are working differently. These two populations are not talking the same language and do not have the same notion of time. Indeed, a three to six months deadline for a company is equivalent to a three-year deadline for a laboratory." Many people are noticing a cultural gap and researchers do not have any results' obligations.

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65. www.retis-innovation.fr/.
66. European Center of Entreprises and Innovation (Centres Européens d'Entreprise et d'Innovation).

The Senate's report[67] from October 2009 [HOU 09] made an assessment of competitiveness clusters, suggesting improvements and long-term prospects. It recommended the creation of indicators of the impact on employment and the territorial attractiveness and a study on the motivation of members. "In the long-term, competitiveness clusters must be put at the service of a real industrial policy, defining strategic sectors for France. The integration of the clusters into the European or even the Euro-Mediterranean network is also a priority".

Competitiveness clusters need to be managed according to the rules of the knowledge economy, combining a long-term vision, translated into strategy, preferably dynamic and tactics. Currently, the vision is not exceeding the project duration. A common language built on the fly via collaborative projects, would facilitate the rapprochement of researchers and companies. Listening and looking for synergies in "innovation cafés" brainstorming, learning to estimate tangible and intangible benefits and calculating the impact on ecosystems are just a few points to be added to the RETIS list. The creation of the brand is strengthening competition and should be avoided. The relevance of organizations supporting innovation still remains to be detailed. Concerning the social corporate responsibility of major groups with respect to small businesses, it simply consists of trusting them as suppliers of solutions and ideas.

Performance measurements (and not observatories) using indicators for knowledge economy and feedback integration are essential to progress. Sharing benefits (and not state financings) is a condition for the sustainability of the system.

We are proposing to transform regional clusters into virtual clusters in the image of the KIZ.

Research has an ambitious task, namely meeting the challenges of the 21st Century. Authorities agree on five priorities: transportation, energy, Green IT, environment and health. Another inferred challenge is to put research at the service of job creation and territorial development from innovation. The mentioned fields influence each other and fields not mentioned, such as the food industry, well-being and economy: currently feeding almost 7 billion[68] people, preferably on a local scale, this industry deserves research other than on artificial manufacturing of food. Chinese researchers are working on the convergence and synergies between natural and artificial intelligences (plants, insects). A better understanding of nature would facilitate an intelligent and balanced development, in harmony with ecosystems, as has already been recommended by Seneca: "True wisdom consists of not departing from nature but in molding our conduct according to her laws and model."

67. www.senat.fr/rap/r09-040/r09-0401.pdf.
68. www.populationmondiale.com/.

Chapter 7

Innovation for Territorial Development

Only one emergency – the future.

Henri Salvador

7.1. The economic situation of regions and cities

Industrialization and rural depopulation have contributed to the desertification and devitalization of regions, which has been accelerated by globalization and decentralization, with businesses always looking for the cheapest workforce to face the increased competition. Industrial companies, even those offering knowledge intensive products, remain imprisoned in the "faster and cheaper" logic. In order to decrease operation costs, they relocate to countries where the workforce is cheaper or to get closer to customers in the opening markets. Consequently, they lay-off some people, as in France for example, or in some cases propose employee transfers to countries like Romania, India or elsewhere to gain the advantage of the lower local salaries. Industries in difficulty bankrupt their subcontractors, who at times have only one customer, considered as certain because it is a major group. The failure of very small businesses is increasing. All fields are involved. Other developed countries face the same difficulties.

In search of a reliable solution, authorities are focusing on training, which is a temporary issue for laid-off workers. Indeed, some of them have been working for 15 to 20 years in the only company of the region. Amongst the training courses proposed by "approved" training centers, most deal with redeployment and business creation via a traditional approach. A significant number of these training courses do

not offer any hiring prospect and do not prepare people for business management in the knowledge economy. Some centers would indeed need to innovate.

In the meantime, unemployment increases, while France lacks a highly-qualified workforce. This is a consequence of the predominant number of universities in comparison to professional schools and other apprenticeship centers. This is also the result of policies of education/training/employment/immigration and of the depreciation of craft and service professions. Many people searching for employment lack geographical and professional flexibility.

In the name of profitability, the ecosystems of the countryside and villages are slowly dying, whereas we could be creating income-generating activities from the local needs and resources, while cultivating the capacity to innovate and opening to the world. Farmers are producing at a loss, except those who have managed to adapt by selling their products directly to customers and by anticipating the "organic" wave. Moreover, climate conditions do not encourage them to continue on this path.

The landscape of small and average cities is changing – clothes and shoe shops (Chinese for most of them), opticians, drugstores and insurance companies are replacing grocery stores and other local services. Large cities continue to grow; by absorbing suburbs, they are transforming into megalopolises.

The discourse on the purchasing power, ubiquitous (and strongly polluting visually and intellectually) advertising generates and amplifies the desire to have more. Temptation by cheaper items *made somewhere else* and the "appearance and having more" trend are not helping the situation. At the same time, these trends are driving companies to relocate and are favoring the competition resulting from globalization, to finally enrich developing countries and impoverish France and other developed countries.

According to the economic newspaper Les Echos on 9 March 2010, amongst the 26 regions in France, only Ile-de-France and Rhône-Alpes are in good economic shape. The unemployment rate varies by about 8% in Brittany and in Limousin and 13% in Languedoc-Roussillon and Nord-Pas-de-Calais. Brittany lost 18,000 private salaried jobs in 2009. The industry sector continues to lose jobs, notably in the automotive and shipbuilding sectors. The only preserved industries – pharmaceutical, energy-water-waste sorting and food processing – resist in this crisis context. Other reports available on the INSEE website[1] are hardly more optimistic.

1. www.insee.fr. French National Institute of Statistics and Economic Studies.

To compare with other European countries, according to the Eurostat press released on the 18 February 2010 [EUR 10], the GDP per inhabitant varied between 26% of the average of the EU-27 in the region of Severozapaden in Bulgaria, 334% in the Inner London region, 169% in Ile-de-France and 172% in Prague.

The general revision of public policies launched in June 2008 [RGP 08] has the objective of modernizing administration, in order to make it simpler, more efficient and to reduce expenditures. The resulting reforms of territorial organization, aims among other things, to intensify the links between municipalities and the distribution of competencies between regions and departments[2]. "Our towns, in competition with European and international cities, must increase their attractiveness" [RGP 08]. What kind of attractiveness is this? What role must it play? Megalopolises are attracting people from all over the world, but this flow must be monitored, in order to attract the desired people, in accordance with the development strategy.

In conformity with the law of 23 February 2005, the implementation of "rural excellence clusters" began in 2006. Their objective is to support initiatives and innovative projects of rural areas, to strengthen the cooperation between the partners and to favor job creation.

The national land revitalization fund[3] allocates €180 million of unsecured loans to companies with 10 to 500 salaried employees, while creating or preserving jobs in the areas affected by economic redevelopments.

Launched on the 29 October 2009, the call for projects for the support of exemplary dynamics of SME clusters is equipped with a budget of €20 million for 2010 and 2011. This policy will be implemented by DATAR[4] with the support of the Secretary of State for Overseas Ministries of Industry, Agriculture, Defense, Environment, Health and Research, Oseo, Caisse des dépôts (French financial organization, part of the governmental institutions under the control of the Parliament) and local authorities. Its objective is the development of coherent national dynamics. The number of actors involved in this action seems excessive. A coherence between SME clusters and competitiveness clusters remains to be defined.

In the field, we can observe many initiatives, all with the objective to activate development, which many players wish to be long-lasting in a world of kaleidoscopic dynamics, where resources are depleting.

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2. www.gouvernement.fr/premier-ministre/la-reforme-des-collectivites-territoriales.
3. www.oseo.fr.
4. www.datar.gouv.fr/grappes_entreprises_798/.

French general councils are multiplying the meetings to brainstorming on the solutions – care services are one finding of these cogitations.

Regions wish to attract foreign companies and to export the local businesses. The most active and organized in this approach are the leaders: Paris region[5] and Rhône-Alpes. Hungry for employment, some are accepting any proposition, such as for example the installation of a Russian chemical factory in Dieppe, as long as it creates jobs and regardless of the environmental impact.

The memorandum of the Association of French Departments [ADF 10] reflects the difficulties of some to complete their budget – they must deal with the various and increasing social security contributions. It highlights the need to rethink the financing of diverse allowance, but the word innovation is lacking here.

On the website of this association, we find a section with a promising title – skills[6] – but its content is less promising. This website could however show its intellectual capital, which is a potential source of income for the departments. It would remain to put them into a dynamics of value creation. To reach this very coveted objective, a change in the way of thinking and acting is essential.

Whereas many initiatives are concentrated on business creation, very few of them have their lasting development and success as an objective. In the first ones, the APCE[7] website guides the people who plan to start a business in the creation process. A plethora of training courses in business creation are already proposed by Chambers of commerce and other organizations. As for funds, the website Aide-enterprises[8] mentions 3,839 regional and departmental systems. According to IFR-Finance[9], there are more than 6,000 different funding systems [COA 10]. IFR-Finance offers the possibility of searching for available funds as a function of the region and the area. As an example, a request for the funds available in Languedoc-Roussillon for "technological innovation-research-diffusion" gives, as a result, a list of about 15 territorial aids, 58 national aids and 110 European aids. We then need to click on each link to understand the conditions. The search for aids for an "ICT and information society" company gives the result of 1 regional aid, 7 national aids and 10 European aids. This system is an obvious example of good will, but is designed using the traditional computer science approach (arborescence and sequential search), whereas it could use a demand and offer matching (analogy engine) [MER 07b]. Despite the energy and knowledge invested in this development, it does

5. www.econovista.com.
6. www.reforme-territoriale-adf.fr/category/competences-representation-territoires/.
7. www.apce.com.
8. www.aides-entreprises.fr/.
9. www.ifr-finance.com.

not provide relevant assistance able also to save time for those concerned. With the research areas being predefined and set, it is impossible to find aid for a company working, for example, in the knowledge management field, associating technologies and management.

Calls for projects are a good way to propose funds for the development of a region[10] or a company. But SMEs do not have access to ministries' projects because of their size. The initiation of business clusters had the objective of strengthening their eligibility. There are a lot of proposed projects and a shortage of financing. Evaluation criteria, except maybe those of the PICF[11] program, are not evaluating the ability of the candidates to create an economic impact.

Innovation remains the watchword. The document: "Innovation and regional competitivity" [MAD 08] limits, like many others, regional innovation to universities, clusters and R&D of preferable large companies. The indicators to measure a progress remain traditional: the number of researchers, the number of patents, and the introduction of innovations of products and processes, directly resulting from R&D works carried out for or in the company. Its authors formulate a few propositions for regional innovation strategies, including to "de-administrate" innovation and put the company at the center of the process.

Many events and actions are organized by Chambers of Commerce, Oseo, MEDEF (Movement of the French enterprises), by the professionals of special events or following the mandatory dissemination actions of European projects. These initiatives do not always help small businesses to develop by innovation. Conferences, assizes, summer schools and other presentations are organized to address trendy topics, such as business intelligence, innovation, sustainable development, management of human capital, Internet services, social networks, etc. During these events, institutional actors and consultants for major groups present methods and tools, which are often not adapted to the needs of the local SME audience. They are rarely invited to testify in this audience and most of these actions are seeking to promote their organizers rather than sharing exemplary practices of the SMEs.

All these initiatives aimed at favoring the development of small and very small businesses, are not taking into account their feedback on the proposed aids and the procedures to apply for it. As in the case of software editors, nobody cares about their needs. Beneficiaries of funds are just asked to testify, in order to promote the benefactor institution via its website.

10. http://cordis.europa.eu/fp7/capacities/regions-knowledge_en.html.
11. Programme Inter Carnot-Fraunhofer.

The introduction of the "auto-entrepreneur"[12] status made the creation of more than 300,000 individual enterprises in 2009 possible. But how many amongst them will develop?

Despite the incentives to hire, obstacles to development remain. They are relative to the labor burden and to the constraints of the permanent employment status, compelling companies to keep their employees till their retirement, in an uncertain economic context.

In the field, we can observe networking initiatives, which could be copied by the most courageous people or organizations, such as the association of creative women[13] and men in Troyes, who meet regularly in order to share experiences, learn together and generate synergies between companies. Let us also note that they are two separate associations, while cross-pollination could come from complementarities, if they were to work together more often. The French national institute of local development[14] (INDL) also proposes events and training courses with the objective of experience sharing. These experiences and initiatives could be a source of inspiration, under the condition that they are registered in a national or even international open base of experience.

Since 2003, the OPEN DAY[15], initiated by the commissioner Danuta Hübner has become an annual key event at which cities and regions showcase their capacity for creating growth and jobs, implementing European Union cohesion policy, and prove the importance of the local level for good European governance. These open days are taking place in Brussels.

Knowledge regions, introduced by the 2003 Entovation Network meeting in Helsinki[16], are part of the European 7th Framework Program[17], which aims to create networks of exemplary territories.

There are many initiatives around the cities searching for attractiveness – we have digital, green and connected cities[18], knowledge cities and territories of the future[19]. The town of Issy-les-Moulineaux is an example to be followed. The

12. This new form of firms was created recently in France to encourage individuals to start a business. The taxes are due only when the businesses are successful.
13. www.creezcommeelles.com/.
14. www.indl.fr/.
15. http://ec.europa.eu/regional_policy/conferences/od2011/index.cfm.
16. http://cordis.europa.eu/fp7/capacities/regions-knowledge_en.html.
17. http://cordis.europa.eu/fp7/capacities/regions-knowledge_en.html.
18. www.acidd.com/UPLOAD/rubrique/pages/157/157_rubrique.php.
19. www.territories-of-tomorrow.org/.

proximity of Paris influences its attractiveness – local authorities were able to draw many leader businesses there.

The *Most Admired Knowledge City Award*[20] has recently been rewarding the knowledge cities selected by a jury of world experts.

As in the case of technological innovation, seen as a lever of growth, we can observe a multiplication of actions of the State, regions and associations, a scattering of the means and a gap between quick fixes, allocated funds and a long-term strategy.

Faced with the crisis, most of the companies and individuals remain locked in the logic of the industrial era when it comes to getting grants, a civil servant position, finding employment, preserving fringe benefits, or going on strike to be heard. They rely on the State to improve the situation. This attitude prevents them from seeing opportunities because, contrary to nature, they lack the adaptability and mental flexibility facilities, that schools and most training are not preparing them for.

The vast majority of players are dreaming of a decrease in unemployment, economic growth and job creation. The fulfillment of this dream requires, more than ever, the capacity to innovate – in the way of managing talents, supporting companies, evaluating projects, giving a chance to small businesses, opportunity hunting, accelerating the flowering of talents and turning them into values. Calls for projects are strengthening a competition logic, whereas a search for complementarities would be more profitable. A knowledge management approach at the national and regional level (holonomy) would allow, amongst other things, a collaborative detection and an intense exploitation of opportunities, under the condition of relying on a flow of knowledge using the best technology.

7.2. Strategies and actions in favor of regional development

With the Lisbon strategy developed in March 2000, European leaders gave a commitment to the European Union to become, by 2010, "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion, with respect of the environment" [EC 00]. This strategy translated into a series of global but interdependent reforms. The idea being that the actions led by one of the state members would be all the more effective, especially if the other member states acted together. But the absence of the fundamental principles of the knowledge economy

20. www.worldcapitalinstitute.org.

[AMI 04], such as the organization of the global process, the systematic measures of benefits (tangible and intangible), the collaborative dynamics, etc., have led to failure. Besides the mid-term assessment [KOK 04], no feedback has been carried out in order to readjust this strategy as a function of its real application in the field. The main angles of the new strategy are now known [EC 10a]. Each country should readjust its own strategy and correct the current actions.

In parallel with competitiveness clusters[21], the implementation of rural excellence clusters aims to support innovative initiatives and projects of rural territories, to strengthen the cooperation between the partners and to favor job creation. Currently, over 500 clusters are labeled[22], covering four themes: the promotion of natural, cultural and tourist resources, the valuation and management of bio-resources; the services and the hosting of new populations; the technological excellence, for industrial, agricultural and craft productions and local services. The second call for project challenges were as follows: to increase the economic capacity of rural territories and meet the needs of the population in terms of services.

The reforms initiated by the French government in 2008 are translated into structural groupings (example: DGCIS[23]) and give more autonomy to the regions. Let us note that the General Directorate for Research and Innovation is attached to the Ministry of Higher Education and Research, whereas innovation concerns the entire population – Quebec has the Ministry of Economic Development, Innovation and Exportation[24]. The reform of territorial collectivities aims to "simplify and clarify the institutional landscape in order to durably establish decentralization, suppress structures which have become obsolete or redundant, to complete the necessary groupings […], to closely articulate the intervention of territorial collectivities, to clarify the exercise of skills between the different levels of local administration. It is then necessary to adapt the territorial organization to todays challenges. In 2008 almost 80% of the 64 million French population lived in towns, compared to 50% in 1936. The development of large urban complexes due to the concentration of populations and habitats, increasingly requires integrated overall policies. It is thus necessary to reduce the gap that has settled in urban areas between the needs of the population and the mode of administration of the territory, which is no longer adapted". This is the purpose of creating megalopolises, replacing France's *Grandes Agglomerations*[25] (specific name), to conform with European and

21. www.industrie.gouv.fr/poles-competitivite/brochure.pdf.

22. http://agriculture.gouv.fr/sections/thematiques/vie-en-milieu-rural/developpement-des-territoires-ruraux/poles-d-excellence-rurale.

23. Directorate General of the Competitiveness, Industry and Services.

24. www.mdeie.gouv.qc.ca/.

25. An integrated urban community encompassing a big town and the surrounding area, for example, http://www.grandlyon.com/.

other international counterparts who use the name megalopolises. The bill also seeks to answer the specific needs of the rural world [HOR 09].

The French national fund of territory revitalization (Fonds national de revitalisation des territoires, FNRT) was created following the announcement by President, Sarkozy during his visit to the Metaleurop site in Noyelles-Godault (Pas-de-Calais), in February 2008. The first strategic policy committee met on the 9 April 2009.

This fund completes the current economic revitalization facility helping the territories most affected by company restructuring and those which either do not, or insufficiently, benefit from the funds given under the revitalization convention. Financed by the Ministry of Economy, Industry and Employment and by the "Caisse des dépôts et consignations", this fund is managed by Oseo and co-piloted by the Ministry of Rural Area and Regional Planning and by the Ministry of Economy.

The implementation of the FNRT in a given territory can be summarized in three stages:

– the department prefect solicits the national monitoring committee of the FNRT with the prospect of obtaining eligibility to fund a territory subjected to economic restructurings which do not lead to revitalization;

– the FNRT national monitoring committee decides on the eligibility of the request. It gives the selected territory a target-budget of loans, as a function of the extent of disasters and the concerned region's economy;

– the local monitoring committee, which includes the territorial services of the State (including the regional management of companies, competition, work and employment), Oseo and the "Caisse des depots", is gathered together and presided over by the department prefect. It is in charge of collecting the projects of the various companies.

The companies eligible for this unsecured loan are those creating between 10 and 500 jobs in the eligible territories[26]. As an example, we can find amongst the companies which benefited from this system, Vertaris (paper recycling) in Voreppe (38,400), FCI Industry (foundry) in Vierzon (18,105), Matelsom (mattresses) in Niort (79,000), Benne (fabrication of conveyors) in Castres (81,100).

The first call for proposals of business clusters was launched on October 29 2009. Its objective was to favor the grouping of very small and small businesses in the same field of activities. When it is relevant, they join major companies; they associate with or integrate actors of training, employment and skill management,

26. www.datar.gouv.fr/IMG/Fichiers/MUTATION/com_FNRT_0911.pdf.

innovation and research, depending on contexts and initiatives. They have a "hard core" anchored on a territory allowing closeness connections between their members and with the concerned company network. They provide services to the companies that can cover all their requirements, from pooling or collective actions, notably on innovation in all its forms, employment and skills, work organization, international development, through to communication and environmental aspects. They have their own governance structure, where CEOs play a leading role, with a collectively developed strategy [DIA 09].

Since Fall 2010, seven workgroups, bringing together over 200 researchers, academics, experts and territorial actors, have been involved in the prospective approach, "Territoires 2040", which was designed and piloted by Datar. The ambition of this program is to imagine the possible future of the country and to identify the major strategic issues and the policies that will be deployed to meet them. The reflections of seven work groups are about:

– the network of French major cities in the world-economy;

– metro integrated systems, territorial development levers;

– the doors of France and territorial systems of large flow;

– industrial areas, territories with a productive economic base;

– intermediate cities and their rural environment as close territories;

– territories with a residential and touristic economic base;

– areas of low population density, with agricultural and ecological resources.

The first day of return of expert work took place on June 14, 2011. The "Globalization, metropolization and industrial dynamics: in prospective areas" document will be shortly on line (http://territoires2040.datar.gouv.fr/).

Many boards, discussions and reports are devoted to the development and revitalization of territories. It is sad that the main local players, small and micro businesses, with the potential for value and certainly ideas generation have such little involvement in the development of these policies. Their involvement would bring more relevance to the simplification and modernization of the procedures and would encourage them to participate and even to become the driving force of territorial innovation.

7.2.1. *Industry*

Because of the long industrial tradition in France, innovation is first associated with industry. But the fact is that "since 2000, France has lost 500,000 jobs in the

industrial sector"[27], the deficit of the industrial trade balance is widening, the share of industry in total value-added fell to 16% against 30% in Germany, investments are dropping and, under the effect of the crisis, industrial production has collapsed. This is confirmed in the CPCI report[28] [CPC 09].

"Growth" was the watch word of the event "Industries: an ambition for Europe" which took place on the 10 July 2008 in Paris. The European industry must meet four challenges, the first of which is *to rethink the industrial policy*, in order to attract industry players [EUR 08].

The second mentioned challenge is *training* – which is supposed to "alleviate the problems of recruitment and creation of industrial jobs, due mostly to the high labor burden. Faced with the urgent need for qualified personnel, the European Union should act in terms of training, which is essential to enable companies to develop new services and to propose customized solutions". Investing in training, while there is no inventory of the existing skills, may be a useless investment. There is a plethora of training courses, so how to choose a really useful one? As specified in Chapter 6, there are too many graduates in France and Europe and educational programs and available training courses do not necessarily correspond to the labor markets needs. There are too many universities and they do not necessarily produce marketable skills. Their level is decreasing and because of a lack of financing, the training cycle is reducing.

The third challenge is *innovation*, which is considered to be the only means of maintaining technological *leadership* and offsetting the costs of companies operating in Europe. To stimulate innovation, authors are proposing moving towards the niche markets in which companies are competitive, or strengthening public-private partnerships with tax incentives.

Finally, the fourth challenge concerns the *environment*, where the threat is also an opportunity [EUR 08, GUI 08].

The authors of this study make assessments and express wishes, but they do not give the formulas for success.

It is obvious that the labor burden reduction could encourage companies to hire people, but this is not the only condition. This is about giving companies *flexibility in human resources management and notably a possibility to "rent" skills between companies or to have multi-card positions. Skill management could be done at a regional level and not at a company level*.

27. www.elysee.fr/president/les-dossiers/economie/politique-industrielle/industrie/marignane-4-mars-2010/conclusion-des-etats-generaux-de-l-industrie.7992.html.
28. French permanent commission for the industry.

As for innovation, Table 7.1 mentions several examples of activities to be developed to face globalization. They are not all innovative and rely for the most part on care services. A few of the proposals are connected to industrial activities.

Scope of action	Examples of industries
Capacities and requirements of the knowledge society	R&D and high-tech technology Expert services for companies and individuals: education for the knowledge society (alternative to the "job for life") Distribution services in addition to e-commerce Intelligent buildings and houses Innovative financial services: venture capital, recognition of the value of intangible products, associated with irregular incomes and to the proliferation of small businesses.
Quality of life	Entertainment industries Environmental industries: air and water quality, renewable energies, waste treatment Creative industries Health industry and services, prevention and care, alternative medicine Beauty, sport, body care, sports and nutrition Housing: architecture, garden design, interior design (offices and housing) Specific tourism for French and foreigners Food: specialized magazines, gourmet restaurants, home delivery, etc.
Growth and ageing of the population	Care services for the elderly, leisure, Care services, Services for companies (small and very small businesses) Urban building and renovation Infrastructures for the extension, improvement and maintenance

Table 7.1. *Activities to be promoted in developed countries facing globalization [EUR 08]*

This table is a reference model for territorial authorities.

The authors of this table list the possibilities, but they do not ask the essential question – who is going to pay and who is going to win money from these activities in France, in order to contribute to the growth? The link to the industry sector is not always there.

Proposing services to people with increasingly less money or services paid by taxes, will not necessarily contribute to organic growth. It can however reduce unemployment by the creation of activities.

The authors of this table associate the knowledge economy with expert services and training. Most of these services use information and communication technologies and high value-added applications, such as knowledge-based systems which can be developed in France. A prior verification of the capacity to intelligently communicate without disclosing any strategic information in the framework of export services, turns out to be essential if we do not want to lose our jobs, our ideas and our know-how.

For example, our experts are training abroad, our researchers are hosting visitors or applicants for technological transfer and are very proud to showcase technological prowess. The clever know-how to communicate should be part of training courses. Some American experts are excelling in this art.

This table is not proposing innovative products or services resulting from a cognitive flexibility and from cross-pollination – those able to create radical innovations, new markets and new industries or able to revitalize industries in crisis. The "sustainable" trend would be useful there.

Another innovation would be for example to propose specific products and services, not only for the elderly, tourists or immigrants, but also for business travelers, conferences participants, Erasmus exchange professors, etc. For example, systematically proposing, in partnership with tourist offices, a tour offer for those going to scientific and professional conferences would enable them to combine business with pleasure and promote values or even create synergies. A country buffet or a "discovery" evening could favorably replace the sempiternal gala evening and make them discover local resources.

7.2.2. *Building the France of tomorrow*

We will help our sectors of excellence to prepare the future, declared the President of the French Republic on the 14 December 2009, by presenting the priorities of the investments for the future. Amongst the key sectors, we find aeronautics, aerospace, automotive, but also railway and shipbuilding; building batteries providing several hundred kilometers of autonomy to electric vehicles; constructing the planes of the future, which are to be quieter and have only half the CO_2 emissions; building a thrifty ship, that one day will equip all large commercial fleets of the world; preparing now Ariane 6. Since the share of French exports in the "Euro" zone has decreased by 25% over the last 10 years, this consists of restoring

the French competitiveness, to enable the emergence of new champions, whose size and reactivity are adapted to the conquest of new markets. This incremental innovation is important for short-term incomes, but France also has the potential for inventing new excellence fields.

In March 2010, in the framework of the industry forum, President Nicolas Sarkozy announced in Marignane a series of measures to stop "massive deindustrialization", which began in 2000. "France must remain a major industrial nation. The French government set a target to have increased its industrial production by 25% by 2015. Besides the €500 million worth of loans, the national loan will help to implement a policy of sectors (€300 million euros will be invested in it) and a relocation allowance for €200 million. To favor the emergence of strategic sectors and evolve the relationships between the industrial champions and small businesses, the government will set up a mediator of subcontracting in charge of the dissemination of best practices and their implementation".

The State will review its role as a shareholder in the major industrial companies. It will now be represented by at least two administrations: the "Agence des participations de l'Etat" (APE – agency for a state interest) and the Ministry of Industry or of another involved sector. "I wish for the management of all these major companies to make exchanges twice a year with their main shareholder on strategy, investments and results. These are not simple interviews, but thorough working meetings at the level of ministers, which are represented on the board of directors and CEOs of companies" (President Nicolas Sarkozy).

The government has decided to triple the research tax credit, Oseo-ISI[29], FSI SME funds[30] and quasi-equity of Oseo, ISF-SME[31]. €400 million will be allocated to a fund for seed financing and will be managed by the "Fonds stratégique d'investissement" (FSI – strategic investment fund). Moreover, €100 million will be allocated to a fund devoted to social and solidarity entrepreneurship. These two funds can be supplemented by private or public partners wishing to join their action. Finally, €500 million will be invested in the field of major projects led by competitiveness clusters. A specific budget of €1 billion will be reserved for the implementation of measures decided during the industry forum.

Half the budget will be dedicated to green subsidized loans, granted to the companies investing in order to improve their competitiveness via the improvement of their environmental performance; €200 million of refundable advances in support

29. Industrial strategic innovation grouping together at least two companies on a collaborative project.

30. Strategic investment fund, to strengthen the small businesses stockholder equities.

31. Participation of those liable to the French solidarity tax on wealth (supertax) in the financing of small businesses via tax planning firms.

for the reindustrialization, in order to encourage companies to notably relocate their production and their R&D back to France; and €100 million of seed money for the start-up incubated in French universities and "Grandes écoles" (French elite higher education institutes).

These three measures are thus part of the first wave of the ten conventions validated in the framework of the national loan, which is making an operational implementation of the funds possible by July 2010, in conformity with the commitment of the Minister of Industry Christian Estrosi.

Press releases from Bercy (Ministry of the Economy) from the 21 April 2010 announced that €3 million were shared between the employment area of Montmorillon-Sud Vienne (€1 million) and the territory of the urban community of Le Creusot Montceau-les-Mines (€2 million). An additional allowance was given to two previously labeled territories: the territory of Cornouaille with €500,000 euros and the territory of Morlaix. These €3 million can be added to the €72 million euros already allocated, i.e. €75 million euros of intervention capacity at the service of the economic revitalization of 47 labeled territories.

This strategic vision does not lack ambition, but a projection into the future is missing – what could the landscape of France be in 10 years? Is it sufficient to make a law, distribute money and control expenditures in order to reach the sought after objective? Asking the right questions is essential to innovate [BRO 09]. What added-value can France produce from its know-how? How can this be repositioned in comparison to offers from emerging countries? What are the innovative and non-polluting industries able to revitalize territories?

The Industrie 2020 platform presented during the Industry 2010 show has gathered together demonstrations resulting from work carried out under the dual banner of the Carnot institutes and of the Intercut consortium, with the CTDEC[32], Armines[33], Arts & Métiers[34], Ensam[35] and Enise[36] as participants. Amongst the demonstrations: new strategies for machining, high-speed vibratory drilling, simulation of mechanic assemblies and collaborative robotics. Some results are already industrializing. Hope remains that this industrializing process will also be carried out in the regions.

32. Technical center of the screw-machining industry, http://www.ctdec.com.

33. Network of reaserch centers of engineering schools, http://www.armines.net/?Set Lang=uk.

34. School of Arts and Crafts (A&M), http://ecoleartsetmetiers.com.

35. Engineering School, Paris, http://www.ensam.fr/en/.

36. Engineering School Saint Etienne, http://www.enise.fr/.

There are other industries and areas with the capacity to generate values, but these are not necessarily trendy, often under-estimated and forgotten by the medias. France could make better use of its excellent research in artificial intelligence by integrating it into consumer applications. Experience and skills in the development of knowledge-based system could be useful, amongst other things, for the creation of bases of "best practices", for knowledge kiosks and decision support systems in all domains, including gastronomy and tourism.

The latter deserve a more global and relevant approach in comparison to the expectations of business tourists. Ecotourism, economic and intelligent tourism certainly have a significant role to play in a global territory revitalization approach.

7.3. Some initiatives in favor of territorial growth by innovation

It is impossible to think about the economic growth without innovation[37]. The main competitiveness factor for companies and a source of well-being for citizens, in terms of quality of life and environment, innovation enables both increased productivity and added-value. For regional businesses, this is the opportunity for new markets. This article reveals several areas: creation of a regional innovation network, relying on scientific sectors, such as the environment, agronomy, water, health and information and communication technologies, in order to propose technical resource centers to companies.

The recently created Regional Development Agency has the objective of transforming ideas into projects and jobs. In its roadmap, there are infrastructures, sustainable development, university campus development plans, tourism, the elderly well-being and finally cultural heritage and sport. However, this document does not contain information on knowledge and on energizing regional skills, nor on the way of measuring the impact of the above actions on local jobs and sustainable development. We can still observe too many unnecessary trips by Parisian or even Californian specialists, because there is no overall visibility of the proximity skills.

Similar policies are discussed and proposed in other regions, without however integrating the principles of management into the knowledge economy or fixing objectives concerning the impact and the way of measuring progress. Despite the pervasiveness of ICTs, they are poorly used in most cases or are promoting local leaders rather than local intangible capital. No site is publishing any map of its "brains", which is an essential element in competitiveness and attractiveness.

37. Roadmap file 2010-2014, Living in Languedoc Roussillon, May 2010.

The various institutional actors, associations and businesses are organizing events aiming at bringing together stakeholders around issues such as innovation, sustainable development or technological approaches. These themes are more and more integrated into professional events. A consultation on a national and even a European level could optimize means, including time, which has become a precious commodity.

Contests for innovation are in vogue. They bring a surplus value to the image of the organizing firm and require a lesser investment than traditional advertising, at the same time as opening access to ideas provided by outside participants.

7.3.1. *Innovation contests*

For a few years, innovation contests inside companies have the objective of involving employees in the dynamics of innovation. In general, this is participative innovation. Other competitions are a means of becoming known or restoring an image. Still others are a source of ideas to be exploited by the organizing company.

The Accor group is one of the pioneers of participative innovation. Their initiative Innovaccor[38], created at the beginning of the 2000s, seeks to involve more than 150,000 employees in the world in the innovation process. This is one of the key-values of the company. Yearly awards are allocated in several categories, at the regional, national and global level. This is a private competition, in which customers cannot take part.

EIFFAGE organizes its innovation trophies[39] every two years. They are open to all employees of the group, to fellows and executives and award the most innovative initiatives in five fields relating to all the activities of the group: core business, construction of highway and buildings, energy and metal constructions; social initiative environment; support function and field technical improvement. They have the ambition of promoting innovation and developing solutions and techniques, commercial offers and efficient and innovative behaviors. An EIFFAGE grand prize awards the most innovative and transversal project. These trophies are part of the process of knowledge capitalization and innovation on the scale of all the professions of the group. They value and award creativity and mobilize all the subsidiaries in France and Europe, in order to pool know-how and to develop an efficient internal innovation network.

38. https://www.innovaccor.com.
39. www.eiffage.com/cms/developpement_durable/engagements/trophees_innovation.html.

CFIA ("Carrefour des fournisseurs de l'industrie agroalimentaire", suppliers of the food industry) proposed innovation trophies[40] since 2008. They award products, equipment and services of the companies exhibited during the fair and falling into four categories: quality, hygiene, service; equipment and processes; ingredients and intermediary food products (IFP); conditioning and packaging.

Batiactu trophies[41] award three categories of innovation: new building (completed or contributed to an innovating construction of collective housing, a house, or a commercial building), renovation (renovation of a building and implementation of innovative solutions) and Internet (exemplary website). Organizers also offer a special "young company" prize.

The sixth Innovation trophy[42] awards to place in 2010. Organized by Syntec Informatique and Orange Business Services in partnership with La Tribune[43], they are dedicated to computer uses, to applications and to business communication solutions. This consists of developing new markets and favoring economic growth through the introduction of computer technologies.

INPI trophies[44] distinguish small businesses and industries for their ability to grow by using industrial property as a lever. They also award research centers and laboratories for their capacity to promote their research through industrial property. Selection criteria include all the components of an industrial property strategy at the service of the economic development of the company: technological and competitiveness watch, securities deposit of industrial property (patents, trademarks, designs and models, etc.), patent management and exploitation, fight against counterfeiting, etc.

Atos innovation trophies[45] have the objective of putting innovation at the service of professions and their adjustment to regulatory, technological, environmental and social evolutions.

The ambition award[46] was created in 2006 at the initiative of the Palatine bank, which is associated with La Tribune. BFM TV and Radio, the HEC group and CCI[47] then joined the project as partners. France is divided into five application regions.

40. www.cfiaexpo.com/fr/cfia-rennes/trophees-de-linnovation/trophees-de-linnovation-2010.html.
41. http://trophees.batiactu.com.
42. http://trophees-innovation.fr.
43. French business and financial newspaper.
44. www.inpi.fr/fr/l-inpi/trophees-inpi-de-l-innovation.html.
45. www.atosworldline.fr/Fr/Innovations/trophees.htm.
46. www.prixambition.fr.
47. Chamber of Commerce and Industry.

The files are studied by a regional jury selecting the regional winners in each of the three categories: growth, international and sustainable development. The regional winners' applications are then submitted to a second study stage by the national jury designating the national winners in each category and also giving the special jury prize. These juries are composed of service and industry entrepreneurs, politicians and professional organization representatives of companies, expert economists, insurance agents and managers of the Palatine bank.

In order to support and encourage innovative start-ups, the city of Paris is launching the Grand Prize for innovation[48] and offering €15,000 in the following categories: digital, health/biotech, design, eco-innovation and innovative services. Are eligible individuals residing in Ile-de-France presenting a project of business creation, as well as companies younger than 5 years based in Ile-de-France. The deadline for submitting applications was set to the 2 July 2010, while the information on this context was published on June 28!

The contest remains a promotion tool of the organizers, as well as of awarded individuals, companies and regions. It is strengthening the competition between applicants, but can also lead to synergies and common projects.

7.3.2. *Other initiatives*

The "International conversations on land settlement and development" organized by the DATAR in partnership with the "Caisse des depots" and the OECD in 2003, obtained some knowledge on the approaches and operational tools for land settlement, which were used in Germany, Switzerland, United Kingdom, Italy, Norway, Sweden and Korea. The role of companies in the territory was also addressed. The presented best practices and good advice has no significant influence on the improvement of the economic situation. Companies are closing, relocating, changing professions by following market evolutions or saying they are getting closer to customers. Economic rigidity, paralyzed by social benefits is impeding progress.

Almost all the regions are making efforts to develop. Amongst the most common initiatives, we can find the accompaniment of project creators, meetings of local companies around a presentation on a trendy subject, such as business intelligence, intellectual capital, sustainable development and more recently knowledge capitalization. These initiatives, institutional and private, are organized by associations or by motivated individuals or those searching for valuation. The Local

48. www.incubateurparisdev.com/qui-sommes-nous-/notre-actualite/grands-prix-de-linnovation-2010.

Chamber of Commerce provides business creation training. Each region has at least one incubator and one business club. Almost all of them have a competitiveness cluster. These resources are not equally distributed and the region dynamics rely on the motivation of individuals and on their capacity to involve the local players.

Thus, the Grand Dole[49] is showing a strategy and ambition to develop through innovation, via the creation of the Innovia cluster, focusing on sustainable development technologies. It is taking the initiative of developing new sectors by the promotion of local resources, such as wood and hemp. It is the instigator and participates in regional and national networks and develops collaborations with universities. Its slogan is "to undertake and succeed". In this context, "creation breakfasts" are held regularly. Their economic newsletter disseminates good news, but it is impossible to know how these initiatives are translated into economic success, while respecting the principles of the balanced development.

We need to mention Nord-Pas de Calais amongst the exemplary regions in terms of vitality. The association "Nord France Innovation Développement" (NFID) federates the regional actors of technological development and innovation. Their platform "I innovate in Nord-Pas de Calais"[50] gathers more than 70 organizations supporting innovation and the promotion of research in the region. Members lay their expertise at the disposal of companies and researchers to accompany innovative projects. An international innovation week was organized in June 2010.

The DRAAF[51] and the regional council of Burgundy launched a call for proposals for the creation and animation of rural networks in Burgundy[52].

The scientific journal (http://developpementdurable.revues.org/) Sustainable Development and Territories (*Développement Durable et Territoires*) offers an interdisciplinary approach to sustainable development across the territory. Coming from the "Sustainable development and vulnerable areas" network, and gathering about 20 researchers in human and social sciences from different universities of the regions, this journal hopes to contribute to the reflection on the forms and finalities of the development logics in contemporary societies.

A significant number of territorial innovation examples are quoted in the report "Créativité et innovation dans les territoires" (creativity and innovation in the territories) [GOD 10]. This collection is in part the brainchild of Marc Giget, inviting innovators to his classes at the CNAM. He is also an entrepreneur – he

49. www.grand-dole.fr/entreprendre/developpement-economique.htm.
50. www.jinnove.com/.
51. Direction régionale de l'alimentation, de l'agriculture et de la forêt (French regional agency of the food, agriculture and forest).
52. www.projetdeterritoire.com.

founded and leads the club of innovation managers of major groups. The authors of this report wish to "make known local actions, all the innovations produced by inhabitants, organizations and businesses of a given territory, in order to give rise to exemplarity and to create a climate open to innovations. Developing feedback on disappointing innovations and establish a center for failure analysis". To materialize this wish, the authors could, as part of their activities at CNAM, offer students a website project on innovative practices, using intelligent techniques, allowing them to act more efficiently than when exploring a pdf file. Such projects could be carried out in partnership with master's students of "Feedback engineering" from the Hubert Curien[53] school in Bourges.

The quoted report notes that "the champions of the French performance abroad are often family governance businesses, born in enclave or outlying territories (Limoges for Legrand, Clermont-Ferrand for Michelin, Lille for Auchan, Marseille for Sodexo, etc.), from innovative initiatives taken by enterprising creators on several generations, long-term strategy and entrepreneurship virus" [GOD 10]. It remains to be found how this virus is caught and how to cause an "epidemic". Note that Legrand and Michelin are cultivating daily innovation, which is definitely influencing their success.

The call for project "ICT and SMEs 2015"[54] is amongst the newest governmental initiatives influencing territorial development. It aims to improve the performance and competitiveness of small businesses through better use of ICTs. In partnership with the MEDEF, this program will support structuring projects of sectors to progress in the development of electronic exchanges, as well as projects led by business groups aiming to implement paperless exchange solutions, logistics processes between customers and suppliers, traceability approaches, in order to meet the increasing safety requirements and the implementation of the collaborative design or e-design processes, in order to reduce design errors and to develop eco-design. Integration of all the mentioned applications in a flow of knowledge would strengthen the efficiency of the small businesses again, and would facilitate opportunity hunting.

Other initiatives and events such as the "Mayors and Local Authorities Trade Show", the "Days of Digital Cities", the seminars of the "Territories of the Future" all tackle the subject of territorial development. The first included an innovation contest in 2011.

53. www.ecole-curien.fr/.

54. www.telecom.gouv.fr/rubriques-menu/soutiens-financements/programmesNationaux/programme-tic-pme-2015.

The Open Days[55], proposed by Commissioner Danuta Hübner in October 2006, have launched a vast European program of 400 projects, endowed with an investment of €500 million. It is difficult to know the assessment of actions and the return on investment. The 2009 edition brought together more than 7,000 politicians, professionals and representatives of businesses, the civil society and the academic world, coming from Europe, but also from the USA, China and India. They participated in 125 seminars, traded on the stimulation of economic, the fight against recession and long-term challenges related to climate change. Some 230 local initiatives were launched in the member states under the Open Days banner. This event takes place in Brussels, however its mobility would certainly be profitable to discussions on the places of practices.

The "South" program[56] aims at a territorial cooperation of the south-west European space and supports the regional development through the co-financing of transnational projects via the ERDF (European regional development fund). Public actors of the Spanish, French, Portuguese and English (Gibraltar) regions can contribute to the growth and sustainable development of this south-western European space by developing transnational cooperation projects in matters of innovation, environment, new information technologies and sustainable urban development. We are hoping that these regional actors will contribute together so that the European southwest reaches the EU strategies in terms of growth, employment and sustainable development.

To our knowledge, there are no documents accessible to citizens providing visibility of all actions and stating their evaluation. Their impact seems to rarely be measured in the terms stated by the objectives.

7.4. Removing obstacles to development

These are obstacles easier or more difficult to surmount. A lack of visibility and appreciation of the efforts is part of the first category. One of the remedies could be an intense use of ICTs. This is not sufficient, but should be mentioned. Communicating effectively is an art, in which France still has to progress. While companies begin to understand the amplifying effect of e-commerce, most of the regions are using their websites to promote their historical heritage, but do not think to make all the components guaranteeing the good health of a region visible, such as companies, schools, specificities or professional links with the world. Website sponsors and designers very rarely indicate their location on the map; some websites are only in French (or another language).

55. http://ec.europa.eu/regional_policy/conferences/od2010/index.cfm.
56. www.interreg-sudoe.eu.

Ile-de-France economic development agency exposes the values of the Paris region[57] with the objective of attracting foreign companies. Almost all the assets are presented in the brochure *Paris Region from Your Point of View* [AGE 10]. A brief description of the tax system is the only element missing. The same cannot be said about advertising from other regions. Some do not have any presentation in English or in another language, some links are not working, the website is not regularly updated and is not visible on social networks. While we offer an increasing number of virtual monument visits, why do we not offer the possibility to virtually visit shops, companies or schools giving original syllabi. In this movement, those in charge of promotion often forget that to attract companies, they need local customers for their products and services. No brochure or website (amongst those we had at our disposal) mentioned this asset.

Valuing the actors is essential for their motivation. A recognition of skills and actions generating values, has much more impact than a fruitless work promotion, following a programmed advance logic.

In the first category, we can also add sales methods. Traditional models, where we pay for the product or service are difficult to adapt to the knowledge economy. New economic models are rather restricted, while they are an excellent playground for experimentations. The model of free advertising in exchange for the diffusion of paying advertising has become too intrusive. The functionality sale model [BUC 05] assumes that a lot of equipment will not be permanently used by their owners. It is thus more economically sound not to buy the equipment, but just its functionality and pay for the time of use. This model, probably inspired by car rentals and used by Velib (large-scale public bicycle sharing system in Paris) (Decaux) is entering other fields such as printing. *Business Model Innovation* [CHR 08] recommends expanding the market with an additional or different offer, but using the already existing resources in terms of skills, customers, equipment, and generating values. In this logic, Apple proposed the iPod when its computer market decreased.

The obstacles of the second category are much more difficult to overcome, being related to the organizational and legal aspects and to the sociocultural heritage; Added to this is the resistance to change. Organizations, despite reforms are still far from the 5th generation of management described in Chapter 2. ICTs, as well as the power of computers are not exploited. Knowledge management processes are embryonic and poorly understood. An obvious lack of synergy between actors and of visibility of all institutional and private actions by region and at a national level, or even a European level, persists.

57. www.econovista.com/en/index.asp.

The authors of the report "Creativity and innovation in the territories" notice that local innovations are slowed down by "general rules and juridical, regulatory and administrative obstacles" [GOD 10]. "The most powerful actors – administrations, companies, unions, lobbies – all have good reasons to be against it in the name of regulations, market positions and acquired social rights or simply of legitimate economic and social considerations".

In his book, *La croissance ou le chaos* (Grow or Chaos), Christian Blanc [BLA 06] talks about "state centralism, administrative complexity and silos, the large gap between the 'public sphere' and 'private sphere', significant corporatism related to the acquired rights… The role of the public authority nowadays is to create the conditions so that innovative companies appear, grow, flourish and revitalize the French economy". He proposes reforms so that public actors become facilitators of the economic development: strengthening the role of regional councils, decompartmentalizing public-private-business research, creating multi-disciplinary research campuses connected to excellence clusters, making DRIRE and CCI the tools of regional councils. All this remains a big machine, however, with too little attention given to the component parts, which are necessary to make it work.

Institutional actors and major groups do not trust start-ups and other small structures. However, they are much more reactive and innovative than large consulting firms, which are often late in understanding trends, offering solutions that are not always the best for the customer but are lucrative for them, without mentioning their high prices. Sometimes, their employees subcontracting the clients' projects do not have any experience and their training is paid by the customer. Institutions still prefer pounds of written reports in their offices instead of coming out to meet and listen to companies, entrepreneurs and other involved populations. To encounter the stakeholders is not yet a part of their approach; however, this is the only action enabling them to better understand the real situation with the aim of elaborating adequate policies.

It is not easy to change the cultural barriers. Amongst them, we can mention the employee status (contract of indefinite duration), the 35 hour workweek and other social benefits, the excess vacation compared to other countries, the closing of shops between 12 and 2 pm in small towns (12 to 5 pm in the south), the prohibition of Sunday work in sectors with the potential to generate a large revenues following the availability of buyers, the fear of moving, related to real-estate prices, etc. Another barrier from the sociocultural heritage is to "divide and conquer". There are many organizations, including associations, for various types of innovation, involving multiple actors. They all have the objective to promote innovation, but are not undertaking any common actions, because they are not acting with the knowledge management logic. They do not conceive that the valuation can be collective. Most

of the companies are fighting against each other, generally by reducing prices or by buying competitors, whereas they could search for complementarities and alliances. Thus, local business clusters are consulting each other to make a proposal, but only one of them is winning at a time, hopefully they will win in turn.

The lack of values and respect also needs to be pointed out. By striking, SNCF employees are making a mockery of their customers; employees of closing establishments are threatening to destroy their work tools and other equipment; farmers destroying the food to obtain fair prices from retail, while they could sell it differently.

Other obstacles are coming from political disputes, the divergence of points of views on laws and their application, or simply the desire to devalue the others in the eyes of the population. The wait, before and after the elections, have a negative effect on the economy. The influence of human factors, such as closed-mindedness, greed, impatience, ignorance, unnecessary competition, lack of curiosity and of a holistic view, are obstacles to be overcome.

The generally accepted idea that businesses are rich and should pay more is also an obstacle to SME development. Bank charges, travel agency and transport fares are more expensive for companies, even though they could be the same as for other customers, or even more advantageous for start-ups.

The authors of [GOD 10] agree that to achieve a prosperous future: "we need to change everything: habits, behaviors and organizations; relocate businesses that are far away in search of lower production costs". They think that these changes alone will be enough, stating that the movement of sustainable development and of corporate social responsibility will drive relocations and proximity productions… They will not have a choice and these obstacles will be swept away by a great wave, which for some will be a tsunami and for others a fruitful discharge. Zbigniew Hockuba, a Polish economist, expressed a similar vision in his book *From Chaos to a Spontaneous Order* [HOC 95]. Can the CSR alone change mentalities and values? Are these principles really respected by businesses?

Information and communication technologies have a major role to play in this evolution. However, the relevance of their influence depends, on the one hand, on the understanding of the needs, and on the other hand, on the anticipation of turning computers – in all their forms – into intelligent assistants. The introduction by actions supported by technologies, of a "knowledge cultivators" culture led with a shared vision and long-term strategy, will certainly have better results than a destructive tsunami.

7.5. Development in the knowledge economy

In the 1970s, there were kiosks in Moscow dedicated to providing information to the population. People paid 20 kopeks (price of tram ticket was 40), to get the exact answer to their question. In case of necessity, those in charge of this service were using documents or phoning to check the accuracy of the information provided to the customer.

Nowadays, we can find "knowledge" for free on the Internet but it is rarely relevant. We have technologies with great potential, but the way of putting them at the service of humans and generating values from knowledge must be rethought. Whereas it is perfectly normal to pay for a product or a service, it is also justified to pay for a relevant and strategic answer, for an opportunity or an idea, even those obtained via the Internet.

The knowledge economy changes our usual reference marks. The major difficulties and challenges are:

– creating and evolving a long-term vision in a changing world;

– learning to think conceptually, independently of the areas (generic thinking) because the same knowledge or experiments can be applied somewhere else. An excellent example of this approach is the offer of 3D commerce by Dassault[58], which is however specialized in industrial design;

– learning to innovate indicators and to estimate the intangible values;

– finding new "clean"[59] economic models to generate values from knowledge, ideas and strategic information;

– harnessing the ICTs;

– looking for complementarities and alliances rather than spending all our energy on fighting against competitors;

– influencing the change in values.

Innovation can contribute to development in two main economic models – encouraging consumption or addressing the real needs. While a majority of funded research projects produce results which can be marketed in the first category, very few of them involve the final users. Some programs such as PICF[60], evaluate the project proposals in three aspects: technological, market and long-term

58. www.3ds.com/company/news-media/press-releases-detail/release/dassault-systemes-completes-acquisition-of-spatial/single/48/?cHash=37915c0a75.
59. Minimizing advertising pollution.
60. Programme Inter Carnot Fraunhofer.

collaboration. The knowledge of the market and the capacity to build alliances to take market shares is the Achilles heel of many applicants. The main causes are the lack of interest and motivation for these subjects and an overestimation of their own capacities to the point of not consulting experts. Regional project creators often start from the real needs or of their skills and abilities. A vision, based on observations, opportunities or personal objectives triggers an activity to which we wish to bring economic values.

7.5.1. *The importance of a shared vision*

At the end of the 1960s, a group of scientists and other personalities rallied around senator Pierre Lafitte (who was at this time director of the Ecole des Mines of Paris) and around his project of creating a city of knowledge, sciences and techniques in the Valbonne area. The objectives were to create and develop an economic center around advanced technologies, with the ambition of seeing the region, Provence-Alpes-Côte d'Azur (PACA), become one of the main economic development centers in Southern Europe [ONI 03]. This first cluster was created at his initiative and with the financial support of the region in 1972. The first company settled there in 1974. Nowadays, this technology park[61] gathers within a territory of 20 km^2 more than 30,000 persons from more than 60 countries. This includes more than 1,000 companies and public and private research centers and has shown an annual growth of 4% since 1990. Sophia Antipolis is a link of the "Telecom Valley", which is stretching from Milan in Italy to Valencia in Spain. The other major sector in addition to information and telecommunication technology is medical research. There are also some companies specialized in earth sciences.

André Mallol, another visionary, created the technology park of Vannes[62] 20 years ago. He invited selected leaders to move there. Archimex[63] – specializing in extraction-purification of natural chemical substances was amongst the first to join the science park. Its ability to enhance the food waste, long before fashion, has largely contributed to the local economy. André Mallol's vision goes beyond the technology park, it aims to raise awareness and spread his country globally through initiatives, such as the club of the most beautiful bays in the world[64] and the club of the medium-sized innovating cities, initiated by INDL[65].

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61. www.sophia-antipolis.org.
62. www.vip-expansion.fr.
63. http://archimex.com/.
64. www.world-bays.com/.
65. Institut national du développement local (French national institute of local development), www.indl.org/.

Yves Rocher has also introduced his village La Gacilly to the world. A recipe of lesser celandine ointment transmitted to him by a healer was certainly a trigger for his vision – offering to women plant-based beauty products, which are sold by mail. Since 1959, his company has not stopped growing. He was also a pioneer in organic plant cultures used for his cosmetics. The Yves Rocher group, now composed of 8 companies, employs 15,000 people in France, Germany, Russia, Italy, Spain, Mexico, Scandinavian countries, Belgium, USA and Canada.

Experiments like these should be stored in a knowledge base on the successes of companies, in order to inspire players and enable them to learn from success, but also to understand the why of failures.

7.5.2. *Thinking global*

The example of Vannes shows that a global approach to the economic activity is necessary and should replace the sectorial approach. Recycling waste requires knowledge of the waste properties, imagination in possible applications, know-how to develop processes and know-how to sell in the country of origin and globally.

Let us take the example of the wine industry – it is gathering much knowledge and it is also a user of industry and technology. To produce good quality wine, it is crucial to know the environment, grape varieties, the care to provide, the winemaking process and materials. Growers need the specific machinery, care products, tanks, barrels, bottles and corks, labels, but also technologies for process control, website and e-commerce, for meeting their peers other than at fairs and agricultural shows. We need add to this list materials such as corkscrews, glasses, decanters and wine cellars. Given the properties of the grape – antioxidant and medicinal – the wine improves well-being and even the waste is used, for example in cosmetics. This field thus generates a lot of jobs and opportunities, some of which are not yet exploited. Our winemakers are using Swedish machines, while we have all the skills to design and build them.

Gastronomy and tourism are associated with wine. While most of the wine-producing castles offer tastings (some of them are not free), it is now possible to also find a formula of guest castles and houses for private individuals, however, it is still exceptional to find accommodation in a wine-producing castle for corporate seminars.

Wine also has an effect on health and well-being, but we need to know its properties and influences on the body depending on its composition and the absorbed quantity. A recent trend is tempting some producers – obtaining a wine of

equal quality from one year to the other, but in an artificial way. This "innovation" certainly has a consequence on the health of the consumer.

This example of ecosystem is proving that the global thinking, knowledge and imagination make it possible to find other means and other sources of innovation .

The ACREOS project[66], aims to revalorize the participating regions through the introduction of a new profession – the energy optimizer. Alternative energy supplies are specialized and most of them propose only one offer, such as photovoltaic or wind turbines. This is about training new professionals to develop a tailor-made and based on local resources offer for business parks, companies, hotels and other area organizations. Candidates could be selected based on their skills, which would have to be as close as possible to the considered profession, by using skills visualization software (Chapter 5) and matching the offer and demand.

In other fields, such as sport, green and intelligent tourism (study missions), agriculture or textile industry could use a similar approach to innovate.

Knowledge transfer and experience sharing are essential in many fields, such as medicine, chemistry and services. Knowledge of nature such as the properties of plants, functionalities of our bodies (i.e. immune systems), basic principles of hygiene and herbal medicine, as well as dietary rules is indispensable in preventive medicine and is a source of innovation.

Care services are creating some jobs. This concerns home support for elderly, disability assistance, organization of outings, shopping and entertainment. These services started from statistical data on the prolongation of life and on the assumption that people are retiring in good physical shape and have money. But the situation is changing – current living conditions are deteriorating following the constant exposure to chemical, electromagnetic and intellectual pollution, stress at work, bad nutrition, omnipresence of electromagnetic fields, food additives, pesticides and chemical fertilizers, which are influencing life expectancy.

Systems with embedded artificial intelligence techniques are able to simulate these influences from the knowledge they have to reason. They can efficiently help decision-makers in their choices and knowledge cultivators in daily innovation. Robotics using the latest trend of direct connection to the brain can provide assistance to people with reduced mobility.

66. Proposal for the European 7FP by the "Institut de régulation et d'automation" of Arles, www.poleira.com and partners from Sweden, Poland, Croatia and Turkey.

7.5.3. *Harnessing the ICT*

Time has become valuable, but the uses of information technologies in most organizations, including small businesses, are still limited to emailing, sometimes with attached documents. Most of these documents are elaborated with Word, Excel or Powerpoint. Thus, companies and institutions are losing a lot of time and energy managing versions of documents written by several people, often working remotely. Their mailboxes are full of spam, not always well managed by anti-spam software which sometimes causes the loss of opportunities. The vast majority use Google to search for information on a specific subject. They then have to look through a mass of given answers, while the search engine provides them with "leisure" by advertising under a more and more invasive and polluting form. They usually exploit only the first three results.

Models of electronic commerce are the same, independent of the company business. The direct relationship with a customer or a potential customer has been replaced by automatic analysis of their navigation and by automatic responses to their emails. Various contests proposed by online stores are intended to get email addresses, in order to continue spamming the people registered on diffusion lists by sending them contents that often have nothing to do with their profiles. This way of working is not optimal for the company or for customers.

Are the companies ready to change and to pay in order to learn more efficient methods? Are the website designers ready to innovate?

The Internet has brought some new business models – they are always the same: we are paying to read newspapers, to search for a job without any guarantee of a result, for posting an advertisement in a social network. Fully exploiting this channel requires a different way of selling – Internet allows us to be known, but we need to learn how to "give" in order to make people buy. Some videos, mostly American, are leading the way– this is about persuading customers that they cannot do without what we offer (functionalities, effects, way of doing), without revealing the essential information of what they have to pay.

7.5.4. *Some proposals for change of logic*

Balanced development through innovation requires a different logic to that of the industrial era and abundance. Thus, fast food becomes slow food. Here are some examples of alternatives:

– Oseo pact in reverse: it is the SMEs that invite major groups and regularly present the impact of these actions;

– clean transport – trip optimization;

– transport of goods – production here;

– agricultural show in its natural environment – in the countryside;

– processed food – gastronomy classes for all;

– retail – direct from the producer;

– selling – adapting to customers;

– sorting out waste – not creating waste;

– consumption –intelligent consumption;

– move the business abroad – bring back the business (relocate);

– work harder – work smarter;

– changing geography – deserting megalopolises;

– education – effective training needed for careers in the new economy;

– sustainable development – prosperous future thanks to the balanced development;

– assize of innovation– innovation cafés;

– clever innovation and human purpose.

7.6. Innovating for a prosperous future

While it is easy to go from lack to abundance, the opposite is laborious and requires the intense use of individual and collective knowledge.

Territories need more than ever to become aware of their values and specificities and to invent others. Current efforts of valuation are related to art or to heritage, but can certainly be extended. Thus, Villerupt is organizing a festival of Italian cinema, Bourges, the spring music festival and other events. In Europe, we can mention Oresund Innovation, Ice hotel[67], Skandia Futur Center and other Futur Centers[68], carried out in the framework of the European project with the same name. Other one-time events, offered to vacationers, could be available all year long on the Internet in exchange for an e-ticket. Any village would benefit from an innovation café or a café of the future, with activities aimed at finding ideas or exploiting complementarities through the collective intelligence occurring there. Creative

67. www.icehotel.com/.

68. www.innovationecology.com/FutureCenters/Start.html.

intermediation sessions [DHE 06, DHE 07], held regularly, facilitate the emergence of projects resulting from cafés and the emergence of other businesses.

Digital and knowledge cities, territories of the future, competitivity and business clusters and other initiatives have their place in a virtual knowledge space[69] for more synergies, joint actions, ideas and opportunities.

The main task of education is to invent and promote the professions necessary for proper economic functioning – this requires a constant connection with the terrain and a vision for the future. Just like *kidzania*[70], this education could be extended to the new professions, including that of knowledge cultivators. Computers and other equipment become more energy-efficient and intelligently guide the "inhabitants of the virtual space" in any place they can be. The progress is regularly measured by using indicators adapted to the new economy. Politicians create favorable conditions to the balanced development, including the requirements and criteria for awarding funding.

69. www.items.fr/spip.php?rubrique102.
70. http://kidzania.com.

Inventing the Future

Usually innovation goes hand in hand with investment. Which investment is essential for the future?

Investment in new education 3W has the ambitious task of changing mentalities and values, to educate a culture of knowledge cultivators and to increase imagination and creativity. This education is based on exchanges, where we learn how to learn, think and break usual connections (mental flexibility), to listen and respect, to undertake and succeed collectively; an education for all, to learn from nature, from the past and from differences, in which technology and means of communication have a significant role to play.

Investment in machine intelligence builds an ecosystem connecting users of all levels, designers of machines (computers, smartphones, robots, etc.), software editors and researchers. This ecosystem would be fueled by needs, feedback, the mutual discovery of problems to be solved and technological possibilities. Endowed with intelligence and with the ability to learn, the machines would become the intelligent assistants of humans.

Investment in another organization and promotion of research – in ecosystems, involving both nature specialists and engineers, rather than by fields – such an organization could produce unusual solutions, respecting the environment.

Finally, we should invest in a virtual knowledge space. There is still too much lost, forgotten or hidden knowledge. European programs have produced an extraordinary amount of technology and solutions, most of which are not visible and therefore not known. This is the same with skills. This treasure is alive, because participants in the different programs continue to enhance it. However, the treasure map is missing.

The near future will rely on e-co-innovation, with "e" as **e**cological, **e**conomic, **e**ducational, **e**lectronic and **e**thical; "co" as **co**llaborative and enabling a **co**nvergence of intelligences and "eco" as **eco**systems. This is an innovation inspired by nature and centered on humans; taking advantages from past knowledge and experiences, from differences; able to make us dream, smile and live in peace, respecting each other and building a sustainable future together.

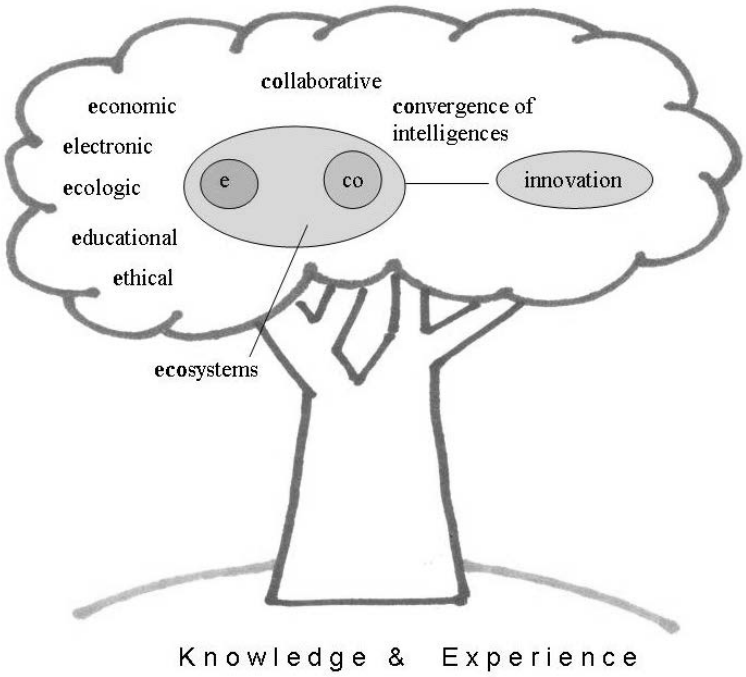

Figure C.1. *E-co-innovation tree*

Such dynamics will certainly contribute to avoiding unbalance and a loss of competitiveness leading to economic, ecological and social decline.

Glossary

Some Definitions

Artificial Intelligence (AI): science, approaches and techniques for creating intelligent machines.

Cloud computing: service of information processing on remote servers, accessible via Internet.

Holonomy: originates from the Greek word *holon*, which means an autonomous unit having its own rules. In that sense, it is entire and it is also a whole. A holon can be part of different sets, such as professional groups, companies, cities and countries – it enhances these environments by performing the role of a knowledge cultivator.

Indicators for the knowledge economy: to measure progress in real-time. These include the presence of an innovation process facilitator, stakeholder involvement, existence of measures of tangible and intangible benefits, opportunities to learn continuously and remotely, capital of links, techno-economic watch by all the participants, percentage of new products/services, strategic alliances, degree of leadership, image, use of ICT and knowledge processing technologies, environmental impact, ethics, etc.

Information and Communication Technology (ICT): ICT is also the name for the Institute for Creative Technology of the University of Southern California http://gl.ict.usc.edu/.

Knowledge cultivator: a person (holon) cultivating knowledge to get fruits (benefits). Its culture includes the following attitudes: learning and innovating continuously, sharing knowledge and experiences, collaborate instead of competing,

working in symbiosis with its "intelligent assistant" (computer), taking care of ecosystems.

Knowledge discovery by computer:

– *data mining*: techniques for discovering relationships between the records of a database;

– *text mining*: a set of techniques for automatic exploitation of text;

– *image mining*: techniques for automatic exploitation of images.

Knowledge economy: an economy in which individual and collective knowledge and experiences are engaged in innovation dynamics producing tangible and intangible values, with respect to individuals, cultures and the environment. It requires a fundamentally new mindset and a common language to exploit the capabilities of individuals and machines, companies and countries and opportunities of a networked world.

Knowledge flow: the creation, collection, processing and sharing of information and knowledge in an organized and optimized way, taking into account the various activities of the extended business network needs and the collective and individual motivations of all the participants.

Knowledge innovation systems (KIS): collaborative innovation systems or *knowledge innovation strategy*, as a function of the context.

Knowledge management: an integrated system of initiatives, methods and tools designed to create an optimal flow of knowledge within and throughout an extended enterprise to ensure stakeholders' success.

Knowledge society: a society producing, using and transforming knowledge into values. This is not limited to education, research and innovation and concerns the whole society, that learns and innovates continuously.

Knowledge trees: graphic representations of individual and collective skills.

Ontology: from the Greek *ontologos* "meaning of a word" – ontology is a structured set of concepts and relationships in a given field. It "translates" knowledge into a language that computers can understand.

Sixth generation of management methods: collaborative knowledge innovation systems.

Semantic Web: combines the techniques of statistical analysis, natural language processing, knowledge modeling and machine learning.

Web 2.0: services provided by the second generation of Internet, such as social networks, wiki, RSS and multimedia.

Wiki: tools for collaborative work, enabling a group of people to work asynchronously and remotely via Internet. It can be used for the collaborative writing of a document or for the requirements of a project team.

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