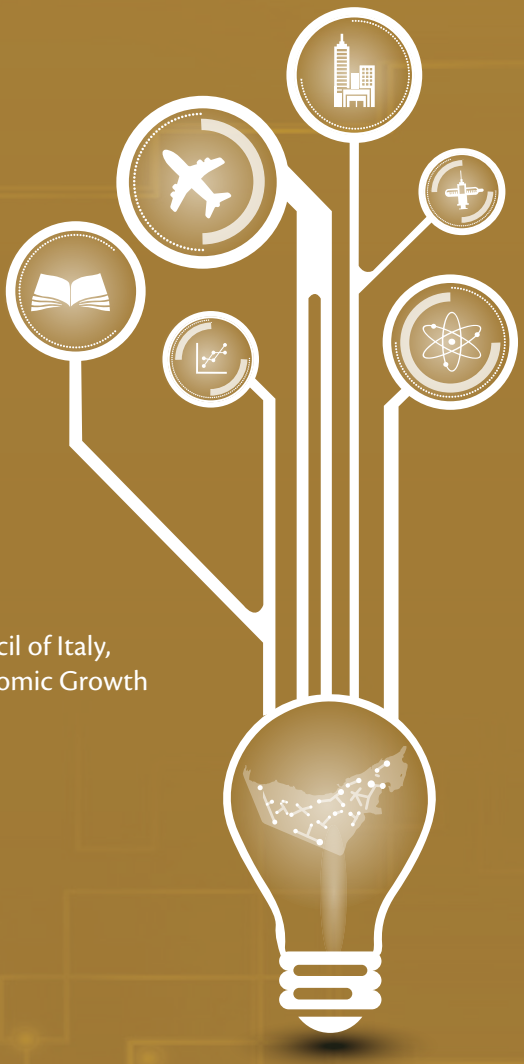
UNITED ARAB EMIRATES
MINISTRY OF ECONOMY

الإمارات العربية المتحدة
وزارة الاقتصاد

THE INNOVATION GUIDE

for Companies in
the United Arab Emirates:
Towards UAE Vision 2021

CNR-IRCRES - National Research Council of Italy,
Research Institute on Sustainable Economic Growth



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THE
INNOVATION GUIDE
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H.H. Sheikh Khalifa Bin Zayed Al Nahyan
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PREFACE

H.E. Eng. Sultan AlMansoori
Minister of Economy

I am pleased to start this preface for this Innovation Guide for Companies in UAE, by expressing our deep thanks and appreciation to our wise leadership of H.H. Shaikh Khalifa Bin Zayed Al Nahyan, President of the United Arab Emirate and his brother H.H. Shaikh Mohammed Bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai and his brother H.H. Shaikh Mohammad Bin Zayed Al Nahyan, Abu Dhabi Crown Prince and Deputy Supreme Commander of the UAE Armed Forces, on their profound vision and extensive and continued support to achieve the UAE Vision 2021 by making the UAE one of the best countries in the world.

This Innovation Guide for Companies in UAE is the result of one of the leading national innovation initiatives, which were introduced by the Ministry of Economy to the National Committee on Science, Technology and Innovation, which is formed by the Cabinet and has approved the initiative among the national initiatives to implement the national strategy of Innovation.

The UAE has become a significant international hub for entrepreneurship and innovation due to offering an attractive legislative and investment environment according to the best international practices. Moreover, the UAE has sustained setting up the specialized institutions and departments to enhance the role of innovation, which became the center of economic policies for UAE as it moves towards knowledge economy led by our notable national cadres.

I also appreciate the efforts of the joint team of the Ministry of Economy with - National Research Council of Italy, Research Institute on Sustainable Economic Growth [CNR-IRCrES] in the Republic of Italy for producing this Innovation Guide by combining scientific theories with pragmatic implementation of innovation for companies with comparison in (6) advanced countries.

The Ministry of Economy is publishing this Innovation Guide as part of its essential role in supporting the private sector and spreading the the innovation culture in UAE and encouraging UAE companies in all its categories to benefit from this Guide in order to enhance competitiveness of our national economy.

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Introduction to Innovation

INTRODUCTION TO INNOVATION

The meaning of the word "innovation" is often opaque, subject as it is to several competing interpretations and misinterpretations. In day-to-day life, the term "innovation" is used to mean different things in a variety of different contexts. However, this free play with the word endangers its correct usage in the correct contexts. All too often, the term is misused to indicate fields, facts, topics or ideas that are in fact quite distant from what could actually be defined as "innovation" or "innovative". Thus, the first order of business is to clear the waters and clarify the exact meaning of the concept, thereby associating it with the correct ideas and situating it within the contexts in which it can actually make substantial contributions. The present chapter will outline and expound upon the basic definitions and concepts of "innovation" and explicate precisely what it means within the context of technology and industrial production.

The first section of this chapter examines the particular geographical context of the UAE. The following section will delineate precisely the meaning and concept of the word "innovation", referencing relevant authors who have published extensively on this topic. Moreover, this section will also seek to locate precisely where the concept of innovation is performed. Once the concept has been clarified and its site of performance located, we shall categorise the various types of innovation and, perhaps most importantly, examine some of the instruments used in gauging the advantages and dangers inherent in this type of innovation. Finally, section one will close with a systematic model of innovation.

The next topic that will be explored in this section is the meaning of innovation in the contemporary world. From this perspective, what is most poignant is the origin of the vast majority of innovative activities in the modern industrial and economic world: the idea of knowledge as a good. Fundamental to understanding this concept, the question must be asked: How can knowledge be used, traded and protected?

The proceeding sections of this chapter will expand upon the manners in which innovation can be implemented in a variety of businesses and firms. Firstly, the case of Small and Medium Enterprises shall be discussed, beginning with the peculiarities they present. Following that, the same analysis will be performed on large companies, again examining the particular strengths and weaknesses of their specific case. Finally, a very specific type of industry will be examined in relation to its features of and potentialities for innovation: technological startups.

The last section of this chapter will present a discussion of the role innovation and R&D plays in the success of a firm. From this vantage point, we will not only examine the importance that R&D (which is, in fact, performed in all sectors related to human knowledge) has for innovation and economic growth, but also the various origins that R&D can have. Specifically, this section will probe the topic of "technology transfer" as well as the innovative use of knowledge produced in academia and public research.

1.1 WHAT IS INNOVATION?

To answer the question "what is innovation?" we must examine the topic from several different perspectives in order to arrive at a comprehensive answer.

However, while we might find this answer simultaneously simple and complex, we must follow a clearly defined path leading to a comprehensive understanding of the concepts underlying the idea of innovation in order to introduce the rest of this report. Moreover, a theoretical sketch, such as the one we seek to create here, is necessary in the present context, as it helps to illuminate the mechanisms underlying innovative processes, such as "good theory is essential to good practice".

First of all, it is important to begin by outlining the historical trajectory the concept of "innovation" has followed in the history of business sciences, starting with the projections theorists have made in the last century. Amongst the very first to discuss the concept of innovation was the Austrian, Joseph A. Schumpeter1. Above all, he must be deferred to for his definition of innovation which still holds true and relevant today. In his work "Business Cycles" he offers us the following definition:

"we include the introduction of new commodities which may even serve as the standard case. Technological change in the production of commodities already in use, the opening up of new markets or of new sources of supply, Taylorization of work, improved handling of material, the setting up of new business organization such as department stores – in short any "doing things differently" in the realm of economic life – all these are instances of what we shall refer by the term innovation"

J. A. Schumpeter, Business Cycles (New York, 1939), Vol. I, p. 84[1].

1) Joseph Alois Schumpeter was born in Tresch, Moravia, Austria-Hungary (now in Czech Republic), on 8 February, 1883, and died in Taconic, Connecticut, U.S.A. 8 January 1950

When considering this definition, some relevant points must be taken into consideration. Firstly, innovation is a concept which applies to each and every process happening in and around the process of industrial production. It is not merely abstract "rocket science" standing apart from the processes, nor is it something happening only in the depths of laboratories. And though the fundamental role of high technology and scientific research should not be understated when discussing innovation, it must be emphasised that innovation is not just a matter of technology and research. This is reflected in Schumpeter's thought. He notes that "innovation" is different from "invention", perceiving invention as a purely technological or scientific process, and reminds us that innovation consists in "doing something new" within the economic and productive system. Innovation may or may not spring out of an invention, as "innovation is possible without a corresponding invention"[2]. Innovation can also be described as a new restructuring of pre-existing elements, accounting also for the cumulative character of technology and technological know-how. In innovation we also deal with clusters and the clustering of innovative ideas depending upon both technological and organisational factors.

Schumpeter also outlines why innovation is considered so important in the contemporary world. Indeed, in his 1942 book, "Capitalism, Socialism and Democracy", Schumpeter describes innovation as the fundamental engine driving the creation of profits[3]. He describes the growth of businesses as a non-linear process of reallocation of resources between firms and industries. Investments in innovation are emphasised as a basis for development, but also as an asset that tends to concentrate and to diffuse unevenly between firms. The two mechanisms it follows are selection (competition between "innovative" and "traditional" firms) and imitation (the likelihood that traditional firms will adopt the innovations of non-traditional or, more precisely, "innovative" ones).

In addition to the definition of innovation and the engines which drive it, there is another point which must be emphasised here. In the vision of Schumpeter, a special role is ascribed to the entrepreneur. In his work, Schumpeter outlines two different types of economic/productive/industrial environments.

In a system with fewer restrictions on the entrance of firm into an industry, innovation is enhanced by the entrance of entrepreneurs with new ideas, thus begetting new products, processes and organisational behaviours. Here, the creation of new enterprises challenging the old ones remains continuous. This interpretation reflects the structure of European industry at the turn of the 20th century, whereby many

2) J. A. Schumpeter, The Instability of Capitalism, Economic Journal, September 1928

3) J. A. Schumpeter, Capitalism, Socialism and Democracy

small enterprises came into bloom. In this case, the pattern of innovative activity is characterised by the ease with which a firm could enter into any given industry, and then by the continuous creation and presence of new enterprises.

However, another kind of entrepreneur must be accounted for, especially when discussing the key role played by "big incumbents", by which we mean large companies firmly positioned within their respective industries. This is particularly important when considering the relevance of R&D activities and the role played by large laboratories in introducing technological innovations. Large incumbent companies set high entrance barriers within their industries and the presence of large scale R&D facilities results in the formalisation of the innovation process. To put it more simply, big firms accumulate and amass knowledge, oftentimes using it to set entrance barriers to new entrepreneurs and small enterprises[4].

It is our belief that the definition of innovation as presented above is still relevant and should be considered as the most appropriate and suitable for the contemporary business world. Nevertheless, some points still need to be expanded upon. In particular, Schumpeter places less importance on the role played by science and technology in determining any given industry's rate of innovation. Instead, he seems to focus more on the central role innovation plays in the dynamics of the economy and the rate of business growth, especially with regard to the important role played by entrepreneurs and the innovative processes they catalyze.

In advancing our understanding of the roles played science and technology in innovation (while bearing in mind that they are not the sole drivers of innovation) we are aided by another relevant figure: Vannevar Bush[5]. By the end of World War II, Bush had become a prominent figure in the fields of science and technology in the United States. At the request of then-President of the United States F.D. Roosevelt, he prepared a report on the role of science and scientific pursuits in the intellectual life of a nation called "Science, the Endless Frontier"[6].

In his work, Bush is concerned with several points regarding scientific progress and its utility. Of utmost importance to Bush is the freedom of scientific enquiry. As he states, "Freedom of enquiry must be preserved", and the role of universities and research centres as that of "wellsprings of knowledge and understanding" able to produce a "flow of new scientific knowledge to those who can apply it to practical problems in government, in industry, or elsewhere" must be protected and preserved. Science creates "the fund from which the practical application of knowledge must be drawn". Finally, he emphasises the importance of scientific research's contributions to the public, stating, "If the colleges, universities, and research institutes are to meet the rapidly increasing demands of industry and government for new scientific knowledge, their basic research should be strengthened by use of public funds".

The point to be highlighted upon examining V. Bush's "Science, the Endless Frontier" is the importance of research and research centres, especially with regard to their contributions to innovation and progress. Moreover, in Bush's work, we can discern a distinction, or even a dichotomy, between "basic" and "applied" research. Finally, what is most important in his work is the understanding of research as a force working for the collective good and as an engine for innovation, rather than simply as means by which one can be trained or educated.

Although Bush is often considered to have invented the "linear model" of research, this is in fact not true. However, some scholars have affirmed that he did indeed lay the basis for the linear model of science, technology, and innovation. Despite the fact that concepts such as the importance of research for development and invention, and thus for innovative production, as well as the basic/applied research dichotomy are present in his work, the linear model per se is not introduced in any of his writings.

The "linear model" is sketched in figure 1. It defines the steps that any "innovative" activity must follow in order to be successfully executed. The basis for innovation lies in basic research (or, in other words, "target-free research", or "research without immediate practical purpose"). The object of this activity is to discover the fundamental behaviour of nature. Once fundamental discoveries have been made, it is then the correct time for "applied research", that is, research able to exploit those now-discovered fundamentals of nature for practical purposes. We can describe the chain of events as such: the results of basic research are transferred to applied research. From there they are put into development and thereafter are used for production. The phases of this transfer of knowledge are linear; there is no interconnection and the flow of innovation moves in one direction: from the laboratory to the market.

Together with the "basic research/applied research" dichotomy (which is to say "the advancement of knowledge" vs. "the systematic attack on a problem") the linear-model is broadly disseminated. This basic/applied dichotomy promotes the idea

4) The two systems sketched here have been labeled by scholars studying the thought of Schumpeter respectively as "Schumpeter Mark I" (described in "The Theory of Economic Development: An inquiry into profits, capital, credit, interest and the business cycle", 1912) and as "Schumpeter Mark II" (described in "Capitalism, Socialism and Democracy", 1942).

5) Vannevar Bush was born in Everett, Massachusetts, U.S.A. on 11 March, 1890 and died in Belmont, Massachusetts, U.S. on 28 June, 1974

6) V. Bush, "Science The Endless Frontier", available online at: https://www.nsf.gov/about/history/nsf50/vbush1945.jsp (link visited May, 2016)

that "basic research" yields practical results only by chance and in no case as a direct consequence of its practise, while "applied research" is relatively unlikely to result in any significant scientific breakthroughs.

After an outline of the basic/applied dichotomy, the term "development" is added to the model. The term derives mainly from the industrial environment. It is this context – industrial production -- which necessitates the final steps of the linear model, those being the production and marketing of goods, and of the diffusion and imitation of the "innovative" goods by competitors.

As it will be demonstrated in the following chapters, the linear model of innovation is judged today to be only a partial model, not able to fully describe and account for all the possible interactions involved in the innovative process. Nevertheless, it is important to describe it for two reasons. Firstly, it sets the precedent for conceptualising future models of innovation. Secondly, this model underscores the importance of technology, science and research as the most important factors involved in the "innovative process". As will be shown in the proceeding sections, innovative processes can be better delineated with a more structurally complex model. However, the simplicity of the linear model offers a good means by which we may begin to figure out how the innovative process can be performed.

However, today we find that the basic/applied dichotomy is at least -- if not entirely -- outdated. This is mainly due to two factors: 1.) the complexity of contemporary research and 2.) the need for accountability amongst researchers and the research process itself. We can observe this when we consider that most of the fundamentals of nature have been discovered and allow that research performed without any practical purposes often results in new discoveries. Furthermore, the majority of research facilities (for example, the Large Hadron Collider) require relevant, contemporary technological components in order to be built and to operate successfully. In turn, this leads to technological discoveries that, again, can be practically applied to everyday life. In addition, because such research projects are often publically funded through taxes, this mandates that scientists and their projects be accountable to society at large. Combined, these factors have blurred the boundaries between basic research and applied research, often causing them to overlap.

Summing up, we come to our ultimate definition of "innovation". Following Schumpeter's thought, we can define innovation as the ability of an entrepreneur – or a group thereof – to do or create something new within their respective industrial sector. Thus, the first relevant point is that the location or place of the innovative process is the firm itself. Any other location – be it scientific or technological research, an organization, a policy, etc. – can be relevant or even essential for the innovative process, but it is not the locus of innovation.

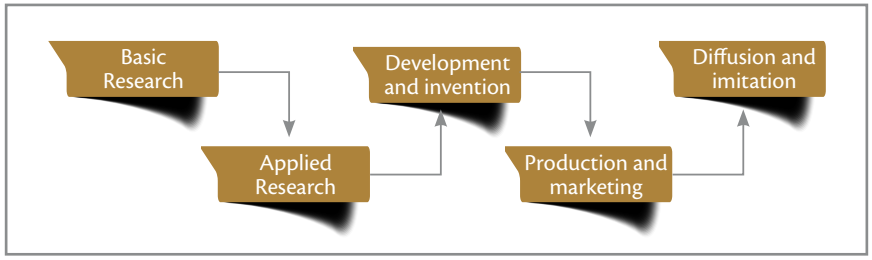
The second relevant point is that many different factors can serve as the origin of innovation. The first and most evident origin is scientific research itself and the new technologies that derive from it. As V. Bush has demonstrated, research begins with quite basic, target-free enquiries and travels a linear path to applied research, a path which often begets innovation. Furthermore, any other factor able to be reconstituted in a novel way can be an engine that drives innovation.

Thus the challenge of innovation can be found in the necessity of entrepreneurial personalities to exploit a pre-existing idea or artifact in a novel, creative way, or to create, by way of the scientific research process, new knowledge and to be able to exploit this knowledge in the service of production, the organization of production, or the commercialisation of the goods being produced. The locus of production is essentially the firm and the "creative entrepreneur" within that firm should be able to successfully apply newly created ideas in an original, novel manner.

Finally, we must not forget the social role of innovation. Yes, the "innovative good" or the "innovative organisation" firstly benefits those who produced it. However, we must remember that any innovation can potentially be socially beneficial. Thus the role of the innovator is not only that of a business man; indeed, the innovator also plays a social role.

How innovation is deployed in a firm will be the matter of the following chapters.

Figure 1 – The linear model of innovation



1.2 TYPES OF INNOVATION

As we have seen in the previous sections, innovation is at once a simple and complex subject. It is simple in the sense that a creative entrepreneur can innovate via a linear process. It is complex in the sense that any innovation can impact nearly every aspect of everyday life.

Thus, the manifestations of innovation are various and unlimited. Once we acknowledge this fact, we must acknowledge that it is virtually impossible to list each and every possible innovation that firms and entrepreneurs might produce through their innovative efforts.

Nevertheless, it is indeed possible to systematically classify the different types of innovations and innovative activities and to draw logical conclusions from this model. This is what we shall do in this section.

In our systematisation of innovative activities, Schumpeter again comes in relevant. In his work, "Theory of Economic Development", Schumpeter discerns (Chapter 2, "The Fundamental Phenomenon of Economic Development") five distinct types of innovation: 1.) product innovation, 2.) process innovation, 3.) business model innovation, 4.) innovation in the source of supply, 5.) innovation in mergers and diverters.

And while the classifications Schumpeter presents might seem outdated, it is important to remember they are, in fact, not obsolete. At present, the five classifications he comes up with are still valid and thus his systematisation is still of great import. In particular, two of his classifications are particularly relevant today: product innovation and process innovation.

In recent years, scholars, experts and theoreticians have offered up more complex schemas of innovation, often using complex, technical jargon. However, in almost all cases, we still find product and process innovation as key categories.

To gain a better understanding of the nature and value of classification systems one century after Schumpeter, we can turn to more recent documents. For instance, let us turn to the OECD publication, the "Oslo Manual – Guidelines for Collecting and Interpreting Innovation Data"[7].

7) Oslo Manual - GUIDELINES FOR COLLECTING AND INTERPRETING INNOVATION DATA - Third edition A joint publication of OECD and Eurostat. OECD 2005. Available online at:

Within this manual, four distinct type of innovation are listed: 1.) product innovations, 2.) process innovations, 3.) marketing innovations and 4.) organisational innovations. The document describes the different types as such:

"Product innovations and process innovations are closely related to the concept of technological product innovation and technological process innovation. Marketing innovations and organisational innovations broaden the range of innovations covered by the Manual as compared to the previous definition"[8]

As can be easily discerned, the four type of innovation as listed by the OECD in 2005 closely resemble those defined by Schumpeter as reported above. It is safe to conclude that we can rely on these four categories to determine ways in which entrepreneurs can innovate within their respective firms and industries.

However, there is another point to consider if we are more comprehensively analyse the means by which innovation can be performed. Here, the question must be asked: "How broadly and to what extent are we able to innovate?" This question leads to another classification of innovative activities, somewhat transversal to the one previously defined. In this system of classification, innovation can be roughly divided into two typologies: radical innovation and incremental innovation. In many cases the terms are blurred, and other terms are used or other types of innovation are introduced. However, for sake of simplicity, we shall stick with the radical/incremental dualism.

Table 2 synthesises the main characteristics of these two types of innovation. As shown, they differ significantly, both in terms of needed inputs and possible outputs. What is important to point out is the fact that radical innovation, from a more general perspective, needs more effort and is more dangerous. However, with great risks come great rewards. While radical innovation has the potential to radically disrupt a market, it also has the power to create a new one. Indeed, there are dangers associated with every type innovative activity: the novel product might not encounter favour within the market; the novel production process might have unexpected drawbacks or, again, result in products that are not sought after by consumers; the novel marketing campaign might not reach its intended audience; or the novel organisational models or techniques might not produce their intended effect.

8) http://www.oecd.org/sti/inno/oslomanualguidelinesforcollectingandinterpretinginnovationdata3rdedition.htm and: http://ec.europa.eu/eurostat/documents/3859598/5889925/OSLO-EN.PDF (links visited May, 2016) Oslo Manual, page 47

Thus, we can safely conclude that any form of the innovative process possesses some degree of potential success as well as some degree of potential failure. Following from this, the decision-making process before beginning any type of innovative activity is of the utmost importance. The types of innovation and their resulting success are contingent upon the quality of decisions made upstream during the innovative process.

Finally, this section must end with a warning of sorts. It is difficult to label an innovation as entirely "radical" or entirely "incremental". It is, instead, a matter of proportions: perhaps an innovation is more radical than it is incremental, or, conversely, it is more incremental than it is radical. Keeping this in mind, one must remember that while more radical innovations are correlated with a higher degree of risk, they also possess the ability to disrupt markets or even create new ones.

In order to precisely illustrate the aforementioned discussion regarding different types of innovation, Table 3 presents a series of examples of each different type. The four categories presented by the OECD report (and partly by Schumpeter) and the two main groupings -- "radical" and "incremental" -- are exemplified with several famous innovations.

The last part of this section refers back to the question of "how?" regarding the performance of innovation previously introduced in Section 2, wherein we discussed the "linear model" of innovation and its practical limitations in the modern world. In short, it is our hope that this section has clarified the idea that while innovation is a complex topic, it can be easily undertaken by a robustly creative and entrepreneurial mind. In short, the dynamics involved in the innovative process are complex and variegated, and the interconnections between the disparate parts are many. However, every step of the innovative process should influence – and be influenced by -- every other step.

Figure 2 illustrates the "iterative" process of innovation. Though the illustration remains somewhat simplified with respect to a "real world" process, it nevertheless serves its basic function as a clear, concise illustration. In this figure, we find the classic steps of fundamental research, applied research, development and invention, and production and marketing clearly delineated until we arrive at the final step: diffusion out of the firm and the subsequent imitation by competitors. Yet, as we have already noted, this scheme is somewhat of a simplification. Regardless, it is a simplification with functionality. What is important here lies within the interconnectivity between the steps. This emphasises the importance of communication and collaboration amongst all actors in each phase of the innovative process. The communication is iterative and reiterative. While in the previous linear model, upstream steps influence downstream steps, in this model, all steps influence each other; influence here is multidirectional.

In this scheme, the needs of the production line may influence marketing. Or perhaps the needs or the marketing department may influence the research process. Or maybe the needs of the research department influence the marketing office. The linear model applies best when considering innovation strictly in terms of production; however this scheme allows us to more easily perceive the manner in which innovation may arise in terms of marketing, organisation or research (though here, the meaning of "research" may not refer directly to the hard sciences or engineering).

The typology of innovation, thus, influences – and is influenced by – the process of creation. What is relevant here is the notion that in today's world, innovations are seldom likely to be borne of the mind of a sole inventor, but rather be the result of collaboration amongst many minds. Though a "Schumpeterian" entrepreneur is essential for an innovation to get its start, in the end it is the entirety of the process, including all persons involved -- and possibly structures external to the firm itself -- that enables the innovation to be brought to light.

Table 1 – The four types of innovation according to the Oslo Manual

Product innovation	A **product innovation** is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.
Process innovation	A **process innovation** is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.
Marketing innovation	A **marketing innovation** is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.
Organisational innovation	An **organisational innovation** is the implementation of a new organizational method in the firm's business practices, workplace organisation or external relations.

(Cited from: Oslo Manual, OECD 2005, pp. 49-51)

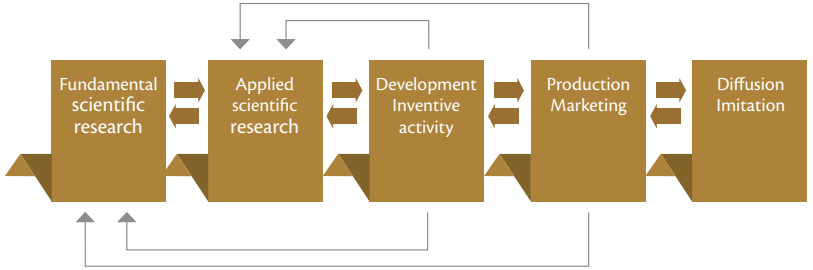
Table 2 – Some relevant characters of Radical and Incremental innovation

RADICAL	INCREMENTAL
Explores novel forms, paths, technologies	Exploits existing forms, paths, technologies
Highly uncertain	Less uncertain
Risky	Less risky
Chances of higher rewards	Chances of lower rewards
May require higher inputs in terms of knowledge	Usually requires less knowledge inputs
Focuses on products, processes, organizational and marketing forms with unprecedented features and performances	Focuses on improving and enhancing existing products, processes, organizational and marketing forms
(Can) transform markets and industries, or create new ones	Improves competitiveness and changes the equilibria inside industries and markets
Often requires creating new competencies, skills, expertise	Less likely to require new competencies, skills, expertise
Can strongly affect societal customs and habits	Is less likely to influence societal customs and habits

Table 3 – Examples of the different types of innovation

	RADICAL	INCREMENTAL
Product	Downloadable music vs. to hard supports (such as CDs, records…); Personal computers vs. mainframe computers; Electric car vs. thermic engine car; Molecular computer vs. integrated circuit; Flat screen vs. CRT.	Automatic gear vs. mechanic gear; New functions in a TV set (e.g. wider screen);
Process	Henry Ford's Assembly line;	Introduction of robots in assembly lines; Reducing the number of steps needed to produce a good.
Marketing innovation	Hard discount retailers vs. traditional supermarkets.	Car leasing vs. car sale; Reorganization of sale points in a retail chain.
Organisational innovation	Reorganization from vertical structure to ad-hoc/project-related horizontal relations	Online ticketing for concerts and events.

Figure 2 – The iterative model of innovation



1.3 SIGNIFICANCE OF INNOVATION IN TODAY'S ECONOMIES

"The innovation is hazardous, impossible for most producers. But if someone establishes a business having regard to this source of supply, and everything goes well, then he can produce a unit of product more cheaply, while at first the existing prices substantially continue to exist. He then makes a profit. Again he has contributed nothing but will and action, has done nothing but recombine existing factors. Again he is an entrepreneur, his profit entrepreneurial profit. And again the latter, and also the entrepreneurial function as such, perish in the vortex of the competition which streams after them. The case of the choice of new trade routes belongs here".

J.A. Schumpeter, The Theory of Economic Development (1912; 1934)
Chapter 4: Entrepreneurial Profit

In order to clearly explicate what innovation means in today's economy, again we can defer to J.A. Schumpeter. To put it bluntly, innovation is probably the most important factor and driving force behind the growth of firms, industries and entire economies.

This holds true for the various types of innovation discussed in the previous section. The reason for this is related to the value of knowledge, the wellspring from which all innovation arises. Knowledge can either be created or discovered (let us think of the scientists and researchers toiling away in their laboratories, or of mathematicians developing new proofs). Knowledge can be an original organisational or managerial idea able to disrupt, for example, the means by which a supply or distribution chain work. Knowledge can even be re-imagined and reconstituted, leading to incremental-type innovations. The most important thing to remember here is that knowledge is considered a good -- a good than can be traded and used.

Therein lies the reason why today's economy is often referred to as a "knowledge-based economy". Indeed, knowledge is the basis of all development and progress, and for a firm it represents what is called an "intangible asset". While structures, equipment and the workforce constitute tangible assets, knowledge is a non-material but just as valuable – if not more valuable -- asset. Presently, many goods, especially those of higher value, require a high degree of knowledge content (especially technological knowledge) for their creation and commercialisation (for example, the Bitcoin explosion happening currently). One may also recall the rapid evolution of the primitive mobile phones of the early 1990s to modern smartphones like the iPhone. The pace at which they evolved was far more rapid when compared to, say, the evolution of the telegraph to the telephone. This is due, primarily, to an exponential rise in knowledge.

Thus knowledge, and in particular technological knowledge, is a relevant, fundamental good. Knowledge can be the engine driving rapid progress and also create entirely new markets leading to greater employment and development.

In this light, knowledge is a very particular, valuable, highly demanded good. In fact, it possesses all of the characteristics of a, what economists term, "common good". Firstly, knowledge is "non-excludable". Due to the interconnected nature of the world, it is nigh impossible to exclude others from newly discovered knowledge. Furthermore, it is difficult to exclude others from taking advantage of this knowledge once they have obtained it. An important point to remember here is that once new knowledge has been discovered, it is impossible to lose – it can only be added to. Thus, knowledge is cumulative. And in its exponential accumulation, knowledge generates what economists call "positive externalities". These are generated when a good (in this case, knowledge) has an unintended effect in another realm.

Knowledge is also a "non-rival" good. That is, it can be possessed equally and simultaneously by multiple individuals. For instance, anyone with access to a scientific journal can equally possess the knowledge presented in that journal. However, despite being possessed by many at the same time, the quality and value of that knowledge is not diminished. To the contrary, it perhaps even enhanced. Moreover the cost of replication is quite low, especially with regard to digital media. In the context of the internet, the replication of this knowledge costs virtually nothing. Generally, the costs are only to be found in the researching and transcription of the new knowledge (i.e. the funds needed to conduct experiments and publish the results of these experiments). The costs of then reproducing it are marginal at best.

Finally, knowledge is a cumulative good: acquiring new knowledge does not diminish the catalogue of pre-existing knowledge. Nor does the pre-existing catalogue diminish the quality of newly discovered knowledge; it merely enhances the ease of its discovery. All discoveries build upon previous discoveries, and in this way, knowledge advances exponentially.

In short, why is the concept of "knowledge as a good" so important? Essentially, because innovation begins with knowledge, regardless of whether it is innovations in technology, organisation, management, etc. Thus, in an innovative environment (such as a firm, for example) knowledge is a valuable asset that must be protected in order to completely secure its fruits. Because of the ease with which it can be replicated and disseminated and because money is spent to research and discover new knowledge, this new knowledge must be carefully guarded if one is to recover and multiply their initial investment.

From this perspective, knowledge-generated innovation is an important means of fostering the growth of modern economies and the businesses functioning within them. The positive impact of technology on economic growth has been attested to by several scholars since the second half of the 20th century[9]. Measures have shown that, in all cases, the contribution of technological innovation and technological progress to economic growth is exceedingly significant And because knowledge is at the very core technological progress, which has been observed to be the driving force behind economic growth, we can better understand the emphasis placed on knowledge, especially with regard to today's "knowledge-based economy".

The concept of a "knowledge based economy" is also explored in a 1996 OECD report bearing this term as its title[10], which examines the exportation of advanced technologies from OECD countries since the 1970s. The report also underscores the significant role science plays in the production of knowledge, as well as the growth in private investments in Research & Development (R&D).

From a historical point of view, innovations do not evolve in a linear manner. That is to say, certain periods of time see a higher number of innovations, and witness the birth, growth and full realisation of innovative technologies that then slowly become mature before becoming obsolete. This wave-shaped behaviour of the economic ebb-and-flow of technologies and their effects was first described by the Russian scholar N. Kondratieff[11][12]. In his analysis, the economic effects of specific technologies follow long, wave-shaped cycles. He notes this trend in the following technologies:

9) With regard to this point, the most famous economist to describe the effects of technological progress in the economic growth has been Robert M. Solow (born 23 August, 1924), winner of the John Bates Clark Medal in 1961 and Nobel Prize for Economics in 1973. He studied an economic growth model that carries his name. He also measured the fraction of growth attributable to the advancement of technology. This residual (that he measured as the 85 % of the growth) is known as "Solow residual".

10) The OECD report "THE KNOWLEDGE-BASED ECONOMY" is available at: http://www.oecd.org/sti/sci-tech/1913021.pdf (link visited May 2016)

11) Nikolai Kondratiev was born in Russia in 1892, and died in 1938.

12) Among other works this theory is described in Kondratieff and Stolper (1935)

the steam engine, railways, electricity, chemistry, petrochemicals and automobiles, and information technology. It is relevant to note that Kondratieff believed that technological innovation depended on these cycles, while, conversely, according to Schumpeter it was technology that caused these cycles.

Other scholars have expanded upon the relationship between wave-shaped economic cycles and innovation. In particular C. Perez and C. Freeman have studied the topic extensively, introducing the term "technological revolutions"[13][14]. These are far-reaching social, scientific and economic revolutions, involving numerous radical innovations and their cumulative effects on the economic and cultural structure of a market. These revolutions are at the core of the Schumpeterian theory of evolution and are generally considered to be the rising phase of the Kondratieff waves. Technology revolutions entail radical transformation of the prevailing paradigm.

century are pertinent examples. During these revolutions markets experienced a decline in the cost of goods as well as a rapid rise in the quality of technology.

Here, it also appropriate to cite the work of K. Pavitt, who organised a taxonomy of firms and enterprises with regard to their innovative ability[15][16]. Pavitt groups the enterprises in four sets:

1. Supplier-dominated: These are the most traditional of manufacturing industries. For example: textiles and agriculture. Their sources of innovation are almost entirely external.
2. Scale-intensive: These industries (such as the automotive and metal industries) produce durable goods and basic materials. Their sources of innovation are both internal and external to the firm, and can have a medium level of appropriability.
3. Specialized suppliers: These firms produce technology that is sold to, and used by, other firms, such as high-tech instruments like medical or optical instruments, computers, and agricultural machinery. The innovation of these firms has a high level of appropriability, due to its tacitness[17].
4. Science-based: These are firms in industries that rely heavily of R&D activities, both internal and external, such as university research. Such industries include the

13)Carlota Perez was born in Caracas, Venezuela, in 1939; Christopher Freeman was born in England in 1921 and died in 2010.10) The OECD report "THE KNOWLEDGE-BASED ECONOMY" is available at: http://www.oecd.org/sti/sci-tech/1913021.pdf (link visited May 2016)

14) This theoretical vision is introduced in Perez and Freeman (1988)

15) Keith Pavitt was born in London in 1937, and died in 2002.

16) The taxonomy is described in Pavitt (1984)

17) For the definition of "tacit knowledge" see below section 2.3

chemical, pharmaceutical and electronic industries. They develop new processes and products generating knowledge with a very high level of appropriability due to patents, secrecy and tacitness.

When dealing with the topic of public research, such as the type performed at universities, it is appropriate to refer to a theoretical approach which arose in 1990s: "Mode 2" which describes universities and their "new production of knowledge" [18]. This is perhaps the best model for understanding the evolution of public research.

From the perspective of this approach, a new "model" of university, research and knowledge production was born in the 20th century. "Mode 2" is described as being trans-disciplinary and it involves the close collaboration of the many actors involved in the process of knowledge creation. In "Mode 2" problem solving is carried out in the context of its application, and knowledge is intended to be useful. Moreover, in "Mode 2" networking is fundamental. In fact, in contemporary research, the number of potential knowledge producers is expanding in tandem with the need for specialised knowledge. As knowledge production becomes more "socially distributed" and ubiquitous, society begins "shaping science" which is then utilised by "practitioners". Economies of scope become more relevant with respect to economies of scale, and innovation and business become more closely related. Moreover, running parallel with "Mode 2" research, the second half of the 20th century also witnessed the growth of the production and use of innovative, "knowledge-based" goods. This, again, demonstrates the importance and relevance of knowledge-based innovation in the modern economy.

We have now arrived at the point in history where what matters most for firms in their "base of knowledge" rather than any base of material assets. The management of this knowledge base will be discussed in the following sections. But what matters now is the protection of that knowledge from "free rider exploiters" who would diminish our ability to profit from this knowledge.

There are two fundamental ways by which this good can be protected. The first one is secrecy. This requires no effort; however, there is a trade-off. Any person with access to the classified knowledge base must be highly trustworthy. There must be strict protocols in place which prevent the escape of that knowledge from the closed circle of entrusted persons. In turn, these protocols might place severe limitations on the use and exploitation of that knowledge by other processes (organisation, marketing, etc.) within the firm. Nevertheless, if done correctly, secrecy can work well. The most cited example of this is Coca Cola: Its recipe has been a secret for over century, yet it remains a highly successful, innovative company.

The second means of protecting knowledge is that of intellectual property rights, or, in other words, patenting. However, this means also has its drawbacks. First of all, in order to obtain a patent, an invention must be publicly disclosed. The contents of patents are publicly available and can be accessed with minimal costs. Secondly, for an innovation or invention to be patented, it must follow several strict requirements. It must be:

- Novel. No prior art of any kind must exist in any place, and the invention must not have been disclosed under any form.
- An inventive activity. The patentee must demonstrate that they have performed some activity to create the invention, which must not be obvious.
- Possible to industrialise. It must be possible to produce the invention in some manner.
- Legal. This character is rather self-descriptive; the invention must not be illegal in any manner.
- Descriptive. The invention must be described in the patent in a form that should allow for its replication. Herein lies the challenge for the inventor: to be able to offer enough description to allow for it to be patented while also managing to retain some secrecy in order to avoid exploitation by free riders.

In exchange for patenting their invention, the inventor retains all legal rights to their invention for a period of time (usually twenty years). In simple terms, this means anybody who attempts to replicate the invention in any country where the patent is valid can legally be sued.

In summation, we can affirm that innovation is a crucial factor for economic development. As scholarly work has demonstrated, this is particularly true for technological and knowledge-based innovation. Today, knowledge is a tradable good that companies can exploit for their own growth and the growth of their own economies. However, knowledge is readily and easily replicable, so extensive efforts must be taken in order to ensure its secrecy if a firm is to maximize its profits from it.

18) Mode 2" and "new production of knowledge" are concepts deriving from the book "THE NEW PRODUCTION OF KNOWLEDGE - The Dynamics of Science and Research in Contemporary Societies" (1994)

1.4 SMES AND INNOVATION

Small and Medium Enterprises (henceforth referred to as "SMEs") have a high innovative potential, deriving from their most obvious characteristic: their size. SMEs are defined (by the European Union) as firms having less than 250 employees and a turnover below €50 million. They represent a large fraction of employers of the workforce in most countries in the world.

In the United States, for example, SMEs represent the 98.7% of the firms in the industrial sector and 99% of those in the service sector; they employ 76.7% of employees in industry and 50% of those in services, for a total percentage of 57.9% of the workforce[19]. Values for the United Kingdom are similar, where SMEs account for 99.4% of firms operating in the industrial sector and 99.7% in service industry, and combined employing 54.1% of the workforce. Values are also similar for Germany (98.9% and 99.7% of firm in industry and service, respectively, accounting for 60.4 of the workforce), Japan (98.2% of firms in industry are SMEs, which employ 66% of the country's employees) and Canada (99.7 and 99.9 for industrial and service firms respectively, accounting for 64.2 % of all employees).

When considering other countries, the numbers of SMEs are even more relevant. In Italy, SMEs account for 99.9% of firms in both industry and services, and employ a total of 81.1% of the total workforce. In Spain, SMEs account for 99.8% of the firms in industry and 99.9% in services, while employing 77.6% of the workforce. All of the figures reported above clearly demonstrate the fundamental role played by SMEs across the panorama of the world's economies. For this reason, countries have initiated programmes to foster innovation in SMEs, such as the SBIR (Science Business Innovation Research) programme in the U.S. and Japan.

Being small often means being dynamic, internally interconnected, and able to take fast decisions while quickly adapting to sudden, unforeseen changes. On the other hand, being small can also mean being more fragile and susceptible to the market fluctuations, as small firms are only able to produce a small quantity of a few specific goods.

However, due to the fact that SMEs are, in general, able to be highly innovative (due to the aforementioned reasons) this section will tackle the topic with a robust analysis. In our analysis, we will prove that in order for SMEs to be innovative and successful, they must build on their strengths while seizing upon opportunities that will allow them to overcome their weaknesses and any possible threats they may face.

19) Data on SMEs are retrieved on OECD (2010).

Their first strength lies in their dynamicity, as small and dynamic SMEs can assume the role of "creative destructors" in any given industry. Their ability to change suddenly, going down new paths of innovation, allows them quickly identify changes and challenges in the market, and, through the use of innovation, rapidly adapt themselves to meet these challenges head on. This ability to "disrupt" markets lies in a dynamism which is far more difficult to obtain for bigger firms.

Creative destruction has a downside, however. The creative part allows SMEs to be highly competitive in their respective markets, but this comes at the cost of "destruction", which is to say competition between innovations. Thus, SMEs must beware of competitors who could easily overtake them. Such competitors are mainly other SMEs in the same market, struggling to cement their position in that market.

Scale is also inherently conducive to innovative success. SMEs, due to having fewer employees and smaller departments, can cooperate, collaborate, synthetise and interact far more easily than bigger firms. This is particularly relevant when the discussion turns towards the topic of knowledge- and technology-based innovations (in particular, product innovations) that require a high degree of collaborative effort in research-related and developmental activities.

The "cooperation" concept is often pushed to its limit when SMEs engage in the activity of "open innovation". The concept of "open innovation" is relatively recent, and has received less attention respect to SMEs than it has for bigger firms. We owe its definition to H. Chesbrough who writes:

"The Open Innovation paradigm can be understood as the antithesis of the traditional vertical integration model where internal research and development activities lead to internally developed products that are then distributed by the firm [...] 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. Open Innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology".

H. Chesbrough, Open Innovation: A New Paradigm for Understanding Industrial Innovation, in: Chesbrough, H.W., Vanhaverbeke, W. and West, J. Eds. (2006), Open Innovation: Researching a New Paradigm, Oxford University Press.

Small and medium enterprises, as well as micro enterprises, are faced with the problem innovative costs. In turn, an "open innovation" regime allows the use of external ideas (scientific, technological, managerial, etc.) in the industrial environment of the firm. This helps SMEs to bypass the problem of the exceedingly high costs related to the production of innovative knowledge. In other words, allowing for the "free flow" of knowledge among SMEs, and encouraging collaboration amongst the firms, is one manner in which these costs can be overcome.

As always, this approach also possesses some drawbacks which must be carefully evaluated. Open innovation entails the transference of some internal knowledge to external actors who might be competitors (mainly other firms within the same geographic area and/or industrial sector). While the entrepreneur must weigh the gains against the losses of such an approach as the free flow of knowledge, chances are that once the SME is placed within the context of open innovation, the best answer to its innovative needs may issue from outside the firm's boundaries.

Here, it is pertinent to introduce another issue facing SMEs: that of clustering and the agglomeration of (innovative) firms[20]. Here, we must distinguish "clustering", which is based on firms sharing a common geographic location from "networking", which is based upon firms sharing a common knowledge base. However, open innovation can be beneficial in both instances.

The positive economic effects of clustering have been extensively studied. However, it must be remembered that these effects are neither instantaneous nor automatic. For instance, clustering can either generate fierce competition or, conversely, be the engine of collaboration. Collaborations within so-called "business networks" can either be based up geographical proximity or a common technological/knowledge basis. What is important here is that positive economic effects can derive from either form of clustering.

Moreover, it is important to remember that innovative clusters can (and often will) benefit from the presence of knowledge-producing institutions (such as universities, research institutes, technological firms, etc.) and bridging institutions (e.g. public offices intended to implement connections and collaborations between firms and research centres).

20) A relevant document (exploited in the present chapter) on clustering of innovative SMEs is the OECD Conference report "NETWORKS, PARTNERSHIPS, CLUSTERS AND INTELLECTUAL PROPERTY RIGHTS: OPPORTUNITIES AND CHALLENGES FOR INNOVATIVE SMEs IN A GLOBAL ECONOMY", available at http://www.oecd.org/cfe/smes/31919244.pdf (link visited May 2016)

Here we should note the fact that clusters almost always result from market dynamics, rather than from public action; however, it can result from public policies when such policies are carefully crafted and precisely relevant to the innovative activities of firms, in particular the activities of SMEs. Market factors that can lead to clustering can include:

- Proximity to markets, despite today's lower costs of transportation;
- Supplies of specialised labour: an example of this is Italy's car manufacturing industry. It has promoted the growth of engineering universities in towns where its plants are located and vice versa;
- The presence of suppliers of equipment and of production inputs: again the clustering around Italian car manufacturers is a good example of this, fostering the growth of a plethora of SMEs in the mechanical industry able to supply big firms;
- The availability of specific natural resources and the presence of certain infrastructure, such as transport facilities (highways, airports, ship ports, etc.);
- The decrease in transaction costs once a clustering is set in motion: this effect depends heavily on the ability to create informal relations and mutual understandings, as previously discussed with regard to "open innovation". Lower costs of transaction deriving from the increasing frequency of interactions can be directly correlated with the ability to open up the "knowledge borders" of firms in a mutually constructive environment.
- Finally, the ease of access to specific mediums and sources of information and knowledge (such as universities and research centres) can be a relevant engine of clustering. Here, we should think of American technological clusters and their proximity to top tier technological universities.

Three possible manners in which entrepreneurs can innovate are patenting, hiring specialised personnel and, perhaps most obviously, investing in R&D activities.

Previously, patenting was discussed with regard to the economic significance of innovation. Hiring personnel with a high degree of specialisation, or with experience in R&D, is another means by which entrepreneurs can foster innovation in their firms. This means is directly related to the concept of clustering. In fact, the proximity of universities able to educate personnel and supply a skilled workforce with a high

degree of specialisation is, indeed, a net positive, but also a driving force behind clustering. Nevertheless, hiring educated personnel is typically not dependent, in principle, on geographical location.

The costs associated with R&D are both an opportunity and a drawback. We have extensively discussed the problems inherent in research costs, as well the appropriability of knowledge. However, in industries less dependent on material assets like machinery, factories and buildings, such as knowledge-based industries (for instance, IT firms, software companies, creative firms, etc.) the costs associated with R&D are far less.

Finally, we should also consider non-technological innovation when assessing the case of innovation in SMEs. Referring back to the different types of innovation we previously categorised, it is clear that each different type has an effect on the various stages of the product's value chain. "Product innovation" and "process innovation" in particular can be understood as primarily relating to the more technological side of the process, as the product transfers from the firm to the market. On the other hand, "marketing innovation" and "organisational innovation" can generally be regarded as non-technological innovation. Regardless, these two forms are particularly important for a firm which needs to deliver its products to the market and survive competition. What is relevant for SMEs is that such types of "non- technological" innovation are often far less expensive than technological innovation. This is an obvious advantage for SMEs which, for reasons of scale and dimensions, have more difficulties allocating money for more expensive activities. In particular, the OECD reports that "non-technological innovation is significantly more prevalent among large firms than among small and medium-sized enterprises (SMEs)"[21]. This seems to imply that much room is still left for SMEs to expand their usage of non-technological innovation. Thus SMEs might successfully utilise this type of innovation in order to enhance their performance and competitiveness.

Oftentimes the conditions that limit economic performance lie not in the product itself, but in the internal organisation of the firm. Within its organisation, we might find conditions that limit its efficiency and/or its ability to deliver the product to its designated market. It is also important that SMEs foster internal networking between their production/technological innovation departments and their marketing departments. This internal networking may be an innovative act in itself.

21) P. 100 of the "OECD Science, Technology and Industry Scoreboard 2009". The document is accessible at the link: http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-scoreboard- 2009_sti_scoreboard-2009-en (link visited May 2016)

Here we should note that states and their respective governments (both local and national) have a relevant role to play in helping SMEs innovate. Indeed, it is their public duty to devise and implement policies aimed at helping SMEs grow and innovate, thereby contributing to the Gross Domestic Product (GDP). Various types of policies can be envisaged for this purpose. Institutions can, for example, support research in cutting-edge sectors which are more likely to foster radical innovation. However, in doing so, issues of appropriability may arise. A solution might perhaps be found in fostering collaboration only between SMEs which jointly work together or subcontract research and share the results.

Another often overlooked means for fostering innovation in SMEs is to offer governmental subsidies or allow for tax credits to aid in their acquisition of hi-tech equipment for production or R&D activities aimed at creating exploitable innovation.

Finally, we must consider the relevant role played by infrastructural policies. That is, policies which establish infrastructures necessary for the transfer of technology, and the cooperation between firms, research centres and collective economic organizations. In order to support SMEs, it is essential that governments establish and/or enhance these infrastructures. Governments must be proactive in implementing initiatives that: promote collaboration among SMEs (in particular, those with a high degree R&D intensity); increase their collaboration with public research bodies; help SMEs network, enter global innovation networks and create new ones.

A relevant example of such a programme is "SBIR" which been in effect in the United States of America since the 1980s. Through contracts and grants, the programme finances the exploration and development of new technologies and their delivery to the market.

Summing up, SMEs possess a high innovative potential mainly primarily due to their dimensions, their scale, their dynamism and their ability to rapidly adapt. Networking and collaboration are of the utmost importance for them, and they should further expand their usage of non-technological innovation in order to grow.

In order to outline a roadmap to innovation for micro, small and medium enterprises, the appendix to this section will describe some cases of innovative firms, highlighting the most relevant useful factors of each case.

APPENDIX _CASE STUDIES

This appendix presents a series of case studies of innovative micro, small and medium enterprises. The case studies are grouped according to the dimensions of the firm. They derive either from literature or from interviews with the owners of the innovative businesses[22]. The aim of this appendix is to offer some examples of how innovation can be performed within the context of SMEs. The case studies will be commented upon in order to clarify their nature and highlight any relevant points.

After each group of case studies is assessed, a tentative roadmap to innovation will be outlined. It must be noted that the roadmap should not be taken as conclusive or definitive, but as an example which might be useful in certain contexts. Each innovative case, after all, has its own unique characteristics. With that in mind, we invite businesspeople wishing to innovate to carefully assess these cases, determine what is relevant to their specific case and then use this new knowledge to outline their own, unique roadmap to innovation.

Medium enterprises

Case 1: Italian medium enterprise, production of taps and valves for domestic use.

This case study regards an Italian firm, based in the north-west of the country, which produces taps and valves for domestic use. The company began its production in the first half of the 1960s, producing components for plumbing applications. Changes in technology forced the firm to begin shifting to other products (in the same sector) until the beginning of the 1990s, when the company performed its last productive shift and began producing valves and taps for the home. These shifts bear witness to the proactive nature of the management and its ability to implement rapid strategic changes. It must be noted that, as is the case in Italy, the management is composed of family members.

Generally speaking, the firm's products have always been considered to be of high quality. Although the company has consistently refused to produce special, on-demand products (due to the high costs of production), it has consistently maintained a high level of quality, able to dominate in a market with a high number of competitors. The most relevant period of this company's innovation took place during the first half of the 2000s when the company began a strategy based upon product innovation and brand identity (marketing innovation) and began entering foreign markets (including the US). Simultaneously, the company sought to renew the design of its existing products while also engaging in R&D to create new products. The goal of this strategy was to cement the role of the firm in a traditionally low-tech market. Because of the firm's success, we might conclude that innovation (with regard to design and branding) appears to have a beneficial commercial impact.

Case 2: French medium enterprise, production of gates and doors for domestic use.

The case study is about a French firm, specialising in the manufacturing of aluminium gates and railings. Again, this is a case study of a family-owned business. The culture in the firm is rather participative.

Besides building a new manufacturing site and investing in new machinery, the most pertinent innovative point this company demonstrates was carried out by its management: the usage of organisational innovation to implement "creative seminars". Considering that the field of gates and doors is rather stable from a technological standpoint, the company's innovation resides mainly in its revolutionising of design and aesthetics, which is to say, the creation of original gates that allow people to distinguish themselves from their neighbours. In order to incentivise creativity in the firm, and to promote a brand image based on quality and originality, the management organises two collective creativity workshops per year. All personnel involved with the firm are invited to participate; however, attendance is on voluntary basis. About 30 per cent of the personnel participate in the two-day seminars, organised at a hotel. Through a participative process employees are encouraged to create and submit new designs for gates, starting with drawings issued directly from their imaginations. The final results of the participative process (which is based on the selection and merging of the initial, imaginative ideas) are then taken into consideration by the firm's engineers with regard to their design and feasibility. A catalogue of designs is then collated based on the results of the seminar's collaborative process.

Participants insist that being part of the firm's culture, being able to contribute their own ideas and having the possibility to see their ideas actualized is the motivating force for attending the seminars and participating. From this collaborative process, the firm is able to generate new, innovative designs that give it an edge in the door and gate market.

22) In order to prepare this appendix the most relevant works exploited to retrieve case studies, besides personal interviews, are: Cullman et al. (2015); Burger-Helmchen and Llerena (2008); Hernandez et al. (2014); Regione Piemonte (2007); Forza and Salvador (2001); Nicholas (2012); Ashurst et al. (2011); De Massis et al. (2012).

What makes this case particularly poignant is its mix of a participatory culture (which also derives from the firm's nature of being family-owned) and its practical outcomes: employees who feel a sense of pride and belonging in the company as well as original, unique products that allow the company to thrive in a crowded market where the possibility to innovate is quite limited.

Case 3: UK-based medium enterprise in the field of precision engineering.

This case study regards the adoption of a specific Enterprise Resource Planning (ERP) system in a UK-based precision engineering SME. The ERP system monitors all flows of resources within the firm, from raw material supplies to the production line to the storage of products. Thus this case regards process/organisational innovation within the company, rather than a specific technological innovation of the SME.

Prior to the adoption of this novel ERP system, the company used a traditional reporting system which was complex and time consuming. Moreover, several bottlenecks occurred and few chances to correct errors were provided. Moreover, data regarding supply and demand was not made available to its suppliers and clients. These combined conditions resulted in an inability of the firm to make their processes more lean and accurate, causing shortages which resulted delays in delivering their products to their clients.

The company was then given the opportunity to implement a collaborative, web-based tool which connected all parties in the supply chain. With the aid of this tool, the enterprise could re-engineer their processes, making them more accurate and lean. Data from customers and suppliers were integrated into the system, and operators in the supply chain could log on, analyse data, share reports and thereby be able to intervene timely in the supply chain. This system enabled all parties to analyse in real time the business's performance and trends, identify any risks and potential problems in the supply chain and enhance the company's performance.

The implementation of this organisational innovation brought forth many benefits. Exchange of real time information helped operators make informed decisions and to plan for production far more accurately. Moreover, bottlenecks and shortages were dramatically reduced.

This case demonstrates the importance of internal organisational innovation for the success of a business, particularly enterprises involved in technological production.

Case 4: Italian enterprise in the field of industrial automation.

This Italian medium enterprise, established in the 1970s as a family owned business, produces production controls, and is particularly prominent in the field of positioning sensors, with a focus on the plastics industry. What is interesting about this case is that, by utilising the interpersonal communication skills of its founder, the enterprise was able to attract highly qualified specialists, many of whom were formerly employed by the firm's clients. In this way, the company was able to cultivate a workforce composed of personnel intimately familiar with the problems the company was struggling to overcome. The company's primary focus was on adopting a radical innovation vis-a-vis the production of position sensors, and the ability to adopt it in a way that rescaled prices one magnitude lower.

What is also relevant here is the company's ability to collaborate extensively with universities and research centers in order to perform research activities geared towards innovation. This collaboration began about ten years after the company's founding and continues into the present.

This case demonstrates the importance of technological innovation via collaboration with external bodies and the importance of organisational innovation, especially with regard to employee selection.

Case 5: Italian enterprise in the field of food processing machinery.

This Italian medium enterprise produces machinery for the bottling of wines, an industry of particular significance in the food sector of northern Italy. The enterprise was founded in the 1940s just after the end of World War Two. Two particular innovations allowed it to gain a dominant position in its market. The first one was a "demand pull" innovation, that is, the production of machines for bottle corking. This innovation was needed due to a market demand (caused by French winters) and was possible thanks to cross-sector fertilisation. In fact, the specific material (steel) needed to produce the machines derived from the cutlery industry.

The second relevant innovation was a system to eliminate oxygen from the bottles before bottling. This was a technology-push innovation, with which the founder of the enterprise was knowledgeable. To carry out this innovation the enterprise was required to collaborate with a university research centre.

This case shows us the complexity of innovation, as well as the chances offered by curiosity and by responding to specific market needs.

Resume and roadmap

The five medium enterprises described in these case studies each performed different types of innovation. In the first case we can see a low-tech production innovation wedded to a marketing innovation concerning brand identity. In the second case we are confronted with an organisational innovation which in turn impacts the production process and means of marketing. In the third case we have a far-reaching organisational innovation, which profoundly impacts productivity. In the fourth we have a technological innovation applied in a high-tech sector. In the fifth and final case the enterprise's innovation resulted from market demands and technological advancements.

All presented enterprises have been able to identify specific needs and problematic areas where it was possible to intervene substantially with an innovative activity (of any kind) in order to make changes to the status quo. The first three cases do not entail any profound technological production innovations (though the third case involves the use of a highly sophisticated informatics product). In the fourth and partly in the fifth we see the use of organisational innovation being put to successful use.

If we discuss these cases in light of the previous chapter on SMEs, we see that they exemplify several previously discussed points. Case one presents the importance of dynamism, as well as that of the relations within the value chain. Cases two and three demonstrate the importance of non-technical innovation in medium enterprises of various sorts, both low- and high-tech. Case four, though it can't be considered as an example of networking, shows the importance of collaborating with external bodies and receiving inputs, either from the value chain (suppliers and customers) or from outside the value chain (firms and researchers). Case five is similar in this regard, as the enterprise received external inputs from universities and the market itself in order to adapt and innovate.

Small enterprises

Case 1: Italian small enterprise, production of sport shoes for mountaineering and rock climbing.

This case regards an Italian small enterprise, based in the Veneto region, in the heart of the Italian sport shoe-manufacturing district. This small, family-run firm was established in the 1970s, when the number of amateur athletes was growing throughout Italy and the rest of Europe.

The firm started producing mountaineering shoes mainly on behalf of older, larger, third party firms which partly outsourced their production to trusted smaller producers. The company's collaborations have also spanned across the Atlantic, working with American shoe makers. Throughout the intervening years between the 1970s and the 2000s, the company had been limited in its production of wares bearing its own brand.

This long history of high level cooperation has allowed the Italian firm to accumulate relevant knowledge with regard to productive technologies, the ability to adapt the product to the customer's anatomy (a relevant issue in shoe making) and with regard to commercial strategies. This relevant background proved essential when, in the mid 2000s, the company decided to launch its own brand comprised of a collection of mountaineering and rock climbing shoes. The timing was strategic, as the second half of the 2000s in Europe saw massive growth in the number of practitioners of these sports, allowing new brands to experiment with success in a burgeoning market.

After some year of growth in the market, at the beginning of the 2010s, came the firm's real technological innovation. Thereupon, the company introduced a new material – a microfiber wedded to a patented technology – to build the upper surface of their climbing shoes. The material had never been experimented with before in this field, but was discovered to revolutionize mountain climbing shoes. The firm spent three years diligently experimenting with the material before arriving at a product that could be presented to the market. What they discovered was that rock climbing shoes must adhere perfectly to the foot in order to increase the sensitivity of the climber. However, prior shoes that enhanced sensitivity also had the concomitant problem of inducing pain. The microfiber innovation allowed them produce shoes that fit perfectly while also reducing pain and discomfort. As an added benefit, it also enhanced the durability of the shoes.

This technological innovation was made possible due to the pre-existing wealth of knowledge possessed by the firm, as well as by the firm's collaboration with expert climbers. The turnover of the firm has grown significantly (about 20%) due to the sales

of the new shoes. Moreover, the company implemented an aggressive commercial strategy, sponsoring several emerging athletes able to demonstrate the benefits of the product to potential customers.

Summing up, what is relevant in this case is experimentation, thinking outside the box, product innovation and revolution by means of exploiting new materials while drawing upon a wellspring of practical, accumulated knowledge.

Case 2: British small enterprise, IT products: development of an internal e-business system.

This enterprise is based in northeast England and is a supplier of business communication equipment. It is involved in both the distribution and installation of the equipment. Its core value proposition is its technological approach towards understanding the needs of its customers and its ability to use this approach to customise its solutions. This value-added support strategy has allowed it to remain competitive and maintain profitability despite the small size of the firm.

In the second half of the 1990s the company began a process of e-business transformation, in order to adapt to the needs of the market. The first step was e-mail adoption, followed in 1998 by a website listing the company's products. As this site was popularised by search engines, the company developed separate websites for its different products and implemented a search engine optimization (SEO) strategy. Hitherto, everything had been developed in-house, utlising internal knowledge resources.

However, in 2003 the, company purchased and customised an electronic customer relationship management system to provide for online stock counts and ordering, in order to meet the growing demand of online shoppers. Then, resources and supplies -- other than the main website itself -- were outsourced to external providers. Thereafter, all resources were integrated, and an online logistics maintenance system was implemented. At that point online sales became the company's most relevant asset.

It must be noted that, in addition to many of their innovative initiatives succeeding, several also failed through the course of the company's experimental trial-and-error approach. The company's key competencies were strategic leadership, business system thinking, web architecture foresight and making technology work in its favour.

In particular, the director/owner demonstrated strong entrepreneurial leadership, making the most of the employees' creative marketing capabilities. Management also demonstrated cunning ability in managing relationships between the internal stakeholders involved in the strategy. The firm was also able to direct investments towards IT, while carefully planning for costs and avoiding unneeded expenses.

This case study reveals the importance of marketing innovations in the context of SMES, and the relevance of internal knowledge to implement the process, coupled with a proactive mentality and, perhaps most importantly, careful management of financial resources.

Case 3: Italian small enterprise producing custom moulds: implementation of product management software.

This small enterprise produces mould bases for plastic moulding. Clients are firms that mould plastic parts for various appliances and goods. As this particular industrial sector is rather crowded and there is little room to distinguish one's firm, this firm managed set itself apart through its ability to deliver customised products in a timely fashion to its clients. While the production of a mould itself is often quite simple, very often customers ask for quite specific moulds (i.e. specific shapes and characteristics). The production process for custom moulds (which are generally single pieces, or very small series productions), based upon the client's specifications, can become quite complex, and must undergo a series of procedures. Moreover, as timing is strategic in order for the firm to maintain its market position, these specifications must be put into production at a rapid pace. This could potentially run into a high rate of errors, which in turn would be costly in terms of lost time, wasted materials and a loss of market position.

Thus the firm had the need for a high degree of product information at every point along the production line without reducing product their flexibility (necessary to produce the high number of customised, non-standard parts) all while not significantly raising prices. The basic idea underlying the innovative process used to meet this need was the automation of quality control. Thus the firm decided to implement product configuration software which was able to translate the customers' specifications in a manner that could be transmitted to and controlled at every point along the production line.

Implementing this software was an arduous task due to the number of steps that had to be integrated into it. At the end, however, it resulted in a system able to dialogue

with the customers and accurately transmit their specifications to the production line. This resulted in an increase of the accuracy of moulds produced; while before the software's implementation the error rate hovered around 20%, it reduced to virtually zero after being put into use.

This case reveals the importance of engaging in process innovation, which, though while it initially may seem costly, can dramatically improve the performance of an enterprise that requires precision and speed in order to stand a cut about the crowd.

Case 4: Italian small enterprise, production of lighting.

This small Italian firm was founded in 1969 by two entrepreneurs. Since its founding, it has been involved in the production of lighting equipment for household and commercial applications. The relevant turning point in its history came in the mid 1990s with one simple yet revolutionary innovation. In short, the small enterprise was able to transform a simple device, developed by a major American company, into an electric power-conducing clamp. With this innovation, the company was able to then produce a cable-suspended lighting system using normal electric power (and not reduced-tension power) thus allowing for the creation of vast lighting system in locations such as showrooms, factories, theatres, warehouses, open spaces etc.

This simple innovation has enabled the firm to become a market leader in its field. This role has been cemented with further innovations that have furthered improved their revolutionary lighting system.

Resume and roadmap

In these four cases, we find various enterprises performing different types of innovation. In the first case we have a technological product innovation; in the second case the firm achieves a high-tech marketing innovation by exploiting emerging IT technologies; in the third case we find an instance of process innovation, by which the firm was able to improve product accuracy and maintain their market edge. Finally, in the fourth and last case, the innovation is a novel use of a standard product in a revolutionary way.

A relevant, salient point spanning these four cases is the importance of internal knowledge in order to innovate successfully. This is particularly clear in the first case, where the base of knowledge gathered throughout decades of productive activities proved to be critical. Internal knowledge was also demonstrably important in the second case, both regarding the decision to implement the innovative technology (as management was aware of the opportunities offered by the new technology) and the ability to employ internal resources to see its implementation actualised. In the third case the knowledge of the personnel involved in the production process was a crucial factor in enabling the programmers to implement the software needed to improve the production process. Finally the fourth enterprise performs a very simple, yet revolutionary product innovation based on their highly specialised knowledge.

Another relevant point here seems to be the will of management to involve the firms in potentially costly innovative activities, envisaging a dramatic improvement in the firms' performances in a short matter of time which would result increased profitability.

With respect to the cases we've reviewed in this section (small enterprises), we can see that dynamism is a key point of small firms, regardless of their activity. This is particularly relevant in the second case and it is also important in the first one. The ability to perform innovation of any kind was made possible due to the flexibility of internal personnel, the existence of appropriate resources and/or the management of the firm. Thus the capacity to act quickly and make rapid adaptations to the internal structure, which is more readily achieved in a medium/small entrepreneurial structure, is a relevant asset that can be exploited in order to innovate successfully

Micro enterprises

Case 1: Italian academic spinoff producing remote sensing systems.

This company is based in Lombardy, the most industrialised region of Italy. It was analysed one year after its founding, when it had nine employees and a turnover of around €300,000. It sold software packages and consultancy for remote sensing systems on a make-to-order basis, offering highly customised solutions and licensing its own internal knowledge produced through R&D.

One year after its founding, the company reached its turning point: a technological partnership with a foreign software developer. Thus, while the company continued to produce essentially the same product, it was able to integrate a wider software solution, produced by a European software vendor. Via this partnership, the company was able to deliver a product that met European standards of quality.

This enhancement in quality of the product, rather than in consultancy, allowed the company to reach a far wider market. Moreover, this new software, written in a more common programming language, resulted in the technological renovation of the product and fostered its diffusion throughout the market.

The lesson here is that combining, at the very advent of a micro firm, technological innovations with adept commercial behavior results in higher quality, more widely marketable goods.

Case 2: French mobile phone videogame startup.

This creative startup was founded in 2004 with the aim of producing high quality games for mobile phones. The company was created by three associates wishing to start their own business. They had the luck, just after their first product became a commercial success, to be contacted by a major company in the field who wanted to outsource their products to the startup. The company grew rapidly thereafter, reaching small enterprise status some years after its foundation.

The one behaviour perhaps most responsible for the firm's success was its ongoing collaboration with its customers. Since the beginning of the firm, one of the three entrepreneurs was tasked with reaching out to customers to beta test their games in development. In exchange for testing these games out in terms of playability, and reporting any bugs back to the developer in order to be corrected, these customers were given early, free access to new games. This strategy was a win-win situation for both the customers and the company. Customers received games for free and the company had the chance to correct any errors in them before releasing them for sale to the general public.

The customer-relations strategy was simultaneously a public relationship strategy, as it built loyalty amongst the firms' customers, but also a product enhancement strategy, as customers were encouraged to give feedback on general improvements that could be made to the games. So, not only were bonds between the customers and the company strengthened, the quality of the company's products were enhanced, being tailored specifically to the customers' demands and tastes and being freed of any errors.

Thus, what is relevant here is the concept (not uncommon in the video games industry) of customer- company relations, where the community of users interacts directly with the producers in order to obtain a "community-customised" product. Here, it is demonstrated how an organisational innovation can greatly enhance a company's products and help it achieve success.

Case 3: British software startup in the retail industry.

This startup, founded by two employees of a multinational retail software company, began its operations in 2007 and was studied between 2009 and 2010. The founders first had the idea to create their startup when they noticed that several clients asked them to implement a specific function (communication with their stores and an ability to track and measure responses) in the software packages they were helping to create through the firm in which they were working at the time. Both founders had over ten years experience in the field and were prepared to meet this demand through their own firm.

As the software neared the end of its development, the founders hired a vice sales director. The first clients of this new software solution – which implemented a specific function not found in other software designed for retail stores – were acquaintances of the founders (that is, clients of their former company). But what proved essential was their close relations with the National Retail Federation (NRF), an international non-profit trade association. Annual meetings provided them with the opportunity to meet prospective consumers of their new, innovative product. Moreover the NRF provided its members with guidance on selecting technologies and gave this fledgling company its seal of approval. Thus, even the NRF can be seen as a source of innovation.

What is relevant in this case is the ability of management to access a relevant trade association (the NRF) on the commercial and promote the innovative relevant, innovative benefits of the product they had produced. Being able to identify and then utilise a unique marketing opportunity (that is, the NRF meetings) was the key factor in their success.

Resume and roadmap

Innovative micro enterprises are generally startups or academic spinoffs at the beginning of their journeys. This is rather obvious, as an innovative enterprise which does not grow is quite often destined to fail. It is no surprise then that the three cases cited above are found amongst the most successful firms.

None of these three micro companies produce hard goods; to the contrary, they are involved in the production of innovative software or in supplying innovative services. In all three cases, however, managerial and commercial innovation proved to be critical. In particular, if we refer to the ideas discussed throughout this chapter, we continually notice the relevance of networking capabilities and the value of cooperation at every point along the value chain. In case three, word-of-mouth networking – and thus a marketing innovation in the context of the software industry, where marketing is often done electronically – is at the basis of the company's success. Case two, as well, demonstrates the beneficial effects of networking in an innovative context. In a similar way, case one demonstrates how integration, collaboration and commercial expansion contribute quite significantly to the survival and growth of an enterprise.

Aside from the innovativeness at the core of these three businesses, we should also note their abilities to find conventional and unconventional ways to commercialise their respective products. The three enterprises find different ways to accomplish this, and we might perhaps conclude that their keen ability to innovate in terms of marketing and networking at the beginning of their journeys is what is most responsible for their success.

1.5 LARGE COMPANIES AND INNOVATION

Historically large companies have presented the highest innovative ability when compared to smaller ones.

This is mostly likely due to the fact that they were the only ones who possessed the required capital to establish large scale research facilities and fund long-term scientific research programmes designed to generate new to knowledge which could be exploited for the purposes of generating innovation. Research and development (R&D) has been a strategic asset for many years, and competitors – particularly in technologically intensive industries – were obligated to pursue a similar path it they wanted to disrupt the innovative dominance of such large companies.

With the advent of the "digital era" the economic landscape has progressively changed and, today, the smaller, younger and more dynamic firms are often considered more innovative when compared their larger counterparts. Generally speaking, smaller companies are typically based on one or two technologically relevant and commercially viable ideas, and are considered to be capable of rapidly adapting in order to respond to the demands of the market. Large companies, instead, are often more traditional in terms of organisation, information flows, etc., and thus are more prone to static behaviour and less capable of rapidly innovating. Nevertheless big actors have the resources – in terms of research budgets and money to be allocated for the contracting of top level researchers and facilities – on their side. These resources can also be invested in new ventures without posing a threat to the larger firm's existence.

However, the internal operational structure and industrial infrastructure of large firms is often massive, cumbersome and extremely bureaucratic. Due to the overwhelming size of their corporate structure, new ideas often never make it to those in the position to act upon them and the decision making process is slow and arduous. These are some the more relevant reasons why large enterprises have begun to lose their position at the forefront of innovation. In fact, one danger of their organisational structure is the insidious growth of a bureaucratic mentality wherein each decision must be strategically evaluated by various committees before being allowed to proceed. This means a decreased ability to respond quickly to market demands, the premature burial of new organisational ideas and novel technologies that might have had a positive outcome if implemented, and also inefficient budget

allocation. Indeed, bureaucracy is the enemy of innovation; however, change itself can also be daunting for a large, establish company and so might be dismissed out of mere inertia in any case.

Another concern for big companies is an atmosphere in which personal responsibility is avoided. For example, an executive might not act out of fear that certain novel, innovative actions, if taken, could result in failure, and thus their own firing. In any case, bureaucratic environments tend to impede (or even discourage) new ideas, decrease budgets meant for their development and be too reluctant to step out of their old, traditional ways, resulting in costly hesitation when a moment demanding rapid adaptation arises.

Indeed, an established firm has its own business model, which is – or should be – efficient and tested, and which satisfies its present customers. On the other hand, the Darwinian behaviour of small firms is to find a new model and adapt it to its potential customers. This difference in business mentalities – routine and adaptation – is analogues to the difference between managers – who run big companies along an established course – and leaders who steer their small vessel of a company across a more unpredictable path. However, in this way, innovative leaders, by navigating uncharted territory, develop the ability to turn an idea into a product customers are willing to pay for.

In addressing this, we return to the inherent riskiness of innovation (which will be discussed in depth later) and of its iterative structure. Innovation involves navigating uncharted waters, using intuition combined with the ability to make rational choices, and is performed through a process of flitting back and forth between the customer and the laboratory. Thus, in order to innovate, firms need to catch customers' attention, engage in a (possibly costly) trial-and-error process and make continuous adjustments. This process is more likely to fail than to succeed. And often this is the precise opposite of what managers want, as it might hinder the performance of a firm in the short term. In general, managers are quite often best suited to running a business steadily rather than shaking it up. Thus, it's imperative that businesses – of all sizes – leave room for entrepreneurs with a capacity for creative leadership within their corporate structure. These creative leaders are the "Schumpeterian entrepreneurs" that we have described and discussed above: those able to mix rationality with vision. Such entrepreneurs should have lateral thinking and a higher tolerance for failure.

However, this is easier said than done. It is not always easy for firms to identify entrepreneurial minds to be integrated as personnel. Too often it pays more in the short term, on the contrary, to hire traditional, high potential managers who possess the greatest ability for keeping the operation running smoothly and maintaining the status quo. However, such managers are typically less able to recognise the limits and barriers that must be hurdled in order to develop new products for new customers in new markets. It is often difficult to endanger present profits in exchange for potential, yet uncertain, greater profits in the future. Thus, it is important to recognise such limits within firms and to empower groups and individuals to work with different goals and strategies in mind. Certainly the traditional manager and the creative leader are not mutually exclusive, and larger firms are capable of incorporating both.

However, this seems to be a strategy that large enterprises have largely neglected at present. Large companies are often less able to "think outside the box" with respect to their smaller competitors. This is one the barriers that hinders their innovative abilities. This is reflected in the lack of original thinkers found amongst the personnel of larger companies. Therefore, it is imperative that larger firms create "thinking space" for their personnel (much like the creative retreats the French door and gate company organised) in order to help foster an innovative environment.

From this perspective, we must also consider how employee performance evaluations can threaten innovative thinking and the innovative process. Bonuses depend, generally speaking, on successful results. This system should be restructured when we consider that the employees most likely to positively impact a company are the very same ones who take the riskiest decisions. Moreover, the leadership should carefully consider that certain work, especially innovative work, might have massively positive results that are not immediately observable and might not be for many years to come.

As noted above, large companies have far greater resources to allocate to innovative activities; however, they are often resistant to such activities due to their static organisational structure and bureaucratic nature. This nature often makes larger companies averse to investing in projects that may seem risky or promise no immediate returns. Coupled with a strong culture of personal responsibility, employee evaluations and an overwhelming demand for accountability, it is easy to understand why those in the position to make such investments in a large company might be reluctant: a simple fear of the money being lost, and reflecting negatively on the decision maker who lost it. However, in some industries this is par for the course. For example, in the pharmaceutical industry, an extravagant amount of money is spent on researching drugs that will never make it to the market. In general, though, companies must be well aware that a large portion of the money invested in research may never yield fruitful results. Regardless, this should not deter them from investing in innovation.

Hitherto, we have discussed the innovation-related challenges faced by many large enterprises. In particular, we have examined problems deriving from their intrinsic internal structure, their dimensions and the form of management such firms typically employ. In order to overcome these challenges, a variety of initiatives can be taken.

One means is creating smaller R&D departments. Smaller departments can help speed up the decision making process. This process can apply to both the technological innovation performed across the production line and to managerial/commercial innovation. A culture of autonomy should be promoted within these smaller R&D departments, as long as their goals are in line with the firm's values.

Research units should then be encouraged to engage in a "learning process" wherein ideas are tested against facts (that is, customers' needs and product profitability) and failures are not perceived as such, but rather as fundamental steps in this learning process. Continuous learning can be a bit disruptive in an established context, but it is a way to innovate. If testing and learning remains continuous, it is then easier to adapt innovations to reality, minimize losses and failures, and successfully secure funding requests. While engaging in this learning process, involved personnel must balance short-term and long-term results.

Interconnectivity is another concept companies should promote in order to foster innovation. Specifically, interaction must take place between technological innovators and commercial innovators. It is important for a new or re-imagined product to be marketed in its own, unique, innovative way. Therefore, personnel in the firm involved in innovative marketing and its management should engage in reciprocal communication channels with the technological innovators in order to synthesise the best possible way to market the product. This might involve a change in the targeted customer base, an augmentation of the sales techniques, uncovering new marketing channels via social media, etc. History is fraught with examples of technologically superior products that lost out to their competitors due to inferior marketing campaigns. A prominent example of this is Betamax vs. VHS. Though superior, Betamax lost out to the VHS cassette due to an inability to market itself with a level of innovation that matched the product itself.

Another means by which innovation can happen in larger firms is by looking beyond the firm's borders, and purchasing new technologies, techniques, ideas, etc., that were innovated and produced by another, perhaps smaller, company. This can be mutually beneficial for the smaller and larger firms, allowing both to focus on their respective strengths and profit at the same time. This is a win-win situation for all involved and could potentially even lead to the larger company purchasing the smaller company. A recent example of this is Facebook's acquisition of Instagram.

A regime of "open innovation"[23] is another means by which larger firms can innovate. In fact, open innovation is more prevalent in larger firms than it is in SMEs. A study by the Fraunhofer Institute and University of California at Berkeley presents some relevant evidence regarding this phenomenon (p. 2-3, cit.):

- Inbound open innovation practices are more commonly practiced than outbound practices;
- Customer co-creation, informal networking, and university grants are the three leading inbound practices, while joint ventures, selling market-ready products and standardization are the three leading outbound practices;
- Customers, universities and suppliers are the three leading open innovation partners reported by survey respondents;
- Firms are much more likely to receive "freely revealed" information than they are to provide such information;
- Establishing new partnerships, exploring new technological trends and identifying new business opportunities are the leading strategic reasons to engage in open innovation;
- Open innovation is not much formalized yet, and cultural norms are as important for open innovation as formal practices.
- The biggest challenges in managing open innovation are within the firm. The change process from closed to open innovation is rated as the most difficult task.

What must be emphasised here is that managers and leaders must be able to overcome their firm's inherent structural limits on innovation. There is no single panacea for innovation, and, particularly in big, structured, businesses it is imperative to adapt to highly specific situations, simultaneously maximizing the opportunities for innovation the company does afford

23) Open innovation in large firms is addressed in the Report from Fraunhofer Instut and University of California at Berkeley "Managing open innovation in large firms", available at:

https://www.iao.fraunhofer.de/images/iao-news/studie_managing_open-innovation.pdf (link visited May 2016)

1.6 INNOVATIVE STARTUPS AND INNOVATION

"Startup companies" are newly formed yet quickly growing companies that were devised according to a business plan to meet a recently arisen demand of the market with a new product or service. Prior to "starting up" entrepreneurs must have secured financing, made a business plan and defined how their ideas might be commercially competitive without relying upon additional sources of funding. An emphasis is sometimes placed on the temporary nature of the startup company.

"In the world of business, the word "startup" goes beyond a company just getting off the ground. The term startup is also associated with a business that is typically technology oriented and has high growth potential. Startups have some unique struggles, especially in regard to financing. That's because investors are looking for the highest potential return on investment, while balancing the associated risks"[24].

What is most relevant in this definition is the fact that the emphasis is placed on the technological orientation of the new business, and its implicit high growth potential. This, in turn, creates a context that is likely to be rewarding to investors as well as the national economy as a whole.

Because the most important characteristics of startups involve their initial stage of evolution, we shall discuss them separately from SMEs. In conjunction with startups, we will also discuss their counterpart, "academic spinoffs", in the next section.

A cursory glance at the internet reveals an inordinate amount of sites offering advice on how to create a startup. This, in combination with the vast amount of scientific literature on the topic, is a good indicator of how important and influential startups have become in the contemporary world. (Again, Schrumpeter's ideas regarding the importance of the recently arrived entrepreneur are of significance here.) High-tech startups have been growing at a rapid pace all over the world, from America to Albania, Canada to Korea, England to Ethiopia. The following sections shall use the definition of startup as set forth by the U.S. Small Business Administration, meaning we are referring to technologically innovative firms.

24) The definition can be found in the webpage of SBA: https://www.sba.gov/content/startups-high-growth-businesses (link visited May 2016)

First, we must point out that startups are inherently innovative, and thus inherently risky. Indeed, the vast majority of startups do fail (think back to the "dotcom bubble"). Therefore, public policy plays an important role when it comes to startups. Many countries have begun setting up support programmes in order reduce the risks startups face in their initial stages of development. However, these policies come with a cost: they perhaps impede the Darwinian market dynamics that weed out the less useful startups from the more productive ones. However, perhaps this is not such a bad thing. The Darwinian mechanics of the traditional market are not always accurate, and quite often startups with a functional, productive idea fail for reasons beyond their control. As such, these policies can be understood as an attempt to make the market less vicious and capricious. In any case, startups can fail for a variety of reasons. Perhaps the management is not of the best quality, or they are operating with an ineffective business model. There could be problems with production, such as costs exceeding expectations or unforeseen technical problems. The list is endless: problems with marketing, a poor sales strategy, a failure in the supply chain, a lack of customer interest, etc.

Regarding the role of management, some studies point out that many innovative startups are managed by creative, quirky types with little organisational and managerial skills. In these cases, an appropriate suggestion would be to hire staff who can fully involve themselves in the creative aspect of the project while also providing a degree of organisation and structure for the firm.

In general, it's important to carefully and meticulously select the proper partners for the startup team. The number of involved persons should be sufficient enough to manage the everyday life of the firm and also solve any problems that may arise. However, it is imperative not to be overstaffed. Responsibilities should be carefully assigned to team members and equally shared. Furthermore, a strong human relations department should be established, as interpersonal problems could hinder the firm's efficiency in the high stress situations it is bound to encounter.

Regarding problems that may arise with the production line, research shows that very often the survival of the firm can be managed when a technological innovation is wedded to an efficient method of production. Also, the innovative entrepreneur would be wise to develop a production system that can deliver their product at

an affordable price. This production process must be developed in tandem with the product. This can help the startup avoid such issues as the product being too expensive, taking too long to reach the market or not being able to be produced in adequate quantities.

In addition, research has shown that innovative startups possess a higher rate of survival than their non-innovative counterparts. In short, the startups should have a new idea that meets a market demand or even create a market demand that it can then meet are the ones who survive and thrive.

Another relevant issue with regard to startups is the age of their typical employees. On average, they are quite young. In this way, startups play a critical role in the employment and training of young people and thereby stimulate the growth of the national economy. This tendency to employ younger personnel perhaps derives from a combination of younger people possessing more advanced technological skills and a decreased sensitivity to risk. Moreover, the clustering of a high number of young, skilled persons in specific location in fact often gives rise to startups due to an ongoing exchange of new ideas and collaborations. Thus, education and the open exchange of ideas play a crucial role in fostering economic growth and technological innovation.

Startups generally begin in one of two ways. They can originate from the initiative of a single entrepreneur or a small group of entrepreneurs. Or, under some conditions, they can originate under the umbrage of a larger company. These startups are typically deemed "corporate spinoffs". These corporate spinoffs typically emanate from the ideas of an employee (or group of employees) or are created at the behest of management. This may happen for various reasons. For instance, the corporate spinoff might be created to develop a specific patent that is not at the core of the parent company's business activity, or to create a sub-market for a specific product. The independence afforded these spinoffs can be rewarding, and the parent company can profit from them so long as they maintain shares in the new company.

The basic idea here is than an innovative business idea is developed inside a larger firm and is then borne in the form of an independent, self-sustaining spinoff company. And while these new firms can maintain different types of relationships with their parents firm, it has been shown that the ability to access the resources of the parent's firm is a driving factor in a spinoff's success.

Here, we must touch upon the issue of patents as an asset of startups. Patent ownership is often a relevant factor in the success of a startup. Intellectual property rights endow small firms with a competitive advantage, especially when the patent concerns a novel idea the firm seeks to commercialise. Intellectual property rights protect the firm from innovation theft and therefore predatory competition. These rights also allow the firm to sell their idea should they decide to. As always though, patents come at a cost, and the entrepreneur would be wise to perform a cost-benefit analysis before proceeding with one.

We should also refer to what literature has had to say about manner in which creative entrepreneurs influence the way in which new firms are created. Indeed, the distinctions between entrepreneurs and traditional firms are quite clear and can be drawn along four lines: individual characteristics, the created organisation, the environment surrounding the new startup and the process undertaken to start the new company[25]

Also of note, many scholars have described the "entrepreneur" as distinctly different from "the rest of the world". Some have even tried to develop a psychological profile of the entrepreneur. What they have noticed is what we can call the "dynamic aspect" of the entrepreneur and of their entrepreneurial activity, particularly with respect to managers, who often engage in linear, routine activities.

Of course entrepreneurs do not operate nor exist in a vacuum. This is why the effects of their surrounding environment is critically important. Two different schools of thought consider the environment as determined (and thus the entrepreneur must adapt to it) or as a reality that organisations create. The organisational environment created by the entrepreneur is the final variable to be considered when describing the entrepreneur, as its characteristics often depend on the mentality of its creator and thus this environment might seem irreducibly complex or even an echo chamber.

Moreover, environment is an important issue to consider when dealing with two public policy initiatives designed to foster the growth of innovative startups: science and technology parks, and business incubators.

Science and technology parks are generally the result of a policy effort by the public administration. In essence, they are locations set up by the government where startups can receive support and funding. Typically, fledgling firms who establish

25) The description of the innovative startup entrepreneur has been done by Gartner (1985).

themselves in these locations benefit from special, low rate conditions (with rent, heating, electricity and other commodities being heavily subsidised) designed to facilitate their growth. Moreover, new firms are established in close geographical proximity to other likeminded new firms. Here, we can discern a proximity based form of clustering bound to lead to collaboration and innovation as a consequence. Many science and technology parks even act as a "theme park" of sorts, gathering startups within the same sector (e.g. biochemistry or electronics) or startups that are most likely to contribute to the most prominent local industries.

A specific subset of science and technology parks is what is known as "university incubators", which draw upon the support of universities for research and experimentation. The startups that are generated as a result of this research are called "academic spinoffs". Typically, the founders and entrepreneurs involved in these spinoffs are either researchers/university professors or someone in close contact with the academic world. Generally, universities or public research bodies then become stakeholders in these new startups.

To sum up, what we hope we have accomplished with this chapter is highlighting the importance of entrepreneurship in creating technologically advanced firms. While there are some drawbacks in terms of elevated risk associated with this activity, the positive outcomes are manifold and far outweigh these downsides.

1.7 INNOVATION, R&D AS ESSENTIAL TOOLS FOR COMPANIES' SUCCESS AND COMPLETION

So far, we have discussed various types of innovation and the different routes innovative activities can take. In this section, we shall try to clarify the importance of R&D, from whence a significant number of innovations emanate. In theory, R&D is possible in any field of any sector of any industry. In fact, R&D activities related to the revolutionizing of management, problem solving, structuring, marketing and the supply chain all exist. Nevertheless, when speaking of R&D, the main focus is on technological innovation, specifically product and process innovation

Hitherto, we have mainly addressed the issue of what internal resources can a firm or business exploit in order to innovate. In particular we have discussed resources for research and development, with a narrow focus on technological innovation. However, this is only a small part of the bigger picture.

It should be noted that firms can perform R&D activities either inside or outside their borders. That is, with regard to the second case, firms can outsource their research by funding outside bodies to perform it on their behalf.

As previously noted, small and medium enterprises, and to a greater degree, innovative startups are favoured when it comes to performing research activities in a dynamic way, and particularly when it comes to finding novel solutions to smaller and circumscribed problems. On the other hand, large firms and industrial groups typically possess the resources to allow them to fund large scale research projects and utilise -- or even build -- much larger industrial laboratories. The results from these projects and facilities can then be used in the service of innovation.

However, there is another way firms and businesses (regardless of size and age) can access external research and thereafter internalize the knowledge to be used for innovative purposes. But this depends on the opportunities a particular firm has to collaborate with research institutes and universities.

Before going further, we must first address the concept known as the "Knowledge Spillover Theory of Entrepreneurship". According to this theory the possible sources of knowledge are many, including two we have previously discussed – universities

and research institutions – which we shall now begin to describe in far greater detail. In prior research, it has been demonstrated that these institutions play a decisive role in fostering economic growth and influencing the creation of new, innovative firms. In particular, we want to look how "technology transfer" occurs between these institutions and enterprises, and how it can be applied internally to R&D departments in order to enhance the firm's performance and generate innovation.

Existing relations between industry and research institutions are very often studied from the standpoint of these institutions. In other words, researchers are often more interested in examining the positive effects these relations have on the universities and research centres. What researchers strive to understand is the manner in which technology transfer produces more knowledge and secures further financing for the research institutes and universities. However, here we shall instead focus on the perspective of entrepreneurs, working to understand the manner in which "academic knowledge" can aid in improving the conditions of their businesses.

The term "knowledge transfer" generally encompasses the entire range of activities performed by a university or public research institute, aside from basic teaching and researching. Knowledge transfer activities are generally aimed diffusing knowledge outside the border of the institution that produced it, while also working to obtain financing. Knowledge transfer is also deemed to be the "third mission" of the university, after teaching and researching.

"Technology transfer" is a subset of "knowledge transfer" and involves all activities which lead to the commercial exploitation of "academic knowledge". Technology transfer is a means by which a university or research institute acquires financial support. However, it is also means by which researchers can contribute to the economic development of a region or country, thereby fulfilling the demand to be accountable to their society.

This brings us to two salient points we must take into account. Firstly, we must consider the growing need for the economic support of research and research institutions as the associated costs rise and resources grow scarcer at the global level. Secondly, we should also consider the need for research to, in some way, meet a public demand or produce a "social good" due to increasing the increasing demand for accountability being placed on researchers. 'Accountability' does not mean, however, that research must be immediately useful. Simply, the research must be conducted in a way that its fruits might one day benefit the public through various usages. One might say that good, accountable research bears its fruits in both the fields of understanding the principles of nature and the exploitation of that understanding for the benefit of society at large.

The activities that can be subsumed under the title are "technology transfer" are manifold. Academic spinoffs are one form of technology transfer. To reiterate, these are enterprises established by university professors, researchers, junior researchers or recent graduates that wish to use the results of their research in a productive, profitable way. These spinoffs can be involved in various types of businesses. While one might reasonably conclude that a typical academic spinoff is a high-tech, innovative startup developing a new gadget or revolutionary material with unforeseen characteristics, this is not always the case. Many academic spinoffs engage in consulting activities which supply organisational or strategic management advice, or are related to cultural projects.

Another important point regarding academic spinoffs is often their need for an investor, a manager and/or an entrepreneur. Quite often, academics possess a vision for ways in which their knowledge can be exploited and utilised, but require others parties in order to realise this vision. Perhaps they do not have the business skills, marketing savvy or required capital to put their idea into action and so they might seek partners who are able to aid them within these domains. And it is by forging relationships with these "entrepreneurial" minds they are then able to innovate.

Another important aspect of technology transfer is academic patenting. This is owing to the fact that professors can patent the results of the research conducted within their respective institutions. Different legislation in different countries offers a variety of opportunities to prospective patent holders. For instance, in countries like Sweden and Italy, legislation allows for what is called the "professor's privilege". That is, university professors have the right to patent the outcome of their research activities and retain (at least partly) a right to the proceeds from the successful application of the patent. For many academic spinoffs (as well as for many innovative startups) ownership of a patent is the key to economic success, as patents are an important immaterial asset that academic spinoffs can exploit.

It is very often the case that universities and research institutes, as well as their academic spinoffs, maintain a full portfolio of patents to be put into the service of their economic activities. This is done for several purposes. In addition to the economic benefits incurred by selling and licensing rights to those patents, such a portfolio enhances these institutions' and firms' visibility. Moreover, patents and the accumulation thereof are a significant point of consideration when universities come under evaluation.

External entrepreneurs and prospective entrepreneurs can gain access to academic knowledge via specific offices intended for its dissemination. Within the organisational structure of most universities and research centers, one will find offices dedicated solely to "technology transfer" and issues related thereof. Appropriately, these are often called the "Technology Transfer Office"; however, they can be established under other names as well. Such offices typically serve a dual function. The first one is internal, that is, performing technology scouting amongst the professors and researchers and attempting to discern what research results can be put to commercial use via patents, spinoffs, etc. The second is externally focused, looking for ways to sell these new technologies to outside firms. In this way, Technology Transfer Offices serve as the gateway for firms external to the institute to gain access to new knowledge and technology.

"Enterprise incubators" are another aspect of universities that are of high interest to prospective entrepreneurs. These institutions, which universities have begun developing and building recently, offer new businesses physical facilities (such as offices and laboratories) as well as low cost utilities (electricity, heating, communications, etc.). Moreover they often provide business consultancy, legal advice and other forms of support. Businesses established in these incubators are given assistance in accessing funding and procuring technological or commercial partners. Generally, incubators provide development programmes for firms under their umbrage, provided the firms are willing to respect the values of the institution and periodically undertake specific challenges on their own.

Academic Enterprise Incubators are primarily targeted at supporting academic spinoffs of the same university or institution. Quite often, they are organised in a manner so as to promote the growth of a multitude of academic spinoffs in order to enhance their own influence and visibility. Therefore, the presence of an accessible incubator is a relevant point for prospective entrepreneurs or firms wishing to develop a spinoff. Moreover, enterprise incubators are of significant importance to policy makers at the local and national level seeking to foster entrepreneurship.

Coming to a close, let us revise the ways in which R&D and innovation are essential instruments for business growth and innovation. R&D is a surefire means by which businesses can obtain innovation knowledge. R&D can be internal, within a firm, or it can be external, and outsourced to other firms. Then we arrive at perhaps to most significant factor involved in this type of innovation: "technology transfer" and access to knowledge generated by public research bodies and universities. In our modern world, this is a crucial means for obtaining knowledge of a highly innovative character.

2

Innovation's Role in a Company's Success

Innovation's Role in a Company's Success

The first chapter of this work addressed the question: "What is innovation?" In addition to providing a clear definition and exploring the variegated ways in which it can be performed, it also strived to demonstrate how firms of different dimensions can best involve themselves in innovative activities. An effort was made to offer the reader a chance to reflect on innovation in the abstract, to understand its practical nature, and to assess its real world application in various contexts. Theoretical reflections have not been offered as mere pedantic philosophizing, but to the contrary, as a means for providing a basis upon which more efficient and efficacious innovative practices can be generated

Here, the second chapter will focus more specifically on the practical side of organising innovative activities, addressing several different related topics.

The first section in this chapter will deal with business survival in relation to innovative activities. Indeed, every technology experiences its own lifecycle, involving a period of expansion and then contraction. Thus, innovation offers solutions to this problem by providing a means by which technology can be reinvigorated, enhancing its market impact.

We will then discuss issues related to the external environment of the firm, and how this can negatively or positively impact innovation. Competitors and collaborators can play an important role in this regard. A further relevant point is the internal organisation of an innovation team. How such a team is organised has a significant impact, regardless of the presence or absence of financial resources, which will later be discussed in this chapter.

Moreover, businesses can compete and/or cooperate for innovation, depending on factors such as their dimensions, environment and needs. Again, this can potential have a significant impact on the innovative process itself, as well as on the general performance of the firms.

Finally, this chapter will conclude with a discussion on the role of social media in innovation. It is our hope that a thorough discussion of these topics will contribute to a better understanding of how innovation can offer a significant contribution to the success of company, business or firm.

Although this section will offer a more practical and straightforward approach, we will engage in theorizing as well. However, this theorizing will always occur in direct relation to the topic under consideration. We believe that by offering such a theoretical approach to support the practical applications of innovation, we can better enable the reader to find their own solutions to any problems that may arise from time to time within their own, unique contexts.

The practical issues discussed herein are intentionally designed to complement the more theoretical approach offered in the previous chapter, thus offering the reader a more systematic, comprehensive understanding of innovation, prior to tackling the issues addressed in the final chapter.

2.1 THE RELATIONSHIP BETWEEN INNOVATION AND THE SURVIVAL OF THE BUSINESS

The direct relation between innovation and the survival of a business or a firm often goes without saying. However, "innovative ability" is only one of the factors involved with a business's ability survive the test of time. Other factors include the business's dimensions, its managerial abilities, production costs, location, marketing skills and so on.

From the perspective of innovation-survival relations, one specific factor should be considered foremost. This is the factor of the "technology lifecycle". The lifetime trajectory of every technology follows an "s-shaped curve" (figure 3). This curve describes its adoption by consumers and, consequently, its commercial success. It can be seen that a technology usually arises from a period of obscurity (perhaps due to a timid marketing campaign), after which it begins to take off commercially and, finally, arrives at a saturation point. At this point there are two possibilities: 1.) The technology can be reinvigorated via innovation, generally in an incremental manner, in order to achieve success again, or 2.) A new technology, possibly arising from a radical innovation, completely subsumes and substitutes the older one.

It should be noted that the same s-shaped curve is followed by the technological performance of the product, as well as by its production process and underlying technology. Substituting appropriate captions on the axis in figure 3, the graph can be reliably applied to all of these concepts. It is important that all of these factors be carefully studied and weighed by any business seeking to engage in technological innovation.

Innovation-survival relations have been carefully studied by several scholars. For instance, a study conducted in the 2000s regarding Dutch firms found a direct correlation between innovation and survival[26]. That is, firms that innovate more are also more likely to survive over time. This finding is with respect to other determinants, such as age and dimensions.

Nevertheless, results of the research, as well as of previous studies, indicate that the firms which are more likely to go extinct are typically small and young. Thus, the effects of innovation are particularly relevant for such firms, as it enhances their chance of survival by 23% (as experienced by those in the studied sample). It is interesting to note here that "small and young" is the typical profile of today's startup companies.

These studies and their findings demonstrate a need for discussing a particular topic regarding innovation: its uncertainty. We have previously observed the fact that, in general, the more radical an innovation, the more uncertain it is. Now it is time to more fully explore that concept. The factors behind this uncertainty in innovation are countless and varied. To analyse them, we must refer to scholars who have synthesized a significant number of cases in order to create a matrix of factors[27]. Table 4 examines and categorizes the factors of uncertainty related to innovation. The table presents data which has been derived from the work of Jalonen (2012).

Amongst the various factors of uncertainty listed by Jalonen, the most relevant ones in this context are: technological uncertainty, market uncertainty and managerial uncertainty. The first factor is primarily attributed to a lack of knowledge regarding the technology. This demonstrates the importance of R&D on both the theoretical and applied ends in order to enhance the understanding of an innovative technology.

We've briefly touched on market uncertainty before, and now we must explore its significance. Before undertaking any project aimed at generating an innovative product, it is crucial to have a clear understanding of the needs and behaviour of the market. A recent study has demonstrated that amongst the top twenty reasons for a startup failing, several are market related[28]. These include releasing the product at the wrong time; poor marketing; being outcompeted; finding a solution to a problem that does not yet exist, etc. In essence: not targeting a "market need" or not properly interacting with the market.

Finally, managerial uncertainty is directly related to the internal organisation of the innovative business. The innovative business must be persistently vigilant of its managers' ability to handle and adapt the various processes occurring within the business. It must pay careful attention that management doesn't become bloated, suffer from a bureaucratic mentality, lose its dynamism or become static and inattentive.

26) The cited study is Cefis and Marsili (2003), available online at: http://www.uu.nl/sites/default/files/rebo_use_dp_2003_03-18.pdf (link visited May 2016).

27) The factors of uncertainty in innovation have been reviewed by H. Jalonen (2012), available online at: http://www.macrothink.org/journal/index.php/jmr/article/view/1039 (link visited May 2016).

28) The study can be found online at:
https://www.cbinsights.com/research-reports/The-20-Reasons-Startups-Fail.pdf (link visited May 2016).

Although these classifications are only a few amongst a possible many, they do derive from an extensive review of scientific literature which examines explicit, real world cases. It also demonstrates some overlap between these factors. What is relevant in the context of this work is their practical outcome. The various manifestations of uncertainty categorized in the table can be encountered by an entrepreneur, a manager or even the layman seeking to engage in innovative activities. This classification system is an appropriate starting point for developing measures to counter various forms of uncertainty. In this way, we can begin devising apt solutions to common problems.

A variety of instruments exist which can help innovators outline the problems that might cause uncertainties and thereby decrease their chances of success[29]. We will shortly introduce a few of these in the following section. Within the present context, a full treatise on each is not warranted. Nevertheless, it is important to at least acquaint our readers with them, as they may choose to further probe them at a later stage.

For overcoming technological uncertainties and selecting the best technological routes to take, an appropriate instrument is "technological forecasting". This technique is designed to help predict the future trajectory of any given technology. "Forecasting" is defined as a prediction of how a variable will evolve over a given period of time, in tandem with the probability of that prediction being fulfilled. It entails a quantitative evaluation, starting with an analysis of past trends and taking present conditions into account. The aim is to forecast how and when a specific technological change will grow or decline in the future. It utilises such methods as mathematical extrapolation, expert opinions, inferential statistics, etc.

These methods do have their limitations, however, including technological discontinuities (sudden breaks in technological trends). These are usually due a change in the external conditions (e.g. a sudden change of tastes, or a period of economic crisis), and thus it must be clear that these models are dependent upon somewhat unpredictable external conditions. An improvement to this instrument can be made by wedding mathematical forecasting to a set of expert opinions. However, caution must be exercised here as well, as even experts are fallible and may give divergent opinions.

Other methodologies utilise different types of data and are structured in different ways. For example, a popular set of techniques is known as "creativity enhancement methods". These include the popular activity known as "brainstorming", whereby a group of people involved in the innovative process meet to discuss (or even conjure up) a novel concept or idea and freely express the first thoughts that spring to mind in relation to that concept.

Another method is the "value analysis technique". Every aspect of an industrial product is analysed in detail for its physical characteristics and attendant costs. All characteristics and attendant costs are then analysed in order of importance in order to discern possible technological improvements and/or cost reductions.

However, these methods address only the internal dimension of technology and technological change. To gain a wider perspective, one might choose to engage the "scenario method". This method involves envisaging all possible trajectories a technology might follow in the future. This method involves considering both the past trends and the current behaviour of the technology under consideration. It uses foresight techniques to imagine the various possible scenarios that might come to fruition while also integrating the forecasting method to generate possible outcomes through a simulation process. It considers several mutually exclusive scenarios, forcing its practitioner to consider all possible technological discontinuities which could occur (not only those in the past or present, but also those that have the potential to exist in the future). Amongst its advantages, this technique provides contingency plans for a multitude of possible futures and their respective effects on the technology (and thus for the business), better helping the business to prepare for unforeseen circumstances before they arise.

Another important activity a firm may choose to engage in is the performance of a "technology audit", by which it inventories and catalogues all of the technology it possesses. As each product generally involves the contribution of more than one technology, this audit aids in ascertaining what technologies are still needed in order to arrive at the finished product. Moreover, measuring to what degree a particular technology affects the costs and performance of a product can offer better insight into its competitive nature. Following from this, it is also possible to measure what impact a specific technology will have on the industry as whole and thus its potential to be sold to competitors or imitated by them.

In conclusion, innovation is often directly correlated with the survival or failure of a business. With respect to this, several points must be taken into account. Technological innovation often involves high costs, and thus technology must be carefully evaluated before being adopted or created. Moreover, there are a variety of different uncertainties that can negatively impact a firm involved in innovation at any level. However, at our disposal are several methods by which we can attempt

29) The instruments described here are described by Dussage et al. (1992)

to forecast and mitigate these uncertainties. Based upon our review of relevant scientific literature, we've provided our readers with a list of these methods as well as the various ways the different types of uncertainties can manifest themselves. This list is not exhaustive by any means, but we do believe it can be a useful instrument in preparing for possible, future challenges. In this way, entrepreneurs can prepare contingency plans for unforeseen conditions and better ensure the survival of their business.

Figure 3 – The S-shaped curve of technology life cycle

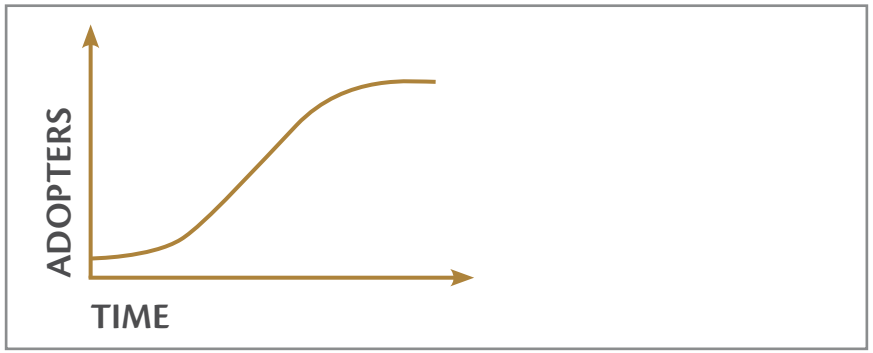


Table 4 – Factors of uncertainty in innovation (source: H. Jalonen, cit.)

UNCERTAINTY FACTOR	EXPLANATION	MANIFESTATION OF UNCERTAINTY
Technological uncertainty	Arises due to a lack of knowledge of the details of new technology or due to a lack of knowledge required to use new technology.	• due to the novelty of technology its details are unknown; • uncertaintyregarding knowledge required to use new technology;
Market uncertainty	Exists, on the one hand, due to unforeseeable changes in relations between firms and customers and, on the other hand, due to unforeseeable changes in relations between competitors from which new markets emerge.	• unclear customer needs; • lack of knowledge about the behaviour of competitors; • difficulties in predicting the price development of raw materials and competing products and services;
Regulatory/ institutional uncertainty	Due to the fact that he more unknown the domain (e.g. consequences and technology) of the innovation, the more ambiguous are the regulations and, hence, the more uncertainty is felt by innovators.	• ambiguous regulatory and institutional environment;
Social/political uncertainty	Social and political uncertainty can result from a diversity of interests among stakeholders and a power struggle between the stakeholders.	• diversity of interests among stakeholders of innovation processes; • power struggle;
Acceptance/ legitimacy uncertainty	Cognitive legitimacy of innovation is uncertain when necessary skills and knowledge contradict the existing skills and knowledge possessed by users. On the other hand, the socio-political legitimacy of innovation is uncertain when that innovation threatens an individual's basic values and/or an organization's norms.	• necessary skills and knowledge contradict existing skills and knowledge possessed by perceived users of innovation; • innovation threatens individual's basic values and/or organization's norms;
Managerial uncertainty	It manifests itself as a fear of failure and as a lack of the tools required to manage the risk inherent in innovation processes.	• fear of failure; • lack of requisite tools to manage risk inherent in innovation process;
Timing uncertainty	It esults from a lack of information in the early phases of innovation, from the ambiguity of information in the late phases of innovation or from temporal complexity faced by innovators.	• lack of information in the early phases of innovation; • ambiguity of information in the late phases of innovation; • temporal complexity;
Consequence uncertainty	Promises of a better tomorrow are uncertain, because in addition to direct, desirable and anticipated consequences, innovations may have indirect, undesirable and unanticipated consequences. Even though the majority of the literature is focused on detrimental indirect and unanticipated consequences, it is important to note that indirect and unanticipated yet also positive consequences may increase uncertainty.	• indirect consequences; • undesirable consequences; • unintended consequences;

2.2 THE INNOVATIVE BUSINESS ENVIRONMENT

External environments possess the potential to acutely impact the innovative ability of a firm or business. Here, we shall look at several external factors which can hinder the ability of a firm to engage in various types of innovation. The first factor under consideration is to be found at the national level, and it is related to the art of policy making and the broader economic situation. As the OECD states,

"Government policies can support innovation by continually reforming and updating the regulatory and institutional framework within which innovative activity takes place. In this context, reforms are needed to make public policy and regulatory framework more conducive to innovation in a range of policy areas from the general business environment — especially in the services, particularly in the network industries — to international trade and international investment, financial markets, labour markets, and education.

Governments can also play a more direct role in fostering innovation. Public investment in science and basic research can play an important role in developing ICT and other general-purpose technologies and hence, in enabling further innovation. This highlights the importance of reforming the management and funding of public investment in science and research, as well as public support to innovative activity in the private sector."

OECD, INNOVATION AND GROWTH - RATIONALE FOR AN INNOVATION STRATEGY, 2007, p. 5[30]

This OECD document is rather self-explanatory with regard to the degree policies and investments can foster innovation within a nation's firms and businesses. However, policy making is only one relevant factor at the national level that can help foster innovation and promote economic growth. It is important to note here that we must also consider the relative quality of the nation's economic institutions; the ability of the country to dispense with burdensome "red tape" related to economic activities; its ability to increase efficiency in the markets; and its efforts to offer greater chances to access financial credit for small and medium enterprises.

The degree to which a national economy is considered to be "open" – that is, the degree to which it encourages international trade – is also a relevant point, in that innovative firms often tend to export their products. Furthermore, we must also keep the availability of national resources in mind.

Another relevant point for knowledge intensive, innovative businesses is the availability of a skilled workforce able to support all phases of the innovative process, be it the marketing, organisational, technological or product innovation phase. Industries involving sophisticated technologies and/or a high degree of R&D costs particularly benefit from the presence of a highly skilled and educated workforce, which, for these industries, is essentially an asset for innovation. Generally, this workforce derives from the universities of any given country. However, immigration is another means by which a country might cultivate a highly skilled workforce. Sometimes this is even more preferable than an indigenous workforce, as the arrival of highly skilled young professionals from different backgrounds often brings new ways of thinking and different types of knowledge that might not yet exist in their adopted country. For example, it has been demonstrated that in the U.S. skilled immigrants and foreign students have contributed greatly to developing new technologies[31].

Another relevant point regarding environmental conditions contributing to innovation relates to the structure of the environment itself. It has been demonstrated that a systemic environment positively contributes to the fostering of industrial innovation. Such environments generally facilitate relationships between all actors involved in the process: the firm, the suppliers of knowledge (universities, research centres, etc.), policy makers, financing bodies, etc. This has been dubbed the "system of innovation".

Systems of innovation are composed of many elements and interactions amongst them, working to produce and diffuse economically viable knowledge. Knowledge is considered the most fundamental resource of the contemporary economy and it logically follows that interactive learning is one of the most important processes. In the process of innovation we find creativity, initiative and the influence of institutions all reflected. To ultimate goal of this process is to uncover and exploit, in a systematic way, new business opportunities. Moreover, systematic innovation introduces new knowledge to the economy and society at large. It has been shown that the "national innovative capacity" directly impacts the economic health of a country[32]. This capacity

30) The document is available online at: http://www.oecd.org/science/inno/39374789.pdf (Link visited May 2016).

31) These results have been shown by Chelleraj et al. (2006)

32) This capacity is analysed by Porter and Stern (2001)

is the potential of a country (as both, a political and economic entity) to "produce a stream of commercially relevant innovations" (p. 29). Of particular relevance to this capacity is the infrastructure and the environment a country provides for innovation. From this perspective, the sum of all resources (both human and financial) devoted by a country to advances in the fields of science and technology, as well as its national policies, are considered to be the "national innovation infrastructure".

A solid, functioning national system encompasses disparate scientific elements and relationships located within its own borders and places them in the service of diffusing and exploiting "economically useful knowledge", which we've previously defined as the most valuable good in the modern economy. Indeed, knowledge is the basis for technological progress and innovation, which themselves are the basis of economic growth. From this perspective, the processes of learning, developing new techniques, adapting to new forms of organisation, discovering new materials and finally inventing new products are perpetually present and ongoing. Moreover, innovation is a cumulative process as it strives to continually build upon past innovations. Thus, the institutional arrangements, innovation-related infrastructure and the underlying systems of production are to be considered the fundamentals of any national system of innovation[33].

The factors contributing to a greater likelihood of success in certain nations relative to others has been studied by Porter (1990), who synthesised his analysis of the topic in the "Diamond of National Advantage" model, shown in figure 4. A productive national environment where companies, businesses and firms are born and learn to compete is determined by four unique attributes. These, according to Porter, are:

- Factor conditions. This refers to the position of a nation in terms of productive factors: skilled labour, infrastructures, etc. In other words: what is needed to compete in a specific industry.
- Demand conditions. This is the internal market demand for the specific product or service offered by any given firm.
- Related and supporting industries. This point is related to the value chain, that is, whether certain industries, or related ones, are present or not in the national context, and if they are internationally competitive.
- Firm strategy, structure, and rivalry. This point is related to the conditions, at the national level, that govern the creation, organisation and management of companies, as well as the structures of market rivalry.

33) A wide introduction to National Innovation Systems is the homonymous OECD document, available online at: http://www.oecd.org/science/inno/2101733.pdf (Link visited May 2016)

These four attributes all influence one another, with the effect of one impacting the effect of another, as shown by the arrows in figure 4. In particular, the effect of domestic rivalry on stimulating the improvement of the specialised factors and promoting the formation of related and supporting industries is quite strong. Also, geographic concentration is significant in that it enhances competition and thus stimulates the development of new products in any given industry. Finally it is important to note that this system is conducive to an environment which encourages several clusters of competitive industries.

We can conclude from this arrangement that innovation systems can be rooted in more narrow contexts – such as regions – and industrial clusters in conjunction with public policies that promote innovation and give rise to "regional innovation systems". In regional innovation systems, firms are encouraged to both collaborate and compete. However, within such a system lurks yet another set of problems related to the specific environment of innovation[34].

Regional systems of innovation present peculiarities related to fact that, when compared to national systems of innovation, they are established in a narrower context. In particular, the birth of "region states" in the early 1990s – along with the crisis of Fordism and the downsizing of corporate structures -- has given rise to more spatially efficient systems, and therefore systems of innovation limited to a region rather than a nation. The literature regarding the evolution from Fordism to post-Fordism addresses the issues regarding the impact of regional development policies on technology. In short, the growth of new relationships in geographically distinct areas, together with supporting infrastructure, has generated an abundance of clusters. It now appears clear that the combination of such clusters combined with public policies that have supported and promoted innovation ultimately have given rise to a sort of "region-state", a powerful phenomenon attracting resources from inside and outside its borders. In such region-states, firms are set in a context that promotes both collaboration for innovation and competition for commercial success.

Finally, an innovation system can be rooted in a specific technological sector or industry, giving rise to what is defined as the "Sectoral System of Innovation"[35].

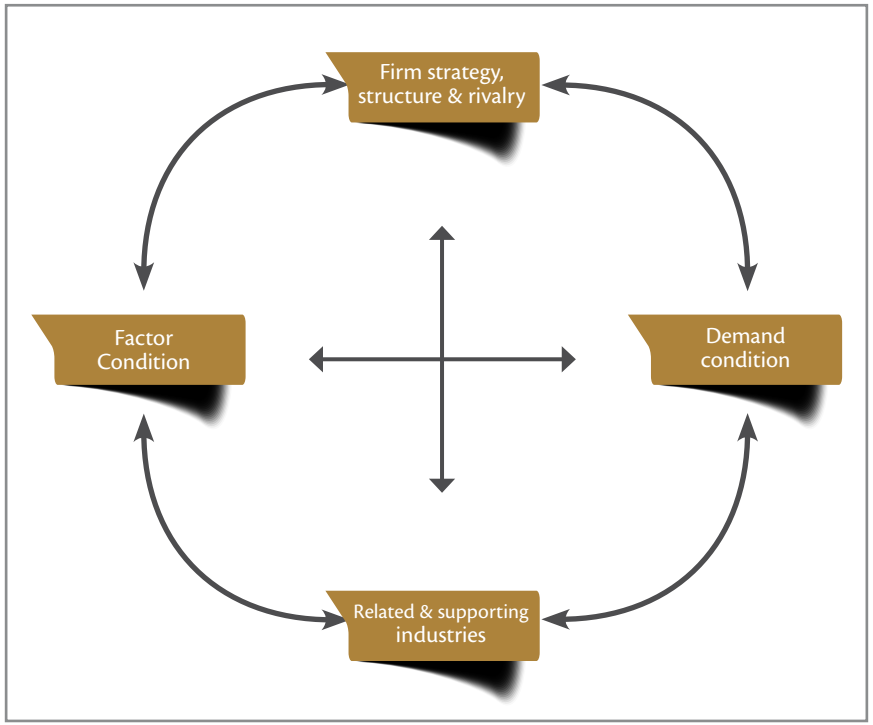
What is relevant here, and what we want to point out, is the fact that innovation is fostered by a systemic environmental outlook, such as that provided by relevant theorists, where the various parts of the system, each playing their own role, interact in a way that works towards a common goal: industrial innovation through knowledge.

34) Regional systems of innovation have been described by Braczyk et al. (1998)

35) Sectoral systems of innovation have been described by Malerba (2002)

Firms, governments and policy makers, public and private research, banks and financing bodies, customers, etc., all can be part of a system that fosters innovation and growth. However, it is important to remember that these theories are nothing but tools that help us understand our present reality, describe it, and prepare more wisely for the future.

Figure 4 – The structure of the Porter's diamond of national advantage



2.3 INNOVATIVE TEAM MANAGEMENT

In order for a firm to innovate, suitable internal organisation is necessary. As we have already discussed with regard to startups, problems often arise due to a lack of sufficient managerial abilities in the new company's team. The present section, being focused on how to best organise a firm for innovation, will address several ways to avoid this problem. We must also remember that organising the structure of a firm for innovative purposes is an innovative action in itself, that is, an example of organisational innovation

To preface our discussion of organisational models and models that can incentivize innovation within a firm, we should point out a relevant approach: the "knowledge-based firm theory"[36]. Knowledge, as previously discussed, is characterised by: 1.) its transferability; 2.) its potential for accumulation (adding new knowledge to pre-existing knowledge); 3.) its appropriability (the ability of its intellectual owner to benefit from its usage); 4.) its specialisation, deriving from the natural limits of human brain; and 5.) its critical role in production. This theory assumes that the acquisition and storage of knowledge, and its subsequent usage in production, generates positive effects. To this end, it is important that individuals' specialised knowledge is integrated through appropriate mechanisms, via an organisational structure where interdependence is of the utmost importance. The mechanisms that can be used to attain this include:

- Rules and directives (as social instruments to facilitate human interactions);
- Sequencing (organising production activities in a time-patterned sequence, where the input of each specialist is independent);
- Routines (intended as the ability to support interaction between individuals where rules or directives are not present);
- Group problem solving and decision making.

In addition to these mechanisms which can complement internal knowledge and facilitate the exchange thereof, there is also need for common knowledge in the firm, which is to say elements of knowledge common to all of its members. It is also important to note that most of a firm's knowledge can be considered as tacit knowledge[37]. Tacit knowledge, as opposed to explicit knowledge, is a type of

36) In particular the work that started the discussion on the topic (and that we are citing here) is the work of Grant (2006)

37)"Tacit knowledge" was first discussed by Polany (1966), who wrote in his book "we can know more than we can tell".

knowledge that a person might possess, but which is difficult to transfer by means of words or writing. Often people are not even aware of the tacit knowledge they possess until they are challenged by a situation to use or explicate it.

That said, the idea of the firm as an institution that is based on knowledge has two important aspects we must consider.

The first one is the role of hierarchy in the firm. Production, and decisions about production, necessitates several types of knowledge. In order to craft a product that meets the prevailing needs and tastes of consumers, firms require information from the market. Moreover, it will require highly specific information from the technical personnel involved in the different stages of production regarding how to best manufacture it. If decisions are taken at only the level of management, it will be to the exclusion of other employees. However, managers possess only a fraction of the knowledge that their subordinates possess, and so decision making cannot be strictly confined to management. Thus, it is imperative to implement a mechanism designed to facilitate knowledge flows and the firm should craft internal policies and directives with this aim in mind.

From this concept we can discern appropriate conclusions regarding the allocation of decision-making authority. If knowledge is the fundamental asset of the firm and it is distributed amongst the employees at all levels, they should be allowed some power in making the decisions that are relevant to the knowledge they possess. Although decision-making authority ultimately resides in the owner and/or the board of directors, knowledge-based firms do allow for some sort of delegation.

Further scholarly studies also underscore the importance of "organisational learning" in creating an innovative environment within a team. Organisational learning in this regard is deemed to be the change in the knowledge of an organisation that occurs as a function of its experience. Under the umbrella term of "knowledge" we can include both facts ("descriptive knowledge") and skills and routines ("procedural knowledge"). This, in turn, can be measured in the ability of the environment ("the team") to adapt and enhance their practices and performance.

From a strategic point of view, different paths can be taken by a team of a firm which is aimed at innovation. Essentially, there are two different paths rooted in two different dynamics: exploitation and exploration[38]. A pertinent point related to the historical trajectory of industries must be noted prior to describing these patterns. Most industries follow a lifecycle patter which goes from birth to growth to degeneration.

38) The debate on the patterns of exploitation and exploration in firm organisation is investigated by Roberts (2004).

Thus, firms entrenched in any given industry also follow this lifecycle pattern. It they wish to survive, firms must be able to expand, adapt, enter new markets or even create new markets. These goals can be achieved either be exploitation or exploration or a combination thereof. However, these two paths each provide for different internal organisational patterns.

Exploitation is best described as an attempt to achieve maximal performance within the bounds of the current strategy. Thus, the structure of an organisation (e.g. its personnel, culture, routines, etc.) must facilitate a particular focus and the execution of present operations. It is also important to have strong incentives, based on performance measurements (measuring not immediate outcomes but rather innovative performance), and to meet the needs of the customers. In this regard, the current strategy, both in terms of production and marketing, must be refined. The design of the organisation must facilitate a precise focus (e.g. choosing activities that are foreseen to create the most innovative value) and the execution of the established routines in the service of that focus. However, this is not a one-off action. The focus must constantly be recalibrated in order to stay afloat. It might also be necessary to implement a system of incentives based on quantitative evaluations to complement the propose system of qualitative evaluations in order to maintain balance.

Generally speaking, exploitation primarily allows for incremental innovation. Truly radical innovations, however, are usually the product of exploration, as it involves seeking out new opportunities for innovation outside the current paradigm. Exploration, though, is also much more uncertain due to the difficulty in assessing the outcome of a project or the value it will possess. In this regard, radical innovation is primarily dependent on resources allocated to uses that bear very little relevance – if any at all – to the current strategy.

There are several cases of companies that have been successful in exploration. Typically, these companies were organised in a manner appropriate to exploration. As an example of this organisational structure, one company established several autonomous R&D units that acted independently of one another but also engaged in a high degree of communication[39]. Moreover, a fraction of the researchers' workload was devoted to projects of their own choosing, instead of assigned ones. The company set an objective for the revenues derived from the new product and allocated awards to the most highly performing scientists. These were not necessarily monetary rewards but did boost the pride employees took in their company.

39) The discussion in Roberts (2004) is for instance based on the case of 3M

Most firms, however, are organised for the purpose of "multi-tasking", simultaneously engaging in exploration and exploitation. The diversity of activities engaged in by these companies helps them to minimize risks, but is also much more difficult to achieve. Employees must be highly incentivized to allocate their time to multiple, often quite disparate tasks. Another means by which this dual structure can be achieved is through a division of labour: allocating exploratory activities to part of the personnel and explorative activities to the other part, in an effort to avoid conflicts. However, conflicts may still arise inside or between these groups as they compete for resources, monetary and human. This competition itself might prove to be costly.

Managing the problems inherent in an organisation seeking to explore and exploit simultaneously is deemed the issue "ambidexterity". Research on ambidexterity has highlighted several points that should be carefully taken in account when organising for innovation. These different issues, of course, are dependent on the unique nature and context of the firm itself. However, it is our belief that describing them can help entrepreneurs discern the best solution for their own specific case[40].

What we've briefly introduced above is descriptive of the "differentiation vs. integration" problem. In some cases, specific structures help workers alternate between exploitation (more bureaucratically structured and routine tasks) and exploration (non-routine, novel tasks). Research has shown that integration and differentiation are a complementary rather than mutually exclusive means of organisation meant to achieve maximum efficiency. However, they must be carefully balanced with regard to the company's specific context.

Another issue we must address is the "individual vs. organisation" problem. At what level should ambidexterity be organised? Firm wide? Within the business unit? On an individual basis? There are examples of business units carrying out two distinct functions with two different teams. Even a single team can delegate different functions to its members. According to several studies, ambidexterity is an issue directly relative to the personal qualities of the personnel; that is, each member should be able to engage in different forms of innovation. The problem is more critical at the level of management, who often must oversee the different types of activities delegated to their subordinates. Again, this is dependent on an admixture of personal qualities and the surrounding environment. Finally, research has demonstrated two other conditions requisite for ambidexterity which are relevant to the innovative firm. First, ambidexterity must be overseen in a dynamic manner, always seeking the best structural arrangements to meet the needs of the project. Moreover, it may also arise from sequential or simultaneous attention to both modes of organisation. Secondly, ambidexterity is contingent upon the ability of the firm to integrate knowledge obtained from external sources with its pre-existing base of internal knowledge.

40) We mainly refer here to the work of Raisch et al. (2009).

The issue pertaining to organising for exploitation and/or exploration does not only relate to established firms. Small, fledgling firms (including startups and spinoffs) will also face this dilemma, typically the moment they depart from the "single product" stage and venture further into the market.

Another relevant point regards the commitment of top management to the goal of innovation[41]. A technological orientation of CEOs and top managers within established industry incumbents (typically large, leading firms) generally has a beneficial effect on R&D intensity. Following from this, it would be a wise move to devise a strategy for procuring, hiring and promoting top managers with technological experience. Moreover, the provision of a technological education for pre-existing top management might also be a means of incentivizing R&D intensity and promoting innovation.

Most of these issues are related to the issue of arranging a firm's structures for innovation[42]. It is important to remember that for every type of innovation, there is a best-suited organisational structure. Within the context of this work, it might be appropriate to briefly describe some of these structures in order to offer some practical insight. Some of these structures are better adapted to maintaining the status quo of existing operations, whilst others are more apt to catalyze radical innovations.

The first figure we shall consider is what are called "intrapreneurs" (not to be confused with entrepreneurs). Intrapreneuship refers to the phenomenon of individuals who – within the firm – act as "promoters" of their own innovation. Such persons – partly technical researcher, partly marketer – negotiate within their company for the financing and marketing of their innovation, typically by means of an informal, internal process. However, such figures may be challenging to integrate into a business. They require an engaging, stimulating environment, from which they emerge via a process of self-selection, integrating technology, novel operations and a unique vision. Several large companies in the U.S. have greatly benefited from the presence of "intrapreneurs".

The presence of "skunkworks units" in a company provides yet another way to innovate. These are researchers (or groups of researchers) who privately and surreptitiously develop innovative projects while off the clock and without official approval. It might be wise for companies to intentionally encourage such small,

41) We refer mainly to the work of Daellenbach et al. (2002)

42) The topic is discussed in Dussauge et al.(1992)

autonomous research units (even outside the company itself) to develop specific, innovative ideas. By nature, these groups are often temporary and are dismantled once their goal is accomplished (such as the development of a new technology and the realisation of an innovation).

Another organisational structure which can help firms engage in innovation is the "matrix structure". This structure combines an organisation structured by internal functions with an organisation structured via production. Thus, every worker in this framework must report to two distinct figures. For example, an R&D employee must report to (and collaborate with) the technical supervisor of their research activities as well as a production manager with whom they must discuss budgeting and strategic concerns. A positive effect of this structure is it helps to eliminate the previously described dilemma of differentiation and integration. In spite of this, the matrix structure is also prone to exacerbate conflicts between the two structural axes, possibly even leading to personal conflicts. However, in the absence of such conflicts, it does serve to enhance internal integration.

Independent business units might also be established when a business engages in even more radical innovation, departing from its established operations. Such units have a unique identity, follow their own strategy and are structured in a highly specific manner. Though they generally are granted access to the firm's resources, they are often established in order to sidestep internal bureaucracy and red tape. Such units might seem attractive due the benefits they confer; however, they also are risky in terms of expenses and their inherent power to disrupt the operations of the company as a whole.

Finally, a powerful instrument for fostering radical innovation is the creation of "new venture departments". Such departments are usually found within the highest tiers of a corporation and are isolated from all other structures, including production and R&D. Their mission is primarily the identification, creation and commercialisation of new products. Such departments typically fund internal projects, seek out joint ventures with other firms, invest in startups as venture capitalists, and brainstorm spinoff possibilities. Generally, these departments benefit from a high degree of autonomy.

Concluding, this section has briefly discussed models of organisation relevant to firms seeking to engage in innovation. At our disposal, we have new venture departments, matrix models, the encouragement of intrepreneurship and several others. As always, we must remind the reader that there is no one-size-fits-all approach, and every solution must be custom tailored to the specific context a firm.

2.4 INNOVATION AND FINANCIAL RESOURCES

The relationship between industrial innovation and financial resources is quite strong, as one might logically assume. In fact, short-term and long-term financing of innovative activities is as essential to the progress of innovation as petrol is in order to propel an automobile. It logically follows, then, that a lack of financing can severely impede the innovative pursuits of an entrepreneur. This is especially true in cases of technological innovations which involve a high degree of risk and are exceedingly costly in their initial phases.

The first relevant point we must take into account when discussing the relationship between innovation and financing is innovation's inherently uncertain nature, particularly with regard to technological innovative change[43]. Previously in this work, we discussed the nature of uncertainty as well as its implications. Here it must be pointed out that this uncertainty strongly impacts all economic actors involved in the innovative process, not the least of which are the financial actors. However, Schumpeter did point out the importance of investments for innovation, and this is an issue that should not be casually avoided.

Thus, we can easily imagine the importance of accessing credit for firms both big and small wishing to engage in innovative activities. The firms stand on one side of the "financial fence". On the other side stand banks and financial institutions, which traditionally are profit maximizing. Thus, the problems for the financing of innovative activities arise from the gap between uncertainty and risk on one side and the need to maximize profits on the other. This gap may often result in less than desirable effects. Let us consider its impact on small businesses (such as startups) who are apt to be confronted with harsh market conditions and ruthless market Darwinism which might select against them for reasons related to a lack of financing, rather than reasons directly related to its innovative product or management.

We should also consider that not every firm or business requires the same kind of financing. Firms of different dimensions, as well as different industries, necessitate different types of economic support. A recent report by the UN-ECE addresses the topic of finance acquisition during the early stages of innovation, examining all involved issues[44]. According to this report, many traditional financing sources are

43) We mainly refer here to the work of Mazzucato (2013)

44) The document is more specifically addressed to the European case, but its contents can be generalised. The document is available at: http://www.unece.org/fileadmin/DAM/ceci/publications/fid2.pdf (link visited May 2016).

not appropriate for supporting innovative enterprises and businesses in their early phases. This is often due to the fact that such businesses are not (yet) commercially successful and thus their cash flow is still in the negative. (To complicate this, they also possess a high probability of failure.) The initial phases of a company can be divided into the seed, startup, early-growth and expansion phases. Quite often, and due to a lack of other recourses, businesses in their seed and startup stages look to the so-called "4 F's" for funding: founders, families, friends and fools. This group is composed mostly of the entrepreneur's closest entourage and social circle, as well as high risk investors who firmly believe in the business's idea.

Figure 5 and table 5 present the stages of development of an innovative firm, along with the financing sources appropriate to each phase. In addition, they illustrate the directionality of cash flows throughout these phases. We should also point out a very specific phase presented in this graph: the "Death Valley" of enterprises. In this stage, the cash flow is typically in the negative due to an imbalance between product development, which can be costly, and the lack of commercialisation. This is the phase in during which firms fail regardless of the quality of their product and management. The length and depth of "Death Valley" fluctuates contingent upon the particular industry of the firm and on its needs for R&D and product development.

As previously stated, not all traditional financing sources are suitable for innovative firms and businesses. In fact, such firms, especially in their early stages, require forms of financing that do not require a guarantee of full repayment. Here, they should turn to prospective inventors with a mentality that is distinct from that of profit-maximizing banks and investors.

The general approach of such an investor is typically the "portfolio" approach. By this, we mean the investor ideally has established a large enough and diverse enough portfolio of investments that if one should fail, they can still support themselves through their other investments. In other words, gains made off of "winning" startups (those who have escaped Death Valley) can be used to counterbalance any losses from non-successful startups. The selection of businesses to be invested in – and thus inserted into the "portfolio" – quite often depends on the instincts and orientation of the particular financial institution or the subjective intuition of the financier.

Also highlighted in figure 5 are different forms of financing – besides the "4Fs" – that innovative businesses can turn to at different points in their lifecycles. The first ones are merit-based awards and grants. This form of financing depends mainly on public policy as it is often government-funded. Indeed, such grants are usually allocated by public bodies and/or national organisations, such as national entrepreneur associations. (In this group we can also include the previously discussed "incubators" and "business parks".)

"Business angels" are often the first form of portfolio investors a firm may encounter early on in its development. Business angels are typically individuals with a high degree of discretionary funds who make equity investments in fledgling yet commercially-promising businesses. Moreover, they personally provide their own managerial expertise to the neophyte entrepreneur. Most business angels are highly skilled managers or former entrepreneurs themselves who, earlier, had founded and/or led their own firms, and, through the success of those firms, secured their own capital. Due to the risky nature of the investment, business angels generally invest only limited amounts of money, which is to say, what they can afford to lose.

Once a firm has begun to grow, the initial investments provided by a business angel may no longer be sufficient to support further expansion. This is the point at which a firm often will look towards venture capital. Venture capital, broadly defined, is a form of private equity capital which is invested in a young business which has demonstrated promise. Venture capitalists are businesses which invest in other businesses, always employing a "portfolio" strategy when doing so.

In order to secure the support of venture capital and venture capitalists, a business should be emerging from Death Valley or even beginning to generate profits. At this point business angels will have begun to recoup their investments and entrepreneurs will have begun to reap the rewards of their efforts. Finally, when venture capitalists begin to see returns on their investment, a business should then be ready to obtain its first loan from a traditional financial institution such as a bank.

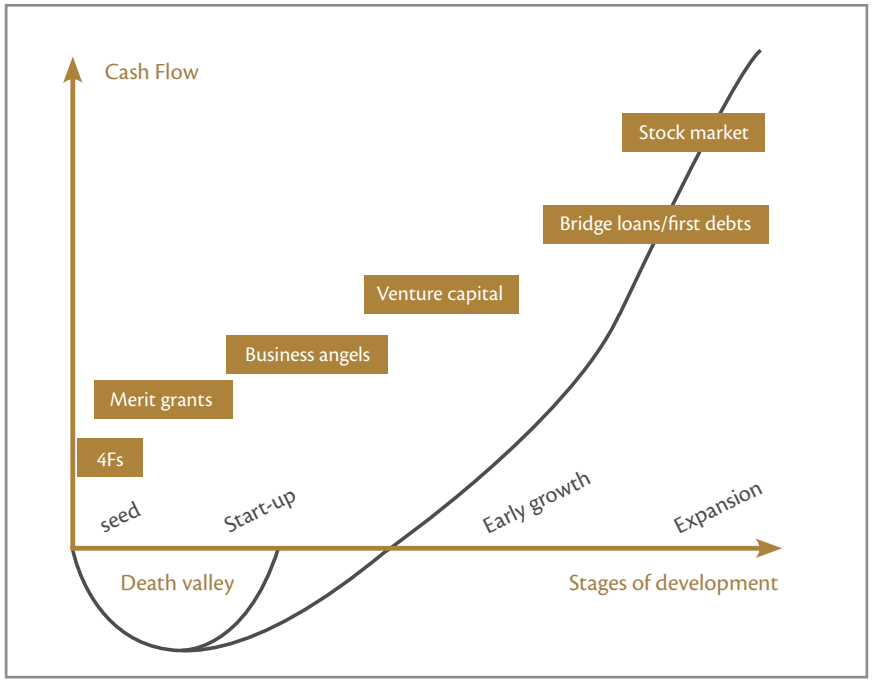
Thereafter a business will enter a stage of true maturity and be prepared to enter the stock market. The firm's owners can decide the best course of action at this point: to sell off all stocks or retain a percentage of them.

Obviously, this is only a rough sketch of the financing process and only briefly describes a few of the tools at the disposal of an entrepreneur seeking to necessary funds to engage in innovative work. Thus, this should be taken merely as an introduction to the topic, after which the reader can dig deeper within the relevant literature.

Table 5 – Development stages of an innovative business, its cash flow and its forms of financing

STAGE	FINANCING	CASH FLOW
Seed	4F (founders, family, friends,"fools"); Initial grants	_
Startup	4F's; Grants; Business angels	_ _
Early growth	Business angels; Venture capitals	+
Expansion	Venture capitals; then Loans; possibly Stock market	+ or ++

Figure 5 – Development stages of an innovative business, its cash flow and its forms of financing



2.5 INNOVATION BETWEEN COMPETITION AND COOPERATION

Cooperation between firms involved in innovative activities is a subject often dealt with in economic and organisational studies, either by expanding upon existing theoretical approaches or by presenting case studies of specific collaborations

In general, studies confirm that cooperation positively impacts innovation and as a consequence, the performance of firms working in the realm of innovation. In short, by establishing relationships with external partners, even those that might appear at first glance to be competitors, positive outcomes tend to be stimulated.

As a corollary, it has been demonstrated that an excess of competition can be detrimental to innovative progress. As evidence, a study on a sample of firms revealed that competition and innovation follow an "inverted-U-shaped" curve[45]. That is, very low but also very high levels of competition result in low innovation (measured by the frequency of patenting activity). From this, we can conclude that an average level of competition is optimal for innovation.

Indeed, cooperation and competition may manifest themselves in a variety of forms and be explicated in several different ways. Common knowledge dictates that complex R&D projects aimed at innovation have dimensions of such a scale that a single firm cannot handle them by itself. This challenge facilitates the establishment of strategic alliances with the aim of coordinating and realising such projects in a way that is mutually beneficial to all parties involved.

Here, it is appropriate to cite examples of strategic cooperation between industrial groups that have led to either radical or incremental innovation. Before doing so, it is necessary to reiterate that innovation can represent extravagant costs, even for large industrial actors. Thus, it is common for businesses of all sizes to engage in strategic cooperation in order to best perform their respective innovative activities.

This holds true particularly in high-tech industries where innovation often comes with a much higher price tag. A poignant example pertains to television recording devices in the 1970s and early 1980s. The dominant market position achieved by the VHS system was obtained through the commercial collaboration of several leading electronics firms. In the automobile manufacturing industry, where costs incurred in the process of incremental innovation – such devising new engine configurations or novel, modern and safer frames – can be exceedingly expensive, it is common for

45) The behaviour is described by Kang & Kang (2010)

various manufacturers to work together, share the costs and develop joint projects which might then be exploited by all involved parties.

It is sometimes the case that firms dedicate a large percentage of their R&D budget to these strategic alliances, spending only a small fraction on its own internal R&D. Moreover, given the magnitude of the impact of such alliances, not only on the firms involved but also the regional and national economies, oftentimes governments offer incentives to support collaboration and cooperation between competing firms

As is always the case, there is also downside with regard to the innovative ability of firm as a result of such alliances. In short, the potential exists for cooperation agreements to fail. This might happen more often where direct competitors are involved in the alliance. Thus, this arrangement whereby the performance of R&D involves both cooperation and competition has given rise to a new term: "coopetition"[46]. Coopetition can most readily be discerned in the resource-based view of organisation, as well as in social networking. Here, it is appropriate to ask: What happens when a firm lacks enough internal resources to engage in innovation? The simplest answer is that they must defer to external yet complementary resources. We've previously discussed one means of accessing external resources: technology transfer, involving public research centres and universities. We shall now present another possible route businesses can take. This is the path of cooperating with other firms and businesses. Direct competitors, quite naturally, possess the highest probability of possessing or being able to develop a technology that is useful for the firm under consideration. Thus direct competitors might be best option when considering a possible innovative cooperation.

As mentioned, deferring to direct competitors is not without its drawbacks. This drawback can be discerned in a situation where the competing firm might discover their own need to exploit the mutually developed innovation or technology in order stay competitive in the market themselves. In doing so, they may use the innovation in a way that allows them to outmaneuver the firm that had initially sought the cooperation. Thus, before in engaging in coopetition, the costs and benefits must be carefully weighed.

Empirical studies have highlighted the importance of balanced coopetition on the innovative performance of a firm[47]. Moreover, these studies have demonstrated the relevance of experience when engaging in coopetition. In fact, experience with the activity of coopetition plays an important role in the innovative capacity of the firm, and aids in realising greater benefits deriving from its innovation. Moreover, the same study also highlights the importance that coopetition experience has for the firm's ability to engage in further coopetition projects. That is, firms possessing a greater degree of experience in coopetition are, logically, better able to perform coopetition itself. These firms, due to their experience, are also able to better benefit the innovative process due to their refined skills in devising routines and practices which contribute to the enhanced management of coopetition activities.

Another relevant issue when discussing coopetition among firms working towards innovation is that of cooperation between larger and smaller firms. When considering this sort of arrangement, it is important to consider whether the advantages are greater for the former or the latter (smaller firms or larger firms). Relevant literature on the matter has so far demonstrated no disadvantages for smaller firms when taking into account market and technological constraints, as well as differences in scale between the firms. There are key differences between large and small firms, differences that may work to the smaller firm's advantage within the context of coopetition. Indeed, large firms, due to their complex structure, breadth of personnel and abundance of resources, may have an easier time engaging in innovation when compared to smaller firms. Employees in larger firms dealing with innovation are not obligated to perform the duties of their counterparts in other departments (e.g. marketing, production, etc.), whereas in smaller firms, employees typically must take on multiple roles. However, due to this division of labour in larger firms, employees dealing with innovation oftentimes have weak relationships with employees working in other departments. Because of the overlap found in smaller firms, they may have something to offer the larger firm in this regard. (Moreover, in some extreme cases regarding smaller firms, the entrepreneur assumes several key roles within the company.)

Most literature regarding the topic of coopetition focuses on high-tech sectors. These sectors are typically characterised by a convergence of different technologies, short product lifecycles and, more importantly, high R&D costs. Thus, strategic alliances can have a profound impact on innovation. Moreover, these markets are often oligopolistic. However, such alliances can serve to foster competition in marketing while also promoting collaboration in production so that their end products are compatible (e.g. any VHS cassette can be used with any VHS player/recorder regardless of who produced either). This compatibility is, naturally, a critical selling point for the products of all involved actors.

46) A relevant contribution on the topic is that of Rolfo (2015)

47) The study has been performed by Park et al.(2014)

Nevertheless, some empirical studies have demonstrated that, at least in some sectors, coopetition might be negatively correlated with radical technological innovation[48]. Thus, perhaps the type of innovation that primarily stands to benefit from coopetition is incremental innovation. However, the same studies do show a positive correlation between coopetition and the innovation of radical business models. In this regard, the coopetition does not give rise to technological innovation but rather organisational innovation. In its own way, this can confer a competitive advantage on the involved actors.

Other recent studies describe the managerial implications of technological coopetition[49]. In particular, one study demonstrates how different types of governance influence the rate of innovation produced by vertical coopetition in high-tech sectors. Here, we should note that repeated interactions within the context coopetition result in an increased level trust which in turn has positive effects on innovation.

Summing up, we would like to point out the importance of mechanisms that foster cooperation as well as competition amongst different businesses and firm, and their significance in generating innovation. In short, reaching out beyond the border of the firm may prove critical for the performance of innovation of every type, at every level.

48) We refer in particular to the study of Ritala & Sainio (2014).

49) We refer in particular to the work of Bouncken et al. (2016).

2.6 SOCIAL MEDIA AND INNOVATION

For the last decade, social media has been an ubiquitous global phenomenon, accessible to anyone, anywhere with an internet connection

According to ITU estimates in 2015, 3.2 billion people have access to the Internet[50]. Of this figure, 2 billion reside developing countries, while 89 million use the internet in the LDC (Least Developed Countries). Thus, as these figures show, the internet is phenomenon with global reach, affecting just about every geographic area and virtually every social environment. Thus, the use of the internet, and its attendant social media, may prove relevant for the creation and diffusion of innovation in a multitude of fields.

The first point we must address here relates to the chances for marketing innovation social media offers. An avalanche of research in recent years has attempted to study the techniques and effects "social media management"[51]. Social media management deals "with the operational issues, managerial challenges, and comparative advantages that ensue from the adoption and use of social media platforms for organizational functions such as marketing and sales, customer support, product innovation etc." (p. 1, cit.). The manifestations of social media are multitudinous; they include social networks (Facebook, Google+, Myspace, etc.), chat apps (Snapchat, WhatsApp, etc.), news sharing platforms (Twitter), image sharing platforms (Instagram, Imgur, etc.), discussion forums (Reddit.com), and video streaming services (Youtube, DailyMotion, etc.). All of these can be leveraged for the purposes of advertising in different ways, from using traditional video ads, as is often to case with YouTube, to using "guerilla marketing", as is often found on discussion forums.

As time goes on, social media is increasingly being exploited by firms and businesses for marketing purposes, due to its interactive nature and ability to turn the internet into a platform for engaging dialogue. By engaging with this form of media in an innovative way, companies are able to generate interest, awareness and value, as well as hire specialists in the field, thereby creating new departments within the firm.

However, there are indeed some challenges associated with social media. We must remember that social media is a round-the-clock, democratic and decentralised business, meaning it can be quite unwieldy and difficult to control, especially when compared to traditional media channels. For this reason, social media marketing

50) See: https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2015.pdf (link visited May 2016)

51) We mainly refer to the work of Tørning et al. (2015)

campaigns must be an ongoing, 24/7 affair. Moreover, the rate at which this form of media moves is immeasurably rapid. Here, seconds, even fractions of a second, matter. Another point that must be considered is that users of social media engage in a rapid "consumption of information" – and a lot of information at that. The implications here are clear: the competition for the attention and engagement of users can be quite intense.

Furthermore, this raises the question of "quality vs. quantity". Where firms used to focus on quantity, or rather, a high degree of saturation in their marketing, the emphasis now is turning towards quality, in order to compete with countless number of competitors. Quite often one piece of high quality web content, such as a viral video or "guerilla advertising campaign", can have a far greater impact than thousands of strategically place advertisements.

Another relevant point to note here is that, while social media is more directly measurable and testable than traditional media (e.g. the number of "clicks" on a link is a unique number), it is more difficult to measure in terms of its performance (i.e. the degree to which it has caused its desired intention, e.g. the purchase of a product or acquisition of a service). However, as technology advances and innovations continue, it is not beyond imagination that we will soon have designed adequate tests for this purpose.

The innovative use of social media for marketing has generated the insurgence of new professions, such as the "social media manager" who specialises in web analytics, consumer trends, digital marketing campaigns and representing the online persona of the company. The innovative social media manager works to create a sense of community amongst the firm's consumers, and, perhaps somewhat paradoxically, by digitally adding a human element to the company – a person (or team of people) able to listen and respond to its consumers' ideas, complaints and requests.

Besides being used to manage online marketing, social media can also be a relevant tool for fostering innovation. Recent studies have addressed the topic regarding the relationship between social media and innovation, with particular attention given to open innovation[52]. Seemingly, due to its interactive nature, social media offers up a wealth of opportunities for innovation to take place. This is due to its high degree of user participation, collaboration, sharing and interaction. In this way, social media offers up opportunities to incorporate customers and even employees into the innovative process. The feedback and data that can be provided by both groups, often in hitherto unprecedented quantities, can be exploited by the firm in order to innovate.

Demonstrative of this, a case study (see Mount and Garcia Martinez, cit.) reports that a company (producing sweets) utilised social media as a test-and-learn tool, using polls and competitions in order to extract consumer information, opinions and attitudes regarding its products. This data regarding product preferences was then combined with individual user personality profiles. Finally, this process concluded with the innovation of a new product that met the demands of the consumers as determined by a thorough analysis of social media data.

Lindegaart lists five key aspects of social media that support open innovation (p. 4, cit.). These aspects are:

1. Better interaction with customers, consumers and other partners;
2. Idea generation and feedback loops for the ideas that are being developed;
3. Business intelligence that helps you better understand your ecosystem
4. Identification of new people who can assist in your innovation efforts;
5. Branding, promotion and marketing of innovation outcomes as well as corporate innovation capabilities.

Lindegaart also lists three questions that any business person with access to social media should reflect on. These questions are (p. 5- 6, cit):

- How many important innovation partners do you have?
- What would happen if these partners were able to interact with each other? Could this bring value to your company?
- How can you make this happen?

These simple questions are intended to foster the curiosity of the entrepreneur and encourage them to proactively engage social media for purposes of innovation.

Although it is quite common to discern instances of open innovation occurring via social media, there are other forms of innovation it can accomplish. In fact, He

52) We refer in particular to the works of He and Wang (2015), Mount and Garcia Martinez (2014) and of Lindegaart (2012). This last work is available online at: http://15inno.contentrobotllc.netdna-cdn.com/wp-content/uploads/2012/08/Social-Media-for-Corporate-Innovators-and- Entrepreneurs.pdf (link visited May 2016)

and Wang (cit.) present a case study related to the use of social media for "closed" innovation. This study underscores the relevance of social media managers' (and their social media teams') level of expertise with regard to the creation of knowledge, and subsequently the performance of innovation via social media exploitation.

Finally, we should note that not only does social media present an opportunity to engage in innovative activities, social media itself can also be the innovative business, when approached with the appropriate knowledge, experience and expertise. Indeed, the last few years have seen an explosion of this type of business in the form of "social media marketing firms", which have been quite the innovation in and of themselves. These firms are involved with the gathering of consumer profiles, targeted marketing based on web and consumer analytics, branding, commercial popularisation, direct engagement with customers and consumers as well as a host of other activities. However, this is only the beginning with regard to social media innovation. The coming years will, inevitably, witness a variety of innovations and innovative firms springing up in relation to this new form of media.

In summation, social media stands in direct relation to entrepreneurial innovation both as an instrument for networking, collaboration and the dissemination of information and as a medium for the performance of innovative activities. Therefore, it is necessary that any entrepreneur be intimately familiar with social media, its potentialities and the new paths it is currently forging.

3

International Examples of the Impact of Innovation on the Success of Companies

INTERNATIONAL EXAMPLES OF THE IMPACT OF INNOVATION ON THE SUCCESS OF COMPANIES

This third and final chapter deals with the innovative features of a sampling of countries, chosen for their relevance at the global level. In particular, we will be examining the examples Canada, Sweden, South Korea, China, Germany and Japan. These countries were chosen due to either their high performance of innovation or because they demonstrate features that warrant our attention. Our hope here is that we may demonstrate how the innovative environment of a given country has beneficial effects on the performance of businesses, firms and companies and the performance of the country's economy as a whole.

Before assessing the case study of each country, we must set each one inside a more general framework. To accomplish this task, we shall analyse relevant data regarding national investments in R&D. Through such an analysis, we can better situate these countries within a generalised global context, especially with regard to innovative activities.

To aid us towards this end, we shall employ the use of several different graphs and figures. In each graph, the six different countries to be studied are analysed in relation two of the most relevant actors at the global level within the domains of science, technology, innovation, research and education: the United States of America and the United Kingdom.

All graphs are based on publically available data published by the OECD.

The first graph (figure 6) presents the values of GERD, that is, the Gross Expenditure in Research and Development, of each country. Though, at first glance, the graph appears to demonstrate significant disparities with regard to this value, it does not in fact represent a significant problem. It should be remembered that such disparities are largely contingent upon the dimensions of a country in terms of its population and geography, as well as its degree of industrialisation and several other factors.

More relevant to our purposes is the second graph (figure 7), where the GERD is compared in relation to the total Gross Domestic Product. Here the differences are less marked, but still exist, and better demonstrate the extent of the efforts these countries make towards increasing the quality and quantity of its R&D and, thereby, innovation. Indeed, there are other factors involved in the production of innovation; however, GERD compared to GDP is quite often considered to be the most important benchmark with regards to the innovative activity of a country.

Within this context it is also important to note the degree to which the private sector contributes to the national R&D effort. Towards this end, we shall assess the Business Expenditure in Research and Development, BERD, values for each country. Figures 8 and 9, respectively, report the absolute values of BERD and the fraction of the GERD the BERD represents. This is a good indicator of the intensity of the private sector's effort in contributing to R&D activities within their national contexts. In particular,

figure 9 reveals a significant variance within these values. The countries where the BERD/GERD ratio is the highest (within our sample) are the Asian ones (China, Japan and South Korea). In these three countries the BERD/GERD ratio is around 75%. Accordingly, these countries also have a reputation of being consistent producers of highly technological innovations.

Finally, the percentage of researchers within the national workforce is another indicator we must consider. Figure 10 expresses this proportion, demonstrating the number of researchers present per thousand full-time employees in each country. Here, we find the trend correlates quite closely with the GERD/GDP ratio. (We should also note that the salaries of research personnel are included in the GERD, which could account for this close correlation.) The only country which does not correlate so closely is China. However, in interpreting this data, we must remember that the population size of China is at least one order of a magnitude higher than the population sizes of the other countries included in our sample, and this could have a significant influence on the data presented.

Once placed in the appropriate context, the following sections will introduce and assess each case study in a brief yet comprehensive manner. A review of each country's innovation policies will give way to a relevant study of their particular innovative conditions and performances.

Figure 6 – Gross Expenditure in Research and Development

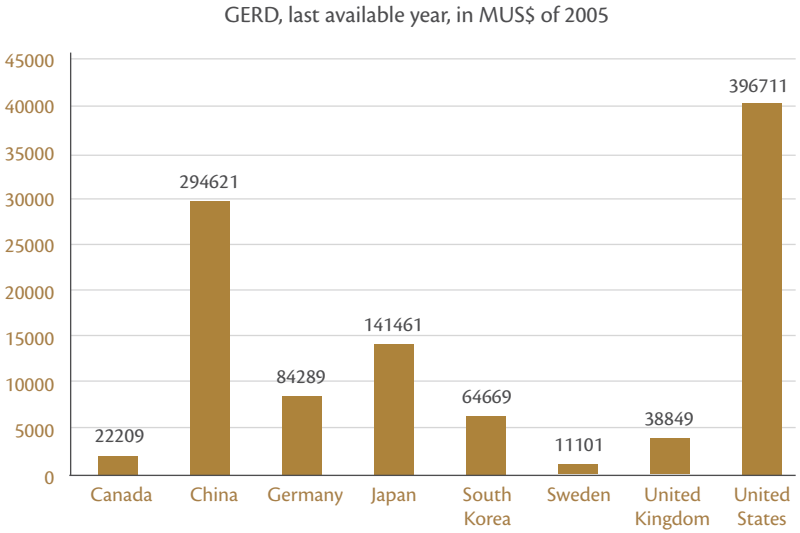


Figure 7 – GERD as fraction of GDP

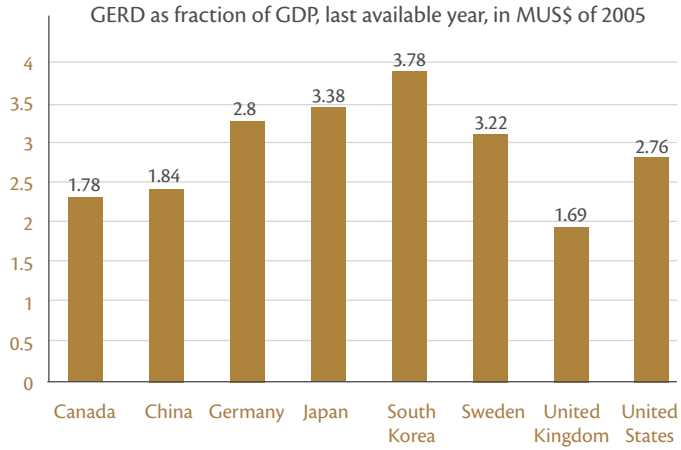


Figure 8 –– Business Expenditure in Research and Development

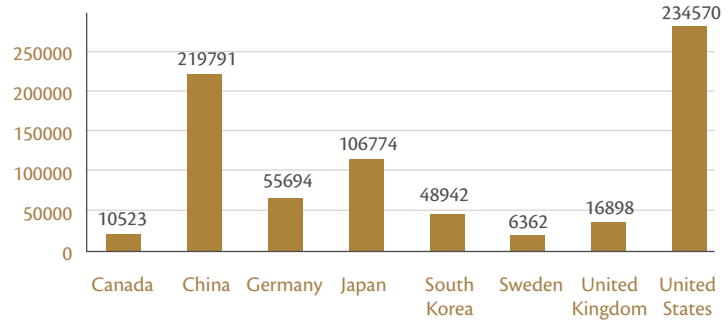


Figure 9 – Fraction of BERD over GERD

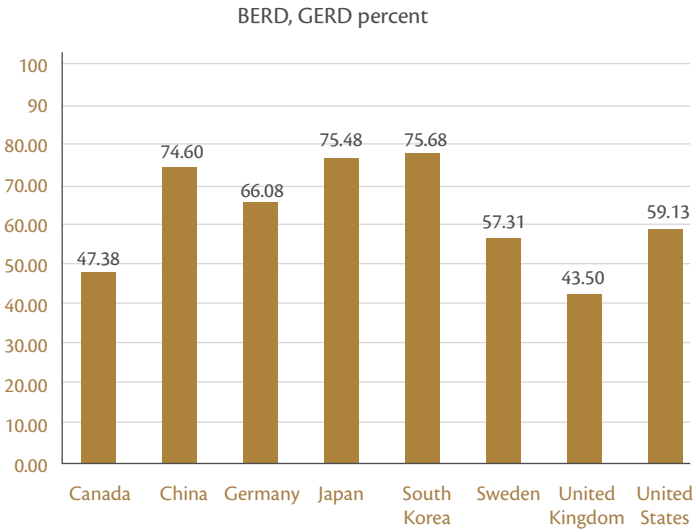


Figure 10– Researchers per Thousand Full Time employees

3.1 CANADA

Canada's systems of innovation are monitored and guided by the "Science, Technology and Innovation Council" (STIC), an independent advisory body. With the mandate of the Canadian government, the STIC helps craft policy related to science, technology and innovation. The STIC prepares a biennial, publically available report on the state of the country with regard to these topics. This report serves as a benchmark for Canada's innovative performance, and we shall thoroughly utilise it to demonstrate the most relevant features of Canada's innovate system[53].

Before proceeding, we should note that science, technology and innovation (ST&I) are perceived by Canadians as directly relevant to the well-being of their country and that ST&I have a profound impact on the economy of Canada.

Canada is a federal country, and both the federal and provincial governments are involved in the ST&I ecosystem. This arrangement must be taken into account when assessing the case of Canada. Funding for higher education institutions (universities, polytechnics and colleges) is, in fact, provided by both levels of government and, as one would expect, the direct costs of research are also supported by both levels (though direct funding and tax incentives).

The provincial and federal governments of Canada are also active within the realm of public policy as it pertains to ST&I, seeking to promote it where possible and mitigate any factors or conditions which might hinder its performance. The federal government itself even actively engages in R&D, especially in those sectors where private enterprise is less engaged.

Relevant to our discussion is the role played by the private innovative sector in Canada, thus we shall explicate it here with slightly more attention.

Canadian firms involved in the ICT and petroleum industries invest in innovation in a manner that far exceeds the national average, according to national statistics. We must also note that data reveals wide variation in R&D expenditures across different industries as well as a steady decrease in total national investments in R&D from the period of 2007 to 2015. However, some sectors demonstrated an increase in investments. These sectors include aerospace, wholesale trade and the petrol industry. In interpreting these facts, our attention should be drawn to the STIC, who attributes Canada's decrease in industrial performance directly to the decrease in R&D investments.

Another key point is related to the importance of investing in a highly skilled and talented workforce. As the STIC notes, "with the right knowledge and the right

53) The most recent version of the report is publicly available (in English) at the web address: http://www.stic-csti.ca/eic/site/stic-csti.nsf/eng/h_00083.html (Link visited May 2016)

skills, business leaders in Canada can have a better understanding of leading-edge technologies and business practice developments" (p 14, cit.). Moreover, Canadian firms which actively manage their performance of innovation outperform those who do not.

A final relevant point relates to the funding available to businesses for the purposes of innovation. Support for financing an "innovative environment" is provided by both the federal and provincial governments in Canada. Both levels of government are particularly active in supporting R&D programmes, especially in an indirect manner with the usage of tax incentives. Because of this, Canada has one of the highest indirect support-to-GDP ratios in the world. Venture capital is yet another key source of funding for innovative businesses in Canada.

3.2 SWEDEN

Firstly, when addressing the topic of innovation in Sweden, we must point out the high level of GERD in relation to its GDP within the European context. As the previous graphs demonstrated, the level of GERD is well above 3%, amongst the highest in Europe and the highest in the OECD area, according to the OECD itself[54]. The value is above (and ahead of) the target set by the European Union, which encourages a minimum of 3% of the GDP being comprised of GERD by the year 2020. However, we must also note that the level of research expenditure has begun to decline since the beginning of the 2000s. In any case, business expenditures represent more 70% of the total expenditure and the rate of enterprises engaging in innovative activities is relatively high. In addition to high rates of R&D investments, rates of venture capital investments in Sweden are amongst the highest in the OECD.

A relevant point regarding innovation in Sweden is the presence of VINNOVA, established in 2001 as the Swedish national agency for innovation. VINNOVA's purpose is twofold. Its first function resides in financing projects for research and innovation. Secondly, it provides structural support for researchers by building networks, organising meetings and performing analyses. Every year it invests nearly €300 million in nearly 2,400 different research and innovation projects. A little less than half goes to research universities and nearly 30% goes to private companies. A portion of the budge is dedicated to financing research and development projects, specifically those taking place within firms.

VINNOVA channels a significant portion of its budget into R&D programmes occurring in specific technological and industrial fields. Constant oversight of VINNOVA is maintained in order to identify the strengths and weaknesses of the activities it funds, thereby ensuring the maximum effect of its budget.

Indeed, national needs fluctuate throughout the course of time and VINNOVA is designed to shift its focus accordingly. At present, the key areas for its intervention include health and healthcare; transportation; environment; services; ICT; manufacturing; and innovation management.

The main initiatives of VINNOVA in recent years include "excellence centres" (VINN centres); the commercialisation of university research; setting up of strategic R&D programmes by partnering with key national industries; and the promotion of programmes developed to stimulate radical innovations within SMEs.

Here we should also consider an important piece of Swedish legislation which affects

54) The "OECD Science, Technology and Industry Outlook 2014" reports data on Sweden and on other countries discussed in this section, and can be found at the web address:

http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-outlook-2014_sti_outlook- 2014-en (link visited May 2016)

innovation, dubbed the "professor's privilege". Via the professor's privilege, Swedish law allows university professors to retain intellectual property rights to the research they have conducted while serving as state employees in the country's universities. Interestingly, only a portion of a Swedish professor's salary is funded by the state; the rest must be obtained through collaboration with external enterprises, VINNOVA projects, EU projects, etc. In this way, professors in the Swedish university system are incentivized to work with private enterprise. Such an arrangement helps facilitate technology transfer and the production of knowledge that can be put to commercial use, both of which foster innovation.

Also of relevance to innovation in Sweden is the presence of a highly skilled workforce. The proportion of PhD holders in the country is uniquely high, standing at nearly double the European average. The presence of such a workforce certainly plays a vital role in the production of innovation in all sectors of the Swedish economy.

3.3 SOUTH KOREA

South Korea is widely lauded for its sudden and dramatic rise from entrenched poverty to being one of the most important industrial counties in the world. The ascent began after South Korea's industrial system was virtually wiped out during the Korean War. Prior to the war, Korean firms possessed a strong imitation ability, mimicking the industries in other countries but rarely engaging in innovation. After the war, the government charted a new course. The government limited direct foreign investments, and instead chose to obtain loans from foreign banks and investors itself, which it then used to subsidise enterprises and businesses throughout the country. For several decades now it has followed what they term the "fast follower paradigm", consistently outperforming many of their peers throughout the region (and even throughout the world).

Several factors have contributed to the rapid rise of South Korea, including a highly skilled workforce as well as cultural and societal factors. In particular, we must consider the South Korean government's hard push for investments in human capital. Moreover, it actively encourages South Korean companies to compete on a global level, cultivating an economy heavily dependent on exports.

Today, in order to meet current challenges, South Korea has begun increasing its efforts to foster further innovation. This has created a litany of new issue that South Korea strives to contend with, often successfully[55]. At present, ICT is the main industry in South Korea, comprising nearly half of the country's businesses. In an attempt to diversify and strengthen their market position, and thus the national economy, the government has begun offering financial incentives for firms operating in other industries. The government also actively works towards creating an environment that encourages the establishment of technological startups. Governmental policy in South Korea provides for the strengthening of technological assistance, the acquisition of venture capital and the endowment of various subsidies.

The vast majority of scientific and technological research in South Korea is performed by public research institutions. These institutions supply the requisite technologies for industrial R&D and innovation. At present, the South Korean government continues to expand its financing of research in hopes that it will foster not only further applied research, but also target-free research that can later be exploited for more practical purposes. In this way, not only does the country grow its technological wealth, but also its accumulated wealth of knowledge.

In tandem with governmental and public support for research, there is also a high rate of private R&D investment in South Korea. As the previous graphs indicate, private

55) See OECD (2014) (cit.)

research expenditures account for over three quarters of total research expenditures. For this reason, South Korea ranks amongst the top five patenting countries in the world.

Our case study of South Korea would not be complete without looking at one last peculiar character of their industrial innovation system -- the highly visible presence of clusters which are fostered at the national level. Through public policy, the government has supported the creation of regional clusters based around specific industrial sectors and structured them as small "innovation systems". These clusters have played a vital role in the rapid growth of the South Korean economy.

3.4 GERMANY

Since the industrial revolution, Germany has been a key player in the fields of science, technology and innovation as well as leader in industrial production[56]. Despite having had its industrial infrastructure decimated during World War Two (as well as experiencing an extraordinary number of casualties), it thereafter experience a dramatic increase in its scientific and industrial capacities which led it to becoming the economic leader of Europe and one of the foremost industrial leaders of the world. This trend has continued into the present; while most countries have experienced a decline in GDP from 2007 onwards, Germany is one of the few exceptions (with South Korea being another notable one).

Regarding the state of R&D in German, we must first highlight the existence of several societies within the country devoted to the cultivation and promulgation of science. The societies wield enormous influence within Germany, due to their relatively large dimensions, intense rate of research and omnipresence within all fields of human endeavours, including science, technology, social sciences, humanities, etc.

In detail, these societies are:

• The Max Planck Society for the Advancement of Science. Established in 1911, it is formally independent and not-for-profit. It is funded by the Federal Government and primarily performs basic research.

• The Fraunhofer Society for the Advancement of Applied Research. Founded in 1973, it is responsible for applied research throughout its 60+ institutes.

• The Leibniz Association for Knowledge. This association is the result of a union between several research institutes from various fields, including humanities, economics and social sciences, life sciences, and natural and environmental sciences.

• The Helmholtz Association of German Research Centres. This association was formed as the result of 18 research centres in the fields of technology, science and of bio-medicine coming together for the common good.

Due to the abundance of public research organisations, Germany's government-funded R&D budget is amongst the few in the world that hasn't seen a decline. To the contrary, governmental provision of funds for R&D and innovation is one of Germany's top priorities. Recent data regarding the 2014 budget of the Germany's Federal Ministry of Education and Research reveals that over €300 million was allocated for the purposes of research and education. Due to this strong governmental support for science and innovation, Germany is consistently ranked amongst the top three destinations for foreign students seeking to study abroad.

56) See OECD (2014) (cit.)

Turning towards the topic of investments made in industrial innovation, we must first note that the intensity of BERD has remained constant over the last several years and has even slightly grown as a percentage of the GDP. It is perhaps for this reason that Germany has a very high rate of innovative firms. Data indicates that nearly 80% of German firms are considered to be innovative. Of this 80%, 15% are involved in organisational and/or marketing innovation only and a similar proportion perform product and/or process innovational only. The remainder of innovative firms are involved in the performance of all type of innovation. Also of note here is that foreign funding for BERD in Germany has significantly increased over the last several years.

To keep pace with international competition, Germany has implemented several policies and strategies aimed at supporting research and fostering innovation. These policies have also helped Germany to better integrate technology and the social sciences so that they may function in a manner that's complementary to one another.

These policies have included grants which were established in 2014 for business angels, aimed at generating further funding for innovative startups, especially in the form of venture capital. Germany's Academic Freedom Act encourages non-university academic institutions to more widely avail themselves of third-party, private funding. Through its technological strategies, implemented from 2006-2013, the German government has fostered research and innovation in the service of central national missions. Towards this end, it has identified the key technologies which support leading global markets; formalised its public policies across the various federal ministries, and established a host of "forward-looking projects". The "central missions" towards which these projects are addressed include health, nutrition, energy, climate change, mobility, communication and security.

On a final note, we must highlight the strong relationship between industry and scientific research in Germany, and that a high percentage of public research is financed by private enterprises. In recent years the government has undertaken further initiatives to embolden this cooperative relationship, which is critical to the innovation growth of the country.

3.5 JAPAN

Much like Germany, Japan has also experience rapid growth since its virtual destruction in World War Two. Despite incurring massive setbacks, not the least of which were due to the overwhelming devastation cause by two atomic bombs, today Japan is a top contender in the fields of science, technology, industrial production and innovation. Although this transmutation -- from literal ashes to a technological phoenix – initially began with mere industrial imitation, it has since evolved into a strategy of knowledge-based exploitation. To this end, Japan has cultivated an environment robustly supportive of R&D activities, focused on both target-free and applied research. Today, Japan ranks third in the World in terms of GDP (after the United States and China) and its GERD hovers around 3.3% of its GDP. Japan is thus set amongst the countries most committed to R&D.

Japan's unwavering commitment to research has resulted in its "Comprehensive Strategy on Science and Innovation". This strategy lays out a long-term vision, spanning the years from 2013 until 2030. It outlines a comprehensive roadmap and provides for intermediate targets along the way. In fact, it aims at designing the ideal Japanese society from a scientific, technological and innovative perspective. To this end, it formulates a set of policies aimed at problem solving while also recommending policies oriented towards a healthy and active society. All relevant stakeholders have been involved in the formulation of these policies and the appropriate roles have been divided and delegated between the government, public institutions and various other actors.

However, the Comprehensive Strategy on Science and Innovation is not Japan's only national policy aimed at the development of R&D, science and technology. The "New Growth Strategy" is another public policy which, among other goals, aims at providing career prospects for young researchers. It provides for the employment of all science and technology PhD holders, thereby aiming at the creation of more than four million jobs in the fields of life science and "green innovation" (which is to say, the development of environmentally friendly technologies).

Accord to this plan, the period of time from 2011 to 2016 is when the "4th Science and Technology Basic Plan" is meant to be developed and implemented. The main points of this plan focus on cultivating human resources as well as on the relationship between science and the needs of society. Indeed, these are not the only governmental policies of Japan which contribute to the flourishing of innovation; however, within the context of this work, we feel that they are the most important.

Within the context of the aforementioned governmental programmes, we must also note the significant relevance of business expenditures (BERD) in relation to public

expenditures. Japan's BERD is, in fact – and perhaps counter intuitively – significantly higher than public expenditure and thus composes the main proportion of the country's GERD. Moreover, while around 50% of public expenditure is devoted to applied research and experimental development, basic research receives only about 30%. The previously referenced programmes, in tandem with private funding, are designed to even out this disparity.

As one may imagine, Japan's industrial and business sectors represent some of the most R&D-intensive worldwide. The fields of science, technology and innovation are dominated by major Japanese corporations. Nevertheless, business R&D expenditure has not grown significantly in the last few years and may soon require an extra boost.

Finally, we must examine the state of technology transfer in Japan. Due to the high level and quantity of R&D in the private sector, firms (especially market-leading, large firms) rely increasingly less on contracted public research. Thus technology transfer deriving from public research is less developed, and the mobility of researchers between public and private sectors is less pronounced. The recent initiatives described here – as well as a host of others – are an attempt to correct this issue.

3.6 CHINA

Figures regarding industrial production, as well the growth of outcome-based scientific research, bear witness to the enormous leap forward China has taken in the last few decades. The success story of China, in this regard, depends much on its systems of innovation.

Before proceeding, there are several relevant facts regarding innovation in China that deserve being cited here[57]. The first pertains to the growth of China's GDP. For the years of 2014 and 2015, this growth was estimated to be around 7%. This relatively massive growth is partly related to the investments made by China's government in R&D. Governmental R&D spending has risen dramatically at a yearly rate of almost 19% between 1995 and the end of the 2000s and has doubled between the years of 2008 and 2012. Hence, from 2009 onwards, China has become the world's second most powerful R&D performer, behind only the United States and ahead of other economic powerhouses, such as Japan and South Korea. Its BERD intensity has also risen since the end of the 2000s, and is currently established at around 1.5% of the GDP. Moreover, foreign business-financed R&D activities in China have been growing at a steady pace. As one would expect, these foreign investments are primarily geared towards applied research and innovative activities.

Clustering is a significant issue related to the organisation of China's system of production. We must consider here that many regional disparities are present in China. For this reason, the Chinese government has established "Innovation Demonstration Zones" in areas that demonstrate the strongest innovative abilities. Enterprises established in these zones experience preferential policies and public support for innovation. At present, the government is developing a strategy to foster innovation in its previously overlooked western zones.

The expenditure of Chinese universities and Public Research Institutions (PRIs) on R&D is also relevant to note here. In 2012, total expenditure for R&D was 70 billion USD, of which 48 billion came from PRIs. The biggest Chinese PRI (in terms of spending and obtaining results) is the Chinese Academy of Sciences. The consequences of such lavish spending are indeed manifold and salubrious for the Chinese economy and the Chinese society as a whole. Firstly, there has been a steady increase in the rate of PhDs candidates and graduates in the country, which is now established at 2.2%. In 2011, Chinese universities awarded more than 127,000 doctoral degrees. Moreover, an increasing number of Chinese universities are now being top ranked. Consequently, scientific production has grown in a fashion parallel to these trends[58].

57) The main source for the description of the Chinese innovation system are OECD (2014) (cit.) and OECD Reviews of Innovation Policy – China, ISBN 978-92-64-03981-0, available online at http://www.oecd.org/sti/inno/oecdreviewsofinnovationpolicychina.htm (link visited May 2006)

58) The evolution and growth of scientific production of China is for instance witnessed by the results of Finardi (2015)

When discussing Chinese policies aimed at fostering innovation, it is incumbent upon us to look at China's "Medium and Long-term National Plan for Science & Technology Development (2006-2020)". This plan places an emphasis on high R&D spending, targeting a figure of 2.5% of its GDP by the year 2020. If this plan reaches its targets, it could lead to China outspending the U.S. on R&D programmes in the foreseeable future. (Of course this excludes the possibility of any economic slowdowns, which could hinder China in their race to the top.)

This national plan also sets other important targets. Firstly, it aims at further fostering the use of innovation as a tool to restructure Chinese industry and the Chinese economy. In fact, the national plan envisions a paradigm shift within the Chinese economy, moving from the current investment-driven model towards a more innovation-driven model of industrial growth. Another important goal of the Chinese government regards clean energy and climate change. The "12th Chinese Five Year Plan" established targets and policies for the years 2011-2015 crafted to reduce pollution, in particular CO2 emissions, and to increase energy efficiency.

From this perspective, China is making efforts to recalibrate its economy, moving away from manufacturing and exports and shifting towards private consumption. Some pertinent issues for the present years, as highlighted by the OECD, include:

- Encouraging innovation in firms and supporting entrepreneurship and SMEs;
- Innovating to address social challenges and to contribute to sustainable and green growth;
- Strengthening public R&D capacity and infrastructures;
- Fostering high-end human resources for S&T and research.

CONCLUSION

Having now arrived at the end of this long, winding path through the topic of innovation, it is time to draw some final conclusions while carefully revising the ideas presented herein. What we have tried to do throughout this work is proceed along two distinct yet parallel roads. On one hand, we have attempted to offer practical advice to the practitioner seeking to engage in innovation within the context of their business or firm. On the other hand, we have tried our best to offer the appropriate theoretical basis by which practitioner may be enabled to think innovatively.

Thus, our effort has not been that of merely presenting the reader with straightforward, practical advice that might turn out to be dull, irrelevant or unimaginative, but on the contrary, offering a solid theoretical foundation upon which they can begin thinking about how to perform innovation independently, in their own specific context. In this regard, this work in not directed solely at those involved in highly technological activities, but at anyone working in any field. Indeed, innovation is a concept most pronounced in the tech sector; however, it is boundless and can take place within any context. For this reason we've presented the reader with various techniques and instruments that might help with innovation in various fields, such as marketing, management, organisation and production.

In short, we hope we have not only helped the reader understand what innovation is, but also how to practice it and manage it within their own firms.

To impart that knowledge, we first offered a foundational knowledge of innovation in Chapter One, in hopes that the reader, if even just a layperson, might better understand what innovation is. The aim here was also to offer a sweeping look at the places where innovation might take place and the various ways in which it might manifest itself. In this way, we hope the practitioner can better synch their personal visions of innovation with their own unique contexts, thereby identifying areas within their reach that may benefit from the use of innovation. We hope our readers will find a use for at least some of the instruments and techniques presented in this chapter, including technology transfer and liaising with research institutions.

Let us here revise the most basic idea of innovation. Indeed, it is at once simple and complex, straightforward and multifaceted. In essence, however, the main characteristic of innovation is a change for the better. To innovate means to make progress in our grasping for something that does not yet exist (or for something that does exist, but can be realised in a better way).

It is important to keep in mind that the applications of innovation are much more numerous than one might initially think. Yes, we have quite often referred to innovation throughout this work as being technological, but only because this is the most common manifestation of innovation in the modern world. However, it is certainly not the only form. We cannot emphasise it enough: Innovation can be applied to any sector of any business of any type in any field. We believe our case study of the door and gate manufacturer in France proves this point beyond a shadow of a doubt.

In addition to defining innovation, we have also made an effort to demonstrate and explicate the complexity of it, both as a phenomenon and as a process. The means by which innovation can be deployed are not necessarily straightforward; indeed, innovation may assume a multitude of forms and be borne of virtually infinite origins. This is best seen and understood during our discussion regarding small and medium enterprises and large companies. We hope the take away from that discussion is this: innovation is directly related to the innate character of the business engaging in it.

In contrast to Chapter One, the second chapter of this work is more oriented towards practical suggestions and stimulating innovative minds into doing something new within their own entrepreneurial contexts. In doing this, we have been careful to employ the same methodology as that used in the preceding chapter. That is, we consistently tried to stay relevant by deferring to those who have reflected on, written about and/or performed a wide variety of innovative activities. In doing so, we hope to have offered a broad vision – in this case, of more practical topics – to those wishing to perform innovation in their own context, both in the short term and the long term.

At last, Chapter Three of this work presents some relevant examples of innovating countries. Looking at the specific policies of these countries as they pertain to their respective economic situations might prove to be of significant relevance to anyone seeking the means to innovate.

We believe that this work will be a useful instrument for those in the UAE wishing to innovate within their business, whatever their industry or aim. Our hope is that "The Innovation Guide: New Approaches to Make Companies More Innovative in UAE" will serve as a launching pad to further foster the social, economic and entrepreneurial life of the United Arab Emirates.

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