POLITECNICO DI MILANO

POLO TERRITORIALE DI LECCO

Master of Science in Mechanical Engineering

Thesis Topic

Study on impact of European Research and Innovation supportive programmes on SMEs in manufacturing Sector

Supervisor: Prof. Giacomo Tavola

Master Graduation Thesis by: Amin Nasiri

Student ID. Number: 10420161

Academic Year 2014-2015

Acknowledgement

I wish to thank Prof. TAVOLA for his help, guidance throughout this work. My special thanks goes to Mr. Albert Torres whom I owe this opportunity to. I also like to show my gratitude to LEITAT international office project managers who helped me during these six months with their warm support. I also like to thanks my family for their support from long distances whom I owe all of my achievements to.

Summary

We are living in a complex and dynamic world in which innovation and entrepreneurship are occupying a decisive role for economic development. According to Joseph Alois Schumpeter "*carrying out innovations is the only function which is fundamental in history*". He also stressed that it is entrepreneurship that *"replaces today's Pareto optimum with tomorrow's different new thing*"(Joseph Alois Schumpeter 2005), (Śledzik 2013).

Innovation is a major driving force for economic growth and development of companies. The globalization of markets caused a very competitive environments for companies. The rapid technology evolution, fast changing market, more customer demand trends requires high quality new product/process to be efficiently and effectively answer to this demand. Innovation play a key role is to transform firm's inner capabilities, making it more adaptive, better able to lean, able to learn, to exploit new idea between (Maravelakis et al. 2006).

Innovation goes far beyond R&D. It goes far beyond the confines of research labs to users, suppliers and consumers everywhere – in government, business and non-profit organizations, across borders, across sectors, and across institutions (OECD 2013)

But the main problem is it is often believed that unlike many other core processes such as manufacturing or logistic, outputs of innovation are hard to predict due to the very fact that the source of innovation is creativity. This makes the management of innovation hard and many firms (mostly SMEs) gave up to bother themselves with it; if the output is unpredictable or even worse you want it to be unpredictable, why bother to measure it. And since it is sometimes impossible to capture innovation in simple and common firms' indicators and targets performance frameworks, most managers leave it in the hand of R&D specialist. (Kolk et al. 2012)

Fortunately there are many successful companies that overcame these challenges and harness the benefits of innovation as a manageable process throughout the whole company. These benefits have included largest market share and greater returns for new products and services; successful entry to new markets, etc. these companies use different policy and strategy and hire different instrument to make this happen. But the most important challenge for managing innovation is the measuring tools and all comes down to this old quota in management that "if you cannot measure it, you cannot manage it". This means that how hard it looks but there are many tools that make innovation management possible through different measures and practice in firms, national and international levels.

The importance of SMEs as backbone of European economy, has been recognized more and more in this decade. SMEs are primarily responsible for wealth and economic growth, next to their key role in innovation and R&D. In Europe, SMEs account for 99 out of every 100 businesses and 58 cents in every euro of value added and 2 in every 3 employees are working in a SME. The five key sectors in EU economy are manufacturing, construction, business service, accommodation and food, wholesale and retailed trade which accounts for 78% of all SMEs (European Commission 2014a).

Manufacturing is one of the largest R&D driven sectors. It is an essential factor of the innovation chain: manufacturing empower technological innovations to be applied in products and services, which are marketable in the marketplace and is key to developing KETs to making new products affordable and available so as to increase their societal and economic benefits and reach the desired impacts. Innovation investment in mechanical engineering (European Commission 2012a), in the business enterprise sector manufacturing, accounted for the highest share of researchers in most EU Member States. In 2008, 14.1 % of all EU-27 tertiary students were attending in engineering, manufacturing and construction education. 39.8 % of enterprises in the EU-27 were considered

innovative in terms of technological innovation in 2008. In most countries, the share of innovative enterprises was generally higher in manufacturing than in services. In 2009, 2.4 million people were employed in the high-tech manufacturing sector in the EU-27 (EC 2009).

But still SMEs in this sector are facing many difficulties in their path to innovation. It is often mentioned that the smaller the firm, the more exposed they are the risk of rapid changes. Pressure from change-demanding market with the moto of *innovate to survive* makes innovation essential part of daily practice of these kind of firm from one hand. On the other hands high risk and limited financial and non-financial resources obstacle many SMEs to innovate effectively. Therefore public provision is vital element for SMEs. Because of this, governments and administrations in country level and higher provide supportive programmes for SMEs. In EU this has been done through research and innovation funding programs like seventh framework for research and innovation and recently H2020. This support has been available in different forms such as grants, loans and, in some cases, guarantees, directly or through programmes managed at national or regional level such as the European Union's Structural Funds. SMEs can also benefit from a series of non-financial assistance measures in the form of programmes and business support services.

This work is an attempt to first have a review on current practice and tools in innovation by study on state of art literature in terms of innovation management, performance and measures. Then the attention is paid particularly to SMEs; The barriers and difficulties that nowadays small firms face regarding their innovation activities. Finally the results from supportive action from European commission regarding innovation activities of SMEs will be discussed to achieve an overview on SMEs performance.

Table of Content

List of Figures

List of Tables

Introduction

We are living in a complex and dynamic world in which innovation and entrepreneurship are occupying a decisive role for economic development. According to Joseph Alois Schumpeter "*carrying out innovations is the only function which is fundamental in history*". He also stressed that it is entrepreneurship that *"replaces today's Pareto optimum with tomorrow's different new thing*"(Joseph Alois Schumpeter 2005), (Śledzik 2013).

Innovation is a major driving force for economic growth and development of companies. The globalization of markets caused a very competitive environments for companies. The rapid technology evolution, fast changing market, more customer demand trends requires high quality new product/process to be efficiently and effectively answer to this demand. Innovation play a key role is to transform firm's inner capabilities, making it more adaptive, better able to lean, able to learn, to exploit new idea between (Maravelakis et al. 2006).

Innovation goes far beyond R&D. It goes far beyond the confines of research labs to users, suppliers and consumers everywhere – in government, business and non-profit organizations, across borders, across sectors, and across institutions (OECD 2013)

But the main problem is it is often believed that unlike many other core processes such as manufacturing or logistic, outputs of innovation are hard to predict due to the very fact that the source of innovation is creativity. This makes the management of innovation hard and many firms (mostly SMEs) gave up to bother themselves with it; if the output is unpredictable or even worse you want it to be unpredictable, why bother to measure it. And since it is sometimes impossible to capture innovation in simple and common firms' indicators and targets performance frameworks, most managers leave it in the hand of R&D specialist. (Kolk et al. 2012)

Fortunately there are many successful companies that overcame these challenges and harness the benefits of innovation as a manageable process throughout the whole company. These benefits have included largest market share and greater returns for new products and services; successful entry to new markets, etc. these companies use different policy and strategy and hire different instrument to make this happen. But the most important challenge for managing innovation is the measuring tools and all comes down to this old quota in management that "if you cannot measure it, you cannot manage it". This means that how hard it looks but there are many tools that make innovation management possible through different measures and practice in firms, national and international levels.

The importance of SMEs as backbone of European economy, has been recognized more and more in this decade. SMEs are primarily responsible for wealth and economic growth, next to their key role in innovation and R&D. In Europe, SMEs account for 99 out of every 100 businesses and 58 cents in every euro of value added and 2 in every 3 employees are working in a SME. The five key sectors in EU economy are manufacturing, construction, business service, accommodation and food, wholesale and retailed trade which accounts for 78% of all SMEs (European Commission 2014a).

Manufacturing is one of the largest R&D driven sectors. It is an essential factor of the innovation chain: manufacturing empower technological innovations to be applied in products and services, which are marketable in the marketplace and is key to developing

KETs to making new products affordable and available so as to increase their societal and economic benefits and reach the desired impacts. Innovation investment in mechanical engineering (European Commission 2012a), in the business enterprise sector manufacturing, accounted for the highest share of researchers in most EU Member States. In 2008, 14.1 % of all EU-27 tertiary students were attending in engineering, manufacturing and construction education. 39.8 % of enterprises in the EU-27 were considered innovative in terms of technological innovation in 2008. In most countries, the share of innovative enterprises was generally higher in manufacturing than in services. In 2009, 2.4 million people were employed in the high-tech manufacturing sector in the EU-27 (EC 2009).

But still SMEs in this sector are facing many difficulties in their path to innovation. It is often mentioned that the smaller the firm, the more exposed they are the risk of rapid changes. Pressure from change-demanding market with the moto of *innovate to survive* makes innovation essential part of daily practice of these kind of firm from one hand. On the other hands high risk and limited financial and non-financial resources obstacle many SMEs to innovate effectively. Therefore public provision is vital element for SMEs. Because of this, governments and administrations in country level and higher provide supportive programmes for SMEs. In EU this has been done through research and innovation funding programs like seventh framework for research and innovation and recently H2020. This support has been available in different forms such as grants, loans and, in some cases, guarantees, directly or through programmes managed at national or regional level such as the European Union's Structural Funds. SMEs can also benefit from a series of non-financial assistance measures in the form of programmes and business support services.

This work is an attempt to first have a review on current practice and tools in innovation by study on state of art literature in terms of innovation management, performance and measures. Then the attention is paid particularly to SMEs; The barriers and difficulties that nowadays small firms face regarding their innovation activities. Finally the results from supportive action from European commission regarding innovation activities of SMEs will be discussed to achieve an overview on SMEs performance.

In the first chapter, first a short introduction about innovation and innovation process will be present. It will be followed by a review on different innovation models that have been theorized during last decades. This begins with simple linear model of innovation then the evolutionary path of innovation dynamic models will be tracked to more realistic complex model which consist of the systems of disruptive and discontinuous events that involve networks of actors and resources.

In the second chapter, innovation in small firms will be argued, first the necessity of innovation for SMEs and furthermore the key enabling factors that helps SMES to be innovative, and finally the barriers.

Third chapter will focus on innovation different metrics and measures- common and new. Advantages and disadvantages of each will be demonstrated in detail.

The fourth chapter begins with a brief discussion about European SMEs (more focus on Manufacturing sector) and their importance for Europe. Then innovation importance through EC perspective and European commission support for innovation in SMEs -Its previous, current and future supportive program will be summarized. This will be followed by demonstration of some of these program results in order to give an overall view on impact of Supportive program role on SMEs in Europe. At the end, by using result of EC surveys, a picture of current situation of SMEs in Europe will be depicted.

1. Innovation, innovation models and management

There is no single definition for innovation. But innovation as described in the Innovation Union plan broadly means change that speeds up and improves the way we conceive, develop, produce and access new products, industrial processes and services. Changes that create more jobs improve people's lives and build greener and better societies.

Innovation can be defined as the development or adoption of new concepts or ideas, and/or the new or adopted ideas themselves as well as the successful exploitation of new ideas. Creativity is having the ideas, and innovation is its application. Creativity only emerges when the innovator takes the idea and does something with it. Successful exploitation of new ideas can lead to any form of increased organizational or social benefit (OECD 2005).

Joseph Schumpeter defined economic innovation "The theory of economic development" (Schumpeter 1961):

- The introduction of a new good — that is one with which consumers are not yet familiar — or of a new quality of a good.
- The introduction of an improved or better method of production, which need by no means be founded upon a discovery scientifically new, and can also exist in a better way of handling a commodity commercially.
- The opening of a new market that is a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before.
- The conquest of a new source of supply of raw materials or half-manufactured goods, again irrespective of whether this source already exists or whether it has first to be created.
- The carrying out of the better organization of any industry, like the creation of a monopoly position or the breaking up of a monopoly position.

We are living in a complex and dynamic world in which innovation and entrepreneurship are occupying a decisive role for economic development. According to Joseph Alois Schumpeter "*carrying out innovations is the only function which is fundamental in history*". He also stressed that it is entrepreneurship that"*replaces today's Pareto optimum with tomorrow's different new thing*". Schumpeter's words that entrepreneurship is innovation have never seemed so appropriate as the nowadays, when modern capitalism is experiencing a serious crisis and lost his strength during last subprime and euro debt crises (Śledzik 2013), (Joseph Alois Schumpeter 2005).

He was among the first to identify a clear concept of innovation & entrepreneurship. He believed innovations trigger creative destruction of old ideas, technologies, skills, and equipment and make them obsolete. Entrepreneurs introduce new means of production, new products, and new forms of organization. According to his definition innovation activities that trigger creative destruction to Schumpeter, innovations can be any of the following (Śledzik 2013):

• Introduction of a new good

• Introduction of a new method of production

• Opening of a new market

• Discovery of a new supply of raw materials or partially finished products

• A new form of organization

Economically speaking, Creative Destruction occurs when something new kills something older. A great example of this is personal computers. The industry, led by Microsoft and Intel, destroyed many mainframe computer companies, but in doing so, entrepreneurs created new businesses based on one of the most important innovations of this century (Śledzik 2013).

In more recent context, innovation can be defined as the development or adoption of new concepts or ideas, and/or the new or adopted ideas themselves as well as the successful exploitation of new ideas. Creativity is having the ideas, and innovation is its application. Creativity only emerges when the innovator takes the idea and does something with it. Successful exploitation of new ideas can lead to any form of increased organizational or social benefit.

Innovation goes far beyond R&D It goes far beyond the confines of research labs to users, suppliers and consumers everywhere – in government, business and non-profit organizations, across borders, across sectors, and across institutions (Oecd 2010)

To accept innovation as a Concept we should first employ some assumption for innovation definition; innovation is a process with identifiable steps. It is studied by many disciplines and it is part of many frameworks. It produces results and more importantly added value and can be systematically modeled. People play roles in the process.

We should not make a mistake by taking other matters as innovation. In other words, innovation is not artistic creativity. It is not just an Invention or the "Bright Idea". Even scientific discovery and problem-solving or simple incremental improvement (without taking to the consideration economical part of innovation definition such as added values and market attraction) are not innovation.

In this chapter first a short introduction about innovation and innovation process will be present. It will follow by a review on different innovation models that have been theorized during last decades. This begins with simple linear model of innovation then the evolutionary path of innovation dynamic models will be tracked tod more realistic complex model which consist of the systems of disruptive and discontinuous events that involve networks of actors and resources.

1.1.Evolution of Innovation

Innovation is the heart of strong economic growth in this era. Increasing globalization, competition and fiscal and demographic challenges like the recent economic crisis show more than ever our need to understand innovation (Tidd 2006). The evolution of innovation begin with a simple linear model but the more innovation models evolve, the more the bottleneck and unintentional dysfunctional implication that included in innovation process have been emerged. It was soon understood that only R&D activities and technological development is not sufficient and for commercial success, latter stages of innovation process; innovation development and diffusion are vital too.

Innovation processes describe the activities that are performed at each stage of the development of an innovation. Innovation management is the governance and organization of these innovation processes. (Ortt and Duin 2008).

The various generations of innovation management emerge in different times and in entirely different contexts, requiring different types of innovation processes. Ortt and Duin 2008 provide a concise description of the successive generations:

"The first generation brought the corporate R&D laboratory. The second generation adapted project management methods to R&D. The third brought internal collaboration between different functions in the firm. The fourth adds routines designed to make more flexible the conduct of the R&D function through the incorporation of the knowledge of users and competitors."

1.1.1. Linear innovation model

The important aspect of understanding the innovation process is that it gives us knowledge and tools to manage it. This understanding has been changed through time. According to Godin (2006), first models come directly from V. Bush's Science: The Endless Frontier (1945). These models of innovation consider it as a linear sequence of activities (Fig 1-1). Scientific research as the basis of innovation was the priority, and the role of later players in the innovation process was lessened. In this model, to minimize the risk, the product and services concept is frozen at the early stage. Even in enterprises, the innovation process considered as a series of sequential phases/steps that for going to the next level, the preceding phase must finish. So there were gates that the project is supposed to pass through them and each gatekeeper check the criteria of that step to give the permission for moving to the next succeeding phase. The criteria were already defined beforehand and the objectives and output of each step are evaluating by gatekeeper to make sure that desired result has been achieved to give them the consent to move to the next step (Godin 2006).

There are mostly two version of linear model of innovation.

- Technology push model
- Market pull model.

From the 1950s to the Mid-1960s, the industrial innovation process was generally perceived as a linear progression from scientific discovery, through technological development in firms, to the marketplace. The stages of the "Technology Push" model are:

Figure 1-1 Technology push innovation model (Inspired by Goldin 2006).

It is mostly based on the idea that the new opportunities arising from research gave a rise to application and refinements which eventually found their way to the market place.

From the Mid 1960s to the Early 1970s the "market pull" model of innovation emerges as the second-generation of linear Innovation model. According to this simple sequential model, the market was the source of new ideas for directing R&D, which had a reactive role in the process. The stages of the "market pull" model are:

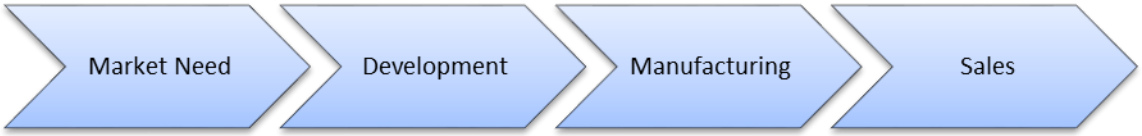


Figure 1-2 Market Pull Innovation model (Inspired by Goldin 2005).

In this model the market will signaled needs for something new which then drew out new solution to the problem need pull where necessity becomes the mother of invention.

The limitation of such approach is clear. In practice innovation is coupling and matching process, where interaction is critical element. Sometime pull will dominate, sometimes pull but successful innovation requires interaction of both models.

The linear models of innovation supported numerous criticisms concerning the linearity of the models. These models ignore the many feedbacks and loops that occur between the different "stages" of the process. Shortcomings and failures that occur at various stages may lead to a reconsideration of earlier steps and this may result in an innovation.

Innovation is hard to manage, mostly because in nature it is a complex, uncertain phenomena which associated with high risk. This, in first place makes it hard to be understood and then managed. Recent works found the limits of linear models (Tidd 2006), (Ortt and Duin 2008) and try to replace or modified it by more complex and interactive framework. Most innovation actions are messy, involving false starts, recycling between stages, dead ends, feedbacks and modification to the preceding stages, jumps out of sequence.

Van de Ven et al. (Van de Ven Vernon 2000) investigate a case study looking at widely different innovation types and explored the limitation of simple models of the process. They drew attention to the complex ways in which innovations actually evolve over time, and derived some important modifiers to the basic model. Some of their points are as follow:

- Shocks Trigger: There is a threshold of opportunity or dissatisfaction which the innovation happens when people or organization reached it.
- Path Divergence: after starting in a single direction the process will grow in multiple directions and advance divergently.
- Setbacks Plans are overoptimistic, problems arise, commitments will pile up, mistakes accumulate, and vicious cycles can develop.
- Reconstruction of the innovating unit: might happen through external intervention, personnel changes or other unexpected events.
- Top management plays a key role in supporting – but also in criticizing and forming innovation.
- Criteria for success might transform over time, differ between groups, and make innovation a political process.
- Innovation involves learning which occur as the innovation develops often making learning superstitious in nature.

As mentioned before our understanding of nature of innovation process has evolved from simple linear models (characteristic of the 1960s) to increasingly complex interactive models.

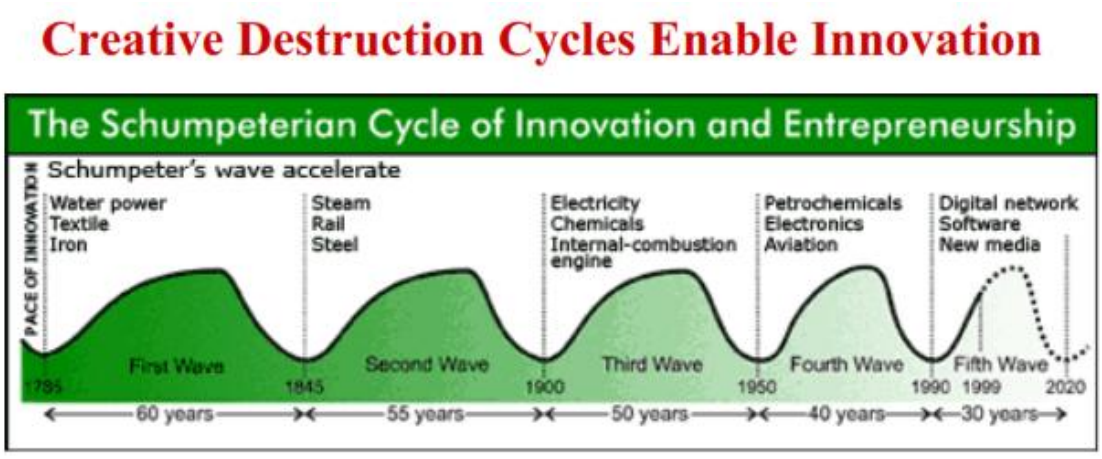


Fig Error! No text of specified style in document.**.1 Creative destruction concept by Shumpeterian.**

There are different perspectives toward history of innovation models. Some authors (Tidd 2006) consider five generation of innovation models and some (Ortt and Duin 2008) consider only four. Tidd 2006 in his work about innovation models presented five generations of innovation models, from simple linear model to most complex model which requires high levels of integration at both intra and inter-firm levels, and which is increasingly facilitated by it-based networking (Table 1-1).

Table 1-1 Progress in conceptualizing innovation: Rothwell's five generations of innovation models (Adapted from Tidd, Bessant and Pavitt, 2005).

Generation	Key features
First	The linear models - technology push
Second	Need (Market) pull
Third	Interaction between different elements and feedback loops between them – the coupling model
Fourth	The parallel lines model, integration within the firm, upstream with key suppliers and downstream with demanding and active customers, emphasis on linkages and alliances
Fifth	Systems integration and extensive networking, flexible and customized response, continuous innovation

Orrt 2008 adopted a procedure by using hallmarks in the societal context to establish when a specific generation prevailed. Thus, he placed the first generation between the end of the Second World War and the mid-1960s. He further explained that in the mid-1960s, a broad awareness emerged about the potentially negative societal effects of technology. The second generation is placed between the mid-1960s and the late 1970s. The late 1970s saw a recession that had a major impact on the resources that were allocated to innovation. The third generation was identified between the late 1970s and the early 1990s, at which point the internet made its commercial presence felt. The internet has played a crucial role in people's ability to cooperate at a distance and it has further stimulated the emergence of a truly global economy. The fourth generation started in the early 1990s and it continues to be the dominant approach to this day.

But Ortt 2008 describes the subsequent generations of innovation management, according to their respective societal and organizational contexts and their advantages and disadvantages (within their specific contexts). In their study they consider WOII, as a beginning of the innovation management, not late nineteenth century. Because after the war innovation was generally considered to be essential to the economic and technological survival of nations and companies alike, which led to a widespread use of and increasing scientific research into innovation management.

Table 1-2 provides an overview of the generations of innovation management, their context and their (dis)advantages. The second and fourth columns of the table represent the forces behind the evolution of innovation management:

1- New generations emerge because innovation management adapts to a changing context; and
2- They emerge to remedy the disadvantages of earlier generations.

Evolutionary forces lead to changes in innovation management: innovation management itself is subject to innovation.

From this historical overview it can be concluded that in each period companies adhere to a different set of best practices. Furthermore, these best practices evolve over time, because different economic, societal and technological contexts require different approaches to innovation management and because companies are forced to improve

their innovation management due to the increasing importance of innovation (Ortt 2008).

Table 1-2 The innovation management generations, their context, approach and disadvantages (Ortt 2008)

Period	Societal and organizational context of innovation	Innovation approach	Disadvantages of the approach
From the post-war period to the mid-1960s	Society Society has a generally favourable attitude towards scientific progress. Governments subsidize R&D in universities and companies to stimulate economic growth and to attain military leadership. Consumer demand exceeds the supply of goods Organizations Organizational strategies are generally technology-oriented and focus on innovation and growth. Most organizations are functionally organized	Technology (science) push The process of commercialization of technology is perceived as a linear progression from scientific discovery to the marketplace. Many R&D-departments are staff departments that are structured like scientific institutions.	Disadvantages Little attention is paid to the entire process or the role of the market place. Innovation processes serve no strategic goals and commercial aspects are incorporated late Professional project management practices are not applied
From the mid-1960s to the late 1970s	Society This is a period of relative prosperity, although economic growth slows down. Demand more or less equals supply. Many markets are becoming more competitive. Government policies tend to emphasize demand side factors Organizations Organization strategies generally focus on growth, to attain economies of scale, and on diversification, to reduce financial risks. Many organizations adopt a multi-divisional structure	Market pull (need-pull) Technological change is rationalized, needs are considered more important to innovation than scientific and technological progress. Because innovation processes are managed as projects, R&D-institutes are organized in a matrix. Divisions become internal clients that directly fund R&D Innovation is generally organized in multi-disciplinary projects. Linear sequential process in a project, starting with market need	Disadvantages Neglect of long-term innovation programs and because of this leads to "incrementalism" Focuses on evolutionary improvements rather than breakthroughs. Projects are individual units, strategic relationships between these projects and corporate goals are not established
From the late 1970s to the early 1990s	Society This is a period with two oil crises, inflation and demand saturation. Supply exceeds demand and unemployment figures rise Organizations Company strategies generally focus on cost control and reduction. Organizations become	Market pull and technology push combined Knowledge about technology and market needs is used throughout the innovation process. To obtain this knowledge (communication) networks are formed with internal and external partners. Innovation projects	Disadvantages Focuses on product and process innovations rather than market and organizational innovations Focuses on the creation of innovations rather than the exploitation

	more flexible and less hierarchically organized. Responsibilities are delegated to business units	become part of a portfolio of projects aligned with the corporate strategy Model of an essentially sequential process with feedback loops and interaction with market needs and state of the art technology	
From the early 1990s to the early 2000s	Society Globalization is important in this period, international competition increases. Organizations realize the strategic importance of technologies. Information and communication technologies influence internal and external business processes Organizations Company strategies generally concentrate on core competences. Strategic alliances, and external networking become important. Time-to-market becomes more important. More organizations adopt team-based and project-based structures	Innovation in alliances; parallel and integrated innovation, from innovation to new business development (NBD) Innovation management means managing research links and external research environments. Parallel processes are used to involve multiple actors and to increase the development speed. The 4th generation includes business and market models in innovation Coordinated process of innovation in a network of partners. The required coordination is often attained by system integration (with key suppliers and customers) and parallel development (of components or modules of the innovation)	Disadvantages Innovation processes are becoming too complex and because of this more and more unmanageable Opening up the innovation process is not suited for any industry and might in general endanger fundamental research which is many cases still the basis for innovation

1.1 Innovation Management

Managers like order. Innovation is disorderly process in nature. It is hard to be planned and outcomes are unpredictable. This would results tensions and makes innovation hard to be managed. But this does not mean that innovation cannot be managed.

Although Management can be considered a broader term than innovation management, since it contains invention processes as well as innovation processes. However, because R&D management usually focuses on a specific approach to innovation management, innovation management may be considered the broader of the two terms. (Ort 2013). To choose the best practice, one should be familiar with the various innovation management approaches and their advantages and disadvantages.

In the following, first the barriers and difficulties that arise from lack of knowledge and partial understanding of innovation problem will be discussed and it will be followed by current models of innovation. It should be born into mind that in the practice innovation managers usually do not automatically follow the best practices as prescribed by the dominant models of their time. In fact, they more often manage their innovation process based on their specific context which is based on the organizational characteristic and values, their targeted market, etc (Ortt 2013).

Mental models are important. But they have their limitation. The simpler they are, the more they are exposed to risk of simplification which in case of innovation can cause many problems. According to Tidd 2006, misunderstanding of innovation is mostly as follow (Table 1-3):

Considering innovation as linear innovation technology push model: First all the attention will goes through the first stage R&D activities and its funding without investigating market and user needs. It could be vice versa with the market pull model, no attention will be given to the R&D activities and technology readiness.

Considering innovation only as a disruptive major breakthrough; The significant importance of incremental innovation will be ignored. For instance the concept of light bulbs designed by Edison was almost unchanged during 1880 to 1896 but the incremental improvement caused the 80% drop on the price during the same period and widespread usage.

Considering innovation as a single isolated change rather than as part of a wider system;

Considering innovation as product and process only without considering interrelationship between the two.

If innovation is only seen as…	… the result can be
Strong R&D capability	Technology which fails to meet user needs and may not be accepted
The province of specialists	Lack of involvement by others, and a lack of key knowledge and experience input from other perspectives in the R&D
Understanding and meeting customer Needs Advances along the technology frontier	Lack of technical progression, leading to inability to gain competitive edge Producing products or services which the market does not want or designing processes which do not meet the needs of the user and whose implementation is resisted
The province only of large firms	Weak small firms with too high a dependence on large customers. Disruptive innovation as apparently insignificant small players seize new technical or market opportunities
Only about 'breakthrough' changes	Neglect of the potential of incremental innovation: with an inability to secure and reinforce the gains from radical change because the incremental performance ratchet is not working well
Only about strategically targeted projects	May miss out on lucky 'accidents which open up new possibilities
Only associated with key individuals	Failure to utilize the creativity of the remainder of employees, and to secure their inputs and perspectives to improve innovation
Only internally generated	The 'not invented here' effect, where good ideas from outside are resisted or rejected
Only externally generated	Innovation becomes simply a matter of filling a shopping list of needs from outside and there is littleinternal learning or development of technological competence
Only concerning single firms	Excludes the possibility of various forms of inter-organizational networking to create new products, streamline shared processes, etc.

Table 1-3 Problems with partial understanding of innovation models (Adapted from Tidd, Bessant and Pavitt, 2005).

1.1.1 Innovation management values and models

For a firm to use the benefits of its investment in technology will depend on two factors (David Teece 1998)

1- The firm capacity to transform its technological capacity into commercially products or process
2- The firm capacity to defend this technological knowledge from other competitors.

Here is the point where management values enter. The provision of complementary assets to exploit the lead in commercialization of technology would be a good example that needs managerial skills. Other factors are slightly affected by management and depend more on the nature of technology and targeted market, type of organization. Tid 2006 identifies nine factors that influence the firm's capacity to benefit commercially from its technology:

Secrecy: Managers practice and preach secrecy but absolute protection is sometimes impossible. Secrecy may have two different effects. On one hand leakage of information from the firm is against the first factor above. it can happen by reverse engineering or simply by researcher in their community. On the other hand, new innovation models such as open innovation praise the open knowledge transfer outside the firm, actually it was proven that firms, who openly share their knowledge with their partner, innovate more.

Accumulated tacit knowledge: is hard to duplicate, particularly when it is owned by specific firms and regions. Rolls-Royce in aircraft engines is a good example.

Lead times and after-sales service: the branding and commitment to innovate and develop the product and ensure the customers of good after sale services are considered by practitioners to be major sources of protection against imitation

The learning curve: will help firm to produce at lower cost and accumulate knowledge.

Complementary assets: Competencies such as production technology, marketing and after sale will help effective commercialization of an innovation.

Product complexity: Will help the firm to protect its product and technology because the lead time for design and produce such product take long time and lots of effort which makes the reverse engineering hard

Standards: Pioneer firms have accepted standard for their products which may raise the barrier for other competitors. Compatibility with that standard is the key to entering the market.

Pioneering radical new products: Studies show that the success of product pioneers is between 25% (for consumer products) and 53% (for higher technology products) (Tid 2006) depending on the technological and market conditions. Being pioneer in a market especially in the early stages of product introduction to the market is not always a huge advantage. Most of the time the product will evolve later through the users' feedback and more experimentation.

Strength of patent protection: often plays a key role in protection of commercial benefits of firm from imitators.

Finally, it should be considered that firm can use more than one of the above factor to protect their innovation.

Innovation is processed in different level of a firm and each unit has its own responsibility. As shown in the table below from a single individual that create idea to the marketing of the idea, every unit is involved.

Actors	**Innovate as**

Individual	creative skills & ideas
Team	problem-solving
Large Unit	innovation roles defined
Organization	process supported
Industry	new technology
Societal/Marketplace	diffusion

Table 1-4 Innovation actors.

There are different views of innovation, depend on type of sector definition of innovation might change. New concept in innovation like organizational innovation and marketing innovation completely change the definition of innovation from technological to non-technological phenomena. Mostly the innovation process can be classified in 3 different categories.

Innovation as New Product Development: In this view point, a product is subjected to innovation process. For this propose strategically planning and allocated rescues and support should be given to the innovation process which will generate a new product concept or modification of existing one.

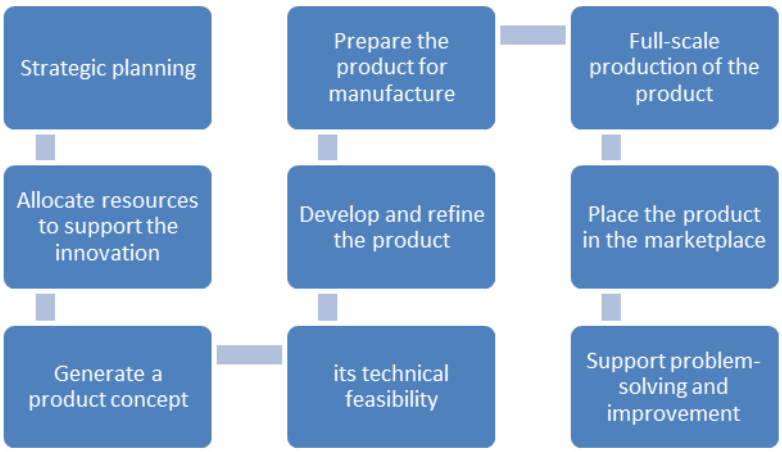


Figure 1-3 Innovation as New Product Development

The stages can be considered as was shown in Figure 1-3 A good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics.

New Technology/Process as an Innovation Trigger: A new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software. In this view point innovation can be considered as a "breakthrough technology". The result is the new technology that can be enter the market. To do so innovation process can be considered as follow:

Figure 1-4 Innovation as New Process Development

Management Practice as an Innovation: Consist of different stages for managing innovation in a firm.

Figure 1-5 Innovation as New Management Practice.

Generic Process Steps in an Innovation: According to the above the whole innovation process can be simplified in the following form. It should be born into mind that this flowchart will have different loop and feedback to the producer stage. For example if the result from prototyping and testing stages are incompatible with expected ones there would be a loop to the concept of development stages.

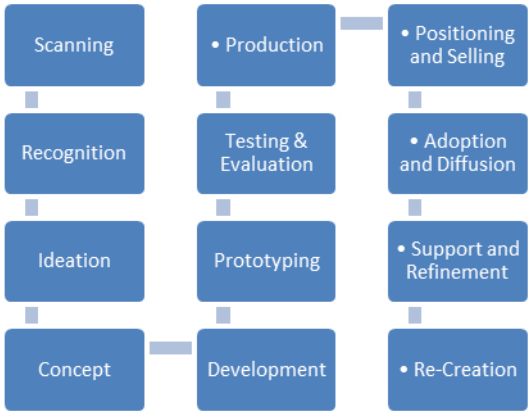


Figure 1-6 Generic Innovation process sequence.

The following could be recognized as Managing Innovation Value;

• **Intellectual Property Management** – generate more intellectual properties; focus on short term returns of patent licensing.

• **Intellectual Asset Management** – focus on broader intellectual assets; assemble both unprotected and protected assets.

• **Intellectual Capital Management** – harness the 'hidden value' of an innovation; deploy intellectual capital toward the firm's vision

1.2 Types of Innovation

In literature there are different models and different types of innovation that sometimes overlaps. But mostly there are three ascending tiers of innovation. The level of innovation dictates the simplicity or complexity of the process and its required resources. These three levels might be called with different name in different references but mostly common names are as follow:

Incremental Innovation: This level consists of small, yet meaningful improvements in products, services, and other ways in which the business is carried out. These tend to be the "new and improved" innovations which are product of organizational strategy and in advanced planning. The common example could be different model of a car which will be improved during years and simply can be new flavors, shifts to better or all-natural ingredients, packaging improvements, faster/slower functioning, just-in-time supply chain enhancements, bigger/smaller sizing, cost reductions, heavier/lighter weight. They will help extend product, service, and business life cycles and improve profitability.

2. Breakthrough/disruptive Innovation: This kind of innovation corresponds to a significant change in business of a firm. Usually it means new product and new

services, etc. that enter the market for the first time. it gives consumers something demonstrably new (beyond "new and improved"). Breakthrough innovation produces a substantial competitive edge for a while, although the length of time anyone can maintain such an advantage is growing increasingly shorter.

3. Transformational/radical Innovation: This is usually (not always) means introduction of a technology that drastically changes the business and even its ground roles. It creates a new industry and even might transforms the life of people. This kind of innovation often eliminates existing industries or, at a minimum, totally transforms them. For this reason, transformational innovations tend to be championed by those who aren't wedded to an existing infrastructure. Transformational innovation is exceedingly rare. That is why sometimes this kind of innovation coming from start-up companies.

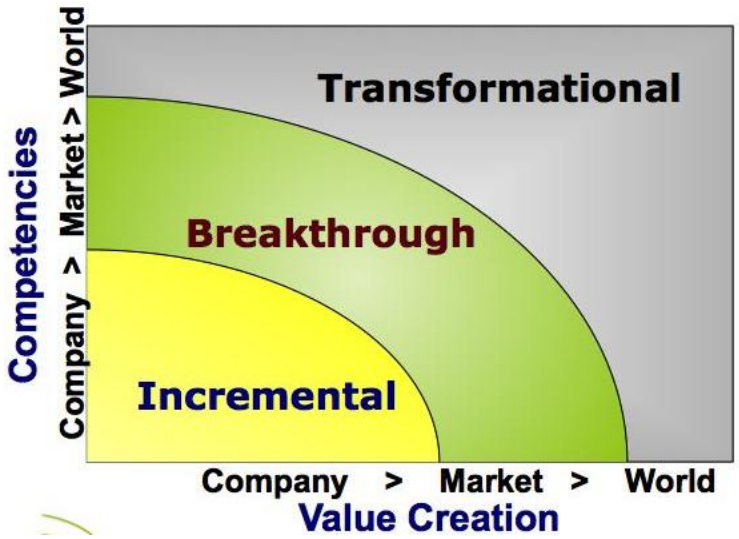


Figure 1-7 Level of Innovation (Creative Realities Desire 2012)

As it can be comprehend from above, the incremental innovation could be the best practice for small and new firms in today's rapidly changing business landscape, incremental innovation can often be unappreciated when compared to other innovation types. Business decision maker often proclaims high overall innovation failure rates, varying anywhere between 70 to 98% (web). This high level of failure and their associated risk and cost makes incremental innovation more attractive.

1.2.1 Characteristics of incremental improvement

Impact and the corresponding changes is the key difference between incremental and other types of innovation (radical or transformational). Incremental innovation is characterized by:

1- Utilizing or enhancing current core competencies and capabilities.
2- Modest technological changes from existing platforms, products, or services.
3- Responding to customer needs identified from current offers.
4- A more predictable path or process, particularly with respect to costs.
5- Often following a formal stage-gate process.
6- Prolonging the market life of a product or service while sustaining the competitiveness of existing products in the market.
7- Enabling continued growth with low risk

1.3 Best investment in innovation

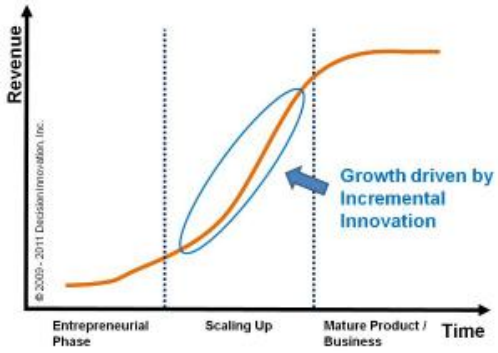


Fig Error! No text of specified style in document.**.2 Incremental innovation growth (**(Open Innovation 2014)**)**

Usually different firms have their own pipelines for innovation process. Through this framework new concepts and ideas will be evaluated and can move through the service or product innovation process within a defined level of risk.

There are different factors that can relate to the viability of incremental innovation (open innovation website 2014).

Time to market –Market opportunities are valid only for a period of time which referred to as a market window. Before this time the market demand is not high for the product or service, after this window other competitors will enter the market.

Low technology, architectural, platform or process risk - Technology, architecture, platform and process changes may take longer time than what was estimated and cause failures. Innovation activities for improvements will generally avoid these risks by limiting or avoiding changes in these areas.

Low resource risk - Incremental innovation will have a lower risk and manageable impacts on resources.

Comprehensible or obvious change for the customer base - Incremental changes will be realized and adopted by old and new costumers.

Cost or price reduction – Most of the time incremental changes are related to the cost. New technologies and processes are developed to decrease the price (e.g. beginning of the light bulb market).

Performance or effectiveness – Incremental changes often improve the product/services to match or slightly exceed the other competitors' products.

Regulatory compliance – Often Innovation may be required to match a process or product to the new regulatory or standards requirements.

Most of the time there is a lack of information for business leaders to where best to innovate. Innovation investments must find the critical balance of short term, medium term, and long term ventures that provide needed growth while preparing for long term survival. A firm often has the struggle between to different motivations; incremental improvement of current product or being aware of the signals of changes that may change rule of the game. So finding a balance between different motivations are important. A successful practices show that greater investment should to the lower risk innovation which enable the growth in near time horizon (one or two years), while leaders should always make sure that the incremental enhancements are generating the

projected returns on innovation, particularly when base innovation diffusion has moved past the early majority adoption phase.

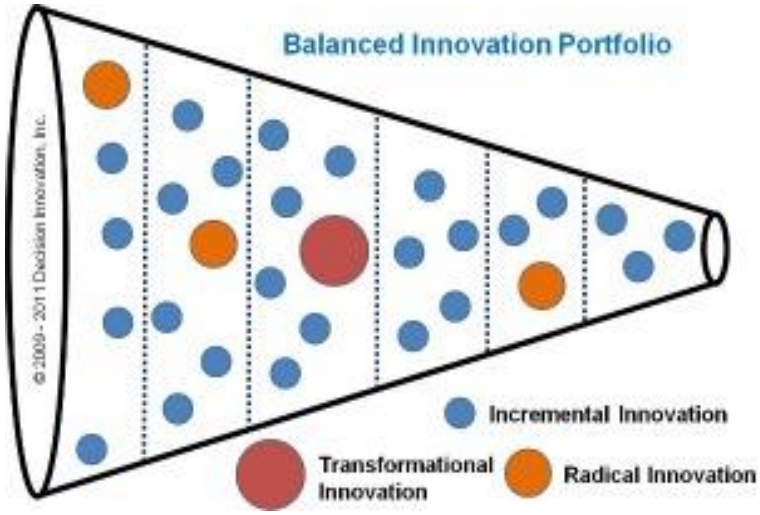


Fig Error! No text of specified style in document.**.3 Balance of innovation practices.**

Although there is some point incremental innovation is not enough to sustain the viability of the business. And there are some warning sign that can signal this. For example, when the innovation is not causing any further increase in sale or reduction of the cost or when sustaining the innovation process may cause damage the profitability. Sometime the innovation success rate after some efforts may be under the expected thresholds or the investment was more than what it was predicted. In addition if they delivery is postponed, the firm might lose the market window that innovation was supposed to penetrate.

Although the radical or disruptive innovation seems more effective and profitable but one should not be absorbed of this idea that incremental innovation are not important. In fact most growth is achieved through a steady stream of incremental innovation that is more frequent and economically predictable. The success rate of radical innovations is amazingly small, likely less than 10%.

Incremental innovation on the other hand can have added value over a time scale and result in a significant change over time, and represents continuous learning by researchers, managers, developers, suppliers and customers. Incremental change is the key source for low risk growth and successful innovation management must establish the balance between evolutionary and revolutionary initiatives that will grow and sustain the business for the short and long term.

1.4 Open Innovation

Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively.

According Henry Chesbrough, the concept of open innovation paradigm can be understood only as the direct opposite of the traditional vertical model where internal R&D activities lead to internally developed products that are then distributed by the firm. Open innovation assume that the firms should use external ideas as well as internal ideas to pave the path of their innovation to the market. It use business models to define the requirement and then required internal and external ideas to create value. It also defines a mechanism for each partner to claim some portion of that value. Alternatively,

it is "innovating with partners by sharing risk and sharing reward." The boundaries between a firm and its environment have become more permeable; innovations can easily transfer inward and outward.

The main idea in open innovation is that in today's market competiveness and globalization. A company cannot innovate only be their internal resource and knowledge. So in order to survive and innovate they have to use other companies' inventions and knowledge.

In contrast the closed innovation can be described as old traditional innovation model where all the innovation process would happen inside a firm.

According to Chesbrough in closed innovation successful innovation need control and ownership of the Intellectual property (IP). A firm should control the creation and management of ideas. Close innovation roots back to the beginning of the twentieth century when universities and governments were not involved in the commercial application of science. Some companies therefore decided to run their own R&D units. And entire product or service development was then integrated inside the company so all the innovation actions were carried out in a closed and self-sufficient way.

The period of closed innovation was between World War 2 to mid-80s. At this time the each private company had its own R&D firm and lead in a scientific research. They tried to maintain this level of innovation by acquiring best individuals (scientist and innovators) internally. In this period new companies may fail to survive due to the fact that to be able to compete they needed a large investment to establish their own internal R&D department. During this period the most of decision makers were believed that "*everything coming from outside is suspicious and not reliable*".

It is true to consider closed form of innovation as an old innovation practice. However, one should note that the birth place of innovation is closed environment. The individual are creative driving force behind an innovation, so even an open innovation will start in closed environments and often performed by individuals, scientists or employees. However, the closed innovation model was coined after open innovation model introduction by Henry Chesbrough, Don Tapscott and Anthony D. Williams. Chesbrough.

1.4.1 Open Vs Closed.

Comparison between Open and Closed Innovation

Closed Innovation Principles	Open Innovation Principles
Firm should hire smart and skilled people in the field.	Not all the smart people in the field work for the firm. Firm needs to work with skilled people inside and outside the company.
To profit from R&D, Firm must discover it, develop it, and ship it by itself.	External R&D can create significant value: internal R&D is needed to claim some portion of that value.
If firm develops and innovation itself, it will get it to the market first.	The firm does not have to originate the research to profit from it.
If the firm creates the most and the best ideas in the industry, it will win.	If the firm makes the best use of internal and external ideas, it will win.
The firm should control its IP, so that competitors don't profit from its ideas.	The firm should profit from others' use of its IP, and it should buy others' IP whenever it advances the business model.

Table 1-5 Open vs. Closed Innovation (Adapted from open innovation webpage 2014).

Open innovation offers several benefits to companies operating on a program of global collaboration (Corne and Marais 2010):

- Reduced cost of conducting research and development.
- Potential for improvement in development productivity.
- Incorporation of customers early in the development process.
- Increase in accuracy for market research and customer targeting.
- Potential for synergism between internal and external innovations
- Potential for viral marketing

Disadvantages (West and Gallagher 2006) :

- Implementing a model of open innovation is naturally associated with a number of risk and challenges, including:
- Possibility of revealing information not intended for sharing
- Potential for the hosting organization to lose their competitive advantage as a consequence of revealing intellectual property
- Increased complexity of controlling innovation and regulating how contributors affect a project
- Devising a means to properly identify and incorporate external innovation
- Realigning innovation strategies to extend beyond the firm in order to maximize the return from external innovation.

1.1.2. Models of open innovation

West and Gallagher (2006) identified different open innovation models as follow:

Product platforming: This approach involves developing and introducing a partially completed product, for the purpose of providing a framework or tool-kit for contributors to access, customize, and exploit. The goal is for the contributors to extend the platform product's functionality while increasing the overall value of the product for everyone involved.

This approach is common in markets with strong network effects where demand for the product implementing the framework (such as a mobile phone, or an online application) increases with the number of developers that are attracted to use the platform tool-kit. The high scalability of platforming often results in an increased complexity of administration and quality assurance.

Idea competitions: This model entails implementing a system that encourages competitiveness among contributors by rewarding successful submissions. Developer competitions such as hackathon events fall under this category of open innovation. This method provides organizations with inexpensive access to a large quantity of innovative ideas, while also providing a deeper insight into the needs of their customers and contributors.

Customer immersion: While mostly orientated towards the end of the product development cycle, this technique involves extensive customer interaction through employees of the host organization. Companies are thus able to accurately incorporate customer input, while also allowing them to be more closely involved in the design process and product management cycle.

Collaborative product design and development: Similarly to product platforming, an organization incorporates their contributors into the development of the product. This differs from platforming in the sense that, in addition to the provision of the framework on which contributors develop, the hosting organization still controls and maintains the

eventual products developed in collaboration with their contributors. This method gives organizations more control by ensuring that the correct product is developed as fast as possible, while reducing the overall cost of development.

Innovation networks: Similarly to idea competitions, an organization leverages a network of contributors in the design process by offering a reward in the form of an incentive. The difference relates to the fact that the network of contributors are used to develop solutions to identified problems within the development process, as opposed to new products.

Throughout the years several factors emerged that paved the way for open innovation paradigms:

- The increasing availability and mobility of skilled workers.
- The growth of the venture capital market.
- External options for ideas sitting on the shelf.
- The increasing capability of external suppliers

These four factors have resulted in a new market of knowledge. Knowledge is not anymore proprietary to the company. It resides in employees, suppliers, customers, competitors and universities. If companies do not use the knowledge they have inside, someone else will. Innovation can be generated either by means of closed innovation or by open innovation paradigms. There is an ongoing debate on which paradigm will dominate in the future (Chesbrough 2003).

1.4.2 Terminology of open innovation

Modern research of open innovation is divided into two groups, which have several names, but are similar in their essence (discovery and exploitation; outside-in and inside-out; inbound and outbound). The common factor for different names is the direction of innovation, whether from outside the company in, or from inside the company out. These groups is subdivide from the monetary point of view (Busarovs 2013):

Revealing (non-pecuniary outbound innovation): This is the type of open innovation is when a company freely shares its resources with other partners, without an instant financial reward. The source of profit has an indirect nature and is manifested as a new type of business model.

Selling (pecuniary outbound innovation): In this type of open innovation a company commercializes its inventions and technology through selling or licensing technology to a third party.

Sourcing (non-pecuniary inbound innovation): This type of open innovation is when companies use freely available external knowledge, as a source of internal innovation. Before starting any internal R&D project a company should monitor the external environment in search for existing solutions, thus, in this case, internal R&D become tools to absorb external ideas for internal needs.

Acquiring (pecuniary inbound innovation): In this type of open innovation a company is buying innovation from its partners through licensing, or other procedures, involving monetary reward for external knowledge

1.5 Innovation Discontinuity

Most of the time, innovation takes place within a set of rules which are clearly understood, and involves players who try to innovate by doing what they do (product,

process, position, etc.), but better. Some firms manage this process more efficiently than the others but the framework is the same thing that has been accepted widely. But so often there might be changes that completely change these rules and framework. They might redefine the capacity, requirements and condition under which innovation takes place. They will open up new opportunities however might challenge and obsolete the current players and situation and reframe the whole procedure by the invasion of new changes. This is what Schumpeter called creative destruction in his theory of innovation. The steady state innovation are usually going through an established pipeline of conditions and regulations but this occasional discontinuities can cause one or more of these basic conditions (Technology, market, social, regulations etc.) shift dramatically. In the following table which taken directly from (Tidd 2006), Some of these examples are presented.

Under this situation, the general idea of incremental innovation (we do what we do but better) is not enough anymore and maybe be inappropriate to the new challenges that disruptive innovation will bring. To deal with these new conditions we need new set of rules in order to develop and steady state condition again. In some literatures the pattern of disruptive innovation where initially divided in three phases. First one is what is called fluid phase in which there is high uncertainty along in two aspects. First the target in terms of what is going to be next framework and who will be the customer of it. Second the technical in term of how should new technology to build and deliver this innovation(Tidd 2006).

In this phase no one knows the right configuration of technology tools and markets. It required many experiences and possible failure and learning. But eventually the knowledge from these experiences converges around a dominant design which new set of rules will be defined inside of it. This convergence is around the most popular solution - not necessarily the most complicated one. At this point the innovation options become increasingly channeled around a core set of possibilities which called technological trajectory. The entrepreneurial interest and resources are focus on these possibilities so going out of this domain is not possible. The key characteristic becomes clearer after experimentation and the bugs refinement were done. In this phase there is co-existence of old and new technologies. It is the phase that mostly referred to as sailing ships where both technologies have rapid improvement.

Innovation characteristic	Fluid pattern	Transitional phase	Specific phase
Competitive emphasis placed on …	Functional product performance	Product variation	Cost reduction
Innovation stimulated by …	Information on user needs, technical inputs	Opportunities created by expanding internal technical capability	Pressure to reduce cost, improve quality, etc.
Predominant type of innovation	Frequent major changes in products	Major process innovations required by rising volume	Incremental product and process innovation
Product line	Diverse, often including custom designs	Includes at least one stable or dominant design	Mostly undifferentiated standard products
Production processes	Flexible and inefficient aim is to experiment and make frequent changes	Becoming more rigid and defined	Efficient, often capital intensive and relatively rigid.

Table 1-6 Stages in the innovation life cycle. (Tidd, Bessant and Pavitt, 2005)

Market may have the same effect and be the starting point of disruptive innovation. The history is full of companies with mulit-million investment in R&D which failed just because they fail to see the new emerging markets and demand.

Most of them fail to pick up the signal of change that coming from the user needs and change their product with it. Sometimes these signals become so strong and can eventually make the market disruptive and change the rules of game.

1.6 Innovation Diffusion

As defined by Everett Rogers (2003), "*The process by which an innovation is communicated through certain channels over time among members of a social system. Diffusion is the process by which a new idea or product is accepted by the market. The rate of diffusion is the speed that the new idea spreads from one consumer to the next*".

Many studies tried to find the factors that influence adoption and diffusion of innovation. Roger 2003 listed the following as characteristics of an innovation that affect diffusion (E. Rogers 2003):

Relative advantage: the extent of benefit and differentiation that new innovation will bring to the market in respect to the current technology and product: this could be quantified by cost as economical measure and non-economical measures such as new features, convenience, user satisfaction, etc. The degree of advantages that new product or process has in respect to its precedence will determine the rate of the new innovation adoption.

Compatibility: the extent that the new innovation as product/process is compatible with user and market needs, values and standards etc.

Complexity: the extent that an innovation is difficult to understand or use. The simpler that an innovation is, faster users will be adopt to it.

Trialability: the extent which an innovation can be put to trial and experimentation on a limited basis. Trialablility shows the degree of uncertainty to the adopters and will present the degree that adopter can learn by doing. The higher trialability generally accounts for higher rate of adoption. It shows the weight of desirable and undesirable consequence of adoption innovation.

Observability: the extent which the results of an innovation are observable to adopters. The easier it is for adopters to see the advantages of new innovation, the faster will be the adoption rate.

The following table which was chosen from Frambach and Schillewaert (2002) study on organizational innovation adoption. Summarize innovation adoption as factor as follow:

Relationships between probability of organizational innovation adoption and determinants

Independent variables	Reported relationship	Selected related research
Perceived innovation characteristics		*In general*: Ostlund, 1974; Tornatzky and Klein, 1982; Holak and Lehmann, 1990; Rogers, 1995
Relative or economic advantage	Positive	Robinson, 1990; Mansfield, 1993
Compatibility	Positive	Holak, 1988
Complexity	Negative	Rogers, 1995
Trialability	Positive	Rogers, 1995; Mathur, 1998
Observability	Positive	Rogers, 1995
Uncertainty	Negative	Ostlund, 1974; Holak et al., 1987; Nooteboom, 1989; Venkatraman, 1991
Adopter characteristics		
Size	Positive	Kennedy, 1983
Organization structure	Varies	Influence depends on the characteristic; see e.g., Zaltman et al., 1973; Kimberley and Evanisko, 1981; Cohn and Turyn, 1984; Damanpour, 1991
Innovativeness/ strategic posture	Positive	Morisson, 1996; Han et al., 1998; Hurley and Hult, 1998; Srinivasan et al., 1999
Social network		
Interconnectedness	Positive	Zaltman et al., 1973; Lind and Zmud, 1991; Fisher and Price, 1992 (consumer context)
Supplier marketing activity		
Targeting/Communication	Positive	*In general*: Robertson and Gatignon, 1986; Easingwood and Beard, 1989; Ram and Jung, 1994; Hultink et al., 1997; Frambach et al., 1998
Risk reduction	Positive	
Environmental influences		
Network externalities	Positive	Markus, 1990; Katz and Shapiro, 1994
Competitive environment	Varies	Kamien and Schwartz, 1982; Robertson and Gatignon, 1986; Baldwin and Scott, 1987; Gatignon and Robertson, 1989

Table 1-7 Innovation adoption factors (Franbach N 2002)

Processes of diffusion have been studied by different authors (E. Rogers 2003). Their researches mostly attempt to identify the factors that influence the rate of adoption of an innovation (slop of the curve). The diffusion of innovation usually is an S-shape curve. At the beginning the rate of adoption is low and only consists of group which called innovators. Next group is early adaptors and then early majority. Then the slope is reduced at top and becomes negative for late majority and laggards. Many studies has been identified the same pattern for separate product but failed to define a generic model for adoption (Tidd 2006)

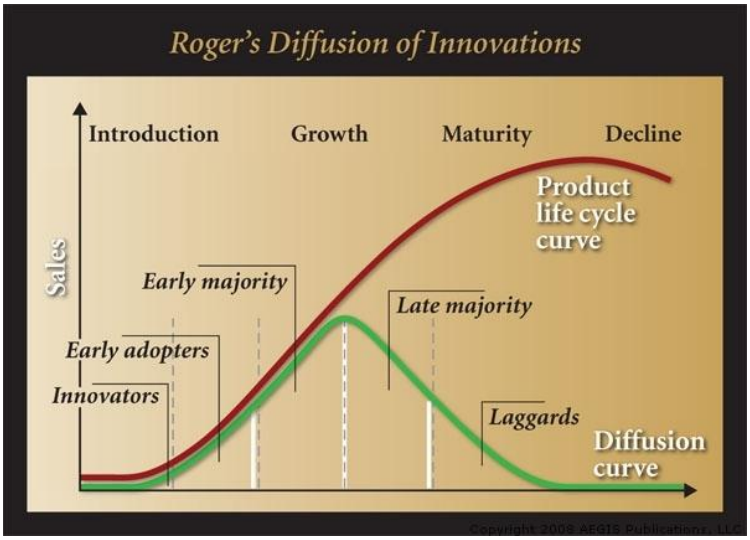


Fig Error! No text of specified style in document.**.4 Roger's Diffusion of Innovation.**

Tidd (2006) concludes that in practice the pattern of adoption is mostly depend on interaction of demand vs. supply factors and mentioned following models:

Demand-side models	based on	Assumption	Disadvantage

Epidemic	direct contact with or imitation of prior adopters and based on communication, and the provision of clear technical and economic information	A homogeneous population of potential adopters. Innovations spread by information transmitted by personal contact and the geographical proximity of existing and potential adopters.	Assume all potential adopters are similar and have the same needs overstate the importance of different adopters underestimate the effect of macroeconomic and supply-side factors
Bass	adopters consisting of innovators and imitators	Two different groups of potential adopters which need two different marketing processes: innovators, who are not subject to social emulation; and imitators, for whom the diffusion process takes the epidemic form	No threshold for adoption overstate the importance of different adopters underestimate the effect of macroeconomic and supply-side factors
Probit	adopters with different benefit thresholds	Adopters know the value of adoption Different threshold values for costs or benefits. Innovation will be adopted beyond some critical or threshold value. Differences in threshold results different rates of adoption.	unrealistic assumption that adopters have perfect knowledge of the value of an innovation
Bayesian	adopters with different perceptions of benefits and risk	Adopters lack of information as a constraint to diffusion Adopters have different beliefs about innovation Revision upon innovation trial test No imitation due to the this private trial	sophistication

Table 1-8 Demand-side diffusion models (Inspired by Tidd 2006)

The characteristics of the innovation and nature of adopters will determine which of these four models is better for a firm to employ. The simple epidemic model will provide a good fit to the diffusion of new processes, techniques and procedures. The Bass model is the best fit for the diffusion of consumer products. In general, both models work best where the total potential market is known, that is, for derivatives of existing products and services, rather than for totally new innovations.

All demand-side models have limitations:

1- Apart from criteria like threshold values, the assumption of relatively homogeneous adopters does not consider the possibility that rationality and effectiveness of adopting an innovation may vary from adopter to adopter.
2- They all assume that the population of adopters is constant at the start and end of diffusion time period. However research shows that population of potential adopters may vary by the changing of innovation during diffusion period.
3- They only emphasis on demand side of diffusion process and do not consider supply side factors.

Sociological models are more focus on the relationship between demand- and supply-side factors. .

Supply-side models	Based on
Appropriability	relative advantage of an innovation
Dissemination	the availability of information
Utilization	the reduction of barriers to use
Communication	feedback between developers and users

Table 1-9 Supply-side models (Inspired by Tidd 2006)

This chapter starts with an introduction to innovation followed by small historical review. Then an introduction to innovation models was made followed by different generation. Next we have reviewed various models of the innovation process, and some of the empirical research that has contributed to them. At first different type of innovation and their characteristic were discussed. Then incremental innovation was recognized as the best practice for small and new firms. Furthermore the open or closed models of innovation were discussed and benefits and disadvantages of both were presents. Then some points were made about discontinuous nature of innovation and how to deal with this discontinuity. The last part was dedicated to the marketing of innovation diffusion and adoption of innovation into the market.

2. Innovation in SMEs, Key enablers – a literature review

The importance of SMEs as backbone of European economy, has been recognized more and more in this decade. SMEs are primarily responsible for wealth and economic growth, next to their key role in innovation and R&D. In Europe, SMEs account for 99 out of every 100 businesses and 58 cents in every euro of value added and 2 in every 3 employees are working in a SME. The five key sectors in EU economy are manufacturing, construction, business service, accommodation and food, wholesale and retailed trade which accounts for 78% of all SMEs (European Commission 2014a).

Globalization and current competitiveness in market force SMEs to innovate to survive. Without innovation SMEs are more likely to perish from as soon as they emerge because of competitive nature of the market(J. H. Love and Roper 2015). So establishing innovation capacities for European SMEs is a most. According to Golovko and Valentini 2011, there is strong relationship between innovation activity of a SME and its exporting and growth. Evidence shows the SMEs which have prior innovation experience are more likely to export, more likely to grow for exporting than non-innovating ones. European SMEs that export grow more than twice as fast as those that do not while international active SMEs are three time more likely to introduce products and services that are new to their sector than those which are entirely domestic in orientation(Golovko and Valentini 2011).

In this chapter, we will argue first the necessity of innovation for SMEs and further more discuss the key enabling factors that helps SMES to be innovative.

According to European Union internationalization survey (European Commission, 2010) approximately half of internationally active SMEs also innovated. Since around one-quarter of the sample exported, this suggests that the majority of SMEs neither export nor innovate, and very few do both, a fact that should be borne in mind (J. H. Love and Roper 2015). Before assessing the evidence on the enablers of SME innovation, it is worth clarifying what we mean by ‘innovation’. We chose a broad perspective here, which means both the technological and non-technological dimensions of innovative activity are included as well as the potential for both radical and incremental changes.

Love and Roperet 2015 carried out an evidence based research on the enablers of SME innovation and exports into three main sections. They divided they works on two main groups of enablers mainly internal and external innovation enablers. Internal factors -or what Wisdom et al. (2014) called organizational characteristic for innovation adoption- are those capabilities of SMEs itself which are linked to innovation success and External enablers of innovation focus on those elements of the operating environment which may either enable or hinder innovation performance e.g. governmental financial help programs for SMEs, financial crisis etc. in this study the same categorization has been employed.

2.1. Internal enabling factors of innovation

There is a good research background about strengths and weaknesses of innovation in SMEs (Lee et al. 2010). It is believed that typically, smaller firms have advantages in terms of rapid decision-making, willingness to take risks and flexibility in responding to new market opportunities, however innovation in SMEs is more of incremental type more due to the lack of resources and higher risk of radical innovation; in contrast, larger firms have advantages linked to scale and the availability of specialist resources. This means that 'the relative strengths of large business are predominantly material (economies of scale and scope, financial and technological resources, etc.), while those of small firms are mostly behavioral (entrepreneurial dynamism, flexibility, efficiency, proximity to the market, motivation)' and the innovation activities in large firm are both radical and incremental (Wisdom et al. 2014).

In this section, we review the evidence on the internal enablers of SME innovation– skills, finance, research and development (R&D), and so on. A key theme which emerges is the resource-constrained nature of many small firms and therefore, their dependence on the broader eco-system with in which they are located. The availability and accessibility of these external resources are the focus of section 'External enablers of innovation and exporting'.

- **Leadership and people management and skills**

Different technologies and different markets require different skills. Also at different stages of innovation different skills are needed for example at developing stage skilled technical staff or creative staff plays the key role and in the commercialization or diffusion of an innovation, marketing staff plays.

Organizational leadership and managerial staff plays an important role in adopting an innovation too. According to Wisdom et al., 2014 the empirical evidences show that Managerial and organizational support of innovation are positively associated with adoption of innovation. Efficient innovation team management and collaborative relationships between staff that are engaged in innovation action are very important. Mangers are the people who like order. They want to have forecasting and plan for every aspect of their work and their work usually evaluate by the order they produced. However innovation often means disorder process. Most of the time its outcomes are different from what was planned. So there always is a tension between managerial issues of innovation. For SMEs it is of most importance to hire organizational structure and managerial capacity for innovation.

Globalizing markets and increasingly open models of innovation therefore, cause significant skills and people management challenges for smaller firms. This, in turn, emphasizes the importance for SME innovation of the national 'skills ecosystem' and related legal, vocational education and industrial relations systems (Tödtling and Kaufmann 2002).

A SME can use partnering or collaborative working for innovation and also accesses external skills through these potential channels and overcomes its internal skills limitation. Collaborative relationship also shows a great skills and people management. In a study in Italy the significant combination of technical skills and technical skills and networking competences as well as relevant relational capital has been identified (Wisdom et al. 2014)

While there has been considerable discussion about innovation strategy in the research literature (Wisdom et al. 2014), (J. Love and Roper 2013), (Lee et al. 2010), the current

state of knowledge is characterized by '*conflicting theoretical predictions, persisting knowledge gaps and theoretical inconsistencies*'. Relatively few focus specifically on innovation strategy in SMEs, suggesting few areas of agreement in terms of the best innovation strategies. For example, while there is much discussion of born global' firms, there is evidence that for many SMEs exporting is an opportunistic and sporadic activity, rather than a strategic priority (J. H. Love and Roper 2015). One area of strategy in which there is growing consensus, however, is the choice between closed and open innovation and the extent of SME external knowledge search. Here, the evidence (J. Love and Roper 2013) points strongly towards the superiority of open models of innovation – particularly for SMEs – and in particular to innovation partnering along supply-chains. Such partnerships may help both to increase levels of innovation in the short term but also to help SMEs sustain their innovation success.

The evidence provides strong support for the reinforcing impacts of innovation (Golovko and Valentini 2011). The importance of leadership in shaping innovation outcomes and differences between the appropriate leadership styles for innovation in larger and smaller firms have been noted. In larger firms, there is positive evidence of the relationship between transformational leadership and organisational innovation (García-Morales, Lloréns-Montes, and Verdú-Jover 2008); however, such effects appear strongly moderated by organisational size. This suggests that innovation in SMEs may benefit more from transactional leadership styles as SME leaders are able to monitor and reward employees more effectively (Vaccaro et al. 2012).

- **R&D**

In house R&D generates knowledge for innovation. R&D capability is one of the most praised factor that linked to innovation outputs, a relationship which is stronger in research-intensive industries. R&D might be considered to be less important in low-tech manufacturing and service sectors however the evidence suggests positive R&D–innovation relationships. R&D is associated with innovation by two main mechanisms: first, R&D may create new knowledge which provides the basis for innovation and second, skilled R&D staff may increase absorptive capacity, that is, the ability to assess, access and absorb external knowledge (Love, Roper, 2015).

In larger firms, R&D may be formally organized in a specific department or unit. In the most of SMESs, reflecting the nature of innovation activity itself, R&D activity – where it takes place – is more often informal, ad hoc and opportunistic (Love, Roper, 2015). R&D in SMEs is also less likely to be a specialist function than in larger firms, with development work often being undertaken by skilled employees or senior management. One implication – strongly supported by the empirical evidence – is that innovation in smaller firms is less dependent on internal R&D than that in larger firms and more dependent on external knowledge obtained either through partnerships or spillovers (Love, Roper, 2015).

In case of exporting, innovation in forms of product and process is more important than R&D, mostly because the ability of firm to compete in global market is rather influenced by firm's capacity to compete in those kind of market than their investment in research .

- **Organizational capacity**

Absorptive Capacity, is the capacity of organization to utilize innovation and existing knowledge. Organization who has a good background in innovation and preexisting

knowledge and skills have the more capacities and willingness to incorporate new knowledge and innovation. (Aarons el al 2012, Wisdom et al. 2014).

Another factor can be discussed is Norms and values and cultures that govern the organization, they plays critical role in adopting an innovation. Shared professional values and customer centeredness and spirit of problem solving are highly associated with innovation adoption capacity of SMEs (Wisdom et al., 2014).

As mentioned before operational size and structure of a firm has a close relationship with type and risk of innovation that they can acquire. Organization resource and size are also substantial for innovation. (Love, Roper, 2015)

SMEs Capital investment and equipment every year individual firms update their technologies through fixed capital investment, and hire new technologies. As matter of fact these purchases is another way in which innovative SMEs overcome internal resource limitations (Love, Roper, 2015). Pellegrino, Piva, and Vivarelli (2009) studied young innovative Italian SMEs and found that purchases of machinery and equipment were the crucial driver of innovative outputs. Procuring such capital, depend on the accessibility of investment finance which may be a particular issue for young innovative SMEs.

- **Internal financing**

SMEs always face problems in acquiring external finance for innovation. The commercial and technical risk associated with their innovation actions is of the most concern. In the early stages of development – exploration of market potential, product or service development – the mix of uncertainty and risk make it difficult for them to present a robust case for potential finance investors, which leads to significant rejection rates. But these issues can be reduced when a robust business case once the initial risks are overcome and the focus moves to the establishment of operations, market introduction, and so on. Even in this stage, commercial risks may be significant, especially in situations where innovation is not protected by either strategic or legal frameworks. This matter increase the focus on the internal financing of such projects (Love, Roper, 2015).

Some studies showed the role of internal financing on expenditure on R&D, generally identifying positive relationships between cash-flow, liquidity and R&D investment (Love, Roper, 2015). It is also suggested that internal funding is more important for innovation in smaller firms than for larger companies – perhaps reflecting stronger external market constraints on the former. Where there is evidence of market failure, this suggests the potential value of public intervention to help potential SME exporters and innovators overcome initial entry/R&D costs and expand their range of products, services and markets (Love, Roper, 2015).

- **Design**

It is suggested that design as a contributor to innovation success in one of the enabling factor. The increasing design efforts leads to a wider range of products and the ability of designers to enhance a product's functional value. Design-driven product development processes may lead to the development of more radical innovations. Evidence from innovation surveys also suggests a positive linkage between design investment and innovation outputs. (Love et al., 2011).

SMEs face some difficulties in this regard. First they may have particular behavioural, cultural and resource issues that reduce their ability and willingness to establish design

as part of their innovation activity. Second lack of knowledge and insight may make it hard for SMEs to understand the potential value of design for innovation success. Third, communication difficulties may mean they find it difficult to relate to designers and establish common objectives and aspirations. Fourth because of limited recourse particularly human and financial resources make it hard for SMEs to have internal design resources and, therefore, they are more dependent on external providers. Again, this issues show the need of the availability of external design resources and the potential value of support measures which help SMEs to embed design practices (Design Council, 2012)(J. Love and Roper 2013).

- **Intellectual property management**

Patents, protected designs and copyright play key roles in innovation. It has been suggested that SMEs are reluctant towards IP regimes due to the costs of IP registration and protection. Again, financial issues of SMEs may cause this matter and make SMEs less able to adopt a technology-swapping mechanism to defend their IP rights than larger companies with a wider patent portfolio. Lichtenthaler (2010) provide evidence that larger patent holdings may also be more conducive to open innovation. Levels of IP activity among SMEs also vary between regions and sectors; however, there is little consistent evidence of any clear association between IP activity and either SME growth or survival as Rogers et al. (2007) conclude:

These findings support the view that SMEs see value in registering their innovations to acquire IP protection … the view that SMEs may be so financially disadvantaged, or lacking in information about IP assets, that they do not widely use these systems of protection is rejected by this study. (p. 41)

IP protection strategies are different in SME from larger firms and are more focusing on speed to market and secrecy rather than patenting. However there is an exception in firms working with Universityies (R&D intensive and science based small firms), which patent is still an improtant tool to aquiring returns from innovation. For these firms, patent is a signaling tool that attracts customers attention and increase venture capital investment.(Wisdom et al. 2014)

- **Social network (inter organizational)**

As in mentioned before informal inter organizational network and intercommunication has a positive effect in innovation in SMEs. It may drive the individual creativity and boost the competitiveness between skilled staff to develop ideas and being innovative. This internal communication or what Love et al 2015 called “Social climate” play an important role in innovation adaptation in SMEs. Factors such as Positive social influence, social learning may increase social pressure on staffs and leaders to adopt an innovation in an organization. Apart from that there are some evidence that showed in house training programs, Organizational training and management support for training are associated positively with innovation. This will increase the Traits and readiness and Receptiveness for change which is in nature of innovation both in terms of organizational, nontechnical and technical innovation action. The knowledge and skilled with higher level of experience and broader insight will lead to increase innovativeness of SMEs and risk reductions.

- **Network with innovation developers and consultants**

Especially in case of SMEs this factor can be very important. As a SME might not have the knowledge, trained staff and capacities for innovation development (Love, Roper,

2015). The effect of consultant and professional association evaluated as a positive effect (Wisdom et al., 2014).

Many studies have been conducted about internal factors that enables SMEs to innovate which elevate our understanding of these factors, although there are many areas that have not been address and more research is required. According to Love et al. 2015 there are four main areas in which there is broadly based and consistent evidence:

1- High quality skills which will vary according to different innovation strategy. There should be a matched between technical skills and values of networking and team-working skills.

2- The relationship between R&D and innovation across all firm size bands and industries are noted as positive. This will lead to both the knowledge creation and absorptive capacity effects of R&D.

3- Capital investment and innovation success show relatively consistent and positive relationship, although there are relatively few studies in this regards.

4- A positive relationship exists between innovation activity and strong cash-flow and liquidity.

There are some areas that there is not much evidence base they are as follow:

1- Relationship between different skills indicators and firm's level performance outcomes is clear but the role of management and personnel engagement is not obvious.

2- There is not much analysis for SMEs regarding the values of design for innovation, however strong positive relationship has been suggested.

3- Relatively little is known about beneficial effect of IP management and its performance

4- There is a limited evidence on relationship between business strategy and innovation success in SMEs. emerge

2.2.External enablers of innovation

By emerge of OPEN INNOVATION model, the degree to which the innovation activities of SMEs depend on external resources become more and more evident. The open innovation cause open network and partnership of innovation, where resource of knowledge and innovation risks will be shared. For SMEs this changed the perception of innovation supporting activities in reach of leaner and most effective innovation strategy. Open innovation for SMEs will provide a tool to overcome their resource limitation in innovation activities. By sharing the risk and innovation sources smaller firms can adopt their resources and seek new opportunities through shared the activities. However, the environment and eco-system that SMEs are operating in can provide them more opportunities and partners if this eco system is stronger and innovation based.

In this part, a review on the evidence regarding the key external enablers of SME innovation will be discussed. The key external enabling factors are as follow:

- **External Environment:**

knowledge base of a SME and their capacity for innovaiton can be enhance by external linkage and factors. This could be through interactive and non-interactive forms of learning. The former is close to open innovation strategy and based on strategic relationship between firms and external knowledge creators. In the second form there is no reciprocal knowledge and resource transfer and considered as closed innovaiton model(Wisdom et al., 2014). SMEs could benefit from their local position and use the un-priced flow of knowledge and information through their social contacts and channels. For sure this could requires strong and well connected local industrial eco-system and can be enhanced by local competition (Chesborough, 2003). Indeed, recent evidence indicates that SMEs shows more and more tendency toward open in recent years (Van de Ven Vernon 2000).

Also evidence indicates that in case of diversity's of firm's portfolio of external alliances, smaller firms benefits more from open relationships rather larger firms. (Love and Roper 2013). There are other indications which shows strong dependency on sectorial rather than regional factors. For example there are some evidence that openness benefits may be weaker in services mostly because a firm lacks the managerial routines to take advantage of these external knowledge sources. Also Innovation adoption shows some association with competitive environments and extra organizational activities in SMEs. For example development of environment and urbanization has positive effect on SMEs (Wisdom et al., 2014).

- **Government Policy and regulation**

External policy and regulation can encourage innovation in SMEs through specific enactment of policies, legislation or regulation. Supportive regulation with financial incentives and reward system can enhance the innovation in SMEs. (Wisdom et al., 2014). Collaborative program have an important role in this regard by lowering the financial risk and easing supply constraints. Innovation projects funded by governments –usually if forms of public grants or loans can have a considerable positive effect on SMEs private R&D activity and subsequent on the business including reducing the cost and risk of R&D to firms, contributing to developments in human resources, improving absorptive capacity, generating reputational effects and creating cost savings through collaborative R&D and the sharing of research results area. However it is worth mentioning that there is bias toward technological support for innovation rather than non-technological (very important for manufacturing). There has been weak support in the past for non-technological support but there are some international examples of effective policy in this area (Freel, 2005).

According to Love, Roper, 2015, a study on SMEs in the United Kingdom shows that public support for innovation is both effective and efficient. This research using a sample of around 10,000 SMEs, found that SMEs with public support for innovation were significantly more likely to innovate and that innovators grew faster than non-innovators. First, it points out that public support has a significant positive impact on the return and medium-term performance of supported firms, related to stronger business growth. Second it has a considerable positive effect on business R&D and innovation and help SMEs remain competitive in their business both domestic and

overseas markets. Third, it can have a direct and great positive impact on business skills and export know how of SMEs, helping them to overcome the internal resource constraints.

- **Social network inter-system**

Social network and contact with other entities outside can help SMEs to innovate. It could promote competitiveness among organization in the same industry section. Lack of external linkage such as advisory board and regulatory agencies and lack of coordination between systems such as governance and administrative system, in contrast, shows a negative effect on SMEs (Wisdom et al., 2014).

The openness for partnering and engagement of SMEs in relationship with other firms in order to collect knowledge about technology and market will enhance innovation. These relationships can be diverse such as informal and formal, collboratice of contractual.

According to Wisdom et al., (2014) not only the extent of openness is matter but the nature of that openness is important too. Study of 1500 European SMEs shows that customers are often a source of innovation inputs. Linkages with Universities and research centers require greater expertise and absorptive capacity, which SMEs are more likely to lack these elements. This kind of relationship is exposed to risk due to the fact that research outcomes might not have commercial applicability and larger firms are well-equipped to handle these risks. In other cases such as supply-chain linkages (with customers and suppliers) are not very common innovation linkage for SMEs but show a positive effect on innovation performance.

- **Learning by Marketing**

By marketing and exporting, firms gain knowledge about market and also potential innovation demand. Such learning is more effective when the targeted market is knowledge intensive and highly competitive (Love, Roper, 2015). SMEs networks and linkages are good sources of knowledge. By learning through this, firms can avoid the information and set-up cost for entering new markets which due to the financial restriction and limited knowledge of SMEs could be a vial source.

Market demand has a key role in shaping innovation performance of firms. This can come from customers that can be intermediate, public sectors or other companies. There are two important elements of demand that affect innovation; first is adoption speed of firms, customers and public sector to new innovation and second is the key role of customer in articulating a demand for innovation (Love and Roper 2013).

As internal factors, there is significant progress in recent years in understanding of role of the external factors of innovation. The debates can be categorize mostly in two areas. Strategic debates that investigating open innovation and partnering of firms and its effects on firm innovation performance and knowledge collection. The second type of debates are devoted to policies and potential impact of changes in framework conditions and business eco-systems. But there has been a great agreement on external factors significant effect on the innovative of SMEs. Although the scale of and size of effects are strongly depended on firms capacity and willingness to take advantages of these factors.

In summary, there are five areas in which the evidence is consistent:

1- Firms openness and open innovation strategy

2- The firm's outside linkage and strong eco-system that can increase firm's absorptive capacity.

3- Public support in forms of financial incentives and loans, etc.

4- Market demand which encourage firms to innovate and export.

5- Consumer and user led innovations which has a catalytic role of public procurement in SMEs development.

There are also some factors that still requires more discussion and evidence:

1- Local position of SMEs, also the positive effect is known but relatively little has been said about the mechanisms through which the gains from being there operate, particularly for SMEs.

2- The Eco-system characteristics which lead to innovation success.

3- The types of purposive linkages will lead to greater benefits.

2.3.Innovation SME performance

There has been a long recognition of innovation as a key factor for competition and dynamic efficency of the market. Innovatitors will take market share from non-innovators and grow faster and benefits more in long term. There are many studies regarind the postitive relationship between innovation and firms peformances (mostly in manufacturin). Many of these studies used some form of production indicator realting innnovaion (input-output) to some aspect of the firm's performance (productivity) (Roper et al., 2008). Some studied a positive relationship between both product and process innovation and productivity, while others showed a positive association between innovation and growth (in employment and/or sales) (Freel and Robson 2004).

In case of SMEs, evidence still are limited and often simplified to small sample sizes and relatively simplistic econometric analysis/ but mostly they fail to address issues such as the simultaneous relationship between innovation and performance or issues of self-selection (e.g. better performing firms choose to innovate, rather than innovation improving performance) (Love, Roper, 2015). According to Cainelli et al., (2006), exploring Italian firms, there is a two-way relationship: innovative firms overtake non-innovators, but better performing firms are also more likely to innovate and to dedicate much of their resources to innovation.

Innovation and exporting

As mentioned before, globalization and internationalization of SMEs is a most. To survive in competitive market and growth, SMEs have to target international market. Exporting play and important role in this regard. There is a strong link between Innovation and R&D activities and exporting capabilities of SMEs. According to Golovko and Valentini (2011), there is solid relationship between innovation activity of a SME and its exporting and growth.

These studies shows SMs which have a prior innovation epirience are more likely to export and reach outside market than non-innovators. European SMEs that export, grow more than twice as fast as those that do not while international active SMEs are three time more likely to introduce products and services that are new to their sector than those which are entirely domestic in orientation (Love, Roper, 2015).

Innovation and exporting are interconnected and have interactive relationship. As innovation can have positive effect on SMEs exporting capabitlies, eportint can provide SMEs with the knowledge and exirience about market and it demand which help them to innovate (Love, Roper, 2015). A survey of 9480 SMEs in 33 European countries showed a strong positive relationship between internationalization (including exporting) and innovation (European Commission, 2010). Other study on 1400 Spanish SMEs over a 10-year period suggest that only SMEs that both innovate and export generate significantly greater sales growth: simply doing either exporting or innovation is not enough (Golovko and Valentini 2011). It concludes that the strong positive relationship between exporting and productivity is more likely to be through (product) innovation.

In summary, in innovation performance, there is general agreement on two key factors:

1- Strong relationship between innovation and firm's performance in terms of productivity and growth

2- Innovation and exporting are interconnected and interdependency

In summary the most important barriers for SMEs to innovation is lack of resources. And the most major limited resource for SMEs is financial investment in innovation. Shortage in other resources such as human resource, skilled staff and managers with knowledge and awareness of innovation process are the other barriers for SMEs to innovation. Other factors such as risk of innovation, uncertainty in the nature of innovation make it less desirable for SMEs, particularly young SMEs.

Lack of awareness and familiarity with innovation process and its advantages could be considered as a barrier too. In addition this lack of knowledge may include not even innovation process itself but it may be lack of knowledge in financial source aids such as research funding programs, network of research, governmental policies etc. this will cause disability of SMEs to access research and knowledge.

It has been concluded that internal innovation-drivers factors consist of skills upgrading and support for investment in R&D, design and capital equipment, also access to finance has an important role by increasing SME liquidity and cash-flow. However it should be taken into the account that access to finance should be accompanied by specialist advice or mentoring and training about innovation development. There is less evidence about the investment policy base for SMEs. For example there are not many research on investment policy (such as design and IP management), and people management and engagement (Love, Roper, 2015).

As with the internal enablers of innovation, the importance of external enablers of innovation has been demonstrated. External factors such as the eco-system within which SMEs operate including both private and public institutions. However building an encouraging eco-system is an essential, but it is not sufficient, condition to promote innovation success among SMEs (Love, Roper, 2015). In case of SMEs, research on eco-system mechanism still need further work. One review on UK ecosystem for SMEs identified five aspects as most important ones; the public research base, competition and entrepreneurial activity, human capital and infrastructure and services (Allman et al. 2011). It is also suggest that innovators SMEs are more likely to experience higher rejection rate when applying for loan (Love, Roper, 2015).

The evidence also suggests that general promotion of liquidity in SMEs is important for innovation, and also particularly initiatives to make these activities less risky through loan or credit guarantees are important in improving access to finance for innovative SMEs (OECD), 2010). But the eco-system is most valuable when SMEs can take full advantage of the resources it offers. Therefore a firm's internal absorptive capacity – itself strongly dependent on skills and R&D investments – should be taken into the account and it is also depended on SME ability and willingness to develop innovation partnerships. This is where public agencies can play a key role in helping SMEs to overcome informational barriers and identify innovation partners.

Public policy is so important too. The recent evidence shows that even if a firm itself is not particularly open of well connected to a network, its operating environment of competitive innovation network will help them to benefit in innovation terms.

At last but not least, market demand is considered as an important factor. Knowledge about market situation and demand could help SMEs to set their target and respond effectively to this demand and set its innovation plan toward what called now market innovation. However this will need client attitudes, beliefs and readiness toward change and willing to adopt innovation.

3. Innovation measures

Innovation is a major driving force for economic growth and development of companies. The globalization of markets caused a very competitive environments for companies. The rapid technology evolution, fast changing market, more customer demand trends requires high quality new product/process to be efficiently and effectively answer to this demand. Innovation play a key role is to transform firm's inner capabilities, making it more adaptive, better able to lean, able to learn, to exploit new idea between (Maravelakis et al. 2006).

It is often believed that unlike many other core processes such as manufacturing or logistic, output of innovation are hard to predict due to the very fact that the source of innovation is creativity. This makes the management of innovation hard and many firms (mostly SMEs) gave up to bother themselves with it; if the output is unpredictable or even worse you want it to be unpredictable, why bother to measure it. And since it is sometimes in possible to capture innovation in simple and common firms' indicators and targets performance frameworks, most managers leave it in the hand of R&D specialist (Kolk et al. 2012).

Fortunately there are many successful companies that overcame these challenges and harness the benefits of innovation as a manageable process throughout the whole company. These benefits have included largest market share and greater returns for new products and services; successful entry to new markets, etc. these companies use different policy and strategy and hire different instrument to make this happen. But the most important challenge for managing innovation is the measuring tools and all comes down to this old quota in management that "*if you cannot measure it, you cannot manage it*".

3.1.Measuring Innovation

"Measurement implies commensurability: that there is at least some levels on which entities are qualitatively similar, so that comparison can be made in quantitative term". (Fagerberg, Mowery, and Nelson 2006)

It is often believed that Innovation inherently impossible to measure. Innovation means novelty, it means creating something qualitatively new through learning and knowledge building. The innovation most of the time leads to changes in something new product/process etc. that requires new measures for quantification. This may lead to new characteristic of the product which might be measurable in technical term. However these technical measurements comparisons often are rarely meaningful across products. In addition innovation involves learning and knowledge gaining which are hard to measure or non-measurable sometimes. Key problems in innovation indicators lies, therefore, in conceptualization of object being measured, measurement concept meaning, feasibility of different types of measurements. Recent works show that one should care in distinguishing between what can and cannot be measured in innovation (Fagerberg, Mowery, and Nelson 2006)

Apart from that, there is always a controversial debate about what we actually mean by new. Is innovation only counts as new groundbreaking idea or incremental innovation should be considered too? New in terms of new to a firm or new to the market?

In this field many indicators has been introduced to measure innovation on different accounts. It begins with input and output indicators such as widely accepted economy measures. Following by Science and technology indicators (STI) and then more recent such as organizational innovation, marketing innovation.

The most recent development in this regard is Community innovation survey (CIS) that has been carried out several times in all EU members States. And the latest result has been published in 2010.

3.2.Difficulties in Measuring Innovation

It has been demonstrated that companies which develop and implement consistent and transparent innovation key performance indicators (KPIs), increase their innovation productivity between 20 t0 50% (Kolk et al. 2012). However, there are different obstacles that companies are facing when they try to manage innovation as a business process and measure innovation performance more effectively.

Innovation performance is hard to measure and even when it is measured through different indicator, interpretation of the measures is not an easy task. Simply hiring best practice innovation KPI system to monitor and manage a firm's innovation process is not enough. According to Global Innovation Excellence Survey (GIES 2010) among more than 400 companies from all industry sectors, 70% of companies rate their innovation performance indicator weak. They were not able to systematically obtain a credible data for benchmark companies or even their own organization. This problem can cause long debates over data robustness and credibility and leads to a gradual loss of confidence in the KPI system. Companies also have problems in distinguishing between cause and effect of innovation such as increase in market share, gross margin improvements or shortening time to market ((Thuriaux-Aleman, Eagar, and Johansson 2012).

As mentioned before even useful KPIs and measures is hard to translate into meaningful interpretation. Even different improvement priorities can lead to a discussion. If for example and R&D manager correctly conclude that company should innovate more in partnership with suppliers, there would be conflict with procurement management who has to meet yearly saving targets. Even if there was some kind of priorities improvement at firm levels, how should one know that which one is the most effective one for a company as a whole?

The Incidental improvements cannot be implemented and developed into the system and culture of continuous improvement. Frequently changing KPIs and priorities often obstruct companies in tracking innovation performance and trends over time, and furthermore demonstration of successful implementation of improvement.

In case of SMEs it is even more difficult. SMEs are believed to have shorter lines of communication, relatively informal decision making and more flexibility, which seems to give them an advantage for rapid innovation over large companies. But quite in contrast, CIS result shows that, overall, large firms are more likely to innovate, on the average across the EU innovations were introduced by 79% of large manufacturing firm, 58% by medium-sized ones and only 44% were small ones. (Fewer that employment ratio) (CIS 2010). Innovation management was a vital requirements for large companies. This is the only way that they can stay competitive and survive. That is why they responded early to the need of innovation management. SMEs on the other hand are well aware of innovation importance but they have been rather slow in adopting these tools and techniques (Maravelakis et al. 2006). For sure they do not lack

product ideas and concept flow. However they are unable to bring successful innovation into the market in a controlled way. This means that only visions and ideas is not enough and SMEs currently suffer in management of their innovation process through lack of structure. The best way to identify the best practice for SMEs is to measure the innovation performance of business process (Maravelakis et al. 2006) (Maravelakis et al. 2006).

Kolk et al. 2012 in their work named following requirements for a successful implementation of Innovation KPI and to overcome the above challenges:

1- Design the framework:

Old indicator used to be more in perspective of R&D or financial accounting, when most of recent indicators are business-wise. Sometimes it is hard to find a right innovation indicator mostly in the output. Different business, different sector in industry, even two firms in the same business have different structures therefore needs different innovation measures. Consequently there is no pre-defined indicator for companies, and companies should seek this based on their own needs and strategy. There are three aspects for developing effective KPIs:

- A best practice perspective:

Using best practice of other companies could be very helpful. Competitors, industry peers and innovation leader from other sector could be good examples. There are numerous indicators that one can chose from but usually there are two basic roles: First, information should be collected at input, output and process of innovation. Second, it should be taken into the account that the KPIs together span the main goals of innovation; to yield financial returns, create competitive advantage and develop the people in the firm.

- Business and innovation perspective:

  Business perspective toward innovation should be objectively defined. Different industrial sector may have different definition of success in innovation.

- Company innovation health perspective

Other important issue is that a company should be aware of the situation that it is right now in its innovation performance. It is vital to measure where a firm is against the objectives and where it lags behind of its targets and/or competitors.

2- Measure your performance:

Using external data on innovation will give a firm a benchmark that the firm can be evaluated against it and the significance of performance and outputs will be interpreted. Finding the right competitors to benchmark against and extracting valuable data to derive meaningful comparison from it are key success factors. The competitors' list should not be limit to direct candidate but should contain diverse source. Historical data on performance of a firm could be practical way to collect detailed and credible data. Considering adjacent industries with similar characteristic and/or similar innovation engines (way companies innovate: idea generation, R&D driven, analysis driven), could be a good approach to identify disruptive innovation in a firm. Most of the time, a firm does not necessary have the knowledge, skilled personnel to implement innovation measures. Therefore considering innovation leaders from outside who can articulate goals and set the plan and train the personnel in this regard.

3- Manage for success

There should be a close relationship between innovation measures and business performance of the firm. The conclusion derived from these measures should be materialized into meaningful business improvements. One of the pitfall to reach this

goal is that a firm cannot articulate how the gap in innovation performance (difference between how others perform in innovation and how the firm performs) relates to gap in innovation outputs (the shortfall in what innovation delivers compared to competitors). For example simply comparting number of filed patents by the competitors respect to ones by a firm may not perceived as an emergency topic by managers of the firm but showing how others are taking away these chances out of firm reach at important platforms for future growth will certainly receive attention.

Apart from that, while R&D may appreciate the gaps between performance and output, these gaps are addressed by singular initiative rather than through a shared and well-designed improvement program base on well-practiced cases from other firms. This may cause such initiative less effective and reliable to the rest of the firm.

Moreover, for this matter, decision-makers should implement some good improvement initiatives. However most of these initiatives would be limited to one occasion rather than long-term continues process of improvement which is a part of culture of firm.

4- Sustain development.

The key for success in any business process is first an effective implementation of the process and second sustain its effectiveness. The most important parameters to have an effective innovation measurement is to keep it simple and not only consider it to a realm of R&D but also marketing and stakeholder.

To make sure about keep the process effective, the managers should have meeting agendas allocated time to innovation measurement. Senior and middle managers should ask for updated information regularly, and key conclusions should make it into the company's strategic dialogue or review. In this way if a gap has been noticed in reaching innovation target, strategy of the firm could be revised. And managers can justify investment in innovation capabilities, network and capacity is required or not.

Open innovation could be a good practice for small firms as they can share ownership of innovation KPIs to secure their development. This lead to closer collaboration of firms (e.g. a firm and its suppliers) in translating changing customers need into a stable development program throughout all of cycle of innovation

3.3. Common measures of innovation

Before going through introduction of Key Performance Indicators (KPIs) of innovation, According to Kline and Rosenberg (1986) chain-link model there are three aspect of innovation that should be taken into the account:

- Innovation is not a sequential (linear) process and involves many interactions and feedbacks and loops (e.g. trial and error effort) for knowledge creation.
- Innovation is a learning process which involves many inputs.
- Innovation is not dependent on invention processes (e.g. discovery). These processes (e.g. R&D activities) could be taken more as problem solving within ongoing innovation process rather than initiative factors.

OECD innovation manual (2010) is affected by these basic notations. The above points clearly stressing out that: first, innovation is not just only the creation of new product/process, but small changes (incremental changes) also counts that mostly happens during long period of time. A meaningful innovation indicator should measure these changes. Second, innovation does not always happen through R&D activities and non-technical inputs like market exploration, training, engineering experimentation and development are important too. Therefore Innovation measures should contain

indicators that cover the whole variety of inputs. Therefore indicators like networking dimension of innovation, collaboration and interactive learning, organizational and market innovation, science and technological infrastructure have been included in.

Innovation has many components that need to be measured. They can be categorized as; input or resources such as personnel and money, processes which act on and transform input to outputs, output, or end results which contains cash return and indirect profit, such as stronger brands name, knowledge acquiring for further development. All of the above components of innovation should be measured carefully, regularly and thoroughly.

According to BCG (2009) survey following metrics have been identified by the managers of the firms as most important ones respectively, Profitability, customer satisfaction, incremental revenue, time to market, idea generation, R&D efficiency, time to volume, portfolio health life cycle performance.

One should pay attention that tracking every single aspect of innovation at a firm is not practical and more important it is not necessary, so all aspects should not be tracked with same rigor. Those which are more important to the firm (depending on the firm particular innovation objectives and strategy) should be tracked more regularly. One of the best ways to find the proper metric is cash curve. Cash curve is a scheme that shows cumulative cash investment and returns (both expected and actual) for an innovation over time (from idea generation to product or service removal from the market). As can be seen in Fig 3-1 the curve shows four factors that affect the success of an innovation and it ability to generate return. These factors are: startup costs (pre-launch investment), speed (time to market), scale (time to volume), support costs (post-launch investment)

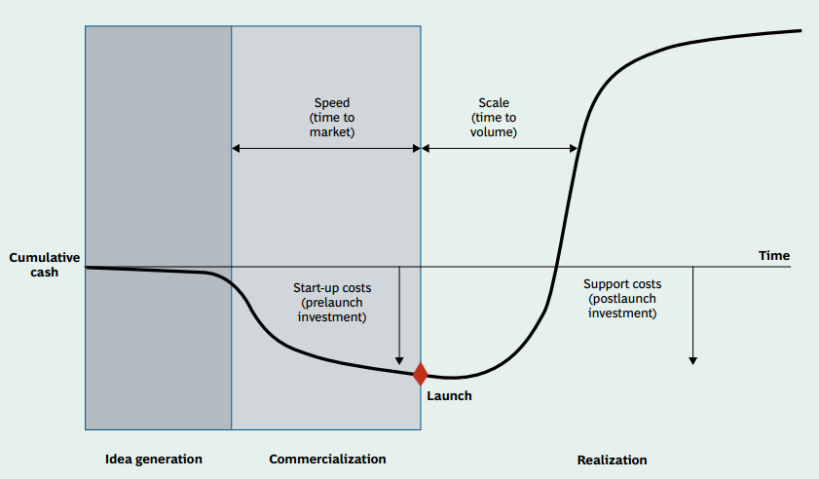


Figure 3-1 Innovation cash curve, BCG Innovation measures 2007.

A proper measurement system will cover all four factors by the firm's strategy and operational plan, as well as capture key aspects of risk.

Here are some metrics for each factor

Table 3-1 Inspired by BCG management survey –(BCG 2007).

Factores	Startup cost	Speed	Scale	Support cost
Metrics	• The number of full time staff involved • Operating	• Actual time to market • Time to key	**Actual versus planned:** • volume	• Cannibalization of existing products in the portfolio

	expenses • Capital expenditure	checkpoints • Actual versus planned full-time-employee hours	produced, • product availability • first-year sales (by channel, segment, and region) • distribution • timing of ad campaigns	• Marketing and promotional activities • Pricing actions • Key staff devoted to the project • Product maintenance and service cost

These factors are aligned with the framework of input-process-output. Finding the right number of metrics to use is very critical. Too few number may lead to inadequate monitoring of innovation effort. And too many is not advisable, since it will be time consuming, expensive, and impractical for the firm. BCG suggests number of 8 to 12 indicators. In table 3-2 an example of most used indicators is listed.

Table 3-2 an example of most important metrics that cover all key aspects of innovation, BCG (2009).

	Inputs	**Process**	**Outputs**
Cash curve-related Metris	• Financial resources • People committed (Ho many and how they are utilized) • Number of ideas generated • Operating expenses • Capital expenditures • Business-unit investment by type of innovation	• Resource efficiency (average and over time) • Actual vs. planned time to market • Cycle time for different stages of the process (idea to decision time, decision time to launch) • Kill rates by stage • Actual vs. expected process performance • Milestone compliance	• Number of new products or services launched • Actual vs. projected incremental revenues and profit • Return on innovation spending • Market share growth • New-product success rates • Number of new customers • Rate of customer adoption • New-product attribution rates • Percentage of targeted market reached • Product quality • Payback period • Cannibalization of existing product sales by new product • Innovation ROI
Other important	• Key capabilities	• Number of suppliers	• Number of patents

measures	(such as IT, manufacturing and tooling) and how they are utilized • R&D as a percentage of sale	and partners involved • Sum of projected net present vaues	filed. • Number of publications written by staff • Brand strength (third party rankings) • Employee satisfaction (base on survey) • Ecosystem strength (based on interview)

There should be a balance between different metrics that suits firm's strategy and objectives. In the following some of the most common Indicators of innovation will discussed in detail and advantage and disadvantages of these indicators will be demonstrated.

3.4.R&D data:

Research and development in terms of knowledge creating process are very incommensurable. This is mostly because of very incommensurable nature of knowledge creating process. So it is hard to find a meaningful indicator to assess actions and events that feed into research. This problem is not completely solvable; however, it can be only bypassed by carefully specifying aspects of the research process that are in some serious sense measurable (Fagerberg, Mowery, and Nelson 2006).

OECD (2005) solution is to write definition of research comprising activities and then seek data on either expenditure or personnel resource devoted to such activities. R&D indicators are economic indicators compatible with industrial datasets and indeed with national accounts. Innovation turns research to capabilities by shifting the knowledge base of firm forward. Neither learning nor capabilities which results from changes in knowledge base are not measurable directly. It is obvious that research has cost in terms of expenditure and use of time of certain personnel and learning process which contains of design, training, market research, tooling up. Expenditure is hardly capture innovation activities because some of the innovation related activities are not reflecting directly in accounting procedures of firm. The knowledge and results of innovation will becomes capabilities of the firms in terms of output but measuring them is hard too. They can be tracked in changes in firm's product mixes and estimate sales on their new or changes products. Therefore innovation input could be expenditure and personnel cost, innovation output would be sales measures.

The major established indicators that have been used to assess innovation impact are outlined below. There are three broad areas of indicators use in STI analysis,

1- R&D data,
2- Data on patent application, grants and citations
3- Bibliometrics data (scientific publication).

In addition to these, there are other three important class of indicators:

4- Technometric indicators: which explore the technical performance characteristics of products?
5- Synthetic indicators developed for scoreboard purposes mainly by consultants.

6- Databases on specific topics developed as research tools by individuals or groups.

According to Oxford handbook of innovation, (2004) Bibliometric *is analysis of composition and dynamics of scientific publication and citation revolves around the science citation index and the institute for scientific information database*.

Bibliometric analysis relates primarily to the dynamic of science rather than innovation. Therefor it is just gives us some kind of research indicator rather than innovation (Mostly because all of research activities are not going to be commercialized) (Fagerberg, Mowery, and Nelson 2006).

OECD (2005) defines R&D as comprising both the production of new knowledge and new practical application of knowledge. R&D is conceived as covering three different kinds of activities basic research, applied research, experimental development. This categorization is based on the distance of the R&D activities from application.

There is a presence of appreciable element of novelty and the resolution of scientific and/or technological uncertainty in R&D. R&D is needed mostly when the solution to a problem is not readily apparent to someone who has the knowledge and experience in the area of concerned.

But it is important to distinguish between R&D and non-R&D activities. For example Education and training, market research are not considered as R&D activities. Industrial activities related to innovation like acquisition of products and licenses product design, trial production, training and tooling up are non-R&D, unless they are part of the research.

When talking about R&D classification, one should take into accounts that R&D can be classified in different forms. Apart from basic, applied research and development which mentioned before, R&D could be classified by sector of performance: business, government, higher education, etc. (Smith, 2004). It can be distinguished by sources of finance; private, domestic, international. There are socio-economic classifications, classification by the field of research. Researcher and innovator usually missed these classifications and focus more on expenditure and missing most of the interesting detail about innovation. For example, when considering R&D by field of research, ICT is the largest single category. However most of R&D researches are performed out of ICT sector and in other sector such as software development by user (Fagerberg, Mowery, and Nelson 2006).

This issue raises other questions about the definition of cross-industries activities and if they can be still considered as R&D action and in more apparent cases its definition in SMEs which mostly lack of systematic R&D activities.

R&D as an indicator has some limitations. It only measure input. However it has some advantages over long period which data has been collected in detailed and classification in different countries and there is good harmonization across the country.

R&D intensity is one of the most used indicators; it is defined as ratio of R&D expenditure to some measure of output. For a firm it is R&D/sale, for an industry it is usually BERD business expenditure on R&D to total production or value added. For a country it is gross expenditure on R&D (GERD) to GDP.

It is usually used in two primary ways; first, to characterize the industries, high BERD/GPD for and industry are held to identify high technology activities. Second

high GERD/GPD ration for a country is often believed to indicate technological progressiveness and commitment to knowledge creation.

Distributions of GERD/GPD intensities for different countries provide criteria to comparison and detect the growth of a country and define the new target. But the basic problem with RD intensity is that it deepened on industrial mix. Currently it uses a four tier model to classify industries in which the basic criterion is BERD/production ratio (OECD 2013)

Table 3-3.Technology Level of a firm Insipired by (OECD 2001)

Technological Level	R&D/production range	
	Min threshold	Max threshold
High-tech industries	5%	-
Medium High-tech industries	3%	5%
Low-tech industries	1%	3%
Low-tech industries	0%	1%

Industrial structures are different across the countries and aggregate BERD/GPD ratio may simply show this fact because industries vary considerably in their BERD/GPD. A country which has large high-tech R&D industries will naturally have a higher aggregate BERD/GPD. Large high R&D industries will naturally have higher aggregate BERD/GPDP ratio than ones with most of activities in low R&D industries. These structural issues largely explain the difference intensities across large and smaller economies. It should be taken into consideration that this indicator may some have difficulties. For instance the attention should be given to the type of industry. Even a single firm might acquire different R&D activities with different technological level. And it is possible to find high R&D firms within low R&D industries.

Recent modification has been added to this indicator. Acquired technologies calculated as the R&D embodied in capital and intermediate goods used by industry and computed via the most recent input output table. Acquired R&D can be calculated by assuming that R&D embodied in capital good is equal to the capital good's value multiplied by the R&D intensity of the supplying industry.

1.6.1 Disadvantage and misuses of R&D indicators:

The technology intensity is likely to be sensitive to the way and method that measurement of acquired technology has been done. There are different criteria and different methods (OECD 2014) which calculate acquiring technology in different way and that makes it hard to have comparison between entities. If for example acquiring new machine (like a pc) gives the customer access to all of the R&D activities that were used to produce it (which is compatible with the theory of externality of R&D), the result of different countries and different firms might change drastically.

Moreover, Low-tech industries do not acquire knowledge by direct R&D and the classification is in effect biased against all industries that do not employ R&D methods for knowledge creation. In SMEs case, it would be more difficult since most of them may not have dedicated R&D team in-house and use eternal resource for their R&D activities.

Moreover it has been stressed that R&D data usually underestimate innovation potential of SMEs which rarely have formal R&D labs. Apart from this very fact that R&D data only measure inputs of innovation and give no information about its output, there are examples of successful innovating SMEs which perform relatively little R&D activities (Maravelakis et al. 2006).

3.5.Patent data

A patent is *a public contract between an inventor and a government that grants tie limited monopoly rights to the inventor to use a technical invention (Oxford handbook of innovation, 2004).*

The patentee should first demonstrate a non-obvious advance and state of art after which the inventor enters into a binding relationship with the state, in general the inventor contracts to reveal detailed information about invention in return for limited protection against others using that invention for the time and geographical area for which the contracts is in force. Therefore patent system is an incentive mechanism for creation of new valuable technologies and more importantly a dissemination mechanism to spread information in a protected way.

According to Smith (2004) patent system has advantages as innovation-indicators. Patents are:

1- It is granted for inventive technology with commercial promise.
2- It systematically records important information about innovation.
3- It collects these technologies according to a detailed classification system.
4- Systematically relates the invention to its relevant technologies.
5- It has a long historical background, which goes back over centuries. It provides a good tool for explorer quantification issues over a long period of time.
6- The database is free to use.

Two major source of patent data are US patent office and it European alike, European patent office.

Patent also of course have weaknesses, first of all they are indicator of invention rather than innovation, since they show new technical idea, not a commercial innovation. There are many inventions that did not have the commercial and economical success in the market.

And also patent indicator misses many non-patent invention and innovation because some kind of technologies are not patentable and in some case there is a big debate that certain items like new business formula can be patented (Maravelakis et al. 2006).

Apart from that some firm might use their patent right not to commercialize a technology or product and just use it as an obstacle for their competitors to using it.

SMEs face more difficulties to use patent as an innovation indicator. Since they have limited financial resources, SMEs prefer to not file their innovations and find it not cost efficient. Also patenting would take long time to be finalized and during this period SMEs might lose their opportunities at the market or even because of rapid technology changes the patent might not still be the state of art when it is registered.

Moreover, in Europe, Firms still fear that current patent system works poorly for SMEs. According to (OECD 2013), it has been declared that one-thirds of firms have experience attempts to copy their patented inventions, but only one in five actually used the courts to defend their patent. Therefore it is believed that patenting as a means of

protecting intellectual property making the patent measuring unreliable for SMEs (Maravelakis et al. 2006).

In the presence of such drawbacks, still patenting seems to be very fruitful indicator especially for large firm. Many different studies (Fagerberg, Mowery, and Nelson 2006) employ it in different manner such as mapping of inventive activities over long time periods, assessing the impact of economic factors of the rate of invention, etc. which show its diverse use cases.

3.6.New Innovation indicators

In recent years, many attempts has been noticed that create new and better indicators for innovation, for example European commission has supported large scale efforts to overcome absence of direct data on industrial innovation and there have been other attempts to improve our knowledge of outputs sources instruments and methods of innovations.

3.6.1. Survey approach for measuring innovation

There has been a huge increase in using innovation survey over past few decades. They can be used as a tool to analyze innovation activities, assessing innovation impact on firms and explorer their practice.

In general there are two basic approaches to collect innovation data: First are those that considering innovation activity at firm level, asking about general innovation inputs (both R&D and non R&D) and outputs (usually product/process innovation). This kind of survey also called subject approach since it focuses on the innovation agent. Second are those that focus on major technological innovation (recognized through peer review and expert appraisal or new product entry in trade journals or other literature). It also is called object approach since it focuses on the object of outputs of innovation process, on the technology itself. Both of these approaches work at ideas, external inputs, users of innovation, and so on and both consider an innovation in the Schumpeterian sense, as the commercialization of a new product or process.

3.6.2. Subject approach:

It collect information at firm level, information on innovation process input and it covers wider range of issues. It can assess impact of innovation by using recorded data on successful and unsuccessful innovation practices in innovating and non-innovating firms. This method usually utilizes questionnaires or direct interview to collect data. Although self-assessment might be prone to bias, they are commonly forms of performance measurements because more objective accounting measures and source can also be biased. Despite these facts, there measures have been shown to be reliable (Maravelakis et al. 2006).

Oslo Manual (OECD 2005) defines basic guidelines for developing innovation survey. This manual is based on subject approach and which has since become a dominant methodology. A group of experts were gathered together and over a period of approximately fifteen months developed a consensus on an innovation manual which became known as the Oslo Manual (OECD 1992). Eurostat and European Monitoring System within European commission have been implementing this methodology since to Community Innovation Surveys (CIS) which has been published regularly since 1992. Six surveys have been carried out in 1992, 1996, 2001, 2006, 2008 and the last one, CIS (2010), is under execution.

CIS (2010) in its different version, collect and present data on following topics:

- *Expenditure on activities related to the innovation of new products (R&D, training, design, market exploration, equipment and tooling up etc). There is, therefore a unique focus on non R&D inputs to the innovation process;*
- *Outputs of incrementally and radically changed products, and scale flowing from these products.*
- *Sources of information relevant to innovation.*
- *Technological collaboration.*
- *Perceptions of obstacles to innovation, and factors promoting innovation.*

The CIS followed the Oslo Manual in most of aspects. First, it emphasize on technological innovation, especially in products then it defined different categories of change by asking firms to allocate the product range of the firm to these different categories. The CIS also asks firms to estimate the proportions of sales which were coming from: new or radically change products, from products which had been changed in minor ways, or firm unchanged products CIS (2010).

Surveys base on the Oslo Manual tend to be rather long and need significant resource within a firm to complete. This becomes more complex when the surveyed companies are SMEs. This kind of survey is carried out under the national statistics legislation, which typically include legal provision requiring the respondent to complete and return the questionnaire. Other surveys usually have lower response rate as firms get tired of the long list of questions. Moreover some SMEs still lack a complete understanding of the innovation concept, which itself also varies from industry to industry. On basic Oslo Manual outcome was that innovation is difficult to define precisely. In reality, survey researches are based on relatively short definitions and taking into the account that different firms will have various interpretations. Therefore it should be noted that the questionnaire's design is crucial for the quality of the data collected.

3.6.3. Object approach

Object approach collects data on the level of individual innovation rather than of a firm, i.e. information on output of innovation process. This kind of survey may have some advantages of representing a direct measure of innovation due to the fact that only the significant innovations are recorded, but it is very difficult to develop comparable database internationally (Maravelakis et al. 2006). One of the attempts in this regard is SPRU database. This database has been developed by University of Sussex, Science policy research unit and contains information on significant innovation in British industries from 1945 through 1983. It also included source and type of innovation, innovation patterns and cross-industry linkage, regional aspects, etc.

USA small business administration provided another database that contains information on innovations that have been introduced to the market by small firms in USA. This approach is technology-oriented which benefits from focusing on technology itself and provide a form of external assessment on important innovation. Since in object survey, an innovation is identified by peer review method and by expert in trade journals, makes the recognizing of an innovation not prone to bias and somewhat independent of personal judgment.

This approach has some disadvantages too. The very fact that innovation must be significantly innovative to be recognized by the database expert makes it prone to bias to the exercise. Therefore only breakthrough innovation to the market will be

considered and incremental innovation practices, which are part of routine of the normal firm's activities, will be lost.

3.6.4. Benchmarking

Benchmarking is a comparative method. It allows comparing two firms continuously and provides a useful tool for allowing the firm to identify its place and performance between its competitors. Oslo Manual (OECD 2010) recognizes benchmarking as a practice which leads to better understanding of the firm's current situation and benefit from systematic comparison and evaluation of practices and performance with those of others. This evaluation will lead to development of improvement actions, which will raise performance levels to or beyond other competitors especially those which identified as the best in rank. As it was stressed before, company innovativeness for long term growth is vital. Benchmarking would allow a firm to assess its innovativeness in terms of necessary activities to innovate in practice (Maravelakis et al. 2006).

4. European supportive programs for SMEs

This chapter will start with a brief discussion about European SMEs (more focus on Manufacturing sector) and their importance for Europe. Then innovation importance through EC perspective will be presented. The European commission support for innovation in SMEs - Its previous, current and future supportive program will reviewed. This will be followed by demonstration of some of these program results in order to give an overall view on impact of Supportive program role on SMEs in Europe. At the end, by using result of EC surveys, a picture of current situation of SMEs in Europe will be depicted.

4.1. Innovation importance through European Commission perspective

Innovation is essential to European competitiveness in the global economy. Various policies and programmes are implemented by The EU that support the development of innovation to raise SMEs R&D activity and capability, and to better transform research into improved goods, services, or processes for the market. As highlighted by EU Industrial Policy (2011)) industry is vital for EU competitiveness and innovation is a key factor in this regard. 80% of Europe's exports come from industries. Manufacturing sector accounts for 65% of private sector research and development (R&D) investment.

In this regard three main requirements have been identified by EC, first, the successful commercialization of product and service innovations; second, the industrial exploitation of innovative manufacturing technologies; third, innovative business models (European Commission 2015b).

According to Innobarometer (2014), companies who prioritize innovation are also those who experience the highest increase in turnover.

SMEs are a particular target for innovation policy. The smaller the company is, the more it faces constraints to innovation or to the commercialization of its innovations. Therefore especial attention are paid by Commission to promote innovation, according to latest Policy Communication (June 2014), innovation set as one of Europe priority. Directorate General for Internal Market[1], Industry, Entrepreneurship and SMEs are as follow:

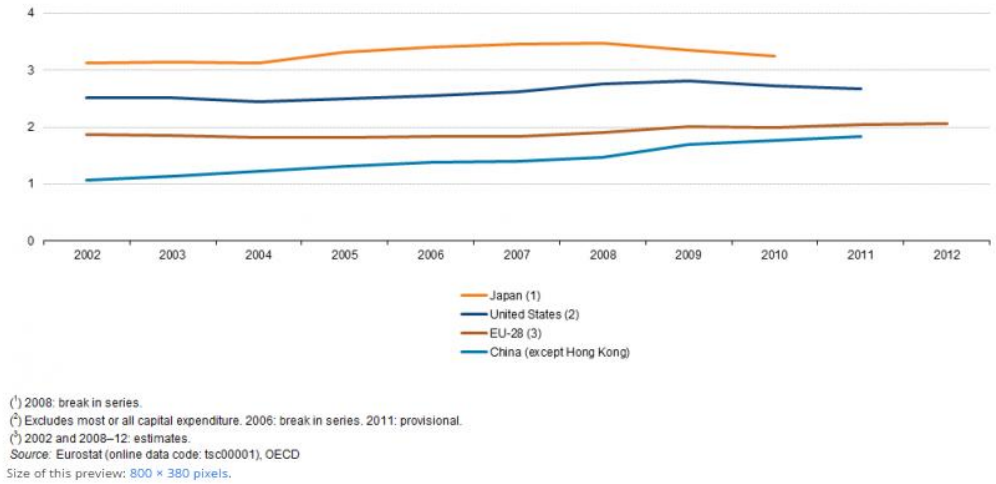
- *Supports innovation development in priority areas and in SMEs, mainly through Horizon 2020;*
- *Fosters the broad commercialisation of innovation in the EU including Public Procurement for Innovation, Design for Innovation, Demand-Side Policies for Innovation, Public Sector Innovation, and Social Innovation;*
- *Develops sector policies to modernise the EU's industrial base and accelerate the market uptake of Key Enabling Technologies such as Advanced Manufacturing Technologies and of other innovations such as Workplace Innovation;*
- *Monitors innovation performance and innovation uptake in order to identify developments that require policy changes. Key methodologies include*

[1] http://ec.europa.eu/growth/industry/innovation/index_en.htm

the European Innovation Scoreboards,Innobarometers, Business Innovation Observatory;

- *Improves regulatory conditions for innovation with measures for entrepreneurship, access to finance, clusters, single market, intellectual property and standards.*

As depicted below the Gross domestic Expenditure on R&D has been increased in EU since 2006 in comparison with other parts of the world.



(1) 2008: break in series.
(2) Excludes most or all capital expenditure. 2006: break in series. 2011: provisional.
(3) 2002 and 2008–12: estimates.
Source: Eurostat (online data code: tsc00001), OECD
Size of this preview: 800 × 380 pixels.

Figure 4-1 Average GPD expenditure on R&D (EC website 2014)

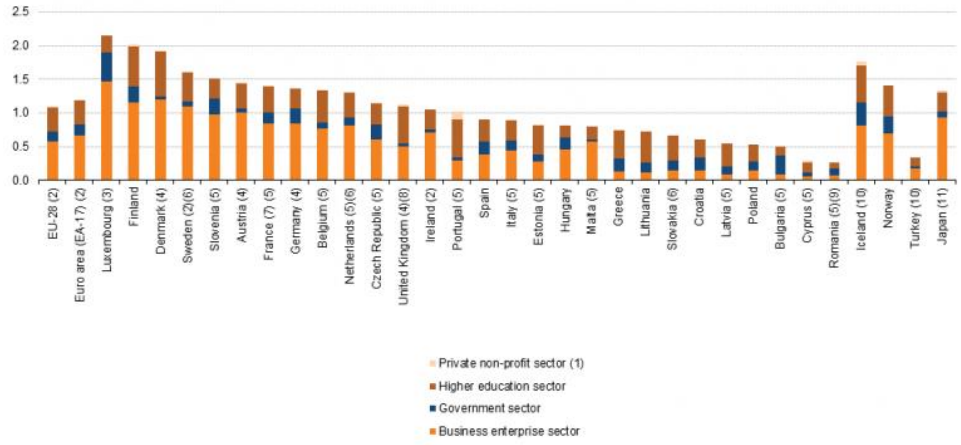


Figure 4-2 R&D expenditure in EU countries (EC website 2014)

4.2. Importance of SMEs in Europe

SMEs are the backbone of European Economy, being primarily responsible for wealth and economic growth, next to their key role in innovation and R&D. In Europe, SMEs account for 99 out of every 100 businesses and 58 cents in every euro of value added and 2 in every 3 employees are working in a SME. The five key sectors in EU economy are manufacturing, construction, business service, accommodation and food, wholesale and retailed trade which accounts for 78% of all SMEs (European Commission 2014a).

To have clear idea about what a SME (small-medium enterprise) really is, a certain defection is required. According to European commission latest definition (European Commission Industry Publications 2005), a SME is an enterprise which its three criteria: staff headcount, annual turnover, annual balance sheet, are below certain thresholds. These thresholds are presented in table XXX. According to this definition an

enterprise is '*any entity engaged in an economic activity, irrespective of its legal form'* (European Commission 2005).

Table 4-1 European Commission defined thresholds for SME. (EC 2005)

Enterprise category	Headcount: Annual Work Unit (AWU)	Annual turnover	or	Annual balance sheet total
Medium-sized	< 250	≤ €50 million (in 1996 € 40 million)	or	≤ €43 million (in 1996 € 27 million)
Small	< 50	≤ €10 million (in 1996 € 7 million)	or	≤ €10 million (in 1996 €5 million)
Micro	< 10	≤ €2 million (previously not defined)	or	≤ €2 million (previously not defined)

Manufacturing by 9.5% percent of total number of SMEs is the fourth major sector in EU28 in 2014. Around 20% of total SMEs added value and 20% of employment are corresponded to SMEs in manufacturing (European Commission 2014a).

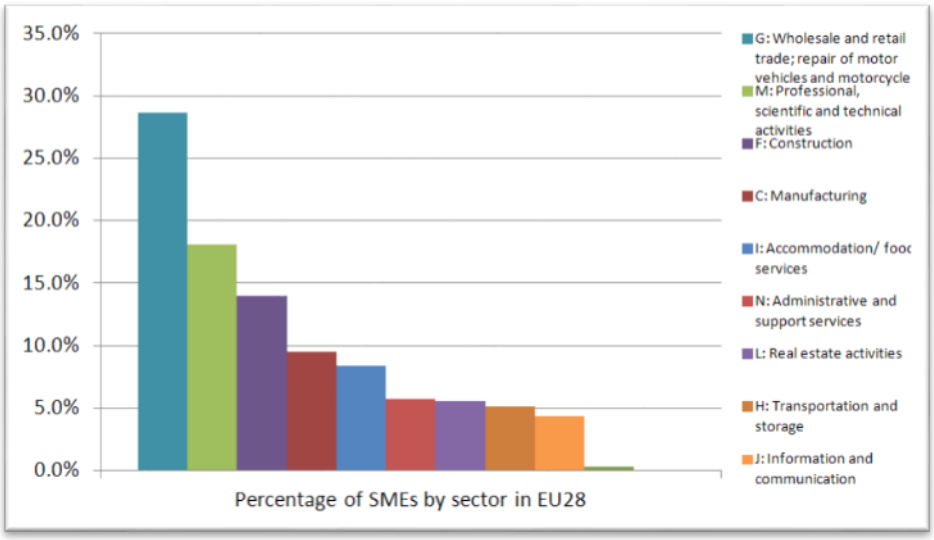


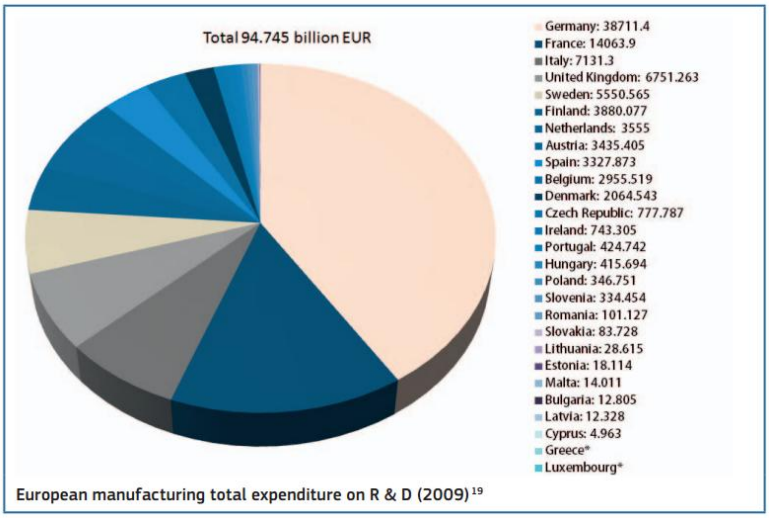
Figure 4-3 Extracted from EC annual database on SME performance 2014.

Foundation of manufacturing industry in Europe is based on SMEs. Micro, small and medium enterprises credit around 45 % of the value added by manufacturing while they responsible for around 59 % of manufacturing employment (EFFRA 2012). Manufacturing is vital for emerging markets: new markets motivated by advances in science and innovation which change drastically Europe's capability to develop manufacturing across traditional and new industries.

Manufacturing is an essential factor of the innovation chain: manufacturing empower technological innovations to be applied in products and services, which are marketable in the marketplace and is key to developing KETs to making new products affordable and available so as to increase their societal and economic benefits and reach the desired impacts. Location is important since 'innovation' is not linear; the ability to innovate mainly comes from co-location of manufacturing and manufacturing-related R & D activities, including product research and development processes. Innovation investment in mechanical engineering (European Commission 2012a), in the business enterprise sector manufacturing, accounted for the highest share of researchers in most EU Member States. In 2008, 14.1 % of all EU-27 tertiary students were attending in engineering, manufacturing and construction education. 39.8 % of enterprises in the EU-27 were considered innovative in terms of technological innovation in 2008. In most countries, the share of innovative enterprises was generally higher in manufacturing than in services. In 2009, 2.4 million people were employed in the high-tech manufacturing sector in the EU-27 (European Commission 2009a).

In 2008, the R & D expenditure in the mechanical engineering sector, before the financial economic crisis in the EU-10 was $ 8,323 million. In 2007, the 'manufacturing' sector had the largest share of business enterprise R & D expenditure in most of the EU-27 countries. The overall Europe 2020 headline indicator GERD (Gross expenditure on research and development) % of GDP ('R & D intensity') in 2011 is at 2.03 % as compared with 2.01 % in 2010, while the Europe 2020 target is 3 %. Across all industries R&D intensity was 3.5 % in 2009 worldwide (European Commission 2009a).

At the same time, R&D intensity of mechanical engineering in Europe was higher than USA and Japan (3.6 vs. 3.2 % and 3.0 % respectively) (EFFRA 2012). This shows that in the EU, mechanical engineering has higher importance for overall technological performance than in the US and Japan where the sector figure was below total industries. However the R&D costs and risks to keep EU industry competitive and sustainable are too high and have long RoI (market failures).



European manufacturing total expenditure on R & D (2009)[19]

In case of SMEs, market imperfections always considered as one of the main challenges. SMEs often face difficulties in finding capital or credit, particularly in the start-up phase (European Commission Industry Publications 2005). Their limited resources may also reduce access to new technologies or innovation. Therefore, the research and innovation activities need public support, as in USA or China. Support for

SMEs is one of the European Commission's priorities for economic growth, job creation and economic and social cohesion.

4.3. European Union Supportive Programmes for SMEs - An overview of the main funding opportunities available to European SMEs

European SMEs has lower R&D expenditure than their counterparts in US. It is reported that less than one third of SMEs in Europe have innovative activities. Therefore public support for SMEs is one of the first priorities of European Commission. It has already emphasized that EU research funding generates enormous added value for Europe. €1 of EU Framework Programme funding increase industry added value, between €7 and €14 (European Commission 2013c). Only macro-economic impact of the 7th Framework programme was beloved to accounts for 900,000 jobs, of which 300,000 in research, and an extra 0.96 percent of GDP (European Commission 2005b) (European Commission 2005a).

The European Union has been providing support to European SMEs. This support has been available in different forms such as grants, loans and, in some cases, guarantees, directly or through programmes managed at national or regional level such as the European Union's Structural Funds. SMEs can also benefit from a series of non-financial assistance measures in the form of programmes and business support services.

The assistance schemes have been divided into the following **four categories**:

1. Thematic funding opportunities

This funding is based on thematics with specific objective - environment, research, education - designed and implemented by various Departments of the European Commission. SMEs or other entities can usually apply directly for the programmes, generally on condition that they present sustainable, value-added and trans-national projects. Depending on the programme, participants can also include industrial groupings, business associations, business support providers and/or consultants. Co-funding is the general rule: the support of the European Union usually consists of subsidies which only cover part of the costs of a project (Table 4-4).

2. Structural funds

The Structural Funds (European Regional Development Fund [ERDF] and European Social Fund [ESF]) are the largest Community funding instruments benefiting SMEs, through the different thematic programmes and community initiatives implemented in the regions as shown in table 4-2. The beneficiaries of structural funds receive a direct contribution to finance their projects. Note that the programmes are managed and the projects selected at national and regional level.

Table 4-2 EC Structural Funds Schemes for SMEs

Structural Funds
European Regional Development is the largest Community financial instrument benefiting SMEs. Its aim is to reduce disparities in the development of regions and to support social and economic cohesion within the European Union.
European Social Fund (2007-2013) provides support for anticipating and managing economic and social change, with a number of opportunities for supporting SMEs.
Rural Development Fund (2007-2013) focuses on three thematic axes: improving competitiveness for farming and forestry; environment and countryside; improving quality of life and diversification of the

rural economy

3. Financial instruments

Most of the financial instruments are only available indirectly, via national financial intermediaries. Many of them are managed by the European Investment Fund.

Table 4-3 EC Financial instruments for SMEs.

Financial instruments
Competitiveness and Innovation Framework Programme (CIP) Under this program €1130 million has been allocated for financial instruments for the period 2007-2013.
Joint European Resources for Micro and Medium Enterprises (JEREMIE) is a joint initiative of the European Commission and the European Investment Fund with the European Investment Bank. It aims to improve access to finance for micro to medium-sized enterprises and in particular the supply of micro-credit, venture capital finance or guarantees and other forms of innovative financing.
Joint Action to Support Micro-finance Institutions in Europe – JASMINE is a joint initiative of the European Commission and the European Investment Fund together with the European Investment Bank, and complements the JEREMIE initiative. It aims to develop the supply of micro-credit in Europe by means of two main actions: by providing technical assistance and financing the activities of non-bank financial institutions. This programme was launched in 2008 with a three-year pilot phase, with an initial capital of €50 million.
European Investment Fund (EIF) own investments is based on two instruments: EIF's **venture capital instruments** consist of capital investments in venture capital funds and business incubators that support SMEs, particularly those that are newly created and technology-oriented. EIF's **guarantee instruments** consist of providing guarantees to financial institutions that cover credits to SMEs.
European Investment Bank (EIB) loans will be delivered via intermediaries such as commercial banks. They are targeted at tangible or intangible investments by SMEs. The duration of the loans will be between 2 and 12 years, with a maximum amount of €12.5 million per loan
EPMF - The PROGRESS Microfinance Facility for Employment and Social Inclusion The EU has set up a new European Progress Microfinance Facility providing microcredit to small businesses and to people who have lost their jobs and want to start their own small businesses. An initial budget of €200 million is expected to leverage €500 million of credit in cooperation with international financial institutions such as the European Investment Bank (EIB) Group.

4. Support for the internationalisation of SMEs

These supports usually include assistance to intermediary organisations and/or public authorities in the field of internationalisation, in order to help SMEs to access markets outside the EU (Table 4-5).

Table 4-4 EC Funding Opportunities for SMEs

<table>
<tr><th colspan="4">Funding opportunities</th></tr>
<tr><th>Environment, energy and transport</th><th>Innovation and Research</th><th>Education and training</th><th>Culture and media</th></tr>
<tr><td>LIFE + (2007-2013) is divided into three strands: Nature and Biodiversity, Environment Policy and Governance, Information and Communication with the budget foreseen for LIFE+ is €2.1 billion.</td><td>The Seventh Framework Programme for Research and Technological Development (FP7 2007-2013)</td><td rowspan="2">Integrated Action Programme in Lifelong Learning (2007-2013) covers four specific programmes: COMENIUS; ERASMUS; LEONARDO DA VINCI GRUNDTVIG</td><td rowspan="2">CULTURE (2007-2013) provides grants to cultural co-operation projects in all artistic and cultural fields (performing arts, plastic and visual arts, literature, heritage, cultural history, etc.). It has a budget of €400 million</td></tr>
<tr><td>Competitiveness and Innovation Framework Programme (CIP) (2007-2013) is a coherent and integrated response to the objectives of the renewed Lisbon strategy for growth and jobs. It has a budget of approximately €3.6 billion</td><td>Competitiveness and Innovation Framework Programme (CIP) (2007-2013) is a coherent and integrated response to the objectives of the renewed Lisbon strategy for growth and jobs. It has a budget of approximately €3.6 billion.</td></tr>
<tr><td>Marco Polo II (2007-2013) aims to reduce road congestion, to improve the environmental performance of the freight transport system within the Community and to enhance intermodality. The programme has a budget of €450 million.</td><td>EUREKA – A Network for market oriented R&D is a pan-European network for market-oriented, industrial R&D organisations, which supports the competitiveness of European companies by creating links and networks of innovation throughout 36 countries. EUREKA's Eurostars Joint Programme provides finance tailored to the needs of small firms, supporting their participation in international projects in the fields of research and innovation.</td><td>Erasmus for young entrepreneurs was initiated by the EU in 2009 to provide practical and financial assistance for new entrepreneurs who wish to spend some time in an enterprise in another EU country and thus learn from experienced entrepreneurs with a total budget of around €4.3 million</td><td>MEDIA (2007-2013) has a budget of €755 million and deals with the training of media professionals; the development of production projects and companies; the distribution and promotion of cinematographic works and audiovisual programmes and the support for cinematographic festivals</td></tr>
</table>

Table 4-5 EC Supportive actions for Internationalization of SMEs.

Support for the internationalisation of SMEs			
Candidate And Neighbourhood Countries		**Latin America**	**Asia**
The instrument of Pre-Accession Assistance (IPA)	**European Bank for Reconstruction and Development programmes** **Financial support: EU/EBRD SME Finance facility:**	**AL-Invest IV**	**EU Gateway Programme**
The European Neighbourhood policy	**Non-financial support: TAM and BAS programmes**		**EU-Japan Industrial Cooperation Programmes**
The Neighbourhood investment facility (NIF)	**EIB loans for SMEs in Eastern Neighbourhood countries**		**China** **.Understanding China**
East-investment" programme	**EIB loans for SMEs in Mediterranean partner countries (FEMIP)**		**.EU-China Managers Exchange and Training Programme (METP)**

4.3.1. Previous European Innovation and Research program:

1- The Seventh Framework Programme for Research and Technological Development (2007-2013)

The FP7 Cooperation Programme supported all types of research activities carried out by different research bodies in trans-national cooperation during 2007-13. The programme had a budget of EUR 32.4 billion with the aim to gain leadership of Europe in key scientific and technology areas. At its outset, the EU Council and Parliament set a target of 15% of the funding to go to SMEs, with the remainder going to larger enterprises, universities, research centers and public authorities throughout the EU and outside. FP7 paid special attention to the SMEs through its different programmes: "Co-operation" (€32.3 billion), "Ideas" (€7.5 billion), "People" (€4.7 billion) and "Capacities" (€4 billion) (European Commission 2013b).

SME was encouraged to participate in almost all of "Co-operation" programme research actions and Joint Technology Initiatives (JTIs) (wherever appropirate). SMEs could compete like other entities in "Ideas" programme on the basis of excellence. In "People" programme (Human potential in research and technology), a great attention is paid towards SME participation under "Industry-academia partnerships and pathways". "Research for the benefit of SMEs" in the "Capacities" programme was designed for SMEs" with aim to strengthen the innovative capacity of European SMEs and their contribution to the development of new technology-based products and markets. The indicative budget for the SME specific actions was around €1.3 billion.

- **FP7 results**

According to FP7 monitoring report 2014 23.814 SMEs participated in the entire FP7 with approximately € 6.2 billion contribution from EC by the end of 2013 (European Commission 2013d).

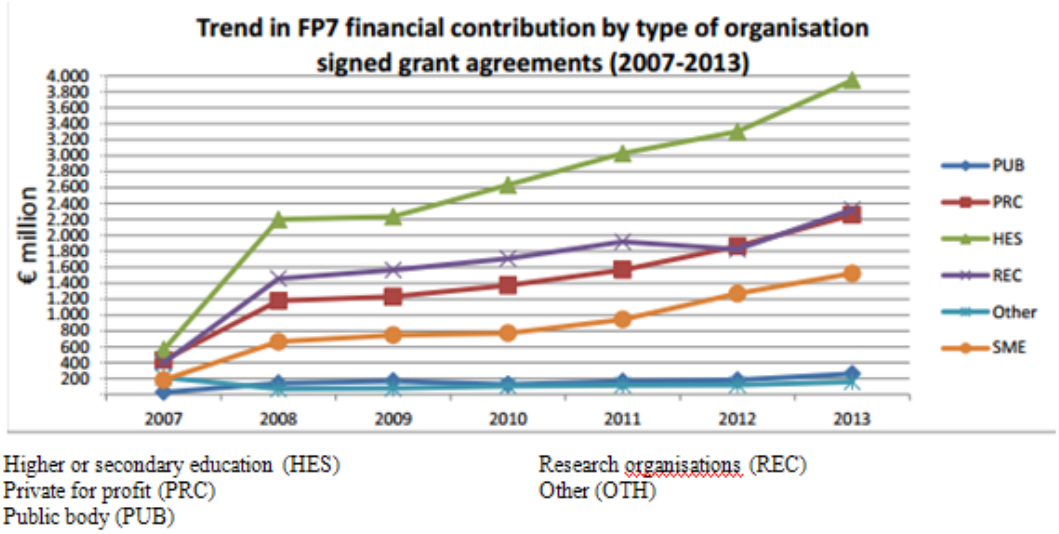


Figure 4-4 SME participation in FP7 (2007-2013) (European Commission 2013d).

Again according to FP7 report (2013), in cooperative program, the target of a 15% of EU contribution going to SMEs was set. This target was reached at the end of 2011 (15.3% of the EU funding went to SMEs). At end of 2013 it reached 16.8% of the total funding which accounts for 4.348 M€. This increase in SMEs' participations shows attribution to the inclusion of SME participation strengthening measures in the Work Programmes of 2011 and 2012 (for instance SME-friendly call topics, ring-fenced budgets etc.). Figure 4-5 shows SMEs share of FP7 EU contribution. The detail has been depicted in Table 4-6.

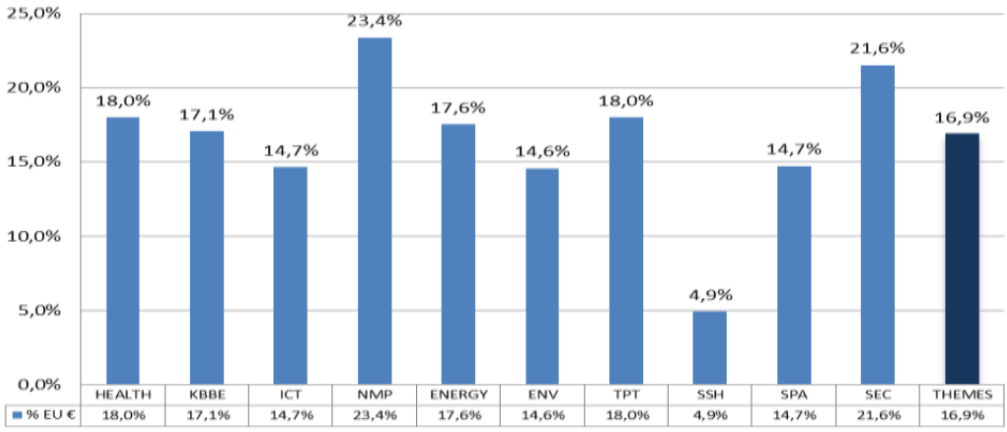


Figure 4-5 SME share of FP7 EU contribution (EC FP7 report 2007-2013) (European Commission 2013d).

Table 4-6 FP7 SME participation overview 2013 (European Commission 2013d).

Specific Programme description	# of SME participations	% of SME participation	EU contribution to SMEs (M€)	% of the budget going to SMEs
SP1 – cooperation	16, 246	19.1	4,606	16.8
Thematic Priorities	15, 223	19.1	4,348	16.9
Other (eg. JTI)	1,023	20.1	258	15.6
SP2 – Ideas	21	0.4	15	0.2
SP3 – People	1,107	6.1	277	6.3
SP4 – Capacities	6,346	35.3	1,265	34.5
SP5 - Euratom	124	6.3	19	5.5
Overall	23.814	18.6	6,182	14.6

46% of all industry organisations participating in grant agreements for the period 2007-2013 in FP7 were SMEs. 69% of these SMEs have participated only once while 98.4% of the organisations have participated less than 10 times, with only 207 SMEs, 1,6%, participating 10 or more times. The average EU contribution to SMEs participating in the FP7 for the period of 2007-2013 is € 259,772 (two third of average EU contribution).

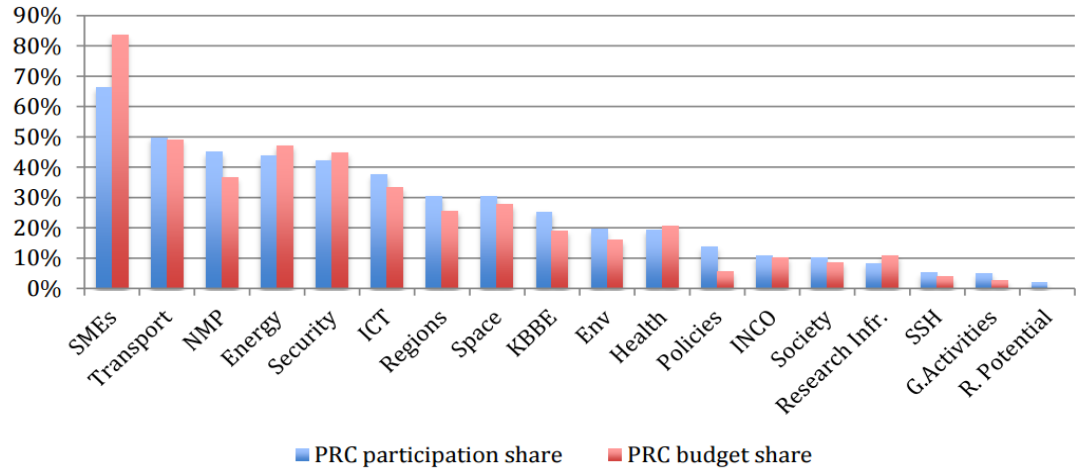


Figure 4-6 PRC organization (Private for profit) participation and budget share. (EC 2014) (European Commission 2013d)**.**

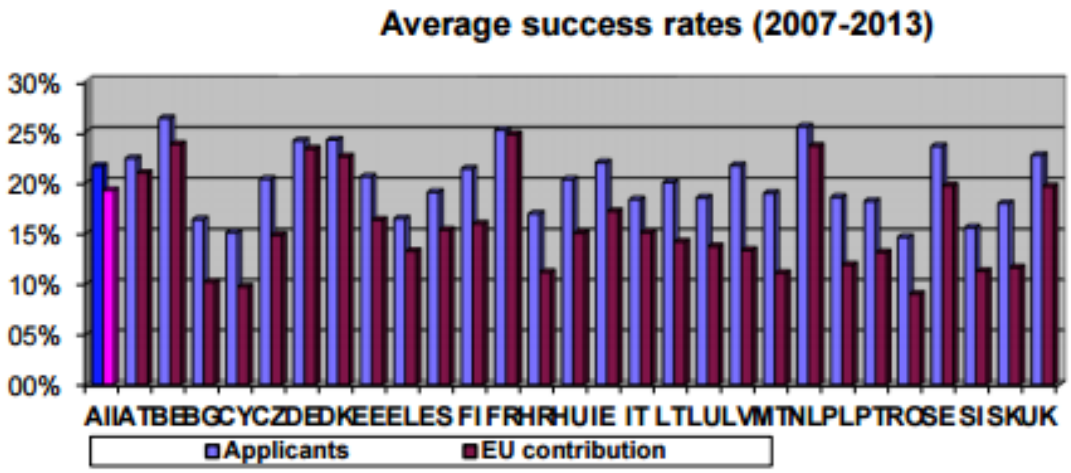


Figure 4-7 Average success rates of EU28 applicants and requested EU financial contribution for FP7 calls concluded during the period 2007-2013 by country (European Commission 2013d)**.**

In 2014 EC published result of an interim evaluation (European Commission 2014f) of the participation of SMEs in the Cooperation Programme and the Research for the benefit of SMEs (RSME) schemes under the Capacities Programme of FP7 2007-2013. This evaluation assesses the relevance, efficiency and effectiveness of SME in these two schemes and their impacts on the participating SMEs and on society. This included impacts on economic performance (employment growth, turnover and exports), Innovation, European Added Value (EAV) and behavioral additionality. In the Cooperation Programme, a positive impact on turnover was reported by 54%, for employment the figure is 50% and for exports 38% from SME participants. On average they reported increases estimated plus 22% for turnover, plus 25% for employment and plus 28% for exports. In RSME a positive impact on turnover was reported by 32%, for employment this was 30% and for exports 27%. On average, these SMEs reported 16% higher turnover, employment and exports.

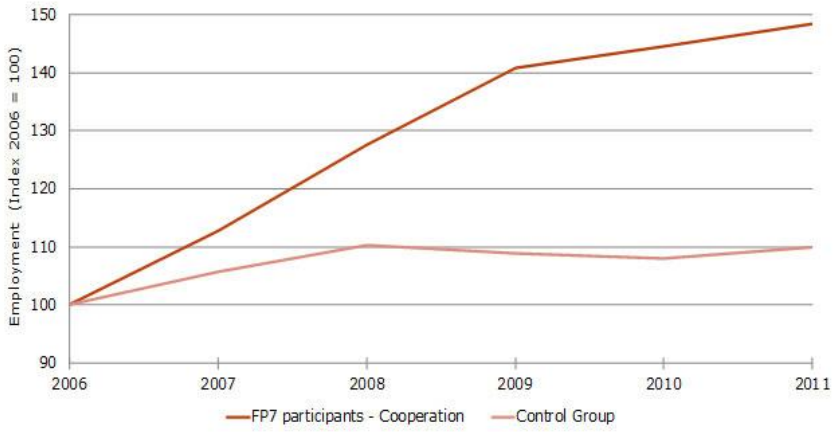


Figure 4-8 Index of employment of SMEs participating in the FP7 Cooperation Programme compared to matched non-participants (control group) (Index 2006 = 100) (European Commission 2014f)**.**

According to this evaluation, the majority of participating SMEs have progress in their innovation plans. In the SME interviews, 70% of SMEs in Cooperation and 67% of SMEs in the RSME schemes report that following participation in the FP7 project they implemented an innovation however the number of innovations successfully implemented in the market is more modest.

2- Competitiveness and Innovation Framework Programme (CIP)

The "Competitiveness and Innovation Framework Programme" (CIP) was initiated as a Lisbon strategy for growth and jobs. Running from 2007 to 2013, it has a budget of approximately €3.6 billion. It was divided into two main strands:

a) The Entrepreneurship and Innovation Programme (EIP) aims to improve the conditions for innovation, such as exchanges of best practices between Member States and actions to improve, encourage and promote innovation in enterprises. It supports actions fostering sector- specific innovation, clusters, public-private innovation partnerships and the application of innovation management;

b) The ICT Policy Support Programme to which approximately €728 million has been allocated. The ICT programme aims to stimulate the new converging markets for electronic networks and services, media content and digital technologies. It also supports the modernisation of public sector services that will raise productivity and improve services.(Urien 2001)

Some of the achievements in EIP are summarized from CIP performance report 2012 (European Commission 2012b):

Improving access to finance

- *Postive impact o*n the economic situation and business prospects in form of stronger business growth and employment sustainability.
- Between 2007 and 2011, assisting more than 155 000 companies with underlying debt financing of 11.4 billion EUR under guarantees and with investment volumes of up to 2.2 billion EUR under venture capital. More than 186 000 jobs were created or maintained (Figure 4-10).

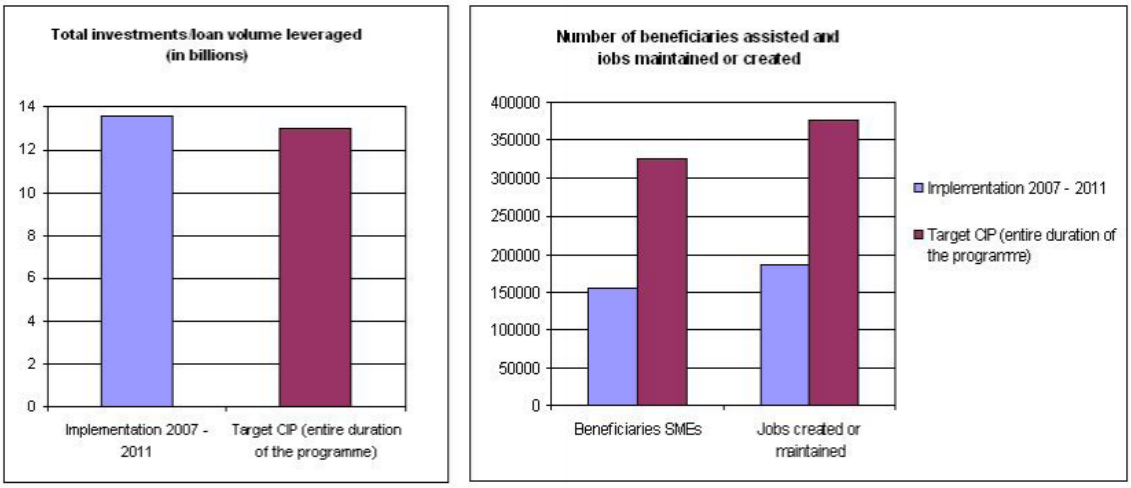


Figure 4-9 Total investment/loan volumes leveraged, number of beneficiaries assisted, and jobs maintained or created (EC CIP report 2012).

Providing business support services

- The Enterprise Europe Network assessed SMEs to access new markets or developed new products.
- Intellectual Property Rights (IPRs) initiating EU-level projects to improve IPR support for SMEs.

Improving sectoral conditions

- Improving framework conditions for SMEs
- Demonstrating eco-innovation solutions by supporting 134 ecoinnovation projects in sectors such as recycling, green business, the food and drinks sector, and the buildings sector.
- Fostering better framework condition for SMEs by facilitating exchanges of best practices between the CIP participating countries. Resulted a fall in the average time and cost required to start a company in the EU, as illustrated by these graphs (Figure 4-10)

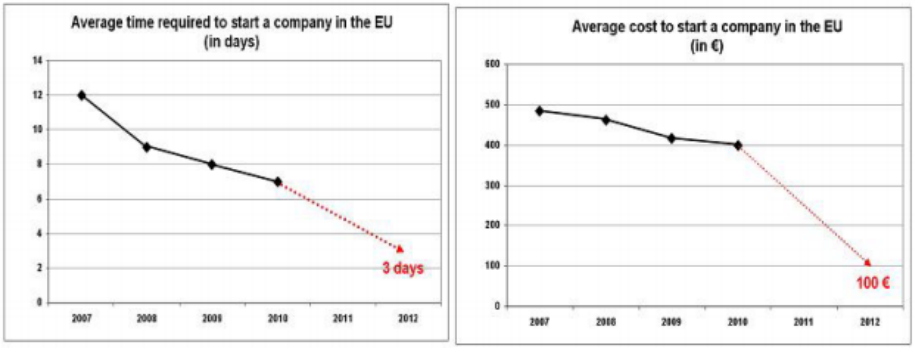


Figure 4-10 Average time and cost to start a company (EC CIP performance report 2012)

Monitoring policies, providing analysis and bench-marking

- Supporting a wide range of policy-related measures such as statistical analysis and benchmarking; policy monitoring and analysis; workshops and exchanges of best practices between policy makers. For instance, the European Innovation Scoreboard. (a yearly comparison of the innovation potential and performance of Member States and selected other countries, drawing on statistics from a variety of sources, primarily EUROSTAT and the OECD).

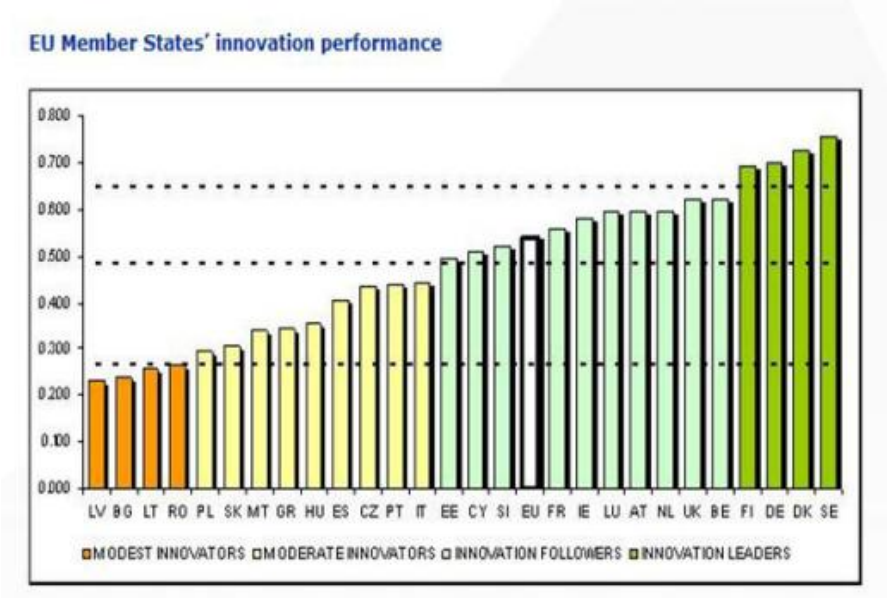


Figure 4-11 Innovation performance of EU members, one of the monitoring policies of EIP program (EC 2012).

Boosting entrepreneurship

- Boosting entrepreneurship and a culture of innovation by EIP common initiatives in the areas of entrepreneurship education and female entrepreneurial activity.

Reducing administrative burden

- Supporting economic and administrative reforms, e.g. by helping to reduce regulatory and administrative burdens.

4.3.2. Current and oncoming Supportive program

1- Horizon2020

Horizon2020 is the largest EU's funding programme for research and innovation. In February 2011 Member States identified R&I as top European political agenda by adopting the Europe 2020 strategy and endorsing the Innovation Union. On this basis, the Commission in 2011 proposed a €80 billion budget for the next research and innovation programme Horizon 2020. Horizon 2020 focuses on advancing scientific knowledge and discovery, but also more than ever on making Europe more competitive through research. In comparison with FP7, H2029 has some differences. For example, Horizon 2020 has an extensively larger budget - about EUR 80 billion over seven years. This compared to about EUR 50 billion over seven years for FP7. Another difference is that H2020 due to its R&I nature has greater focus on close-to-market activities (Higher TRL activities) and impact which thought to bring greater economic benefits. More over the EC contribution (funding rate) for industrial participant has been raised up to 70% respect to FP7 which was 50. In addition time to grant (the period of time from submission of proposal to grant) decreases to from more 12 months in FP7 to 8 months (Event 2014) , (European Commission 2014c).

The design of H2020 consists of three pillars Excellence Science, Industrial Leadership (LEIT) and Societal Challenges (Figure 4-13). The majority of research and innovation actions for manufacturing sector under LEIT pillar. One of the programs that directly planned for this sector is Factory of the future (FoF). This call specifically designed to address manufacturing challenges in today's Europe with the budget of EUR 142M (EFFRA 2012).

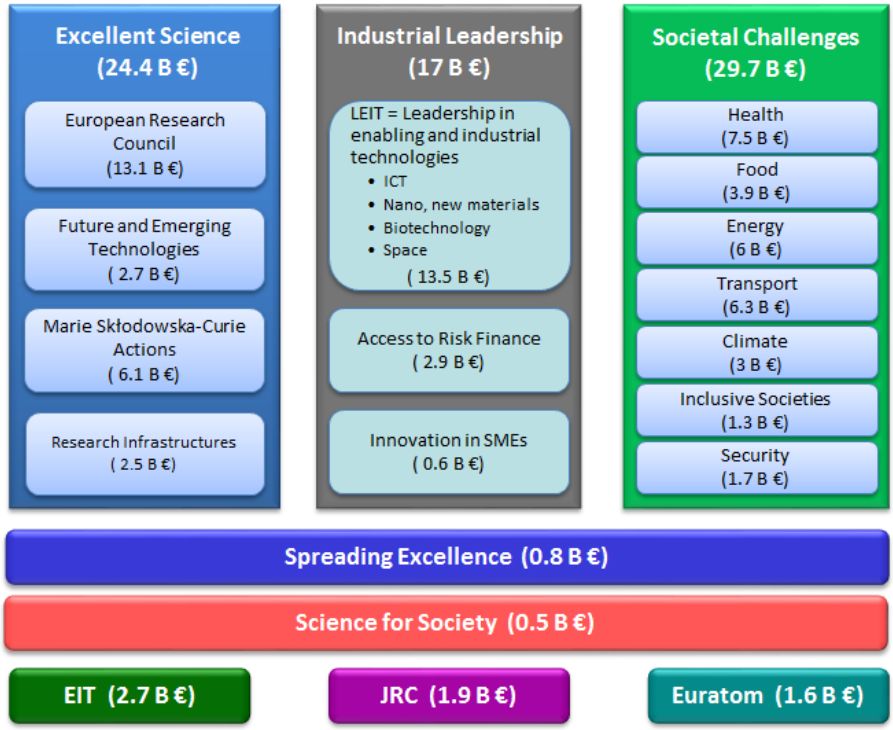


Figure 4-12 H2020 Different Pillars (European Commission 2014c)

In H2020 also greater attention is paid to SMEs. According to European Commission report following barriers recognized for SMEs to innovation and growth (Event 2014):

1- *Inadequate Access to Finance (additionality of public support)*
2- *Inadequate Access to Skills / Knowledge (innovation management capacity)*
3- *Weakness in Networking and Cooperation with External Partners (Open Innovation)*
4- *Lack of Internationalisation*
5- *Inability to bring the result of the project to the market.*

H2020 (European Commission 2014f) is claimed to overcome these obstacles by more financial public support and higher rate of funding for SMEs and more opportunities more opportunities to benefit from funding. It was also noted that in many FP7 project with SME participation the results have not yet reached the markets. This is often related to the short time elapsed since the closure of the FP7 projects, but also some SMEs stated that they do not have the funds to actually bring the results of the FP7 project to the market. But the anticipation for SMEs contribution still is 15% as FP7. H2020 research funding is designed to encourage internationalization of SMEs by cross-border links. Despite its relative success, independent assessments measuring the impact of EU FP7 in supporting research and development activities have revealed that SMEs do not really manage to reap full commercial or strategic rewards and create value for the economy and society through their participation in these programmes(European Commission, Expert Group. Annerberg 2010) .

Different methods have been considered for participation of SMEs in H2020. Besides participation in collaborative projects, SMEs are encouraged to take part in the Marie Skłodowska-Curie Actions and in the activity on Future and Emerging Technologies under Horizon 2020. Furthermore, a new dedicated SME instrument is supported to fill gaps in funding for close-to-market innovation aspects in SMEs.

In addition, a number of activities will be funded from the €619 million budget of the specific objective 'Innovation in SMEs' which includes:

a) *A specific action for research intensive SMEs building on the Eurostars joint programme.*

b) Measures to enhance innovation capacity of SMEs through new and experimental types of SME innovation support. Measures may include, for example, projects animated by intermediary organisations to develop and demonstrate new industrial value chains between innovative SMEs and a commitment of regional authorities to put value chains in practice. Furthermore they may comprise assistance to SMEs to connect with research and innovation partners across the Union ('spin-in projects').

c) Support for market driven innovation, for example, through procurement networks (European Commission 2014f).

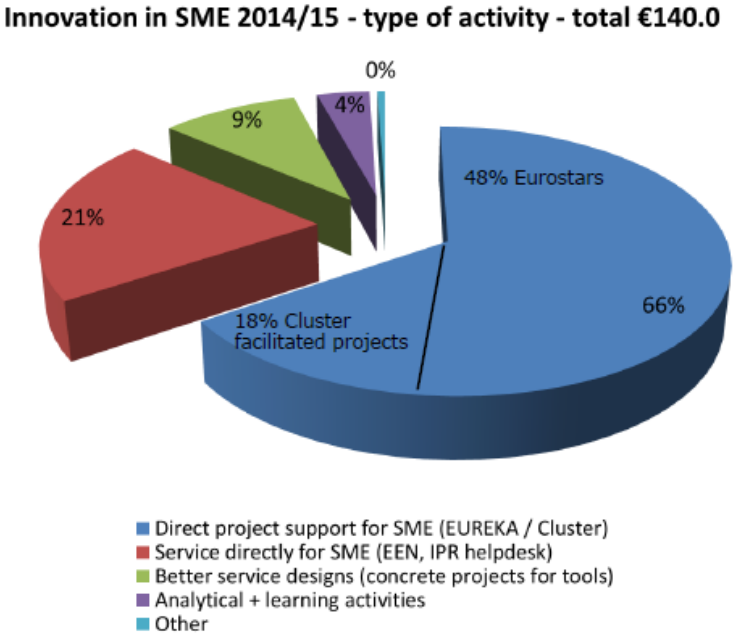


Figure 4-13 Innovation in SMEs type of funding activities (Event 2014).

1- SMEs Instrument:

SME instrument is the new program only for SMEs, aiming to support SMEs R&I activities whether they are high-tech and research driven or non-research conducting, social or Service Company. This program tends to facilitate the innovation to market path for SMEs through comprehensive, simple and easily accessible scheme. Unlike cooperative program, even and single SME can apply.

Figure 4-14 SME instrument at single glance (EC 2014)

This program was initiated by Innovation Union with the aim of creation of innovation-friendly ecosystem for EU to encourage greater involvement of SMEs in R&I activities. With a budget of over € 3 billion over the period 2014-2020 were designed to grant tailored support to SMEs that have ground-breaking ideas with a high market potential, but are short of certain resources, or a real strategy, to deliver. It will address the financing gap in developing high-potential, but high-risk innovative ideas of small companies and bringing them closer to the market. This has been a widely recognised EU-wide market failure which relates to the market's difficult relationship with uncertainty and estimating the potential value of new technologies, new products, new resources, new firms or new entrepreneurial capabilities. The SME instrument addresses all types of innovative SMEs so as to be able to promote growth champions in all sectors.

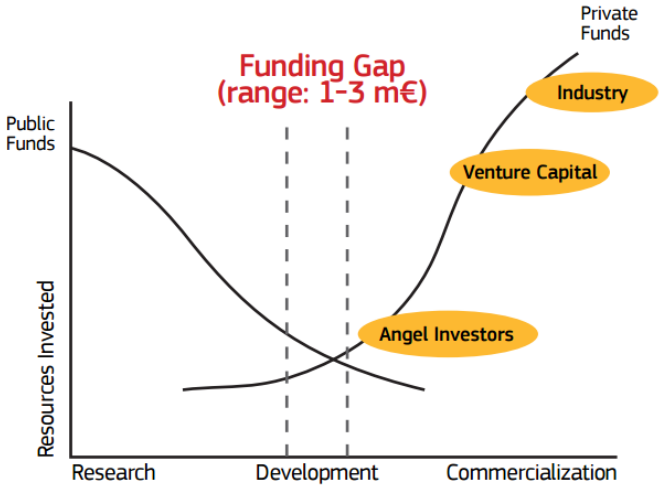


Figure 4-15 SME instrument funding scheme (European Commission 2013e).

The SME Instrument is divided into four phase (European Commission 2013e):

1- *Business innovation grants for feasibility assessment purposes (optional phase I): EUR 50,000 (lump sum) per project (70% of total cost of the project);*
2- *Business innovation grants for innovation development & demonstration purposes(possible phase II): an amount in the indicative range of EUR 500,000 and 2,5 million (70% of total cost of the project as a general rule);*
3- *Free-of-charge business coaching (optional in phases I and II), in order to support and enhance the firm's innovation capacity and help align the project to strategic business needs;*
4- *Access to a wide range of innovation support services and facilitated access to risk finance (mostly in optional phase III), to facilitate the commercial exploitation of the innovation.*

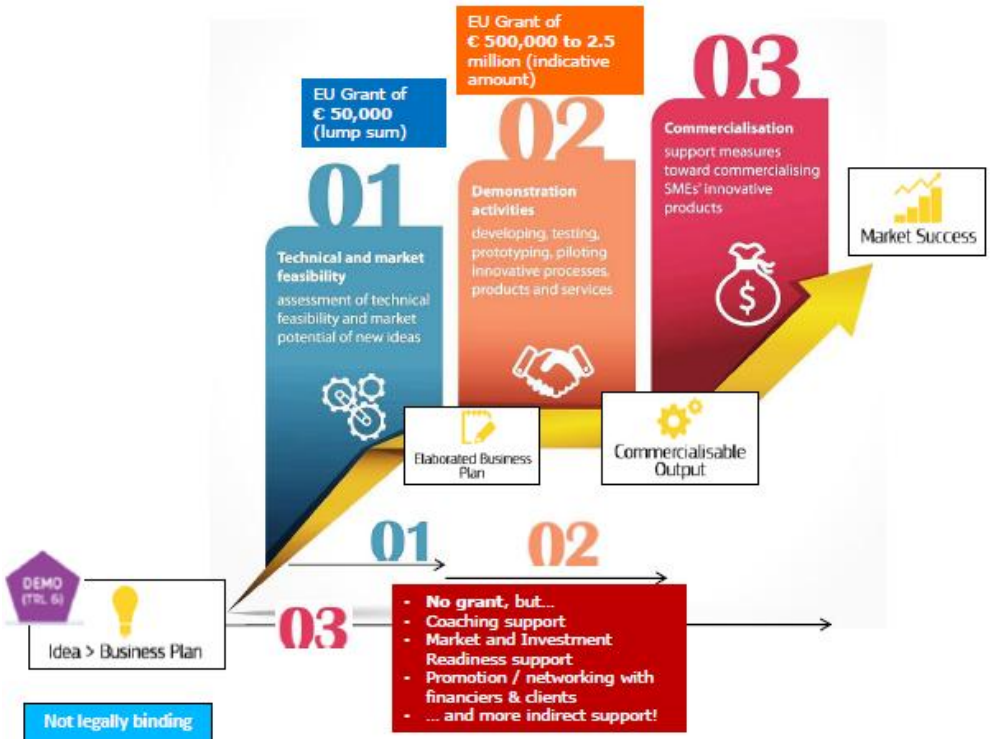


Figure 4-16 different phases of SME instrument (EC 2014).

2- Eurostars Joint Programme

Eurostars is a European joint programme that supports research-performing SMEs, which develop innovative products, processes and services and look for easier access to international markets to exploit the benefit (European Commission 2014b)("European Commission" 2009b).

Eurostars is co-funded from the national budgets of 34 EUREKA countries and by the European Union through Horizon 2020. The program is open for applications on a continuous basis, with a minimum of two submission deadline dates per year. After first result the EU has decided to increase its commitment to the programme from EUR 100 million in between 2008 and 2014 to a maximum of EUR 287 million under Horizon 2020. The combination of EUREKA's well established Secretariat and the network of National Project Coordinators / National Funding Bodies will guarantee local support in terms of promotion, assessment and monitoring, based on their proximity and an experience in funding SMEs (European Commission 2014b).

Some of Eurostars results:

Table 4-7 Eureka results (European Commission 2012).

Programme indicators		2008 (1 cut off)	2009 (1cut off)	2010 (2 cut offs)	2011 (2 cut offs)
Submission	Applications received per year	215	317	595	745
	Increase of applications submitted per year		*47%*	*88%*	*25%*
	% of SMEs	74%	73%	71%	72%
Funding	Public funding originally estimated (M€)	63.5	61.6	98.7	94.4
	% Funding vs initial earmarked (66,6M€)	*95%*	*92%*	*148%*	*142%*
Success rate	Applications funded per year	90	90	149	145
	Success rate: funded vs submitted	*42%*	*28%*	*25%*	*19%*
Quality rate	% Funding Top ranked 20	100%	100%	95%	98%
	% Funding Top ranked 60	88%	100%	83%	83%
Timing	Time for evaluation (in months)	3.8	3.8	3.7	3.7
	Time for funding availability (in months)	5.6	5.6	5.0	5.5
	Time-to-contract - project (in months) *ref: median (rank 50% of all projects)*	13.2	14.1	14	12.6
	Time-to-contract - top 5 countries (in months, median participants) *Number of participants approved in this group*	7.5 29 part.	7.3 33 part.	7.3 81 part.	5.9 75 part.
	Time-to-contract - bottom 5 countries (in months) *Number of participants approved in this group*	17.8 23 part.	19.8 72 part.	32.6 47 part.	N/A N/A

Source: EUREKA Secretariat (June 2012)

According to the interim evaluation of Eurostar I, SMEs account for 60% of EUREKA Individual projects participants. The impact of Eurostars 1 can be accessed through (European Commission 2011):

1- Eurostars 1 is estimated to boost European GDP by 5.1 billion €.
2- SMEs found this platform attractive this can be noted by high steady increase in number of application; 215 in 2008, 317 in 2009, 595 in 2010 and 745 in 2011, which are almost 5time more than expected.
3- Substantial leverage effect. With 1 M€ of public funds, 9.8 M€ of additional turnover is expected.

3- Access to Risk Finance supports

According to H2020 plan more than € 900 million will flow to SMEs and small midcaps. This support consists of:

1- *A debt facility providing loans, guarantees and other forms of debt finance to entities of all forms and sizes, notably research and innovation-driven SMEs.*
2- *An equity facility providing finance for mainly early-stage investments, with a particular focus on early-stage SMEs with the potential to carry out innovation and grow rapidly* (European Commission 2013a).

They are implemented via the European Investment Bank (EIB) and the European Investment Fund (EIF) and/or other financial institutions of comparable stature. Two main supportive initiatives under Horizon 2020 are InnovFin and COSMOS.

InnovFin – EU Finance for Innovators

InnovFin is the successor of RIS in H2020 which promotes a range of debt and equity products and advisory services in order to effectively give a boost to the availability of finance for research and innovation activities in Europe (European Commission 2014g).

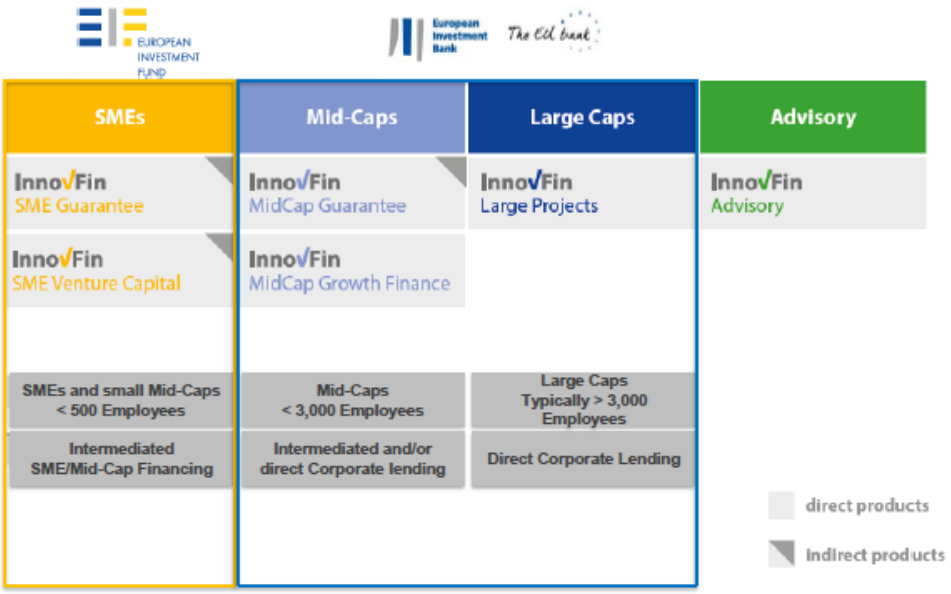


Figure 4-17 InnovFin products overview (Event 2014).

InnovFin - EU Finance for Innovators will deliver a range of tailored products to SMEs in different forms; from guarantees for intermediaries that lend to SMEs to direct loans to enterprises. It is designed to support the small and large R&I projects in the EU and countries associated to Horizon 2020.

Risk-Sharing Finance Facility (RIS) was InnovFin successor that was developed under the FP7, which helped provide over €11 billion of finance to 114 R&I projects worth more than €30 billion.

The InnovFin and COSME (EU programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises) will operate in conjunction.

The European Investment Bank (EIB) will play a key role, as entrusted entities, in implementing each financial instrument facility on behalf of and in partnership with the European Commission.

The two key players in this initiative are the European Investment Bank (EIB) and the European Investment Fund (EIF). They are entrusted entities in implementing each financial instrument facility on behalf of and in partnership with EC. EIB will offer loans to medium to larger companies, or guarantees to banks lending to them while EIF will grant guarantees to banks lending to SMEs and – at a later stage – invest in venture capital funds providing start-ups and fast-growing firms with equity.

COSME (European Commission 2015a) is the EU programme for the Competitiveness of Enterprises and SMEs. With the budget of €2.3bn during 2014 to 2020, COSME will support SMEs in the following area[2]:

- *Better access to finance for SMEs*
- *Access to markets*
- *Supporting entrepreneurs*
- *More favourable conditions for business creation and growth* (European Commission 2015a)

[2] http://ec.europa.eu/enterprise/initiatives/cosme/index_en.htm

H2020 Initial Result

Up to this date, no complete report is published by European Commission on results of first round of Horizon 2020.

The initial results of H2020 (European Commission 2014d) mostly are in form of a small presentation and articles from different EC DGs published in EC website which is not covering detail data on SMEs performance in H2020.

These small reports show that the success rate in LEIT respect to its successor COOP in FP7 seems a little lower in terms of overall success rate, percentage of applicant and EU funding. In H2020 LIET Proposals success rate is 12%, Application 15%, EU funding 15%, which in FP7COOP they were 20%, 22%, 22% respectively.

But in case of SMEs, in societal challenges 15.8% of EU financial contribution and 22.2% of participations and in LEIT, 22.8% of EU financial contribution and 28.4% of participations are accounted by SMEs. Therefore the objective of SME participation of 20% of the combined budgets of societal challenges and LEIT has been reached. Moreover in respect to FP7, the financial contribution and participation of SMEs (respectively 17.1% and 19.3%) both have been increased. But, as shown below overall requested EU contribution by eligible SMEs were 21% in respect to 25% in FP7.

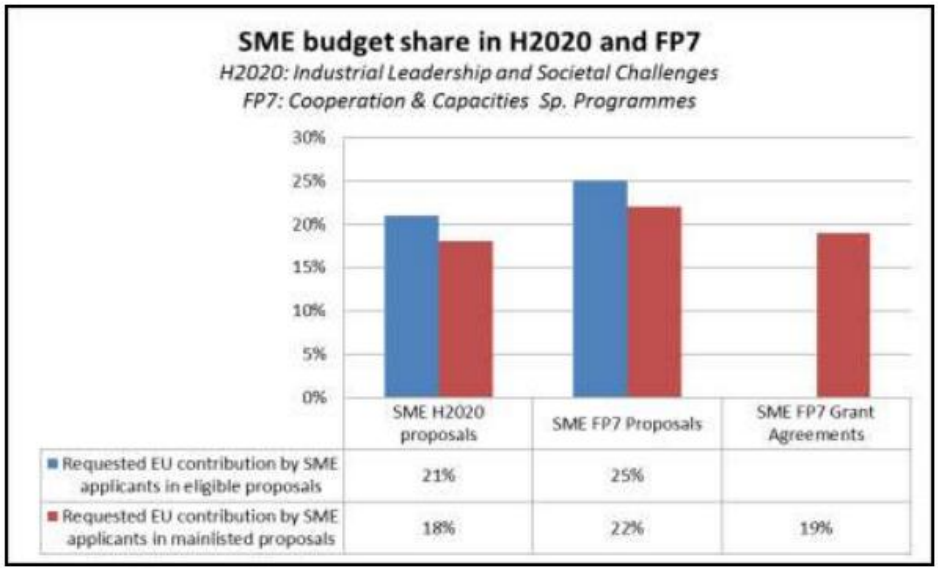


Figure 4-18 SMEs Budget share in H2020 and FP7 (EC 2014).

SME instrument first round results show that 293 SMEs from 30 countries have been selected under Phase 1. For each project, the participants will receive €50,000 to finance feasibility studies. They can also request up to three days of business coaching. According to Commission website, 2,363 proposals were received by the third cut-off date of Phase 1 on 17 December 2014. 13.5% of these proposals (320) received an evaluation score above the application threshold, from which 81% (259) have been considered for funding.

Table 4-8 Horizon2020 SME instrument first three rounds results (EC website 2015).

	Cut-off date	Number of SMEs	Number of projects	Funding (€ m.)
Phase 1	June 2014	162	155	7,75
	Sept. 2014	200	178	8,9
	December 2014	293	259	12,95
Sub-total		*655*	*592*	*29,6*
Phase 2	October 2014	78	60	108,13
	December 2014	94	74	117,62
Sub-total		*172*	*134*	*225,75*
TOTAL		827	726	255,35

Accounting first two rounds in 2014, Spanish SMEs were at the top in Phase1 by 129 beneficciaries in total accepted for funding, followed by Italy (108) and the UK (81)., 655 SMEs have been selected under Phase 1 of the SME Instrument and with almost €30 million contribution from EC since the launch of the programme on 1st January 2014.

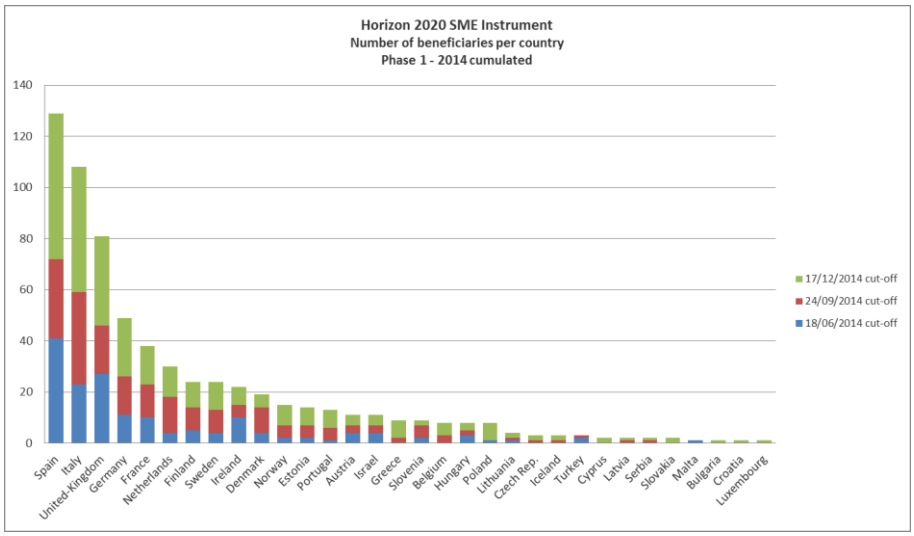


Figure 4-19 SME instrument funded SMEs based on the counties.

4.4.Europe Innovation performance

The Innobarometer (EC 2014) is an opinion poll on activities and attitudes related to innovation which has been carried out by European Commission every year since 2001. It collects opinions and feedback from the general public and European businesses. This survey provides a unique source of direct information on innovation. It is based on a standard questionnaire to help monitor change in how companies manage their innovation activities, plan investment to improve their business and the barriers that they faced in doing so. The following data has been extracted from Innobarometer survey which summarized the current situation of innovation in Europe.

1- **Types of Innovation that been carried out in Europe**:

Only two third of surveyed companies has at least one innovation since 2011 and the innovation types are Services (38%) and product (37%), Marketing innovation (33%), Organizational innovation 30% and improvement in processes 29%. (Figure 4-20 and 4-21)

2- **Activities related to innovations**:

Only 20% of companies have conducted R&D activities since January 2011 (either in-house or via outsourcing) but lower applied for one or more patents or trademarks (7%). Therefore there is no notable difference between European companies and their counterparts in Switzerland or the US. Furthermore more than 75% of companies identified management and employees the main contributors to the development of ideas for innovations while 54% recognized other companies the main contributors. (Figure 4-22)

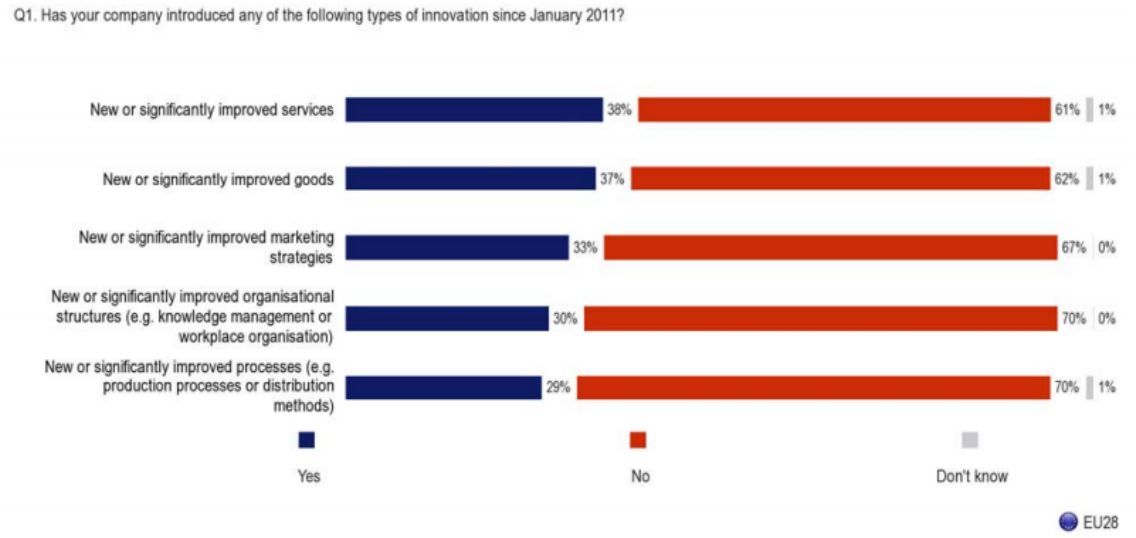


Figure 4-20 Innovation Type in Europe (EC 2014).

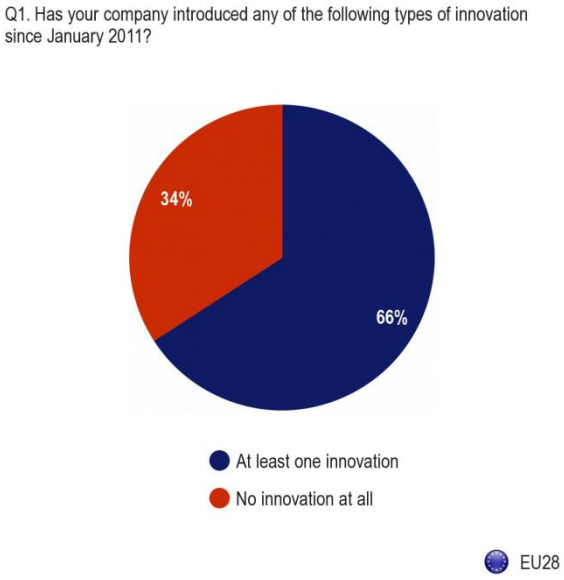


Figure 4-21 Percentage of Innovative Firms from 2011(EC 2014).

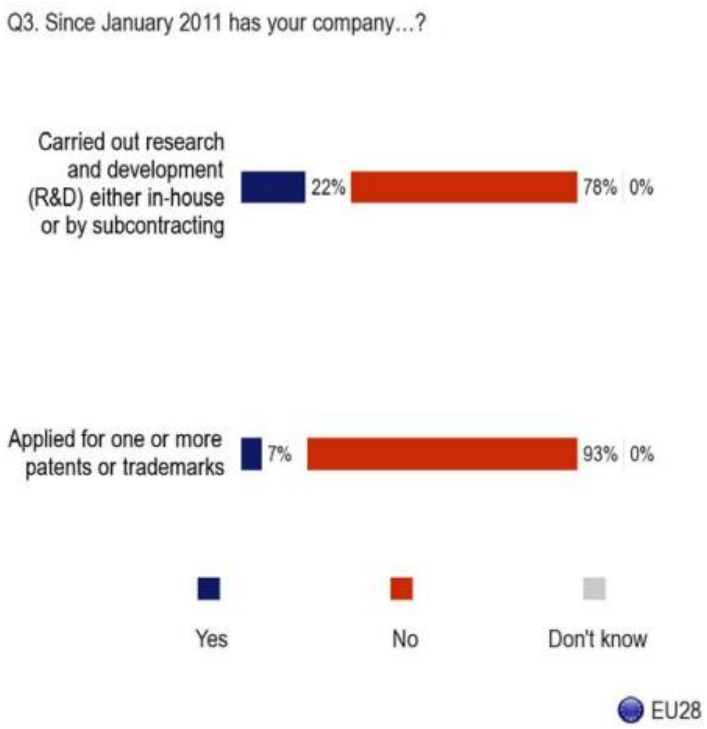


Figure 4-22 Innovation Activities (EC 2014).

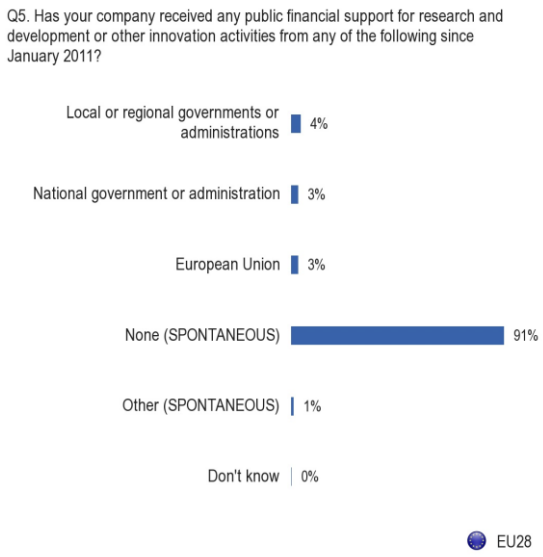


Figure 4-23 % firms that accessed R&D support (EC 2014).

1- Partnership Innovation activities:

Regarding marketing, distributing or promoting innovative goods or services, 35% of companies collaborated with partner companies or external consultants and 33% with companies or individual consumers. Non-innovative companies are less likely to have collaborated with other entities (17%).

2- **Public financial support for R&D and other innovation activities**:

Most of the companies have not received public financial support for R&D or other innovation activities since January 2011 (91%). 4% have received local or regional government assistance, 3% received national government assistance and 3% assistance from the EU (EC 2014). (Figure 4-24)

12% of companies have received some kind of support for commercialising their innovation, with support in training staff how to promote innovation (6%) and assistance meeting regulations or standards (4%) as the most common types of support. In comparison, the US companies claim to receive more financial or non-financial supports from a governments or administration for developing a marketing plan (14% vs. 2%) or for training staff in how to promote innovative goods or services (11% vs. 6%) (EC 2014). (Figure 4-25)

The majority of innovative companies believe that public support are not effective enough For companies that received public financial support of some kind there is an even split between those that say this support was important for developing innovations (48%) and those who say the support was not important (49%) (EC 2014).

Companies that received financial or non-financial support from governments or administrations for commercialising their innovations are most likely to say this support was not important (67%).

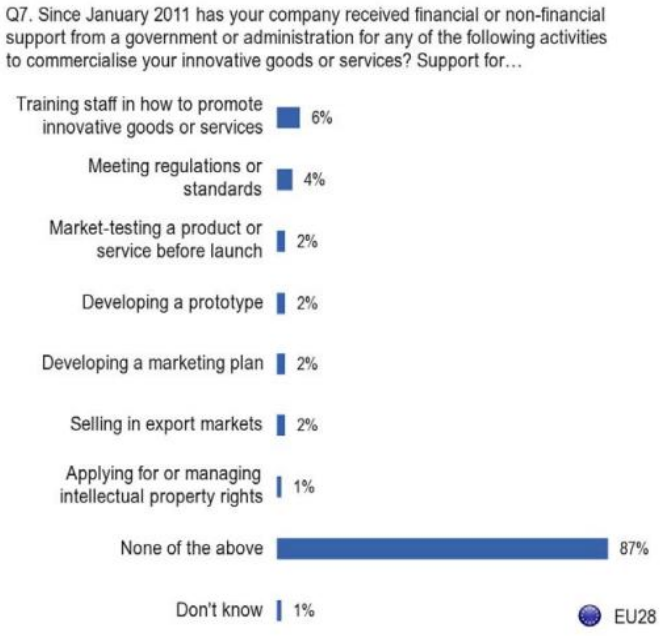


Figure 4-24 % of Firms which received financial or nonfinancial support (EC 2014).

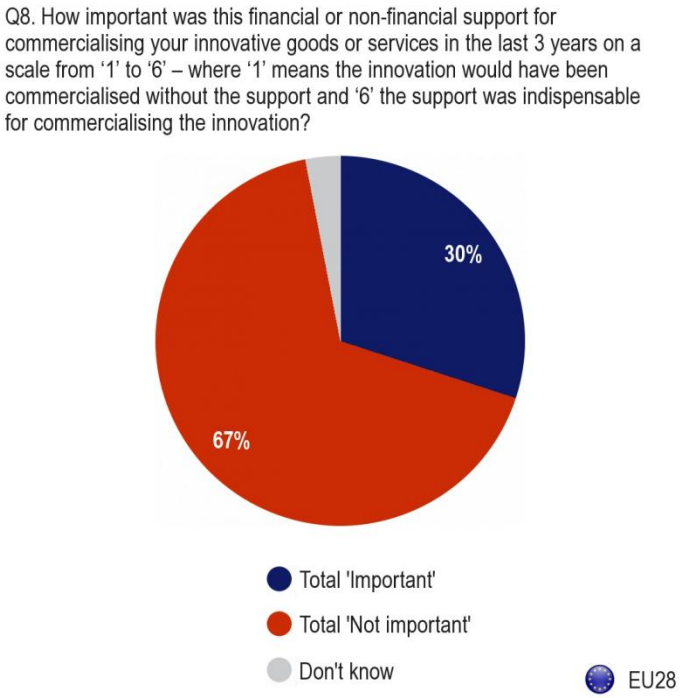


Figure 4-25 Financial Support for Commercialization (EC 2014).

3- **Commercialization of innovation**:

40% of companies that have innovations also commercialise them. 48% declare that they do not have any innovation to commercialise and 66% have innovations and commercialize them (EC 2014). (Figure 4-26)

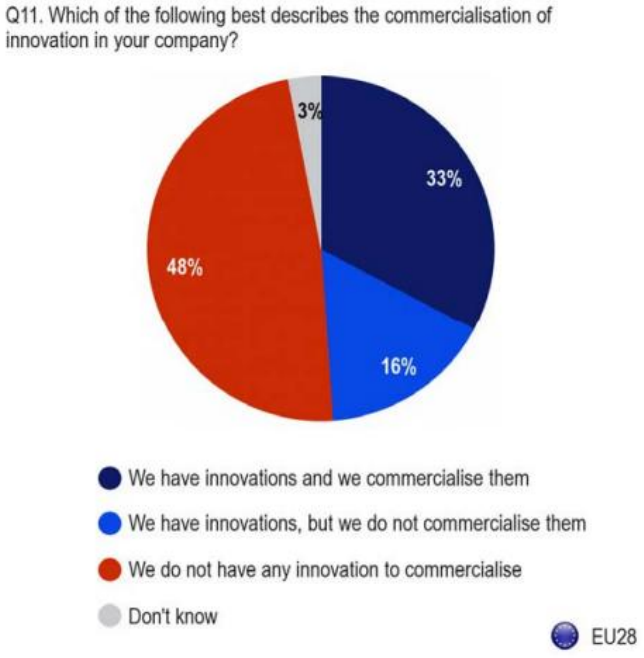


Figure 4-26 Commercialization of Innovation (EC 2014).

68% of companies recognize lack of financial resources as the main barrier for commercialisation of their innovation. The results of the Innobarometer are suggesting the same as the Innovation Union Scoreboard 2014 which confirmed that the EU is still lagging behind global leaders. Notably, while other innovation performance indicators are improving in all Member states, the commercialisation of innovation (SMEs introducing product innovation / sales of new to market and new to firm innovations) is slow (EC 2014).

This is followed by a market dominated by established competitors (64%) and the cost or complexity of meeting regulations or standards (62%) as other barriers (Figure 4-27).

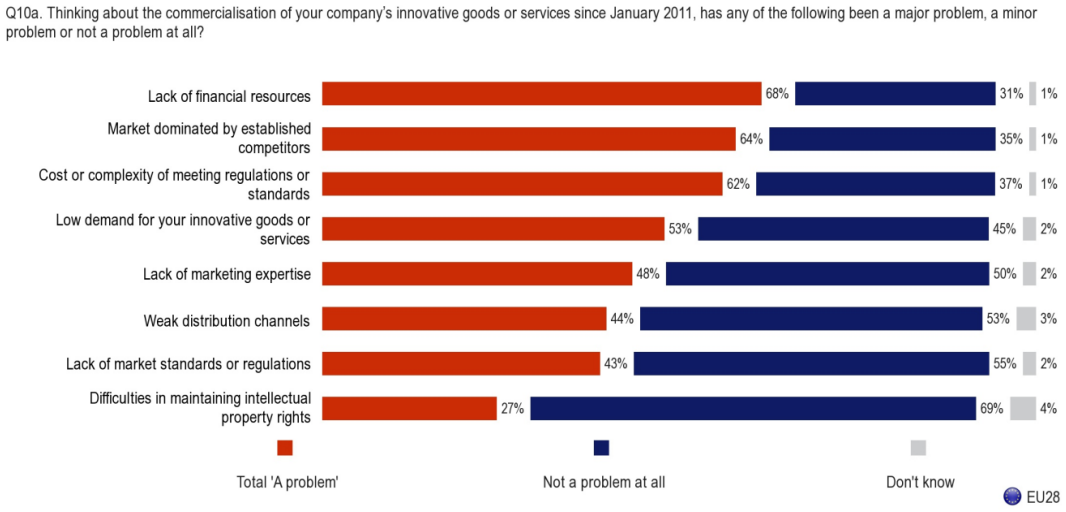


Figure 4-27 Reasons of unsuccessful commercialization of Innovations (EC 2014).

6. Public procurement:

18% of companies have won at least one public procurement contract but just one third of companies that won, sold their innovation as a part of this.

Only 5% of companies have been involved in the Public Procurement of Innovative Solutions since January 2011 and these companies are more likely to have won at least one public procurement contract (61% vs. 15%), or to have made an unsuccessful tender (38% vs. 12%) compared to those not involved in the scheme(EC 2014) (Figure 4-28).

7- Innovations share in the company's turnover:

For 39% of companies 25% of their turnover in 2013 was due to innovation. For 61%, innovation contributed 25% or less to the annual turnover in 2013. Just 13% said innovative goods or services contributed 26% to 50% to the annual turnover, 3% mention a contribution of between 51% and 75%, while 4% said the contribution was between 76% and 100%. 10% said that innovation did not make any contribution to the turnover in 2013. Compared to the last wave in 2012, companies seem now more aware of the extent of the contribution of innovative goods or services to the annual turnover (+11 percentage points). At the same time, they are also now more likely to say that 1% to 25% of turnover is due to innovative goods or services (+15) (EC 2014) (Figure 4-29).

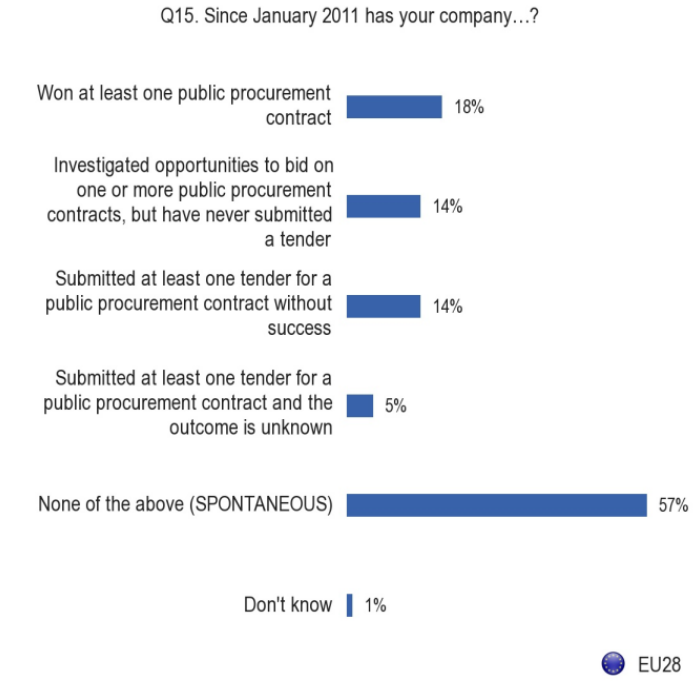


Figure 4-28 Public procurement and Innovation (EC 2014).

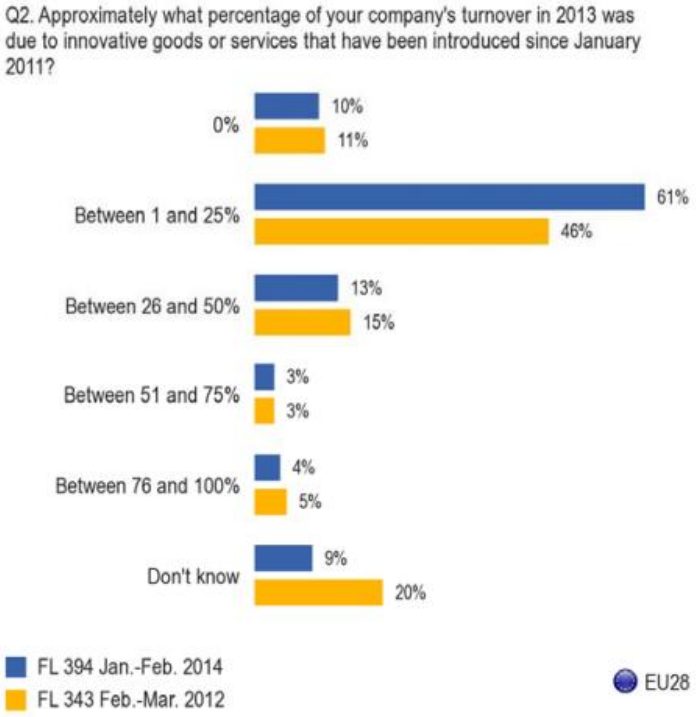


Figure 4-29 Innovation and companies turnover (EC 2014).

5. Conclusion

This work was an attempt to achieve an overview on current situation of SMEs innovation performance in manufacturing sectors and impact of the European supportive actions on these kind of firm. The first chapter was a review on different literatures on innovation, innovation performance and management. In this chapter different disciplines and frameworks of innovation management were discussed and the evolutionary paths of innovation management were depicted. This was followed by important factors such as innovation diffusion. This results of this chapter were foundation of next chapter, which was a overview on innovation in small firms. The second chapter was dedicated too SMEs innovation; different practices, internal and external influencing factor and barriers where pointed out. Results of these chapter show that innovative SMEs currently faces different barriers. The most important ones can be respectively summarized as follow; restricted financial due to nature of these firms, need for internationalization as vital factor for SMEs to reach a global market mostly through exporting, lack of education of personnel and skilled human resource both in R&D and non-R&D innovation activities of the firm.

By having this mind the next chapter addressed the metric and measure on innovation and answered this question how/when/where should innovation be measure.

Finally the last chapter was dedicated to study on current situation of SMEs in Europe and the supportive actions that are provided by EC to address the barriers that has been counted above. By using different measure and surveys the following conclusion could be draw:

SMEs in Europe still lagging behind from their counterparts in US and Japan regarding their R&D activities. However there has been many R&I program under European funding scheme, still there is a need for more. Most of SMEs in Innobarmeter survey identified lack of financial and non-financial support from governments and administrations. This can be because of first, still SMEs in Europe are not aware of these supportive programs, or if they knew they are reluctant about participating due to complex procedure and regulation. Apart from that, the success rate in many of these indicatives are low, for example in factory of the future first round of call, the average of success rate was 7%. This is due to the fact that this call topic is very competitive and unless a SME participates with a good and expert partners, there is a low chance of funding. Therefore, the role of SMEs in this kind of actions should be emphasize more and more, however the result from first round of H2020 shows more participation of SMEs than FP7, but still only a few percentage of SMEs are able (have the knowledge and network) to participate and majorities of SMEs in Europe are not benefiting from these actions.

Bibliography

H Van de Ven Vernon. 2000. Organizational Change and Innovation Processes: Theory and Methods for Research: Theory and Methods for Research.

Allman, Kurt, Jakob Edler, Luke Georghiou, Barbara Jones, Ian Miles, Omid Omidvar, Ronnie Ramlogan, and John Rigby. 2011. "Measuring Wider Framework Conditions for Successful Innovation: A System's Review of UK and International Innovation Data," no. January: 1–76. http://www.nesta.org.uk/library/documents/Measuring_Framework_web_v2.pdf.

Andrew, J. P.;Sirkin, H. L.; Kaanaes, K.; Michael. D. M. 2007. Measuring Innovation 2007 : A BCG Senior Management Survey. The BOSTON CONSULTING GROUP.

Andrew, J. P.;Sirkin, H. L.; Kaanaes, K.; Michael. D. M. 2009. Report Measuring Innovation 2009 The Need for Action. The BOSTON CONSULTING GROUP. Vol. 112. http://209.83.147.85/publications/files/BCG_Measuring_Innovation_Apr_2009.pdf.

Busarovs, Aleksejs. 2013. ""OPEN INNOVATION: CURRENT TRENDS AND FUTURE PERSPECTIVES." Humanities and Social Sciences: Latvia 21 (2): ., 103–19.

Cainelli, Giulio, Rinaldo Evangelista, and Maria Savona. 2006. "Innovation and Economic Performance in Services: A Firm-Level Analysis." Cambridge Journal of Economics 30 (3): 435–58. doi:10.1093/cje/bei067.

Chesbrough, Henry William. 2003. The Era of Open Innovation.

Community innovation statistics. 2010. The Lisbon Community Innovation Statistics- CIS 2006. Community Innovation Statistics.

Corne, Stephan Schutte, and Marais. 2010. "The Development of Open Innovation Models to Assist the Innovation Process."

EFFRA. 2012. "Factories of the Future PPP FoF 2020 Roadmap Consultation Document." Advanced Manufacturing, no. October: 1–89.

European Commission. 2009. Eurostat 2009.

European Commission. 2005a. "ACTION PLAN TO IMPROVE COMMUNICATING EUROPE BY THE COMMISSION."

European Commission. 2005b. IMPLEMENTING THE COMMUNITY LISBON PROGRAMME MODERN SME POLICY FOR GROWTH AND EMPLOYMENT.

European Commission. 2009a. Eurostat, "Statistics in Focus, Industry, Trade and Services."

European Commission. 2009b. "Impact Assessment Guidelines." Evaluation, no. January: 1–51. http://ec.europa.eu/governance/impact/commission_guidelines/docs/iag_2009_en.pdf.

European Commission. 2011. "Interim Evaluation of the Eurostars Joint Programme" 32 (April): 1–3.

European Commission. 2012a. An Introduction to Mechanical Engineering: Study on the Competitiveness of the EU Mechanical Engineering Industry within the Framework Contract of Sectoral Competitiveness Studies.

European Commission. 2012b. "CIP Performance from 2007 to 2012."

European Commission. 2013a. "Factsheet : SMEs in Horizon 2020," 1–3.

European Commission. 2013b. "FP7 Roadmap (The 7th Framework Programme Funded European Research and Technological Development from 2007 until 2013)." Challenge.

European Commission. 2013c. "Questions and Answers on Support for Small- and Medium-Sized Enterprises (SMEs) in Horizon 2020- The EU Framework Programme for Research and Innovation Why Is Research and Innovation Important for SMEs and the," no. March: 2011–14.

European Commission. 2013d. "Seventh FP7 Monitoring Report."

European Commission. 2013e. "The SME Instrument: Your Highway to Innovation." doi:10.2777/43984.

European Commission. 2014a. "Annual Report on European SMEs 2013 / 2014 – A Partial and Fragile Recovery Final Report -July 2014 SME Performance Review 2013 / 2014."

European Commission. 2014b. "EUROSTARS Funding Excellence in Innovation Guidelines for Completing an Application," no. January.

European Commission. 2014c. Horizon 2020. Horizon 2020. http://cordis.europa.eu/guidance/welcome_es.html.

European Commission. 2014d. "INITIAL LESSONS LEARNED FROM THE FIRST CALLS OF HORIZON 2020," no. October.

European Commission. 2014e. Innobarometer : The Role of Public Support in the Commercialisation of Innovations.

European Commission. 2014f. "Report Reveals That SMEs Participating in FP7 Perform Significantly Better than Comparable Non-Participating SMEs." http://ec.europa.eu/research/sme-techweb/newsletter/issue20/editorial_en.html.

European Commission. 2014g. "What Is InnovFin SME Guarantee ? What Are the Benefits for Financial Intermediaries ?," 499.

European Commission. 2015a. "COSME Workprogram," no. 2014: 1–61.

European Commission. 2015b. "Innovation Policy." European Commission. http://ec.europa.eu/enterprise/policies/innovation/policy/index_en.htm.

European Commission Industry Publications. 2005. "The New SME Definition." Official Journal of the European Union C (October): 1–52. doi:EN NB60-04-773-ENC-C 92-894-7909-4.

European Commission, Expert Group. Annerberg, R. Et Al. 2010. "Interim Evaluation of the Seventh Framework Programme," 90. http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/fp7_interim_evaluation_expert_group_report.pdf.

European Union Law. 2011. "General Principles of EU Law." Law 3 (of 3): 1–11.

Event, Launch. 2014. "Horizon 2020 : An Overview on SMEs Support & Financial Instruments SME Support in Horizon 2020 An Overview," no. February.

Fagerberg, Jan, David C Mowery, and Richard R Nelson. 2006. The Oxford Handbook of Innovation. Oxford Handbooks Online.

Frambach, Ruud T., and Niels Schillewaert. 2002. "Organizational Innovation Adoption: A Multi-Level Framework of Determinants and Opportunities for Future Research." Journal of Business Research 55 (2): 163–76. doi:10.1016/S0148-2963(00)00152-1.

Freel, Mark S., and Paul J.a. Robson. 2004. "Small Firm Innovation, Growth and Performance: Evidence from Scotland and Northern England." doi:10.1177/0266242604047410.

García-Morales, Víctor J, Francisco Javier Lloréns-Montes, and Antonio J Verdú-Jover. 2008. "The Effects of Transformational Leadership on Organizational Performance through Knowledge and Innovation." British Journal of Management 19 (4). Blackwell Publishing Ltd: 299–319. doi:10.1111/j.1467-8551.2007.00547.x.*

Godin, Benoît. 2006. "From Eugenics to Scientometrics : Galton , Cattell and Men of Science Benoît Godin 3465 Durocher Street Montreal , Quebec Canada H2X 2C6 Project on the History and Sociology of S & T Statistics Working Paper No . 32 Previous Papers in the Series." Statistics, no. 32: 49.

Golovko, Elena, and Giovanni Valentini. 2011. "Exploring the Complementarity between Innovation and Export for SMEs/' Growth." J Int Bus Stud 42 (3). Academy of International Business: 362–80. http://dx.doi.org/10.1057/jibs.2011.2.

Joseph Alois Schumpeter. 2005. A Theoretical, Historical, and Statistical Analysis of the Capitalist Process.

Kline, Stephen J, and Nathan Rosenberg. 1986. "An Overview of Innovation." The Positive Sum Strategy: Harnessing Technology for Economic Growth 14. National Academy Press Washington, DC: 640.

Kolk, Michaël, Phil Kyte, Frederik Van Oene, and Jeroen Jacobs. 2012. "Innovation: Measuring It to Manage It." Prism 1: 41–51.

Lee, Sungjoo, Gwangman Park, Byungun Yoon, and Jinwoo Park. 2010. "Open Innovation in SMEs-An Intermediated Network Model." Research Policy 39 (2). Elsevier B.V.: 290–300. doi:10.1016/j.respol.2009.12.009.

Lichtenthaler, Ulrich. 2010. "Intellectual Property and Open Innovation: An Empirical Analysis." International Journal of Technology Management 52 (3): 372–91. doi:10.1504/IJTM.2010.035981.

Love, J. H., and S. Roper. 2015. "SME Innovation, Exporting and Growth: A Review of Existing Evidence." International Small Business Journal 33 (1): 28–48. doi:10.1177/0266242614550190.

Love, James, and Stephen Roper. 2013. "SME Innovation, Exporting and Growth." Enterprise Research Centre 2013 (5): 1–56.

Maravelakis, E., N. Bilalis, a. Antoniadis, K. a. Jones, and V. Moustakis. 2006. "Measuring and Benchmarking the Innovativeness of SMEs: A Three-Dimensional Fuzzy Logic Approach." Production Planning & Control 17 (3): 283–92. doi:10.1080/09537280500285532.

OECD. 2005. Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data. Oslo Manual. Vol. Third edit. doi:10.1787/9789264013100-en.

OECD. 2010. The OECD Innovation Strategy: Getting a Head Start on Tomorrow. Innovation. doi:10.1787/9789264083479-en.

OECD. 2013. Science, Technology and Industry Scoreboard 2011. /content/book/sti_scoreboard-2011-en\n/content/book/sti_scoreboard-2013-en.

OECD. 2014. OECD Science , Technology and Industry.

Open Innovation. 2014. "Open Innovation." http://www.openinnovation.eu/openinnovatie.php.

Ortt, J. Roland, and Patrick a. Van Der Duin. 2008. "The Evolution of Innovation Management towards Contextual Innovation." European Journal of Innovation Management 11 (4): 522–38. doi:10.1108/14601060810911147.

Pellegrino, G., M. Piva, and M. Vivarelli. 2009. "How Do Young Innovative Companies Innovate?" IZA Discussion Paper 4301 http://ssr (2): 208–17. doi:10.1177/0160017602250977.

Rogers, Everett. 2003. Diffusion of Innovations.

Rogers, Mark, Christian Helmers, and Christine Greenhalgh. 2007. "An Analysis of the Characteristics of Small and Medium Enterprises That Use Intellectual Property." UK Intellectual Property Office.

Schumpeter, Joseph. 1961. The Theory of Economic Development.

Śledzik, Karol. 2013. "Schumpeter ' S View on Innovation and Entrepreneurship," 89–95.

Thuriaux-Aleman, Ben, Rick Eagar, and Anders Johansson. 2012. "Getting a Better Return on Your Innovation Investment - Results of the 8th Arthur D. Little Global Innovation Excellence Study," 24.

Tidd, Joe. 2006. "Discussion Paper 1: A Review of Innovation Models." Innovation Models, 16. www.emotools.com/static/upload/files/innovation_models.pdf.

Tödtling, Franz, and Alexander Kaufmann. 2002. "SMEs in Regional Innovation Systems and the Role of Innovation Support--the Case of Upper Austria." The Journal of Technology Transfer, 15–26. doi:10.1023/A:1013140318907.

Urien, Carlos M. 2001. "THE PRESENT AND FUTURE OF SUPPORTING PROGRAMMES FOR SMES," no. May: 373–402.

Vaccaro, Ignacio G, Justin J P Jansen, Frans A J Van Den Bosch, and Henk W Volberda. 2012. "Management Innovation and Leadership: The Moderating Role of Organizational Size." Journal of Management Studies 49 (1). Blackwell Publishing Ltd: 28–51. doi:10.1111/j.1467-6486.2010.00976.x.

West, Joel, and Scott Gallagher. 2006. "Challenges of Open Innovation : The Paradox of Firm Investment in Open Source Software Challenges of Open Innovation : The Paradox of Firm Investment in Open Source Software." R&D Management 36 (3): 319–31. http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9310.2006.00436.x/abstract.

Wisdom, Jennifer P., Ka Ho Brian Chor, Kimberly E. Hoagwood, and Sarah M. Horwitz. 2014. "Innovation Adoption: A Review of Theories and Constructs." Administration and Policy in Mental Health and Mental Health Services Research 41 (4): 480–502. doi:10.1007/s10488-013-0486-4.