Regional Innovation Systems: An application and a Framework

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Abstract
Boosting economic growth and competitiveness in different spatial contexts such as national, regional, metropolitan etc. has always been in the epicenter of both large and small-scale planning efforts pursued at different levels of government from local to extra-regional and their significance is still, and probably will always be, on the rise given the ever increasing competition in today’s, and yet-to-come future world. In order to achieve this, relevant authorities have devised and implemented a vast variety of policies and approaches which are, more often than not, based on abundance of theoretical contributions in the field of economic geography. This thesis explores one of the main theoretical contributions to this field being Innovation Systems theory and tries to adapt the concept, originally intended for application at a larger scale, to the perspective of an individual firm rather than a whole production system while briefly using empirics from the spatial context of Adelaide/South Australia, loosely defined as a region, and the sectoral context of electricity infrastructure. The initial conclusion here is that applying the concept to the more manageable context of an individual firm, may have the potential to enable one to identify the relevant organizational and institutional setup more effectively and present a better explanatory description of their role in the whole Innovation system and in turn, can contribute to a more informed planning and policy-making process for regional economic growth.

Keywords
Economic growth, region, Innovation, Innovation systems, governance of innovation, organizations, institutions, firm
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Introduction

The history of rivalry between all kinds of man-made administrative delimitations and sovereignties is as old as the history of mankind itself. These conflicts of interests and rivalries manifest themselves in a wide range of contexts from ideological to pure economical bases. Often, even in the most unlikely of the situations when the rationale behind the conflict looks purely ideological there are economic motives hidden in the shadows. These conflicts of economic interests have shaped and destroyed whole cities and countries. The development and the history of Italian city-states is a prominent example in this regard. Economic growth and prosperity has always been a measure of power and influence in the political spheres as well as attractiveness of a location or spatial delimitation.

Similar to this, the history of authoritative ‘intervention’ in order to create or boost economic growth is a long one. Some economic historians even argue that without intervention from above, i.e. governments, some of the most prominent elements of the modern economy such as markets themselves wouldn’t have existed even though the rationale behind some might not necessarily be ‘benevolent’ from an individual or class perspective as some authors argue. A common example could be establishing and/or removing tariffs etc.

Innovation, on the other hand, has long been accounted for as a contributing factor to the overall economic growth. In fact, the fundamental role of innovation has been realized in all major economic growth theories since the introduction of neoclassical models including endogenous and unified theories and of course, The Schumpeterian growth theory in which the role of innovation is greatly emphasized. Consequently the policies and schemes for encouraging and boosting innovations and innovative activities by economic agents have been highlighted in the economic agenda in all levels of government from local to extra-national.

With such a background, and with the ‘interventionist’ mindset an overarching theme on the agenda of a significant number of governments at different levels, they have turned to the theoretical contributions in the field in order to be able to plan and devise policies to effectively manipulate the ability and potential of the their respective production systems
across various sectors to promote innovative activities which are perceived to result in stimulation of economic growth. These theories seek to understand and explain the process of innovation and the differences in the innovative performance in various contexts e.g. sectoral, spatial, social etc.

The concept of Innovation Systems (IS) is an important input and contribution to this line of studies which is perceived as an umbrella for a whole family of related concepts including location-specific (e.g. national, regional etc.) technological and sectoral systems. The common theme with the whole stock of ideas categorized under the innovation systems general theory is the adoption of a systems perspective in the investigation of the innovation phenomenon as their point of departure. Such an assumption has significant implications both for the theory and practice which we will discuss further in this study.

Based on these theoretical contributions, an Innovation system can be defined and described as the sum of all the determinants of the innovation process meaning all the “economic, social, political, organizational and institutional factors with their overall aim being development, diffusion and use of innovations” (Edquist, 1997). Here we focus on a specific strain of the IS concept which introduces a spatial, regional to be specific, aspect to it. The introduction of this spatial aspect, as we will also investigate further in the coming chapters, is due to a variety of reasons with its initial one being facilitation of the interaction and exchange (of ideas, resources etc.) in close physical proximity as it is considered to be the pillar of the innovation and innovative activities. Here, the spatial Innovations System concept is defined as “the localized network of actors (organizations) and institutions in the public and private sectors whose activities and interactions generate, import, modify and diffuse new technologies” (Seo, 2006) having its roots in the institutional and evolutionary economics as well as general systems theory and studies in economic geography.

The issue with RIS concept, as with all other theoretical abstractions, as expected, lies in the realm of application. The rather direct and straightforward ‘interpretation’ of a theoretical framework into explicit policies and action plans by the authorities which usually tends to disregard the complex and multi-faceted nature of the processes involved with such a transcription will generally result in costly yet sterile efforts in the form of regulations, agendas, policies and policy implementation instruments which are
ultimately destined to fail in their mission to support innovation and boost innovative activities. What a lot of interpretation processes lack is identification of all relevant institutions and organizations interacting in an innovation system which, in turn, stems from, as some authors have pointed out, starting off a “a generalized, organizationally-defined typology of actors and the generic, disembodied institutions that influence them” (White & Liu, 2001) and, as we argue here, adoption of a limited top-down and macro perspective, putting the minimum emphasis on the individual firm as the fundamental organizational element of an innovation system.

Based on what was said before, shedding some light on (the process of) identification of organizational and institutional setup in a given regional innovation system is initially the aim of this study or, in other words, what this thesis is concerned about and In doing so, a framework outlining the ‘areas of interest’ which one needs to look into in search of the organizational and institutional components will be proposed.

Accordingly, the objectives of the study will be achieved through adoption of, and following, the principles of concatenated exploration, which we will elaborate on in the research methodology and approach chapter, and are as follows:

1- Explore the existing theoretical contributions to the RIS theory and the notion of functions and activities within its framework in order to develop a comprehensive understanding of it, as a theoretical construct, and pinpoint and identify those with potential for analysis relevant to the aim of the study being the development of the framework

2- Develop an inclusive framework, mainly based on previous contributions to the idea, to ‘interpret’ and adapt the concept of RIS into a micro level i.e. to the perspective of, and focused on, the individual firm with a scope wide enough to accommodate the whole spectrum of relevant institutions and organizations and with the ultimate aim of establishing the foundations for a proper process for institutions and organizations identification contributing to the innovative activities and performance of a firm. This will be done, partially, through a scale change analysis in relation to the Regional Innovation System (RIS) concept and also utilization and adoption of a Micro perspective, in addition to a Macro one, a perspective which has not been fully investigated before in the RIS literature.
3- Perform a very limited application exercise for which the initial question would be if, and also how, a sample of the organizations and institutions identified as the ‘nodes and networks’ of an innovation system engulfing a specific firm in a specific RIS have the potential to be identified, explained by, or fit into, the developed framework. A fully-fledged testing of the hypothesis in the form of a confirmatory study was not intended and isn’t expected in the current study due to the limitation in scope.

It should be mentioned that, here, the emphasis on the individual firm is an indication of the overall perspective of this study, which intends to, as Uyara states, revisit the evolutionary roots of the concept. Also, and in order to avoid “different and even conflicting theoretical assumptions and policy rationales” (Uyara, 2010), it also presents a summary of the ideas underlying the development of RIS framework.

We hope, in the long run, this study and similar ones will contribute to more informed policy-making and policy implementation processes in regards to the innovation and innovative activities.

**The Structure of Thesis**

The overall study can be broken into five sections:

1- **Introduction**: Presents an overview of the case being studied here in the light of previous contributions and developments and describes the overall aim of the study together with the corresponding objectives

2- **Theory**: The chapter in which the theoretical background for:
   a. The Regional Innovation Systems, as the focal concept from its origin to its current form and,
   b. Depiction of the RIS concept in terms of its functions and activities. (Essentially based on Johnson, Edquist and Liu and White’s theoretical contributions) and,
c. The institutional setup of a region (mainly based on Cooke’s theory), referred to as the ‘Macro’ perspective on the issue of the institutional setup of a firm

Is investigated through reviewing the corresponding literature

3- Synthesis: This section will comprise of two chapters in the form of:

a. Proposing a ‘Micro’ perspective, as opposed to the Macro perspective, into the issue of the institutional setup of the firm as a hybrid concept partially based on Cooke’s theory

b. A framework for adapting the system perspective of the RIS concept into an individual firm perspective is developed on the basis of theories investigated. In essence, the abovementioned Cooke’s concept of the institutional setup of a region, adapted to a firm’s scale, in combination with functions and activities perspective on an innovation system discussed in the theory section will comprise the backbone of the framework which will put forward and suggest guidelines for identification of organizational and institutional elements. This framework will essentially aim to illustrate and show ‘where to look for’ when trying to identify and pinpoint the organizational and institutional setting of an individual firm within the context of a regional innovation system

4- Empirics: As the first step, both contexts in which the developed framework will be applied are briefly presented. Theses include the spatial delimitation of South Australia/Adelaide, loosely defined as a region, and the sectoral context being the electricity infrastructure sector. Next, the individual firm at the center of empirical study (Tenix Australia) is presented followed by identifying (a sample of) institutions in relation to the innovative activities and the regional innovation system in which the corresponding firm is embedded. This brief identification has elements of a case study methodology and utilizes the daily routine of on-going activities of technical staff in the sample firm to probe into the organizational and institutional setup of it. The institutions identified in this manner are then very briefly scrutinized and explored against the framework developed in the previous section to confirm and verify if they would fit into, and can be explained by the it.
Here, the intention of such verification would be to perform a limited scope test of the framework and shed light on the areas where it might have shortcomings and theoretical ‘holes’ to be addressed in the future when the scope of the study might be extended and a more detailed framework and a substantial empirical study might be performed.

5- Concluding remarks: In the concluding remarks, a brief summary of the achievements in terms of the goals and objectives of the study together with its overall significance and suggestions for possible future studies will be presented.

Research Methodology and Approach

The general approach of this study has an exploratory and formulative element to it. Stebbins, in his 2001 contribution, explains the initial goal of the exploratory research as “the production of inductively derived generalizations about the group, process, activity, or situation under study” (Stebbins, 2001). On this basis, this study begins with exploring the theoretical contributions to the Regional Innovation Systems theory, followed by steps in both general and ‘scale change’ analyses necessary for the task of adaptation of the system level perspective of the general RIS theory to the component level perspective of the individual firm which is, obviously, a different perspective for which it was originally developed for. In the next step, described as the formulative part, the objective is to develop and formulate a framework with the potential to accommodate the identified institutions and organizations in relation to that individual firm in the context of the regional innovation system as described. This is also in line with the principles of the exploratory research as, according to Stebbins, the next step involves the researcher to combine and ‘weave’ “these generalizations into a grounded theory explaining the object of study” (Stebbins, 2001).

The study also has a more explanatory (confirmatory using Stebbin’s terminology) side to it in which we will attempt to ‘explain’ the identified institution, as a sample, in terms of the developed framework. This is, again, in line with Stebbins’s reference to the term ‘concatenated exploration’ which illustrates a chain of research starting with exploratory studies eventually giving way to introduction and generation of new concepts and
formation of (grounded) theories and resulting in confirmatory/explanatory studies to test the hypotheses/theories vis-à-vis real world instances (Ibid.). It is worth noting that, though, the confirmatory element of this study, as also emphasized in the delimitations section, will be, to a large extent, limited to a single example and there is no such intention for this study to include a detailed explanatory element.

In regards to the methodologies, literature review was naturally chosen in order to investigate the theoretical background and previous contributions to the overarching concepts and ideas discussed such as RIS and regional institutional frameworks while case study together with some qualitative approaches such as informal discussions with a wide range of discussants including suppliers, clients, employees, management or competitors was utilized in order to deepen the personal insight of the author in relation to the matters in question.

The choice of Tenix Australia as the case study for the short empirics section was obviously based on the author’s ongoing involvement and personal insight due a full-time employment arrangement at the time of study. Theoretically, any firm in any region, and within any innovation system, could have been the subject of a case study but arguably, personal attachment and association with the subject of study can contribute to a more effective and informed process of gathering data, which is the case here. The details of the informal discussions, as described above, which can be a major contributor to the identifying organizations and institutions within the firm’s immediate innovation system environment have not been recorded and thus, are not presented in the thesis. The reason, as can be expected, is the sheer number and variety of such social interactions and, to some extents, their limited direct contribution to the current study due to the very limited scope of the empirics section. The technical staff in any given firm, those active in the design and construction of large infrastructure projects for instance, are involved in daily exchange of information via all sorts of communication channels with a full spectrum of internal and external stakeholders which is almost impossible to document in detail. And it is exactly through the medium of this constant dialogue which a vast amount of data is streaming. Such interactions can happen on a regular basis such as the weekly meetings with external parties e.g. clients or internally between colleagues or alternatively, they can happen as an ad-hoc communication in the form of a phone
conversation or a thread of emails with a supplier, a client or a government agency. Either way, they are invaluable source of data and extraction of, and utilizing, what they offer may constitute a large part of the raw material required for conducting a study with an empirics focus. Examples of such transactions in our specific case include, among all, weekly general safety meetings at an intradepartmental level (Engineering and Operations department), bi-weekly project-specific meetings between different departments, technical team meetings, meetings with clients or supplier with a wide variety of agenda, and general meetings initiated by the high level management occasionally to discuss issues or changes affecting the whole firm. Add to that the countless ‘limited’ communications spanning the whole range of technical and administrative issues in an individual firm.

In addition to this general methodology section, in-depth and more detailed presentation of methodologies may appear in different sections of the thesis as the need for a more clear and descriptive ones arise.

**Delimitations**

Initially this study is focused on investigating a range of theoretical concepts followed by a brief indication of an example, embedded in two contexts: The spatial context being the South Australia/Adelaide delimitation, defined as a region, and the sectoral context being the electricity infrastructure design and construction sector. As briefly mentioned in the research methodology and approach section, the current study is supposed to be considered as one in the early and middle stages of the chain of studies in a concatenated exploration, using Stebbins's terminology, meaning the scope of it is limited to exploring and investigating a set of theories and, subsequently, proposing a theoretical construct in the form of a framework. The short empirics section that immediately follows is solely intended to present a quick 'glimpse' of the potential embedded in the developed framework to be further investigated and tested through moving along the line of the aforementioned concatenated exploration in the direction of explanatory and
confirmatory studies which should explain the significantly limited nature of the empirical chapter.

Also, in regards to the two contexts within which the example in the empirics chapter has been discussed, it is worth nothing that Inherently the findings and any conclusions drawn from those may only be relevant in the corresponding contexts. As an example from the spatial limitation aspect the federal system of government and administration dominant in the specific spatial context under study here has significant implications on the macro and, to a lesser extent, micro organizational and institutional setting in which the firm is enveloped. Potentially, such settings can be considerably different from one in a different authority regime or arrangement in terms of both the institutions and organizations and their respective roles in relation to an individual firm.

This is equally valid in regards to the sectoral context on which the corresponding conclusions and the findings are based, also manifested in the form of the institutions and organizations and their interactions and interrelations with the individual firm, which may not be relevant and be replicated in the context of firms active in other industry sectors such as manufacturing with their distinct development trajectories and technological regimes. The same can be argued in relation to the firms in more high-tech industry sectors with their clear distinctions in the organizational order and their innovative characteristics.

Of course, this doesn’t suggest that the findings and conclusions, and specifically developed framework lack the potential of being extended into different firms in different organizational, institutional, spatial and sectoral contexts. Rather, it suggests that although the framework has been developed with the intention and a tendency towards general applicability due to the mainly theoretical methodology adopted, application of it in different spatial and sectoral context should be exercised with caution and special attention should be given to these contextual distinctions.

In addition, this study isn’t concerned about the all-inclusiveness of the list of institutions and organizations identified. As referred to before, initially, the focus here is on developing a framework for identification and exploration of the organizational and institutional setting in the immediate innovation systems environment of a firm and the list of institutions and organizations that may be produced here is only intended to serve
as a sample and the raw material for a brief confirmatory chapter or 'verification practice' rather than being considered as a complete and definitive list relative to the specific firm and the specific context.

Theory

A. Regional Innovation Systems

The Origins

Cooke et al, in their 1997 article, inform two bodies of knowledge as the main sources of inspiration for the RIS concept, namely research in systems of innovation and contributions in regional sciences with the introduction of “supply-chain relationships” as the link between. Again, Cooke, in his 2008 contribution to the RIS theory, returns to the question of the origins. According to Cooke (2008), The concept has its origins in general systems theory, past experiences and trials in regional innovation policy (in both theory and implementation realms) and finally the concept of networked regions which, in turn, has its roots in the industrial districts theory, milieu research and innovation systems studies. The discussion is then followed by mentioning that the ‘nodes and networks’ character and the potential for distinction between analytical and policy/application aspects of regional systems analyses (while may not necessarily be applicable in Cooke’s opinion) are legacies of its systems theory and formation forefathers. As for the ‘networked regions, and in fact specifically for its ‘network’ component, two distinctive source of inspiration are mentioned being Innovation and industrial (with no spatial indication though) networks in the early works of European Research Group on Innovative Milieu (GREMI) and the notion of ‘networks of innovators’ as the social side of the story.
developed by a line of economic geographers such as Saxenian, both having references to Marshalian ideas.

Another perspective on the origins of the RIS concept is presented by Doloreux and Parto in their 2005 article. According to them, the origins of the RIS concept are to be found in two major bodies of research, namely Systems of Innovation and tributaries of Regional Sciences talking about the dominant socio-economic conditions that lead to innovative behavior in the context of a region.

While the systems of innovation framework itself has its roots in the evolutionary economics ideas which links the innovative abilities and behavior of firms to both internal and external (to the firm) factors evolving through the ongoing (social etc.) processes, the focus in the regional sciences is on the social and institutional environment and the dominant knowledge-related culture existing in a delimited spatial context (here a region) and also the localization/urbanization effects of proximity, referred to as agglomeration economies in the urban economics realm (Doloreux & Parto, 2005).

And Finally, according to Uyara (2010), elements of a wide range of concepts with their origins in subjects such as evolutionary and institutional economics (e.g. systems of innovation), interactive learning theories and economics of innovation can be identified in the RIS, woven together with ideas from regional sciences and economic geography such as studies in regional competence, location-specific learning and innovative milieu theories and even industrial districts in the neoclassical economics of Alfred Marshall. In this regard, principles such as considering the firms and their routines as the basic unit of study, emphasis on the path-dependency of economic and technological development of a region/sector and the evolutonal nature of dynamics ruling the economic arena of individual actions have been borrowed from the evolutionary economics while relevance of (changes in) institutional environment as the primary explanatory factors behind the difference between the economic and innovative performance in different spatial contexts (national, regional etc.) is clearly an indication to the influence of institutional economics. Concerning this, though, there seems to be a fair distinction between the influences of the two notions. Whereas actors and networks (e.g. of firms) are the principal units of study for the former and their co-evolution with the governing institutions is pivotal for the
theory, the influence of institutional setup on the networks of actors and their relations is a very strong focus of the latter (Boschma and Frenken 2006). On the economic geography’s side, a fair share of spatial (regional in this context) characteristics have been studied and credited as the performance factors of a typical successful region. These are derived from an abundance of studies in the field, from the early works of Marshall (and more recent contributions to it) to innovative milieu theories. These features mainly include, among all, social and cultural influences and attributes of a region such as supportive institutional setup, effective governance modes, dynamic networks of firms with vertical differentiation and horizontal cooperation characteristics, pervasive innovative culture and an available pool of workers with relevant trade skills (Uyara, 2010).

Similarly, an abundance of contributions can be found on the learning themes where the focus is on the organizational and institutional learning abilities, distinction between explicit (codified) and tacit types of knowledge and the location-specific attributes of the latter. In this regard the (institutional) ability to convert the tacit into explicit knowledge embedded in a spatial setting and competence building based on “sticky” properties of tacit knowledge leads to a geographically-bound competitive advantage which is not easy to replicate in other spatial/regional contexts are the focal points of such studies.

Regional Innovation System: Path to the Definition

Preliminary Definitions: Innovation

The conventional definition of the term innovation refers to it as the actual introduction of an invention/idea into the market in the form of a commercial product. It has also been noted as the whole commercialization process in relation to a new concept or physical product. In fact, some authors such as Seo put more emphasis on the latter definition as a result of its more practical application (Seo, 2006).
In Cooke et al. (1997), a more pragmatic definition for the term is presented as the processes enabling (predominantly manufacturing) firms to utilize new (to the firm) products and processes (to gain more profit).

The classic Schumpeterian definition, being one of the most referred-to delineations of the innovation concept, acknowledges the inclusion of none-manufacturing and less technology-intensive categories of clientele into the above definition while widening the overall scope of the concept by introducing more ‘Schumpeterian inputs’ such as new markets in addition to the initial products and processes perspective. Furthermore, he affirms that product and process innovations cover both technological and organizational aspects. Overall, Schumpeter defines the concept of Innovation as being implementation/introduction of a [commercial] concept into the realm of practice entailing one or more of the following elements:

1- [Introduction of] new goods
2- [introduction of] new production methods
3- [opening of] new markets
4- [securing/utilization of] new sources of supply
5- [utilizing and application of] a new organizational form (Schumpeter, 1934).

Predominantly, the essence of Schumpeter’s theoretical construct is the fact that innovation, as defined above, is the Holy Grail on which entrepreneurial activities are based. The individual, taking on its role as the entrepreneur, creates the opportunity through innovation, which is, in its turn, a product of scientific, technological, social and institutional (legal etc.) breakthroughs. It is this breakthrough that disrupts the markets in equilibrium and makes innovative and entrepreneurial activities possible.

In contrast to Schumpeter’s ideas, Kirzner has a different view on entrepreneurship based on the innovation and innovative activities. The idea at the core of Kirzner’s theory is that there is no need for an ‘innovation’, in its Schumpeterian sense, to be in the center of an entrepreneurial activity. Opportunities are not necessarily created as a result of, as Schumpeter coins it, ‘creative destruction’ and disruption of an existing equilibrium. Rather, they can be realized or discovered as a result of imperfections or “information asymmetries in incumbent markets” (Jong & Marsili, 2010). In fact, as Jong and Marsili have proposed, Kirzner’s deviation on Schumpeter’s theory of innovation and entrepreneurship are outlined along five major lines:
1- Distinction in the nature of opportunities in which Kirzner introduces the idea of arbitrage as opposed to innovation. Kirzner argues that the concept of arbitrage, although still incorporating elements of novelty, is not a disruptive phenomenon and entrepreneur doesn’t necessarily recombine resources (he might as well not have any resources of his own). Rather, he utilizes market imbalances through the process of discovering opportunities which may be new to him or the organization rather than to the market.

2- Relationship to the market meaning Schumpeterian innovative activities are meant to, by definition, unsettle the market equilibrium through introduction of ‘out of market’ novelty not yet accounted for in the market pricing system while Kirznerian ones function inside the limits of a market in constant disequilibrium due to the knowledge asymmetry in the players and exploit the opportunities which are already there. In short they are the forces that push the market towards equilibrium not away from it.

3- Distinction in the entrepreneur’s relationship to the opportunity. While Schumpeter talks about creation of opportunities on the basis of macro-economic changes, Kirzner states that the opportunities already exist in an imperfect market and the role of entrepreneur is to discover them rather create.

4- The abundance of opportunities in which Schumpeter’s opportunities are considered to be rare due to the fact that introduction of them entails realizing a breakthrough in one or more relevant fields such as technological or institutional while the Kirznerian opportunities are more common as they don’t rely on such premises to be discovered or realized.

5- Distinction in the level of dependency on novel information. Schumpeterian innovation and entrepreneurial activities are heavily reliant on new and novel ‘extra-to-the-market’ information that are created as macro-economic changes take place in the non-market world. The entrepreneur then utilizes that information to perform innovative activity. On the other hand, Kirznerian entrepreneurship doesn’t depend on novel information created outside the market domain. Alternatively, the entrepreneur exploits the information already available (to him but not necessarily to every other participants) in the market. In other
words, as Jong and Marsili have stated, “differential access to existing information” (Jong & Marsili, 2010) is the key element in the entrepreneur’s trade. And that is how the imperfections in the decision making processes of economic agents, here the market participants, works in favor of the entrepreneur as he is able to exploit “shortages and surpluses” created through this process (Jong & Marsili, 2010).

Ultimately, it should be stated that that in this study, the notion of innovation is predominantly used in its Schumpeterian conceptualization as it corresponds more accurately to the way the term is used in the realm of infrastructure design and construction firms, in specific, and also generally for technical consulting and construction companies. As the nature of business in such firms dictates, the innovation is fundamentally pursued through introduction of advanced and novel solutions to the problems within the industry sphere. This can include scientific and technological resolutions applied to a client’s question as well new and more efficient ways of delivering and managing a common and typical project of a day-to-day character. Also addressing a shortcoming through changes in the organizational setting i.e. putting forward and organizational solution and opening of new (to the firm) markets in a variety of forms constitute an important strategy in such companies’ growth and expansion plans. As it can be clearly observed, all these examples point out to the relevance of the Schumpeterian mode of innovation in this context hence, a Schumpeterian definition of innovation is adopted here.

**Preliminary Definitions: Systems**

The idea and perception of system, as an ontological concept, together with the notion of a ‘systemic’ view i.e. looking at the phenomena as a system and not an individual occurrence, dates back to a time when the term ‘system’ wasn’t even coined. Examples of such precedence can be found in Aristotle’s famous quote “the whole is more than the sum of its parts” as well as the Taoist philosophy in which Lao Tsu depicts a system based on the interaction of two forces, namely Yin and Yang. Following the trail in the more recent ideas, the contributions of European physicists namely Sadi Carnot and Clausius, in
the form of application of a systemic perspective in the field of thermodynamics, are worth mentioning. Also Checkland cites early works of biologists and natural scientists in the 1920s in which there are references to a phenomenon called ‘organized complexity’ in the study of living organisms (Checkland, 1993), which was then followed by the seminal contributions from a variety of scholars from different disciplines including Bertalanffy. As described by Bertalanffy, Aristotle’s system perception was not embraced by the forthcoming philosophic and scientific society, as it deserved. Rather, the course of events in the history of science and philosophy was set in a way that his fundamental idea was overrun by ‘resolutive’ notions promoted by influential figures such as Descartes and Galileo. Their methodology which was based on breaking down a phenomenon/problem to its constituents and dealing with each as an individual problem, while having a huge positive impact in the fields such as mathematics and formal sciences, acted as a resistance force against the advances in the scientific perception of the ‘complexity’ concept and development of systemic perspective in general. Furthermore, Bertalanffy recognized the underdevelopment of mathematical principles and methodologies with the ability to deal with complex (i.e. explanation of systems) problems as an important contributing factor. He believed that mathematical sciences, thus far, were more equipped to tackle problems in the classical scientific paradigm sphere, defined as the ‘isolability’ of components of complex entity and provide solutions accordingly so he started by introducing of “mathematical descriptions of system properties”(Von Bertalanffy, 1972) and tried to develop a dynamical/general systems theory. Simultaneously, Wiener and Ashby, each building upon the knowledge of their respective fields, advanced the system ideas both in theory and practical applications. In the following decades, scientists and scholars from different disciplines added to the theoretical richness and practical value of the notion which, apart from more developments in the general systems theory, included, among all, other strands such as systems engineering, systems analysis and system design (predominantly applicable in the realm of so-called hard systems) and methodologies to deal with intricacies and ‘subjective’ attributes of systems incorporating a ‘human factor’ i.e. soft systems. As fairly referred to by Cabrera (Cabrera et al., 2008), the history of the development of system movement, or as he denominates it, the field of “knowledge about systems” covers a vast expanse of theoretical and applied contributions and a few authors
have tried to present a big picture of the realm. Notable among them are Midgley, the editor of four-volume collection "Systems Thinking" consisting of 97 articles considered seminal in the history of systems ideas (for which Cabrera finds the ‘Systems Thinking’ title controversial due to indications towards a conceptual framework), Francois with his two-volume “International Encyclopedia of Systems and Cybernetics” comprising of a comprehensive collection of system-related concepts and Schwarz with his “Some Streams of Systemic Thought”, a visual ‘big picture’ which condenses over 1000 system concepts into a map complete with nodes and connections to be able to present an idea of the expanse of the system notion as a subject matter (Cabrera et al., 2008).

On the basis of this background, following we have mentioned a few definitions of the term ‘system’ which are found to be of relevance to the current study. The definitions are presented in chronological order:

Bertalanffy defines a system as “a set of elements standing in interrelation among themselves and with the environment” (Von Bertalanffy, 1972).

In an attempt to present a ‘textbook’ definition, Backlund cites a few basic, and rather recent, definitions from previous contributions, among them Langefors’s “a set of entities with relations between them”, Miller’s “a set of interacting units with relationships among them”, Van Gigch’s “an assembly or set of related elements” and Skyttner’s “a set of interacting units or elements that form an integrated whole intended to perform some function”. He then proceeds to discuss the discrepancies and inaccuracies, associated with these definitions and suggests, a multi-criteria general definition which, for example, doesn’t necessitate having a specific function for a system (Backlund, 2000).

On the other hand Edquist, Based on the numerous contributions to the idea, and in the context of a discussion on ‘innovation systems’ which we will deliberate on further in this study, presents a definition of system as an entity consisting of I) components and II) relationships between them. According to him, the key defining concept here is ‘coherency’, described as forming an article with properties distinctive from its constituents, having a specific function and having well-defined boundaries (Edquist, 2005).

And finally, as defined by Checkland, a system is a “set of elements, connected together, which form a whole; this showing properties which are properties of the whole rather
than of its component parts” (Checkland, 1993). The author also suggests a classification for the systems comprising of four main categories and an extra one set aside for ‘transcendental’ systems. These four categories include Natural Systems, Designed Physical Systems, Designed Abstract Systems and Human Activity Systems. The last category, being human activity systems, similar to some others, has a purpose, mission or function as one of its properties. From this perspective, a system, as intended here, falls into the category of human activity systems that and this is why we have adopted Edquist’s definition here which, while covering other aspects of a comprehensive definition, accommodates the extra constraint of having a function as an integral part.

**Preliminary Definitions: Region**

The term region can be defined in a variety of contexts. These contexts include, among all, physical geography, in which a region is defined on the basis of physical e.g. terrain features, human geography, in which a region is defined on the basis of impacts of human activities on its immediate environment, jurisdictional, in which a region and its boundaries are defined on the basis of authorities of one or more judicial and political entities and economical, in which economic relationships and trade links are the key concepts. In a lot of instances though, what actually happens is that the regions are defined under hybrid terms and provisions which transcend the above-mentioned contexts and combine elements of two or more of them in order to present a more comprehensive definition. This is also the approach adopted in the current study since the definition of region in the context of innovation systems in a specific spatial delimitation should take both physical and human geography aspects into consideration, hence, from a wide spectrum of relevant definitions, those that have considered more than one dimensions in formulating the definition have been presented here.

The Great Soviet Encyclopedia defines a region, in its economic sense, as “a territorial component of a country’s national economy. It is characterized by a specific economic-geographical status, by an economic unity, by distinctive natural and economic conditions, and by a production specialization that is based on the territorial social division of labor and has developed overtime” (The Great Soviet Encyclopedia, 1979).
A region (denominated as Labor Market Area or LMA), as defined by the US department of labor for statistical and economic data collection purposes, is “an economically integrated geographic area within which individuals can reside and find employment within a reasonable distance or can readily change employment without changing their place of residence” (Labor market areas, 2014).

Another definition for a region (called a Functional Economic Area or FEA), optimized for economic modeling, is presented as “An area which covers a relatively contained and cohesive network of trade” (Fox & Krishna Kumar, 1965).

Cooke and others in their 1997 article propose a definition for region as being “territories smaller than their state possessing significant supra-local governance capacity and cohesiveness differentiating them from their state and other regions” (Cooke et al, 1997).

In a later contribution to the notion, Cooke also defines a region in terms of “a geographically delimited and administratively bound spatial context” (Cooke, 2001), which can act as the basis of human activities and interactions.

Doloreux and Parto, on the other hand, propose a definition for a region in the form of an area with socio-cultural and institutional homogeneity for which geographical boundaries are not necessarily distinct (Doloreux & Parto, 2005). As can be observed, the two definitions have clear distinctions so as while Cooke’s has geographical delimitation and boundaries as a fundamental part of the attributes that define a region, Doloreux and Parto’s puts the emphasis on institutional consistency accompanied with uniformity in social and cultural aspects.

Generally, this distinction in emphasis stems from different perspectives, or rather perceptions, in the debate over the definition of the regions namely cultural and administrative regions. While ‘cultural region’ identifies the regions with distinctive cultural, linguistic and territorial characteristics which may or may not have equivalent legal/political titles (such as Basque region or Scotland), administrative regions are the ones which their unique or different character is the result of formal power relations, political processes and, in some cases, reforms at different levels of governance with the latter type incorporating different versions based on intensity in ‘autonomy’ level. Examples include Austrian, German and Belgian regions and also federal systems as in the US and Australia (Cooke et al, 1997).
In addition to the numerous contributions to definition of a region in all sorts of contexts, it is also useful to have a brief look at the process responsible for creation of regions due to its potential for identifying the definition context(s) that are more significant in the current discussion.

As Cooke, Urange and Extebarria have described, the driving forces behind creation, or rather ‘perceptualization’, of a specific region can be classified into two major categories, namely regionalization and regionalism. In this regard, regionalization refers to ‘top to bottom’ processes in which the higher level of government (state, national etc.) intentionally triggers the process of transfer of title and authority to a lower level (regional as an example), while in the case of regionalism bottom-up forces and demands are responsible for giving rise to such expectations and claims (Cooke et al, 1997).

The point here is that these processes, being top-down or bottom-up, will have a strong influence on the regions created in terms of their future institutional settings and subsequently, the innovative performance as a whole. This is why, apart from any definitions suggested for a region, the respective processes leading to the current institutional outcome should be taken into consideration.

The institutional setup of a region, as referred to here, comprises a wide range of inter-related aspects, from the institutions dealing with financial and budgetary arrangements of a region to the ones that affect the decision making processes and public attitudes towards planning and implementation of physical infrastructure and also those which deal with the learning potentials, abilities and infrastructure of regions. Other examples may also include, among all, the overall legal and contractual environment, organizational norms and routines and general business milieu. It will be discussed in detail further in this study.

Based on all this, the idea is that any definition for a region in the context of innovation systems has to consider a variety of factors from social and cultural viewpoints to formal, political and administrative aspects. Such a definition which will aspires to present an all-inclusive and comprehensive account cannot afford to leave any of the related aspects out as every one of them could have eminent effects on a given region’s institutional setup. To sum up, we believe the areas of interest for both categories of contributions in terms of emphasis on socio-cultural versus formal and administrative divisions are justified as the
weight and significance of any of those in the final configuration and structure and, subsequently, the (innovative) functioning of a region can't be overlooked.

**Preliminary Definitions: Institution**

The concept of institutions is probably the most complex one between the preliminary definitions we have discussed here. In order to propose a definition which fulfills both necessary and sufficient conditions with the ability to yield the full potential of the phenomena while limiting its boundaries to the point of maintaining its functionality, and as part of reviewing the relevant literature, we need to adopt a descriptive point of view and take a close look at a specific descriptive narrative which presents useful insights into the subject of institutions, seen in a broader context.

As Doloreux and Parto have suggested in their article, an institution’s initial function is to “define the structure of the interactions among humans based on rules, norms, and values”. Another ‘functional’ perspective of the institutions, recited from Setterfield in the same article, is the representation of the “social relations’ that frame the activities of production, consumption, and exchange” (Doloreux & Parto, 2005), being primarily affiliated with the realm of economics. On a more general scale, North’s account of institutions as offering “a guide to reducing uncertainty in human interactions” (Ibid.) is also mentioned in the same article to suggest a wider perspective covering more fields rather than just the economics. By these accounts, institutions are depicted as instruments having the potential to create a continuum in the socio-economic life and lend cohesion, security and predictability to it.

Later on, Doloreux and Parto develop their descriptive account in more detail and state that while “symbolic elements, social activities, and material resources” are the building blocks from which the institutions are made of, they themselves can manifest in the form of “organizations, cultural phenomena, or structures that share important commonalities” (Doloreux & Parto, 2005). They also suggest a classification system for institutions comprising of five categories. Based on this categorization, institutions are classified into five groups:

1) Associative; encompassing “socio-political structures... to express certain values or
interests” (Ibid.) of which the mechanisms facilitate “privileged interaction” (Parto, 2005).
Obvious examples of such institutions are business networks and institutions such as trade unions.
2) Behavioral; described as “standardized social habits” with their transmission vehicles being “symbolic and relational systems”. Examples include habits, established routines and ways of performing tasks (e.g. if the firms habitually and routinely turn to external or internal financing when in need of financing), “shared beliefs and theories in use”.
3) Cognitive; manifesting as “mental models and constructs or definitions” with examples being the vast realm of “cultural and social values”.
4) Constitutive; described as high level social structures which are established over time and widely accepted in the society. Examples include society-wide institutions such as languages, [the structure of] agreements, property rights, “collective actions initiated by the state agencies, firms, unions, or citizens groups”.
5) Regulative; including both “written and unwritten rules of the game” basically being all the laws, regulations and legislations regulating various aspects of social interactions in one way or another by which way they are able to provide and offer some degree of security and stability the participants (Ibid.).
It is worth noting that based on the definition, here the [physical] organizations are not defined as separate entities and are classified as just another manifestation of the general concept of institutions.
With the descriptive introduction presented as a backdrop before, ‘textbook’ definitions will be discussed next in order to draw conclusions in the institution concept.
In his seminal 1991 article, North defines an institution as "humanly devised constraints that structure political, economic and social interactions" or, in summary, “rules of the game” (North, 1991). Since the time this has been one of the most widely accepted and influential definitions for the term. He then proceeds to give a concise account of the term ‘constraints’ and classifies them into two categories being formal and informal ones. As for the formal constraints (institutions) he mentions a couple of examples of laws and regulations in relation to constitutions, properties etc. while informal institutions are the
‘undocumented’ ones such as traditions, social and behavioral protocols and customs. North’s fundamental ideas, along with other authors’ accounts in relation to institutions, though, have later been scrutinized by authors such as Hodgson, which, in case of North, is based on North’s ambiguous perspectives regarding the issue of inclusion of the concept of ‘organizations’ into the general definition of institutions.

Initially, Hodgson himself defines institutions as “systems of established and prevalent social rules that structure social interactions” (Hodgson, 2006), thus including a wide variety of entities from conventions of etiquette such as ‘table manners’ to physical organizations such as firms. He then argues that based on such a definition, organizations have to be categorized as a special category of institutions with three additional conditions being 1) they establish their own boundaries and (can) distinguish their own members 2) establish who is in charge and 3) clear-cut chain of commands and determining responsibilities within the organization. He then proceeds to explain that, despite common belief, North’s perception of institutions as the rules of the game and organizations as the actors or players doesn’t necessarily imply that organizations can’t be classified as a specific kind of institutions. Rather, the problem lies in the expression of the concept meaning instead of differentiating organizations from institutions and ‘defining’ them as actors, they should be ‘abstracted’ as actors for simplicity of analysis since they are, as mentioned before, a specific type of institution. The process of abstraction here is the same process, taking place in a lot of scientific disciplines such as physics on a regular basis as, for example, a whole planet, despite being a complex system in itself, is considered, or rather abstracted to, a single element in the calculations of the effects of gravity forces on a space probe. Overall, he believes that North, despite his personal admission to the author in regards to the abstraction, is to be blamed for the resulting ambiguity, at least partially, as a result of his failure in drawing a clear line between these two distinctive analytical procedures of definitions and abstraction. He also criticizes North’s definition of organizations as “… groups of individuals bound together by some common purpose” on the grounds that the individuals within an organization may not necessarily be committed to, or united around, a prevailing goal. Rather, it’s the organization’s rule system and internal authoritative mechanisms, which enforce such a commitment (Hodgson, 2006).
And finally, unclear and inconclusive descriptions of different types of institutions (i.e. formal rules versus informal constraints), is another source of scrutiny by Hodgson. As he states, the vague definition of the formality and informality concepts in terms of, for example, their connection to the notion of legality, together with similar inexplicit distinctions and interchangeable use of the terms ‘rule’, ‘constraint’ and ‘norm’ creates a significant amount of confusion in the debate and leaves the door open for misconceptions and blurring in the denomination which, in turn, can lead to fundamental analytical issues. (Ibid.)

In addition to his critiques in relation to North, Hodgson has similar concerns regarding other authors as well with an example being criticizing the perceptions that reduce institutions to the level of “patterns of correlated behaviors” by scholars such as Foster, stating that institutions are not the equivalent of the behaviors stemming from them (Hodgson, 2006).

With this background in mind, this study adopts North’s definition of institutions as ‘the rules of the game’ together with the abstraction of organizations as actors while realizing Hodgson’s ‘amendments’, which emphasizes on the institutional origin and nature of the organizations and the existence of the internal interactions and processes within an organization, though not necessarily of significance for studies such as the current one due to the a different viewpoint and focus. Also, in the case of description of formal and informal institutions, in line with a few contributions, and without submitting to a detailed debate on the relevant terminology such as rules and constraints, we consider formal institutions to exist in the form of codified and written-down (including but not limited to legal documents) record while informal institutions to manifest in the form of unrecorded and undocumented, using North’s terminology, “norms of behavior, conventions, self-imposed codes of conduct”, common habits and established practices etc.

In regards to Doloreux and Parto’s categorization, the institutions are mentioned here in the order of relevance for the current study. The list starts with regulative, associative and constitutive categories, being the most appropriate ones to the matter in hand, followed by the behavioral and finally, the cognitive category, which is considered to have the least significance and applicability in this case.
Innovation as a systemic Phenomenon

Defining Systems of Innovation

An innovation system can be perceived as the sum of all the determinants of the innovation process meaning the [sum of] all the important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations (Edquist, 1997).

Before we proceed any further, a fundamental question we need to answer is that does the phenomenon we are discussing (i.e. innovation) have the potential to be called a system? In other words, can the process of innovation, both in general and in a spatial context, be considered a systemic occurrence?

Based on the previous contributions of Lundvall (1992), Nelson and Rosenberg (1993) and Edquist (1997), Cooke, Urange and Extebarria, in their 1997 article, argue that considering that a system comprises of a collection of components and the relationships and interactions between them, the processes and interactions resulting in innovation in a territorial context can be conceptualized as a system with universities, “research institutes, technology-transfer agencies, consultants, skills-development organizations, public and private funding organizations and, of course, firms, large and small, plus non-firm organizations” accounted for as organizational features while “flows of knowledge and information, flows of investment funding, flows of authority and even more informal arrangements such as networks, clubs, fora and partnerships” considered as inter-component relationships and interactions(Cooke et al., 1997).

Also Asheim and Gertler, in their 2004 article, argue that, based on the available evidence, innovation activities in recent times more and more rely on the interaction between agents at different levels e.g. firms, suppliers and customers rather than traditional R&D-centered variants hence the growing relevance of networked and interaction-based (systemic) models for innovation (Asheim & Gertler, 2004).

Following this, Seo, in his 2006 contribution to the innovation systems and clusters, argues that since innovation is the outcome of interactions in networks consisting of horizontal and vertical relationships between users, producers and suppliers of different kind rather than the actions of an individual agent, the whole process can be perceived as
a system. Following this, he states that based on the innovation systems literature, this multi-agent interaction is a preeminent measure of innovation together with the strong institutional dimension of innovation processes (Seo, 2006). Considering all this, together with Edquist’s definition of a system adopted for the current study, being a coherent entity consisting of components and their relationships with a specific function and well-defined boundaries, the innovation process in a given spatial context can be considered a systemic phenomenon as it corresponds to all the relevant properties and conditions.

**Implications**

As the systemic nature of the innovation processes in a given context (e.g. spatial) is established it should be noted that such a conclusion has accompanying implications according to the nature and definition of a system.

Cooke et al., in their 1997 article, classify those implications into two categories. One is the classification potential which makes it plausible to categorize innovation-related structures into categories with reference to those of systems (e.g. hierarchical, heterarchical or network, polycentric etc.) while the second one deals with the operational characteristic of a system and also its capacity as a system to be designed. While the first one is relatively straightforward, comprehensible and relatively easy to apply, the latter issue is of a more complex nature. In this regard, Cooke et al. briefly mentions a couple of contributions such as Carlsson, Nelson and Rosenberg and Edquist advocating for or against the designability of such a system in different degrees and concludes that due to the operational issues, there is a strong rationale for considering the notion of regional innovation systems a conceptual perspective rather than an operational one (Cooke et al, 1997).

Also Edquist, in his 2005 book chapter, voices a similar concern and argues that the System of Innovation (SI) concept should in fact be considered as a theoretical framework/approach rather than a theory, based on the fact that it is not able (and perhaps, as he puts it, by some accounts, it is not even desirable for it to be able) to give an exact account of the casual relationships (if any) between the constituents of the
system. He states that alternatively, the regional innovation, though probably after application of some modifications, might be able to yield hypotheses regarding the relationships between the components and/or relevant factors that can, in turn, be put to test through empirical studies (Edquist, 2005).

In general, there seems to be a consensus, more or less, in the academic sphere, about the value of the innovation systems concept, perceived as the aforementioned theoretical framework rather than describing a clear-cut system with full potential to be analyzed, manipulated and ultimately, designed, at least using the conventional methodology and tools applicable to a wide variety of other systems. Having in mind the fact that innovation systems are categorized, as discussed previously under Checkland’s classification, as human activity systems, such a conclusion is, by large, in line with the general perception of the difficulties associated with efforts undertaken in order to analyze and design such systems. This means human activity systems generally don’t respond well to the system analysis and system engineering/design methodologies common in the realm of ‘physical’ designed systems thus making any attempt to manipulate such systems towards fulfillment of specific functions or achievement of certain goals ridden with confusion and ultimately futile. In order to tackle these shortcomings, methodologies such as Soft Systems Methodology (SSM) have been developed and introduced. The aim of such a methodology is to try to deal with the complex real life situations in which, for example, the problem formulation or definition, an essential step in common system analysis and engineering methodologies, isn’t applicable anymore with human activity systems being an obvious example of such a situation due to the subjective nature of observance and conceptualization of the problems by different individuals. Such methodologies though, haven’t been applied extensively to the complications in the realm of innovation systems (to the extent of author’s knowledge) thus their usefulness and effectiveness, so far, hasn’t been tested in this field.

*Strengths and Weaknesses*
In regards to the strengths and weaknesses of the Innovation Systems concept, as a theoretical construct aiming to make sense of the shed some light on the complex and intertwined web of relationships between innovation process constituents, Edquist lists some which he considers worth mentioning. As for the former, the following are considered to be the strong ‘sides’:

- Holistic and interdisciplinary nature of the concept in regards to (its attempt towards) incorporating all factors affecting the process and also taking into consideration a wide spectrum of perspectives from various disciplines e.g. economics, regional studies and sociology
- Putting the (mostly indigenous) learning processes in the epicenter of the innovation phenomenon rather than (exogenous) technological change
- Putting the emphasis on evolutionary [economics] and historical perspectives resulting in rendering any ideas of an ideal/optimal system on innovation inapplicable
- Underlining the significance of interdependent and non-linear nature of innovative activities in the sense that it is the interactions between firms and their immediate environment that is likely to result in innovation rather than the actions of an individual firm
- Taking both product and process innovations into consideration as discussed before and finally
- The fundamental and primary role of institutions in the innovation processes (Edquist, 2005).

As for the weaknesses, two are mentioned:

- The ambiguity and uncertainty around some key concepts such as the definition of ‘institutions’
- Blurred boundaries of innovation systems (Edquist, 2005)

It’s worth noting that, as mentioned before, the supposedly shortcoming of the concept as a theory and its inability to explain the system in terms of casual relationship between its constituents can be interpreted both as a weakness or a strong point depending on the researcher/observer’s perspective.
Major approaches to study Systems of Innovation

In her 2001 paper, Johnson mentions three major approaches to the study of innovation systems namely national innovation systems, technological systems and the network and Development block approaches (Johnson, 2001). Following, we will discuss each approach briefly.

According to her, the main characteristic of the national innovation systems approach is its adoption of the national level, among other possible spatial levels, as the most suitable level of investigating the innovation process. Other than this common feature, different contributors have expressed different views in relation to the focus of the approach. While Porter has put the focus on the competitiveness of the industries and the role of the government and the assistance it can offer to the firms in reaching the competitiveness goal through provision of infrastructure (physical, training, financial etc.), motivations for innovative activities and stimulation of markets, Lundvall, Edquist and Johnson believe in the production and exploitation of new knowledge, on the basis of various sources of learning including interactive learning, to be the key drivers of innovation in a national context. Also mentioned by Johnson, the other major contributor to the approach is Nelson who, in his 1992 work, while comparing national innovation systems for 15 countries, puts the emphasis on internal R&D activities of the firms and its financing, assigns a smaller role to the government compared to the aforementioned authors (Johnson, 2001).

Regarding the second approach, the technological systems, Johnson also emphasizes the different authors’ distinctive perceptions of the initial idea while having the evolution and dispersal process of an individual product or technology at the epicenter of the corresponding system analysis. In this regard, Hughes’s perspective emphasizes on the process of identification of a demand (or so-called problem) and realization of complimentary resources to fulfill it, together with the necessary institutional ‘preparations’ which may include, among all, setting the socio-political stage and overcoming the institutional ‘resistance’ to novelty while Carlsson and Stankiewicz promote a similar concept focusing on the processes of learning and exchange of information accompanied with other necessary ‘inputs’, both in the form of physical
resources e.g. finance and capabilities, and institutional aspects such as appropriate mechanisms to ensure security in transactions and effective resolution and management of conflicts and disagreements. In addition to the aforementioned contributions, Johnson mentions other authors who have adopted almost identical perspectives though not necessarily under the ‘technological systems’ heading. The list includes Lundgren with his ‘industrial networks’ concept discussing the distinction between different actors in identification of the problem and the role of ‘network of relationships’ in regulating the environment and managing the actors’ activities, Gunnar Eliasson with his notion of ‘competence bloc’ who describes the system as comprising of innovators, entrepreneurs, venture capitalists and other financial agents, education-providing agencies (offering skills and competences necessary for recognizing commercially viable solutions and opportunities) and supporting agents who ‘manipulate’ various aspects of the social life to facilitate the process of change, and Bijker’s idea of ‘sociotechnical systems with its three-layered structure: singling out the problem, proposing a range of solutions (and subsequently corresponding artefacts), and primacy of one through institutional change, which also emphasizes on varieties in the outcome of innovative activities in case of different institutional mechanisms.

Finally, the third approach discussed by Johnson, the network approach and the development block approach, are less influential in the study of innovation systems as they have a sub-system focus and don’t take the whole innovation system into consideration. From this line of study, Johnson mentions Håkansson who focuses on the relationships of actors, comprising mainly of companies, in the solution/product development stage, as a specific section of an innovation system, and Dahmén with his Development Bloc concept who stresses the importance of the complementarities of various resources, provided by different actors to the system, in achieving a new balanced situation (an equilibrium) after “structural tensions” have disrupted the incumbent equilibrium and thus realizing the potential of a development (Johnson, 2001). Considering all this, there are two important points to be made here. Firstly, Johnson, in her description of the national innovation systems approach, has chosen (intentionally or unintentionally) to ignore other strains of the same general idea of geographically based, or alternatively, spatial innovation systems. In other words, the concept of national
innovation systems is only one of the variants (although admittedly an influential one) of the more general notion of spatial innovation system. Obviously, in this case, the national level or country level has been selected as the relevant level of spatial analysis but with a quick review of the pertinent literature it can be observed that there is an abundance of smaller or larger scales of spatial analysis which might be sub or supra-national. Different spatial levels will be mentioned in the coming chapters but as an example, regional level of analysis is one of the spatial contexts which has received a lot of attention and significant contributions made by different authors has established its place as another leading line of study on the general subject of innovation systems and based on the arguments which will be discussed further on here, this is exactly the spatial context which has been selected for the study of innovation system in the current study.

Secondly, it should be emphasized that in the review of the approaches using which innovation systems are studied, Johnson, has limited herself to the three approaches mentioned before, thus ignoring another important approach being sectoral perspective in the study of innovation systems. As with other three approaches, here we will present a brief description of the sectoral systems of innovation approach. Initially introduced in Breschi and Malerba's 1997 paper and later detailed in Malerba's 2002 article, a sectoral system of innovation is defined as “a set of products and the set of agents carrying out market and non-market inter-actions for the creation, production and sale of those products” (Malerba, 2002). To be exact, the focus and the level of analysis here is an industry sector while an emphasis on the role of institutions in shaping and regulating the interactions of the system components both within and beyond the original system, similar to what that of other approaches, is existent. It's worth noting that Malerba, unlike Johnson who has taken no notice of the regional innovation systems approach, has admitted to the existence and significance of such an approach. This is similar to what a vast majority of authors have also done and in fact, He has categorized his notion of sectoral systems of innovation as a fourth approach together with national, regional and technological innovation systems approaches. Also another important feature of his contribution is acknowledgment to the complimentary nature of the four approaches and in fact, without some sort of contextual limitation of the scope, it would be very difficult to generate testable hypotheses from any of these theoretical constructs.
and apply the frameworks to real world situations. Obviously, this is also the case with the concept of regional innovation system which is better defined, comprehended and applied inside the boundaries of a specific sector. This is both relevant for the case studied here also the concept of regional innovation systems in general as contextual (i.e. sectoral) delimitations are included into the RIS definition which will be discussed in detail further in this study.

**Different types of knowledge and their corresponding spatial relevance**

It’s a generally accepted notion in the scholarly circles in the innovation field that the process of “production and circulation of new knowledge” (Johnson, 2001) is the basis of innovative activities and many authors have developed entire innovation systems theoretical constructs on the basis of this initial assumption while others have used it in order to advocate their argument. As a result, the study of different types of knowledge and their corresponding geographical relevance constitutes an integral part of the innovation systems (spatial etc.) literature. The aim here is to start from the definitions and comparison of these two types of knowledge and follow the discussion through reviewing Asheim and Gertler’s major contribution to gain necessary insights into the relevance and significance of the subject in the overall innovation systems framework. Lam, in his 2000 article, discusses the two variants of knowledge, being explicit and tacit knowledge, and compares them along three main lines. According to him, the notion of tacit knowledge was first articulated in Polanyi’s 1962 seminal work in which he stated that human beings generally “know a lot more than they can tell” meaning the scope of human knowledge is, by no means, limited to what can be transmitted, expressed and communicated through prevalent channels of communication. This potential for transmission articulation is what is generally referred to as ‘codifiability’ property (Lam, 2000).

He then proceeds to the actual comparison on the three bases namely codifiability and transfer mechanism, methods of acquisition and accumulation and finally, potential for aggregation and mode of appropriation.

In regards to the first basis, explicit knowledge can be codified, specified or
communicated both verbally and/or symbolically relatively easily. It also has the potential to be abstracted and stored in the, as Lam puts it, ‘objective’ world, that is, for example, it can be recorded in a retrievable physical form. More importantly, its potential for formulation, abstraction and transfer is independent of the ‘knowing subject’ and can also span boundaries of time and space. Finally, Lam designates facility of exchange and transmission as the essential feature and characteristic of this category of knowledge from the codifiability and transfer mechanism point of view. On the other hand, tacit knowledge, when observed from the same perspective, is neither easy to codify and transfer nor can be described and detailed easily. In fact, tacit knowledge harbors an intrinsic personal and subjective quality that renders the presence and involvement of a ‘knowing subject’ absolutely essential to the process of transfer, comprehension and utilizing it. In other words, the learning process in this context is ‘action-oriented’ and may entail practices such as what is traditionally called a master-apprentice relationship which, in turn, involves working together and effective communication which results in common understanding of the issue at hand and mutual trust.

As for the second basis, Lam explains that explicit knowledge is transmitted and acquired through ‘formal’ avenues such as formal and tertiary studies with its medium of transmission and comprehension being logical deduction while in the case of tacit knowledge, the acquisition is through practical human experience which can take a whole lot of forms with a major one being various learning-by-doing arrangements. It has been also mentioned that a variety of human-induced factors can affect the quality of such acquisition processes e.g. individual commitment, enthusiasm and dedication of the learning subject.

Finally, Lam, elaborating on the issue of aggregation potential and appropriation mode, emphasizes on the capacity of the explicit knowledge to be codified, aggregated and stored in (physical) locations and in objective forms without the involvement of learning subject. Tacit knowledge, on the other hand, lacks the capacity to be shared or stored in one or more of objective forms. Furthermore, direct application or what we can coin as ‘practical learning’ is the only way the potential of tacit knowledge can be materialized and fulfilled by the ‘knowing subject’ whose close involvement, participation and dedication is considered to be the key contributing factor in, using Lam’s terminology,
appropriation of the corresponding tacit knowledge. Here, the term appropriation means adoption, embracement and ‘localizing’ the knowledge. As described before, these two types of knowledge utilize two distinctive modes of appropriation relating to their respective different natures. To draw a clearer picture of this distinctive nature of the tacit knowledge, Lam employs the terms “personal and contextual” to describe it. Tacit knowledge is personal because it is totally dependent on its willing ‘host’ and transmission medium and it’s contextual as it is only comprehensible and acquirable if put in a certain context. These attributes, naturally, are in total contrast with universal and context- independent properties of explicit knowledge that render it codifiable and transmittable across time and space (Lam, 2000).

Based on the definitions and subsequently, distinctive properties of the two types, being tacit and explicit (codifiable) knowledge, elaborated upon by Lam, Asheim and Gertler argue that the former is the key to the heterogeneity of innovative activity in spatial terms and two reasons are mentioned as major correspondents to the situation: First, in contrast with implicit knowledge, the ‘stickiness’ and context-specific nature of the tacit knowledge in all sorts of innovative activities makes it non-transferable and quite difficult to reproduce elsewhere hence making it an influential factor in strengthening the spatial/locality-based aspect of the process of innovation. Second, the very essence of innovation in recent times, by all measures, is interaction between different agents of innovation such as firms in various locations in the supply chain, knowledge-producing bodies and governmental organizations and the resulting “learning processes” (Asheim & Gertler, 2004) are more likely than not to happen in relationships which incorporate organizational elements in close proximity.

Following this, the authors then proceed to classify industry sectors into two general categories, namely industries with synthetic knowledge base and industries with analytic knowledge bases (Asheim & Gertler, 2004). These two industry types differ from each other in terms of two factors: the proportion of tacit knowledge involved against codified knowledge and “reliance on different organizations and institutions (Asheim & Gertler, 2004).

Suggesting a definition, Asheim and Gertler argue that synthetic knowledge base is prevalent in industries in which the major part of new knowledge is created through
application and recombination of existing knowledge thus tacit knowledge in the form of shop-floor, hands-on and learning-by-doing and learning-by-experimentation is the mainstream type. Majority of innovative work is carried on by the engineer/technician in their daily routines. While the relationship with external research centers and institutes are not uncommon, it’s the user-producer relations and interaction between firms, clients and suppliers, which is the dominant source of innovations. As a consequence, it’s the large established firms that are in the forefront of the industry innovations and are in a position to exploit technological breakthroughs as they have the necessary resources including experienced workforce. As the final quote, the process of innovation in such industries is based on inductive activities rather than pure science-based deductions. Industrial machinery and automotive industries are good examples of this category.

An industry with analytic knowledge base, on the other hand, is characterized by new knowledge dominantly stemming from basic research, R&D (both in-house and externally sourced) and rather radical theoretical breakthroughs hence implicit knowledge. The activities in relation to innovation take place in specialized departments/research institutes rather than in shop floors while performing daily routines. Established relationships with internal dedicated research and development divisions and external public and private research centers/institutes provide the basis for innovations. Furthermore, implicit (codified) knowledge plays an essential role here although the important role of tacit knowledge can’t be ignored either. Since technological and scientific breakthroughs are a major source of inspiration for innovative efforts, small new companies and spin-offs are not uncommon at all and in fact, a considerable share of the innovations introduced into the market have their sources in such firms. And finally, in contrast with what was said about the synthetic knowledge bases, in this case deductive processes, together with inductive ones to some extents, contribute to the development of the innovations. Famous examples include biotech and IT industries, among others.

Next, the authors turn to a discussion on the significance of spatial dimension in the context of these two industry typologies and argue that although it might seem that geographical proximity and spatial concentration should have more influence in case of industries with synthetic knowledge bases compared to ones with dominant analytical
knowledge bases, in reality, it might not be as such. To make the matters more clear, the importance of spatial factors can easily be observed in case of industries with synthetic knowledge bases in the form of the role various institutions play and the capacity of the existing institutional setup in transforming the tacit into explicit (and readily applicable) knowledge and, as also referred to in the origins section here, competence building based on “sticky” properties of tacit knowledge leading to a geographically-bound competitive advantage which is not easy to replicate in other spatial/regional contexts.

In relation to the industries with an analytic knowledge base, similar relevance of proximity-based effects can be found in, as Asheim and Gertler mention based on the results of a couple of studies, several aspects. First, although explicit and codified knowledge is of high importance in the case of these industries, there are still specific knowledge-related phenomena, such as spillover effects, which remain highly spatial-bound and will only be transmitted in the ‘expert circles’ local to those geographical delimitations/areas in which they’ve taken place. An obvious example, as mentioned by the authors, is the information about ‘unsuccessful attempts’, which failed to yield anticipated results (Asheim & Gertler, 2004). The next two aspects both correspond to the significance of highly skilled workforce for industries relying on analytical knowledge bases. While the first of the two talks about the importance of diverse and interesting employment prospects in those high profile localities with a concentration of firms and supporting infrastructure for creative workforce, the second one mainly emphasizes on social aspects in such an spatial context e.g. livelihood, cultural and ethnic tolerance and, in summary, “low barriers to entry” (Ibid.).

Overall, spatial concentration and geographical proximity are considered to be relevant factors in innovation in industries with both synthetic and analytical knowledge bases. Next, the importance of spatial dimension will be discussed further in the more general context of innovation systems as a whole.

*The significance of spatial dimension for the Innovation Systems concept*
In general, the concept of spatial (e.g. regional, national, metropolitan and all other relevant geographical scales) innovation system is an extension of the initial ideas of “territorially based innovation systems” (Asheim & Gertler, 2004) which emphasize on the role of locality-specific learning and knowledge attributes and the influence of knowledge-creating organizations on their immediate institutional environment. Such geographical delimitation is perceived as having an “institutional infrastructure supporting innovation within the production structure” (Ibid.) of the aforementioned locale. Initially, Asheim and Gertler used the description in relation to a more specific case of a locality, being a region, but overall, we believe the same characterization has the potential to be applied to the whole range of spatial contexts of different scales and used across the whole spectrum.

Following this, the rationale behind the introduction of the spatial dimension to the general concept of innovation systems, similar to what Seo has argued in the case of development of the notion of national innovation systems (Seo, 2006), comprises of multiple perspectives.

Starting with insufficiency of firms’ strategy and performance as the sole explanatory factor behind heterogeneous performance of countries and regions in terms of economic growth and innovative activities which has been examined and investigated by a lot of scholars and researchers in the field, the list extends into the relevance of institutional and organizational factors, embedded in any spatial/territorial context and finally, the issue of manageability of the abundance of contributing factors based on which it is argued that any spatial limitation can prove to be extremely useful in facilitating the analysis.

Similarly, Doloreux and Parto, in their 2005 article, discuss three related perspectives supporting the spatial character of innovation: Contextual Innovation view which argues that innovation highly depends on the context, be it institutional, political, economic or social and these contexts usually happen locally or, in other words, are relevant in a geographically delimited locality. Second perspective, Innovation in Social Relationships, emphasizes on the role of social institutions and networks, also deeply rooted in the geographical contexts, in the innovation process and finally the Geographical Concentration and Proximity in Innovation view reminds about the significance of
physical superstructure such as industrial districts, clusters and their immediate effects i.e. localized spread of knowledge and knowledge spillover, among other things, for dissemination of innovative activities (Doloreux & Parto, 2005). This is obviously in line with the fundamental idea of proximity facilitating all kind of exchanges and he fact that innovation, in recent times, is based, more than anything, on the concept of exchange specially exchange of knowledge and information.

**Regional versus other scales**

When introducing the spatial dimension into the innovation systems discussions, it should be noted that it that theoretically, any spatial delimitation could be considered as the locational context, or the arena, for innovative activities and interactions. In fact, there are different spatial scales with each of them offering a distinctive perspective into the subject matter. In fact, different studies have focused on various territorial boundaries. Some examples, according to Doloreux and Parto, include metropolitan (Diez 2002), Urban (or a city’s) (Simmie, 2001) and local/Sub-urban/district (Isaksen 2004, Rantisi 2002, Britton 2003) systems, NUTTSII units (developed by the Eurostat and used in CIS-based analyses) and even the larger sub-national/supra-regional scale (Capron & Cincera, 1998). As previously stated, each and every one of these scales might be able to provide unique and equally useful insights. At the same time, scholars who have put their focus on the a regional scale in the study of innovation systems have put forward arguments in favor of preference of, and adopting, the regional rather than other scales. Some of these arguments, mentioned in Seo’s article, are as follows:

- Physical proximity as a stimulant for interaction between actors that is considered fundamental in the innovation process. As Cooke et al. puts it, this can also be translated into the increase in significance of inter-firm collaborations, as the key factor, “in order to tap into specific expertise or economic efficiencies” (Cooke et al. 1997). Naturally, this can be considered as supporting the application of innovation systems concept in smaller scales e.g. metropolitan and regional rather than the ones spanning larger territorial contexts.
• Significance of “informal routines and norms” (Seo, 2006), which are most likely attributes of a region rather than being valid in a national scale, in the innovative activities and behavior of firms. This, of course, doesn't imply that such institutions are non-existent in spatial delimitations of larger scale, only that those are more likely to develop in more uniform modi operandi in relatively smaller scale locational contexts.

• The value of “face to face contacts” in transferring tacit knowledge which is considered a factor of high importance in the innovation process

Also in their 1997 article, Cooke et al. mention a few more reasons in favor of adoption of a regional scale which add to the strength of the overall argument:

• The increase in specialization across industries leading to more ‘stickiness’ of relevant knowledge and skills in industrial networks and structures

• The fast-growing process of externalization which is a wide-spread phenomenon both in the manufacturing and service sectors

• The significance of ‘mass effect’ for exchange of tacit knowledge, similar to what was argued in relation to the general notion of relevance of a spatial dimension in the context of an innovation system

• The positive role a regional government can play in provision of “elements of a necessary innovation support structure” (Cooke et al. 1997). Here, the regional government represents an “important level of governance of economic processes between the national level and the level of the individual cluster or firm” (Asheim & Gertler, 2004) i.e. the meso level with organizations involved from both private and public sector.

To these factors we can add (the relative) consistency in institutional setup (of the regions) and manageability of scale in comparison with larger scales e.g. national. It’s also worth mentioning that, the terms region and regional in regards to the constituents of an innovation system, being actors and networks of relationships are perceived in a variety of forms. This issue of different perspectives is clearly mentioned in Uyara’s article. Citing from Hassink’s work, she discusses these differences stating that the use of any spatial terminology e.g. regional or local in a context such as an innovation
system doesn’t necessarily mean that those actors and networks are (physically) located inside the perimeters of the system. Rather, it means that, using Uyara’s terminology, “frames of reference and action for system institutionalization and development are defined in local terms” (Uyara, 2010). Here, system institutionalization (and development) may refer to the processes that initiate and facilitate the conversion of any social or symbolic element or activity, “organizations, cultural phenomena, or structures” (Doloreux & Parto, 2005) or all other forms of constraints into what we call and institution. Also, the frame of reference and action, as referred to here, can be considered as the criteria and principles by which the aforementioned processes can be judged as belonging and, at the same time, contributing to the development and formation of the system under study.

**Pre-Definition Notes**

As Uyara puts it, and similar to what was discussed in the case of an innovation system, the rationale and logic behind development of the concept of Regional Innovation System (RIS) is “the need for systemic network relationships for innovation at the regional level” (Uyara, 2010). Using such a notion can help us as we try to understand, explain and make sense of the complex web of connections, relationship and interdependences between abundance participants ranging from organizations of different scales and at different levels to the full spectrum of institutions inside the network environment of the comprehensible framework of a system. In addition to that, DeBresson’s ‘interdependency hypothesis of innovation’, introduced and discussed in his 1996 contribution, also mentioned by Seo in his 2006 article, can be considered as another strong argument in favor of significance and fundamental need for developing a theoretical basis with the potential to explain the interdependent and interconnected nature of relationships between the agents of innovation in a given context as it emphasizes on the tendency of innovation as a phenomenon happening in the ‘clusters’ of firms, organizations providing intermediary services such as knowledge transfer, various suppliers and users with an abundance of connections and linkages (Seo, 2006).

Also, before turning to the issue of definition itself and presenting various perspectives on
defining a hybrid and multi-faceted concept, it should be noted that, as Uyara puts it, each RIS is inherently unique and complex as a result of its spatial, sectoral, institutional and other expressions and this is relevant in both theoretical and policy/application aspects of it. As a result, provision of a uniform definition won’t be an easy job and may even prove to be impossible though some levels of consistency and shared conceptualization are desirable and can certainly be reached in the theoretical aspect. This way, the “one size fits all” pitfall, which has plagued the early innovation systems studies, can also be avoided (Uyara, 2010).

Following this introductory notes, here is a quick review of some general characterizations and descriptions, elaborated on the basis of previous contributions in the RIS field, which will help us ultimately, present a necessary and sufficient definition for the concept:

Reciting from a few previous contributions, the authors of ‘Regional Innovation Systems: Current Discourse and Unresolved Issues’ give out a short description of the concept as “a promising analytical framework for advancing our understanding of the innovation process in regional economies” (Doloreux & Parto, 2005). Here, the authors have put their emphasis on the ‘framework’ character of the RIS concept. Such a depiction of RIS has its own implications in the form of lending an ‘underlying structure’ character to the notion that, depending on the observer/researcher’s viewpoint, can be considered as both a blessing and a curse. It is a blessing as it leaves the door open for, and can accommodate, a whole lot of similar structures of different scales and with varying properties, that deal with innovation policy and dispersal, to be included in the definition. In other words, it is, by no means, a restrictive definition. At the same time, it has its own disadvantages in the sense that the receptivity and tolerance associated with such a general framework strips it from the capacity to perform a whole range of functions usually performed by similar definitions.

Next, is Doloreux and Parto’s account of a regional innovation system as a “normative and descriptive approach that aims to capture how technological development takes place within a territory”(Ibid.). In this representation of the concept, it is depicted as an approach, or rather a method or modus operandi, for describing and understanding of the complex processes that operate in multiple layers of an innovation system. An innovation
system, as referred to here, has been portrayed as, to some extents, resembling a technological regime or technological system, which are, in turn, the terms used to characterize and illustrate all the components that create, frame and control a specific technology. It includes both the physical products and artifacts and the processes and interactions (e.g. social, political, economic etc.) underlying the development of that technology. Also, as stated here, it is considered to be a normative approach as, in the process of probing into the issue of describing, and in its quest for making sense of, the logics behind the complex web of the multi-layered and multi-faceted system at hand, it represents and relies on values and norms concealed in the daily routines of social life. To be more concise, innovation systems heavily rely on, and are mainly constituted of, institutions that are, in turn, predominantly based on a variety of norms and values. In fact, on the basis of what was discussed before, and deriving from Doloreux & Parto’s work, these norms and values are one of the several manifestations of the institutions themselves. The essence of all discussions on the principal role of institutions in the general idea of systems of innovation can be briefed into the aforementioned authors’ fundamental statement about a regional innovation system as it [the RIS concept] “explicitly recognizes the institutional nature of the innovation process and the key elements that influence a firm’s capability to innovate” (Doloreux & Parto, 2005).

**Definitions**

When trying to look for a definition for the regional innovation concept in the relevant literature, one comes across an abundance of contributions, each adopting a unique perspective together with distinctive intermediary tools to be able to present a definition which portrays the phenomenon as precisely as possible. Here, we will try to present a fair sample reflecting the most influential and the ones with the widest acceptance in the scholarly fields:

Asheim and Isaksen, in their article, have proposed a definition that is based on the definition of a cluster. Initially, they start with the notion of an existing cluster and add two important conditions: first, significance of more methodical inter-firm relations that is prone to result in more innovative activities in the cluster and second, existence of a
strong supportive institutional set-up. In the process, they identify two initial types of actors (or rather organizational elements) present in a RIS: first, the main body of firms which, accompanied by supporting sectors, suppliers and customers etc. shape the focal point of such a system and second, organizations such as technical and vocational colleges, universities, public and private research institutes, financial institutions and technology transfer agencies which reinforce and sustain it. As for the cluster itself, Porter’s definition in the form of “a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities” in his seminal work “Clusters and the new economies of competition” (Porter, 1998) is the primary point of reference for the authors. Here, clusters are portrayed as comprising of “an array of linked industries and other entities important to competition” (Porter, 1998). According to Porter, these other ‘entities’ include, among all, “suppliers of specialized inputs such as components, machinery, and services, and providers of specialized infrastructure” (Ibid.). Following this definition, there are two points worth noting. Firstly, the use of term ‘institutions’ by Porter here may not correspond with the definition used in this study. In line with North, here we have adopted the notion advocating a clear distinction between the terms institutions and organization (also by Asheim and Gertler in their 2004 contribution) while clearly this is not the case in Porter’s work as the term institution has been used in a wider and more inclusive sense and in reference to (mostly) physical organizations surrounding the main body of firms in the context of a cluster. And second, is the fact that the relationship between a cluster and a RIS, although close, is, by no means, a simple linear relationship. As Seo also mentions, while “clusters and RIS may co-exist in the same territory and the regional innovation system [of a given area] may in fact contain several clusters” (Seo, 2006) but clusters aren’t necessarily a part of RIS and can in fact exist regardless of the existence of a more ‘comprehensive’ phenomenon denominated an RIS. In other words, cluster-based definitions of RIS state that an RIS always includes clusters, as clusters are the basic ingredients of a regional innovation system but the existence of one or more clusters in a given territorial delimitation doesn’t necessarily result in a RIS being shaped and clusters can exist independently of, or as Seo puts it, co-exist with a RIS. Another definition/description of a regional innovation system, also based on a cluster,
what Cooke et al. have presented in their 1997 article. Here, the point of departure is a regional learning system, i.e. a regional cluster comprised of firms and their network of customers and suppliers, knowledge creation organizations (universities, public and private research institutes etc.) and a wide spectrum of supporting infrastructure and relevant public and private agencies such as business development and support, syndicates and training and technology transfer organizations etc. embracing an associative culture, accompanied by a system of financing and investment able to fulfill the needs of the system in terms of the capital required for innovative activities. In other words it can be portrayed in the form of a region incorporating a dominant associative and cooperative culture in the inter-firm relations within a cluster while scoring high in accessibility of ‘specialized’ services, networks and other relevant resources (physical etc.) vital to innovation (Cooke et al. 1997). According to the same authors, the associative culture, as referred to here, is “systemic i.e. regular and two way interchange of matters of importance to innovation and competitiveness to firms”. (Ibid.) Later on, the same idea is revisited by Cooke and Schienstock as they describe RIS as a “geographically defined, administratively supported arrangement of innovative networks and institutions that interact regularly and strongly to enhance the innovative outputs of firms in the region” (Cooke and Schienstock, 2000).

Doloreux and Parto, in their 2005 article, defined a regional innovation system as “a set of interacting private and public interests, formal institutions, and other organizations that function according to organizational and institutional arrangements and relationships conducive to the generation, use, and dissemination of knowledge” (Doloreux & Parto, 2005). This component-based picture is then followed by the authors’ essential acknowledgement that collective effect of the aforementioned components, being organizations, institutions and the relationships, is supposed to result in a sustained innovative culture and activities in the firms which, consequently, lead to an economically prosperous profile of a region. Again, here the terms ‘institution’ and ‘organization’ are used in a manner that may not fully conform to the definitions presented in this study. According to the authors, institutions are considered to be a specific type of organizations while here, we have chosen to take on an approach that, mainly based on North’s seminal
contributions to the field, keep the two terms relatively independent in order to avoid any possible confusion.

RISs can also be looked at, and subsequently defined, from a more formalist or structural point of view. For instance, Cooke depicts a regional innovation system as a concept with its origins covering a wide range of preceding theoretical and practical contributions as previously discussed in the origins chapter (Cooke, 2008). Eventually these ideas, filtered through the abundance of deliberations and theoretical and experimental contributions, were woven together into a 'layered' system, consisting of sub-systems which support, influence, interact and, most importantly, network with each other to govern the overall process of innovation in any given spatial context. Here, a regional context can be as relevant as any other locational delimitation hence, when put in a regional context, can provide a definition for the RIS concept.

A sub-system based definition can take a variety of forms and include a wide range of sub-systems in terms of functions performed. As an example, Cooke, proposes a system with three sub-systems based on knowledge properties consisting of the knowledge (generation and) exploration sub-system, knowledge exploitation subsystems and an intermediary third one translating the (tacit) knowledge of the former to a codified one useable for the latter, being knowledge translation sub-system. He then proceeds to argue that the efficient functioning of a RIS depends on the transparency between the knowledge exploration and exploitation sub-systems i.e. proper and smooth performance of the intermediary system (Cooke, 2008). (Fig. 1):
Another variety of the same concept, which adopts a different perspective in relation to the sub-systems, again discussed by Cooke in the same article proposes a RIS, again with three sub-systems, based on institutional functions consisting of three financial, learning and productive [culture] sub-systems. In this case, the three sub-systems are considered to act at the same connection level meaning none of them are supposed to take on a 'medium' functionality between the others (Cooke, 2008). (Fig. 2):

Moving forward, Seo presents a component-based definition of RIS in the form of “the localized network of actors and institutions in the public and private sectors whose activities and interactions generate, import, modify and diffuse new technologies” (Seo, 2006). Here, it’s notable that Seo has acknowledged a distinction between actors (i.e. organizations) and institutions. In fact his perspective on the issue of organizations and institutions can be considered as complying with the views and perspectives we have discussed in the previous chapters (definition of institution). It is also in line with Edquist’s definition as he gives an account of the organizations as “formal structures that are consciously created and have an explicit purpose” (Edquist and Johnson, 1997) which is based on a previous publication. Examples mentioned by Edquist include firms (as the main organizational component in the system), universities, financial organizations dealing with financing innovative activities and governmental and non-governmental
bodies involved in innovation policy, standardization and setting and/or enforcing rules and regulations (Edquist, 2005). As for the institutions, Edquist portrays them as “sets of common habits, norms, routines, established practices, rules or laws that regulate the relations and interaction between individuals, groups, and organizations” (Edquist and Johnson, 1997). This means that in comparison, institutions are considered to be “rules of the game” while the organizations are “players or actors” (Edquist, 2005). Examples may include rules and regulations governing the relationships of firms with other firms, with financial agencies or with public or private research institutes. Again, Seo’s ideas are in line with those of Edquist’s.

To conclude, the brief review of major contributions to the definition of the RIS concept is an indication of the fact that the initial idea of Regional Innovation Systems has the potential to be interpreted and defined on a variety of bases and, depending on the viewpoint and the perspective adopted, certain aspects, features and characteristics may be emphasized on or rather infringed. The most common theme, though, in most of the definitions presented is the presence of two fundamental constituents of the innovation system, namely institutions and organizations. For this reason, and also due to more practical matters, such a component-based definition with institutions and organizations at its epicenter is the definition of choice for this study. The pragmatic implication referred to here is in fact, the practicality associated with the study of an innovation system using the institutions and organizations as its building blocks.

Varieties of the Concept

Regional Innovation Systems have been categorized based of a variety of factors and bases of classification. Depending on the author’s angle of view, the relevant perspective is adopted which reflects the requirements of the study and, respectively, the interests of the researcher. Following, we will have a brief review of the dominant and he most widely referred to classifications in the corresponding field:

Uyara, in her 2010 article, mentions two classifications which are based on the organizational typology and the development direction of RIS. A similar categorization has also been mentioned be Cooke in a concurrent contribution:
Top-Down: A smaller scale version of a national system with its function being "top-down coordination of economic processes" (Uyara, 2010), usually by a governing system functioning in the space between the “distant level of governance” (Ibid.) such as national government and firm level such as clusters.

Bottoms-Up: A sub-system of a national or sectoral system with spatial attributes, focusing on localized spillover as dispersant of innovation and innovative activities. In such a case RIS initially consists of an agglomeration of firms with “related variety” functioning as the cohesion factor inundated in a supporting liquid of organizations and institutions that facilitate the spillover. (Ibid.)

As seen in its title, the direction of development for the former is top-down meaning the formation of such systems is usually initiated by initiatives or incentives from higher levels of innovation governance with the intention of tackling the issues in relation to management and guidance of innovation activities in a given region while in the case of the latter, the regional system is considered to be shaped organically and from within, without the any initiation or intervention from higher levels of innovation governance (which can manifest in a variety of forms including a government organization or department responsible for innovation policy etc.). Also the concept of ‘related variety’, as referred to here, being “Complimentaries of knowledge bases and competences which, in turn, will result in stimulating employment creation” (Frenken, van Oort & Verburg, 2007) can be described as one defined in relation to Jacobs’ externalities with its immediate significance being positively affecting the economic growth of a region (as opposed to the unrelated variety, defined as “Portfolio effect of diverse unrelated activities with its outcome being less vulnerability of regional labor markets to external shocks in demand” (Frenken, van Oort & Verburg, 2007) the effect of which is supposed to ‘absorb’ external shocks to a regional economy as a result of changes in demand rendering a specific sector obsolete (Ibid.). In this regard, Jacobs (1970) argues that the concept of “related variety” is the key to regional economic accomplishment and growth. In this sense, she believes both over-specialization and over-diversification (in a given locality such as a region) can result in undesirable outcomes.

To paint a clearer picture, there are three external economies, or rather externalities, which can be considered in relation to the innovation and regional economic performance
debate (Fig. 3):

**Figure 3: Externalities in the innovation and regional economic performance debate**

Both concepts of related and unrelated variety are defined and discussed in relation to Jacobs externalities, putting the emphasis on ‘variety’ as a positive factor in boosting innovative activities and the resulting high scores in economic performance of a spatial delimitation while Marshall (MAR or localization) externalities consider specialization in one or more industry sectors to be the driving force behind successful innovation and subsequently, economic growth and prosperity in a given context. Somewhere in between is the urbanization externalities, explained as the positive effects of urban size and density which can be conceived as a contributing positive factor in both other externalities although a lot of scholars consider it to be mostly associated to Jacobs externalities as opposed to Marshall ones (Beaudry & Schiffauerova, 2009).

Another classification, initially based on the governance of innovation, is mentioned by Asheim and Isaksen in their 2002 article. There, based on empirical studies, three types of RIS are suggested in order to “capture some conceptual variety and empirical richness in this phenomenon” (Asheim and Isaksen, 2002) which, according to the author, correspond also to Cooke’s typologies, discussed with some minor alterations in his both 1998 and 2008 contributions:

- Territorially embedded regional innovation networks, consisting of a local cluster of firms engaged in an interactive systemic relationship based on geographical, social and cultural ties and few or no supporting organizations
• Regionally networked innovation systems, in which the main components are still a collection of firms in a cluster with geographical and socio-cultural links while incorporating a more ‘planned’ characteristic due to the existence of supporting organizational/institutional infrastructure such as research institutes etc. and finally

• Regionalized national innovation systems, which have more of an exogenous character due to the larger number of external connections and also integrates a more ‘linear’ rather than interactive approach as the initiatives are mostly top-down and project-driven as part of a larger systemic interaction in higher governance levels (Asheim and Gertler, 2004).

As mentioned earlier, these typologies can be considered to correspond with Cooke’s categorizations discussed in two separate articles. In his 1998 article, Cooke presents a classification with three categories namely Grassroots, Network and Dirigiste, reflecting the abovementioned categories respectively (Cooke, 1998). Also in his 2008 article, he revisits the same categorizations under different titles as localized, networked and hierarchical regional innovation systems (Cooke, 2008).

Another classification of RIS, on the basis of significance of entrepreneurial activities, is again suggested in another contribution by Cooke (Cooke, 2003). This classification has later been used by the author in order to set the stage for a discussion of the relationship between national and regional innovation systems. The two categories comprise of:

• The ‘old’ interpretation of the idea namely “Institutional Regional Innovation System” (IRIS) and

• The “New Economy Innovation System” (NEIS) also dubbed as “Entrepreneurial Regional Innovation System” (ERIS)

Asheim and Gertler, in their 2004 article, give a detailed account of attributes of each and states that while the former is initially indigenous to the old world strong economies of northern Europe such as Austria, Germany and Sweden, the latter is the dominant model in the Anglo-Saxon economic systems of, for example, the US and the UK. As for the characteristics, the authors, again based on Cooke’s discussion, identify distinctive aspects
of each and discuss those in the light of different socio-economic milieus and the predominant market structures in the corresponding spatial contexts.

According to Cooke, IRIS is the prevalent model in the industries with synthetic knowledge bases in which “the technology and innovation tends to be path dependent rather than disruptive” (Cooke, 2003). The strength of it, to a great extent, lies in the powerful relationship between the organizations active in the production structure of the region (SMEs etc.), coordination of innovative activities with active policy support from all levels of governance, favorable institutional milieu and interaction /cooperation at different levels between firms, customers and different types of suppliers in the supply chain. Also close ties with knowledge-creation organizations in the form of public and private research institutes and universities and the role of providing relevant education tailored to the corresponding industries of the region, carried out by technical colleges and vocational schools is an integral part of the regional system which feeds and supports innovation and innovative behavior of regional actors of various scale.

ERIS, on the other hand, is the dominant mode of innovative activities in the industries that are more reliant on analytic knowledge bases and innovation mostly happens in the context of rather split advances in the technology and/or introduction of novel and new-to-the industry products, artifacts or systems. Rather than reliance on systemic long-term relationships between different elements of production and research systems and a surrounding web of institutional setup comprised of public and private regulatory and supporting organizations, ERIS is formed around venture capital, entrepreneurship and university spin-offs initiated by highly skilled workforce and experts with an idea in hand to be commercialized. As stated by Cook, while the extents of long term effects and support and sustainability of such a system are unknown, they seem to be more flexible and less likely to end up in dead end situations in regards to their development paths (Asheim and Gertler, 2004).

What is interesting here is that, the authors then expand and develop the issue of RIS classification into a more general discussion on (market) economic systems, their varieties and their institutional properties and argue that, following in Cooke’s footsteps, the nature and properties of those systems significantly affects development of regional innovation systems in terms of the classifications mentioned before. The initial argument
here is that differences in the way a national capitalist economy is managed in terms of the level of regulation and overall coordination, to some extents, is directly reflected in their production system and industry competitive advantage which in turn, is translated into divergent national systems of innovation. These two categories are Coordinated Market Economy and Liberal Market Economy. Starting with a ‘coordinated’ market economy, the properties with which such a system is defined consist of:

- A coordination mechanism between private and public organizations with origins not necessarily embedded in market processes but instead stemming from long-established interaction patterns between the economic agents.
- A financial system willing to provide financing and invest in prospects with long term return expectations.
- The ability and willingness in long-term investment and consequently commitment to the workforce; This workforce, itself the product of an educational system which favors vocational and on the job training above all, will then be the basis on which the future innovative activities will be based on through continuous interactive learning and face to face articulation of tacit knowledge. The workforce in this context also contributes considerably to the overall direction of the innovative activity and, as a result, is more embedded and integrated into the whole production system.

Taken together, these attributes form a distinctive governance system, which rules the whole production structure together with all other related systems. Such a system, by nature, is more adopted and specialized in the production of, “complicated artifacts and products for which the manufacturing/production entails complicated operational procedures and tasks together with solid troubleshooting and client services requirements in ‘mature’ industry sectors with a longstanding history (obviously having a synthetic knowledge base). The best examples relevant to this description are machinery industries in northern European countries. The Anglo-Saxon model, or rather the system prevalent in liberal market economies, on
the other hand, is characterized by a different set of attributes comprising of:

- A financing regime majorly based on venture capitalist organizations focused on rather fast circulation of financial resources and short-term returns
- A highly mobile workforce with considerably shorter-term employment prospects which is basically the agent of knowledge transfer and circulation in the economy. As a result, the labor in such a system has a lot less ‘embeddedness’ in the production process and plays a minor role in determining the overall direction of development and decision-making processes as the management processes here demand more authority.

Such a system is generally more successful in the industries with analytic knowledge bases with market-driven production and dominated by fast-paced technological change and product development resulting from radical innovations (Asheim & Gertler, 2004). With a fairly necessary and sufficient definition of a Regional Innovation System at hand, ready to be utilized in the next chapters, the Part A of the theory section of the current study is concluded.

### B. Regional Innovation System in Terms of its Functions and Activities: An Illustration (Based on Johnson, Edquist and White and Liu’s Contributions)

#### Functions and Activities in RIS

*An Introduction*

In the previous chapters, we have established a component-based definition of a regional innovation system in which organizations and institutions are the principal constituents of the system. As it can be expected, when trying to study and investigate a system of any size and complexity, identification and pinpointing the components that collectively form the system can be of fundamental importance.
Over time, different authors and researchers who have been active in the field of innovation systems studies have suggested various approaches in tackling the issue of identifying the components i.e. organizations and institutions of an innovation system from which the concept of functions and activities (or alternatively goals and functions) can be considered a dominant one. In fact, within the context of regional innovation studies different authors have referred to the same concept using slightly different terminologies.

**Johnson’s Perspective**

Starting with the most influential contributor to the concept, Johnson states that the study of innovation systems through a ‘goals and functions’ perspective (Johnson’s preferred terminology) can be justified on the grounds of a number of benefits which have the potential to overcome some major obstacles in this field. First, is the ability to set or define system ‘borders’ based on functions served in a systems that can be very useful when dealing with complex systems such as RIS which go beyond the spatial, technologic and social borders and combine elements of (these) various discourses rather than relying on conventional limitations of those. In such a case, as Johnson puts it, “The innovation system would then include all components that influence one or more of the identified functions for the object of study” (Johnson, 2001). Second, is the ability to influence the system (for example through policy measures) once the system is ‘translated’ into functions (and activities) as the obstacles to proper ‘functioning’ of a specific function are easier to pinpoint and address rather than one of a system’s. Third, if an innovation system is perceived in terms of its functions and how those” functions have been served” (Johnson, 2001) in time, it would be relatively easier to develop a ‘big picture’ of the system and its evolution path. Fourth, easier assessment of the performance of the system based on how well those functions are served and finally, the ability to detach and abstract a system from its actors and, in a comparative study, focus on ‘functionality’ rather than structure of an innovation system” (Ibid.).

Following through the idea of perceiving systems (of innovation) in terms of their functions and (subsequently) activities, Johnson emphasizes that every single system
component is supposed to ‘add’ to the ultimate objective of a system of which it wouldn’t have been conceived part of otherwise. This objective can also be, by author’s account, an ‘analytically constructed goal’ as is the case with more than a few of systems. What is worth noting here, as also mentioned by Johnson, is that the rationales or even directions of individual components may or may not be in line with the overall system goals. Rather, it’s the cumulative course of actions that matters.

Starting with the concept of goals (of an innovation system), and based on what mentioned above, Johnson, inspired by previous contributions, describes the goal of an innovation system as “develop, diffuse and utilize innovations” (Johnson, 2001) and gives an overview of previous inputs into the notion of functions in innovation systems at different levels. Following, in an attempt to extract functions, she probes into major contributions in the field and corresponding functions, defined by the article as “The contribution of a component or a set of components to the goal [of a system]” (Johnson, 2001) are extracted and a comprehensive list of them, categorized into Direct functions and supporting functions, is comprised as follows:

The first set of functions are directly involved in and integrated with the innovation process hence, here referred to as direct functions:

- Pinpoint and identify (technical, organizational etc.) problems or bottlenecks
- To develop a solution or create new knowledge either by combing elements of old (and new) knowledge or by creating totally new knowledge

Starting with the first direct or primary function of an innovation system, it can be performed or fulfilled by a variety of actors or organizations including the firms themselves, suppliers, customers, external actors such as research institutes, regulating bodies, inter-firm organizations such as contractors associations or even government itself through special task forces, relevant departments in ministries etc. obviously in this case performing or fulfilling this function is interpreted as the organization or actor simply realizes a problem either when it is dealing with a new (to the organization) assignment or task or in its daily routines. As mentioned here, a whole range of actors/organizations have the potential to identify the qualifying problem hence fulfill the
function. Johnson sums this up as “within industrial networks, innovation is often driven by the identification of imbalances or bottlenecks in the technological system or the relationships between actors” (Ibid.).

The Second primary function, which is, using Johnson's terminology, the next logical step in the process can be depicted as, in short, solving the problem identified in the previous step and to do this, a solution involving new knowledge must be devised. The source of this new knowledge could be, according to Johnson, R&D (both internal and external), search and experimentation, learning in relation with the “everyday activities i.e. learning by using or learning by doing” and imitation (Johnson, 2001). In terms of who will, or is supposed to fulfill this function, actors/organizations including, but not limited to, firms themselves, external ones such as research institutes, overseas peers or rival companies, customers, suppliers, various arrangements of actors such as partnerships, different government bodies, regulating and standard developing bodies etc. can be mentioned.

On the other hand, indirect, or rather supporting functions are the ones which are supposed to have indirect contributions to the innovation process (here in a firm) but are, by no means, less significant to it. The supporting functions are listed as follows:

- Providing companies with incentives in order to encourage them to be involved in Innovative activities.
- Provision of necessary resources in terms of funding, competence etc.
- Directing the innovative activities of the actors (predominantly firms) towards specific courses which are supposed to be more in line with innovation-related objectives
- Identifying the development and growth prospective (in terms of identifying technological possibility, commercial viability and/or complementary resources)
- Opening the doors for, and provision of necessary prerequisites of free flow of information and interchange of ideas
- Fuel and promote creation of new markets and development of the existing ones as an instrument to encourage innovative activities (mainly in the firms)
- Decrease the amount of risk involved in innovative activities in regards to the transactions between different actors active in the arena.
• Overcoming hurdles and (social, technological etc.) opposition to transformation and changes in the incumbent order and existing system that can happen in multiple ways and across a variety of arenas (Ibid.)

Starting with the providing incentives to the companies, being the first function, Johnson states that companies must be ensured that they will receive appropriate remittance in return for the both material and human resources they assign to the innovative activities and at least part of that can be offset by the relevant authority or the government in the form of some sort of a ‘handout’. These incentives may cover a diverse range from direct measures such as government financial support, grants or other sort of benefits to indirect ones such as subsidies, tax reliefs and property rights (intellectual or otherwise). Clearly, this function will predominantly be performed by various contributing government bodies through a wide spectrum of institutions which can be specifically devised to fulfill the role or otherwise.

The next supporting function talks about providing companies with resources (both material and non-material) required for initiation of, or supporting the existing, innovative activities in firms. Funding and competence are predominantly what is meant here by resources but it has also been mentioned that there might be others which can qualify to be considered as resources (Johnson, 2001). This allocation of resources primarily in the form of funding and competence can happen in a variety of forms ranging from direct approaches such as training and education grants which may overlap the strategies also referred to in the examples regarding the supply incentives function to indirect forms such as funding the tertiary education institutions which will benefit firms in different ways with the education and provision of skilled workforce being the major contributor. As for the organizations and agents who are supposed to perform this function, government bodies, private organizations with or without government initiatives such as financial institutions (organizations), inter-firm organizations such as contractors associations etc., among all, can be mentioned.

The third supporting function, as mentioned by Johnson, is to “guide the direction of search” (Ibid.). As she puts it, such guidance “might influence a company's perception of opportunities” (Ibid.). While different perceptions exist between the scholars regarding
the agent(s) performing this function, a big body of researchers believes that in the
case of a firm, this function is predominantly supposed to be served by actors external
to the firm. The two dominant processes through which the leading and ‘advisory’
activities of this function are channeled include actions e.g. pressure or demand from
customer[s] or suppliers due to the introduction of a new technology and similar effects
created through enactment of standards and regulations set by corresponding
organizations, which “help (or force) companies to choose specific development paths”
(Johnson, 2001). Based on this, the list of performing organizations may include, among
all, customers (through the demand they create), suppliers (through the introduced
novelty), government bodies, standard setting and regulator associations and
organizations etc. through, as mentioned above, their regulatory and directorial tasks and
activities.

The fourth support function Johnson talks about is recognition and identification of
growth opportunities which can be realized in terms of a variety of aspects including new
‘strains’ of technology, potential for financial exploitation (of new markets for example) etc.
This function, having some connections with the third function, can actually be fulfilled by,
among all, the firms themselves, suppliers and, in general, the whole range of actors located
along the supply chain and even government bodies which can, in turn, with reference to the
supporting functions 2 and 3, act on the realized opportunities through the appropriate measures
in the form of providing resources and taking necessary measures to ‘guide’ the direction of
firms’ policies, investment and activities in accordance with the aforementioned opportunities.

Support function number 5 talks about any actions having the potential to mediate and
support better communication and exchange of knowledge and information between
actors relevant to the innovation process. This facilitation of exchange can happen
externally to a firm in the form of promotion of cooperation in relation to other firms
(peers, suppliers, rivals etc.), corresponding agencies and other organizations. Equally it
can be internally applicable to a firm translatable into the ease of communication and
effective articulation of ad rem information between the individuals and divisional units
e.g. in the inter-departmental space. Similar to other functions, this function can also be
fulfilled by our fundamental unit of study, the firm, as it initiates and regulates its
communication ‘lines’ on a regular basis with external actors and also governs its internal
information transmission and exposure procedures dealing with a whole range of inter-organizational actors and stakeholders. Additionally it can be fulfilled by any other agent or organization dealing with the same process of knowledge circulation, distribution and sharing. This can cover the whole range of intermediary and supporting organizations (both governmental and non-governmental) with the potential to contribute to the aforementioned process. Examples may include, among all, major trade organizations or syndicates and other professional associations of companies including related panels and forums with support from ministries and government bodies or more limited inter-firm partnerships, cooperatives and agglomerates.

The next support function is, using Johnson’s terminology, is to stimulation of the existing, or creation of new markets. Although not discussed in any detail in Johnson’s article it has been briefly mentioned that, based on some scholarly contributions, markets may not be created impromptu and major or partial intervention (predominantly by the government or in joint efforts with the government) might prove necessary at some stage. There is also a brief reference to the arguments of some researchers who consider the function of creation/stimulation of market to be more of a direct function in relation to the innovation process rather than a supporting/secondary function. In regards to the fulfillment of this function, government (through corresponding agencies, policies, etc.) is primarily considered to be responsible for devising and implementing policies in relation to this function although an abundance of examples can be found when resourceful firms have successfully formed and carried out their own market creation and stimulation strategies and initiatives.

The sixth function Johnson discusses is to “reduce social uncertainty” (Johnson, 2001). Social uncertainty, as explained here, is inability to predict about the outcome(s) of a transaction within a specific social context which has the potential to eventually result in a major disagreement with the context, here, being the immediate environment in which a firm interacts with other economic agents with innovation and related transactions as part of it. As explained by Johnson, this can be achieved through either provision of useful information about the possible reactions of the other parties or, alternatively, initial reduction or elimination of the need for such information. Just as a variety of institutions can be mentioned as examples in relation to this function such as legal, financial and
corporate relations regulations, the organizations which usually carry out this function are abundant. They could span public and private boundaries and can include, for example, the vast variety of organizations offering financial services (mainly to the firms) through partial absorption of financial risks, trade unions and professional associations through advocacy, pursue of common interests and providing assistance in regulating the business environment and resolving industry-wide road bumps.

Finally, the last of support functions mentioned by Johnson is to curb any opposition that might exist in the path of ‘change’, be it in the form of a reform or a radical one. As a general rule, introduction of any sort of novelty is highly likely to face numerous challenges that could stem from different sources and may happen as a result of countless interactions between the agents active in economic domain. Next, Johnson presents two examples of such interactions and, reciting from different sources, briefly mentions methods that can be utilized in order to overcome such resistance ranging from creating and boosting relationship between the actors with the aim of collecting momentum behind the novelty/innovation to instigate and provoking general impulse towards the aforementioned novelty and laying the necessary foundation for the introduction in terms of possible legal and political prerequisites (Ibid.). As for the organizations having the potential to fulfill this function, again, it could include a wide range of public and private ones starting from the individual or agglomeration of firms, professional and trade associations and syndicates, regulating and standard setting bodies both governmental and non-governmental and even governments through their direct or indirect intervention in favor of, for example, a new technology.

To sum up, Johnson proposes an approach which looks into the question of (regional) innovation systems through a ‘goals and functions’ spyglass. The approach defines the common goal of an innovation system and on this basis, presents sets of direct and indirect (supporting) functions which can, in turn, be utilized to facilitate the study of RIS as a complex system from different aspects.

*White & Liu’s Perspective*
Next in the line of similar approaches towards the RIS is White and Liu’s contribution. The authors in their 2001 article employ the same goals, functions and activities perspective in the study of RIS with minor changes in the definition of the concepts. Their fundamental point of departure is the criticism of a large body of systems of innovation studies in regards to their initial assumption being “a generalized, organizationally-defined typology of actors and the generic, disembodied institutions that influence them” “(White & Liu, 2001) and they initially state that their fundamental argument, or rather objective, in adopting such a perspective is to avoid, using the authors’ term, asking “actor-centric” questions e.g. the role of a given or assumed organizations in an innovation system. Potentially, these actor-centric perspectives could be problematic as they tend to take a standard structure for (any) RIS as given and effectively shifting their focus to positioning and ‘inserting’ individual organizations they come in contact with inside that pre-defined structure or organizational ‘map’. Instead, their intention is to replace this with a functions and activities perspective which, similar to Johnson’s approach, examines RIS through a set of functions and how they are served. The difference here though, as mentioned before, is a slight divergence from Johnson’s in terms of naming conventions of the principal definitions. While Johnson designates a regional innovation system with a fundamental goal and a numbers of functions which are served to the ultimate objective of realizing the goal itself, White and Liu use the term ‘function’ as equivalent to the goal of a RIS in Johnson’s terminology and employ the denomination of ‘activities’ as a concept comparable to that of a function as utilized by Johnson. The relationship between the two terminologies is depicted in the following illustration (Fig. 4):
Following, White and Liu, based on numerous previous contributions, suggest five fundamental “activities of innovation process” with the objective of inferring the system components (organizations and institutions) from those later on instead of having an organizational and institutional structure as a presumption and try to accommodate the role of existing components to that. These activities include:

- Research consisting of basic, (product) development etc.
- Implementation (with the authors’ focus mainly being on manufacturing side)
- End use (product customers or those receiving the output of the process)
- [Provision and facilitating] linkages defined as “bringing together complimentary knowledge”
- Education

In regards to these activities two points are worth noting here. One is that the list of activities here are mainly comprised and collected from a set of contributions and literature related to production/manufacturing sectors and corresponding technological regimes and thus, lacks the capacity to be fully applied to different technological regimes and industry sectors such as services or technical consultancy sectors etc. In fact, some levels of revision/modification might certainly be necessary in order to render them applicable for the purpose of the current study or similar ones. Still, here we consider them to be a good starting point in this discussion as they have the potential to be used as
a basis and a guide for composing a more relevant list in a more detailed study. The second point, and probably the more significant one, is the fact that the aforementioned list, as is the intention of its authors, has been prepared with a systems level perspective in mind. The current study, rather, having the idea of a firm being the basic and initial unit of study, has a distinctive focus and the use of activities mentioned here to infer components (in other words connections and connection points) from, should be done with this in mind.

The authors then, present a categorization of organizations/actors into primary and secondary tiers. This classification can also potentially be used in simplifying the analysis of complex and interwoven network of actors (organizations) interacting in the immediate environment (institutional context) of an individual firm similar to what it does in its current setting in a system-level study. In this regard, ‘primary actors’ are described as those ones which are directly involved in one or more of the five innovation process activities while the ‘secondary actors’ are the ones which, through their actions and interactions with primary actors, influence the accomplishment and performance of the activities and consequently, the innovation process as a whole. These actions and interactions of secondary actors, by the article’s account, include direct ‘delegation’ of particular activities by means of “dictating operational plans, setting organizational targets, or deciding other operational or strategic means or objectives related to any of the fundamental activities” (White & Liu, 2001) or indirect influencing through institutional apparatus. Examples of the latter include policy instruments such as tax incentives or deterrence, employer and employee relationship laws or foreign investment regulations.

**Edquist’s Perspective**

Edquist’s contribution to the goals, functions and activities perspective of RIS follows the denomination convention of White and Liu meaning by its account, RIS has one main function, defined as “to pursue innovation processes i.e. to develop, diffuse and use innovations” (Edquist, 2005). He calls this main function the ‘overall function’ and
discusses it in the more general context of (all) innovation systems rather than specifically a regional one (RIS). Following this, he defines activities of RIS as “factors that influence the development, diffusion and use of innovations” (Ibid.) and, in reference to E.H Carr’s ideas, considers them to be equivalent to determinants or causes in the study of history and historical phenomena. Based on this, he promotes the notion of compiling a set of determinants, here referred to as activities, and organizing them into a hierarchical order to facilitate “developing theories about relations between specific variables within the approach in a pragmatic way” (Ibid.).

In the next step, he presents a list of activities sourced from the available literature and author’s personal insight on the matter as follows:

The first and the essential activity in the process of the innovation process being generating novelty and creation of knowledge, predominantly on the basis of research and development conducted in R&D-intensive fields.

Next (activity) talks about pouring the foundations for undertaking R&D in the form of development of skills in the workforce and providing education to the workforce with the ultimate goal of supplying a competent manpower for the innovation process.

Similar to Johnson’s fifth support function, the third activity is (assistance in) creating new markets for products that are to be developed. This is, by author’s account, a demand-side function as it supposedly influences the process of innovation through creation and stimulation of demand for the ultimate ‘fruits’.

The next activity, by Edquist’s account, is again a demand-side one emphasizing on the significance of developing standards and ‘quality requirements’, usually by the customer, or rather demand side and communicating those to the relevant agents active in the process. Such standards, if appropriately developed and set high, would in turn encourage the firms to employ more innovative measures to address those and pave the way for a better functioning innovation system to evolve over time.

Edquist’s next activity talks about founding and new agents and organizations that could prove useful, in one way or another, in the process of innovation. The task of establishment and initiation here includes both the creation of organizations from scratch and initiation and stimulation for changes in the existing ones in order to make them a better ‘fit’ for the task at hand, being creating motivation and inspiration for innovative
activities. Edquist mentions encouraging entrepreneurial (and also intrapreneural) efforts together with more straightforward tasks of starting up new research institutes as examples for this activity.

The sixth activity, as referred to by Edquist, revolves around the concept of sharing information and acquired knowledge between organizations responsible for advancing innovation. According to him, this sharing of information through networking activities presents firms with a chance to complement their acquired knowledge, sourced from their in-house research and development or other processes e.g. learning by doing, learning by interaction etc. with other players’ knowledge. This activity is of specific importance as the essence of innovation in recent times, as previously mentioned, lies in the close contact between the agents active in the innovation system and the networking between them.

The next activity, similar to what was discussed in the fifth activity, is about creating new ‘components’ of the innovation system. The difference here is that it talks about creating new institutions, as opposed to organizations in the fifth activity, which have the potential to contribute to the innovation processes in one or another way. Edquist has then briefly mentioned examples of laws, regulations and routines that fall into this category of institutions with the potential to contribute to the creation or supporting and sustaining IS.

Edquist mentions the eighth activity as being a support ‘platform’ for other relevant activities of IS i.e. Incubation, nurturing and offering support for other activities in the form of provision of services considered to be generally important for all of them which can include, among all, assistance in managerial aspects or facilitation of access to vital physical, learning etc. infrastructure.

The ninth activity, deals with the subject of financial support of the innovative activities and innovation, in general. In this regard, the vitality of finance in the innovation process in order to advance the ‘commercialization’ goal(s) of an innovation system has been emphasized. The significance of financing is, in fact, a widely accepted idea a recurring theme in almost every scholarly discussion with innovation at its epicenter.

And finally, the last activity mentioned by Edquist revolves around the notion of assisting the process through general consultancy support services. Examples of these services, as
described by Edquist, are “technology transfer, commercial information and legal advice” (Edquist, 2005). It is worth noting that a substantial overlap between this activity and activity No. 8 in terms of offering supporting services for innovation related activities. The difference between the two, though, can be described along two lines; firstly the timing of the provision of services and second, the range of services offered. As for the timing, the eighth activity, as indicated by use of the term ‘incubating’, refers to facilities available to the system agents in order to encourage and ‘kick start’ actions that will ultimately lead to innovation i.e. commercialization of developed (material and non-material) products while the focus of the tenth activity is on the on-going support and assistance in the realization and implementation stage. In regards to the range of services the assistance offered in the activity number 8 as of a more general nature while the scope of services discussed in the activity number 10 has a more specialized focus and revolves around provision of information which are more specific to the task at hand which are not readily accessible to those involved in the process of innovation.

To sum up, three perspectives on the functions and activities in an innovation system have been briefly reviewed here; Johnson’s notion categorizing the functions into two categories of primary and supporting ones and while being of a more general nature, it also focuses on the organizational side of the story and tries to offer an insight into the organizations responsible for fulfilling each individual function. White and Liu’s ideas which, while having its departure point in Johnson’s ideas and also shares its ‘general’ outlook, employs a distinctive terminology and produces a set of activities (functions by Johnson’s account) with physical production and manufacturing sectors in mind; and finally Edquist’s contributions which, again based on numerous previous contributions to the concept, presents a somewhat more detailed set of activities in an innovation systems.

As for the concluding remarks of this chapter, the three major perspectives discussed here obviously have a lot in common both in terms of their overall conceptualization of the whole innovation system, the specific angle of view employed as a prerequisite for their attempt to interpret a complex human system in terms of its goal, function and activities and ultimately, the functions and activities identified. At the same time, they incorporate clear distinctions based on, using an analogy, the individual ‘spyglass’ different authors have picked to probe into the system. Conclusively, the goal here is, by
combining elements of all three perspectives we can achieve a better understanding of the current approach adopted for the study of the innovation systems and also compile a more comprehensive set of functions or activities in order to be used further in the study as the raw material, or rather building blocks, to develop an umbrella framework with the potential to cover and explain both institutional and organizational components/elements of a regional innovation system immediately ‘surrounding’ the individual firm.

C. The Institutional Setting of a Region (Based on Cooke’s Contributions)

Introductory notes on a Macro Perspective

The third part of the theory section of this study is dedicated to the review of the institutional setting of a region. This will predominantly be based on Cooke’s ideas. This review will shape an important part of the foundation on which basis we intend to synthesize a hybrid framework for adaptation of the system perspective of the RIS concept into an individual firm perspective. As this is previously discussed in the thesis structure section in detail we will not elaborate on that any further here.

In their 1997 article Cooke, Uranga and Extebarria discuss the institutional setting of a region in detail, presenting a classification of four categories as illustrated here (Fig. 5):
Figure 5: A macro perspective of the institutional setting of a region

As it can be seen, the account of Cooke et al. of the institutional setting of a region is denominated and depicted as a ‘macro’ perspective. The reason for such a choice is the fact that the authors’ perspective, similar to that of the majority of the researchers in the field, is focused on the ‘system level’ thus reflecting the overarching institutional setting of a whole region, defined in the form of, using a physics analogy, the overall institutional ‘electrolyte’ in which all the organizational components ‘float in’. In other words, it includes abundance of systemic relationship between abundance of constituents of the innovation system hence enveloping a much wider range of institutions in terms of both number and outreach and this is exactly why we have decided to denominate it as the macro perspective in the discussion of institutional setting.

It is worth noting that, as inclusive and ‘macro’ its point of view may be, Cooke et al.’s description of the general institutional setting of a region will help us tremendously in developing our understanding of the institutional implications of such a system and finding indications which will ultimately lead us to identifying and pinpointing those institutions which are in direct and close interaction with an individual firm within a spatial (and in this case) regional innovation system.

As it might be expected, this macro viewpoint will be matched against a micro perspective of institutional settings further in this study which, in contrast with the former, won’t be based on any previous contributions. Instead, it will aim to use hands-on and first-hand experience of the author to help develop a more ‘intimate’ view of the institutional setting in which the individual firm is inundated in, thus having a much smaller scale while looking through a much more focused lens. It shouldn’t be ignored, though, that the micro perspective isn’t supposed to form a totally independent analysis. Rather, it is intended to borrow a lot of inspiration from the former and utilize them in order to develop a more comprehensive micro viewpoint.
Cooke’s perspective

Part 1, Financing:

Reciting from previous contributions, Cooke and others mention a classification of the financial systems which can be considered to be relevant in any territorial domain having a coherent governance system for governing of the economic activities. The classification has been illustrated here (Fig. 6):

![Classification of financial systems](image)

**Figure 6: General classification of the financial systems**

Starting with a market-oriented finance system, it is defined as a system where “funds are allocated in a developed capital market” (Cooke et al. 1997). A more comprehensive definition, presented by Levine, describes a market-oriented system as one in which “securities markets share center stage with banks in terms of getting society’s savings to firms, exerting corporate control, and easing risk management” (Levine, 2002). Examples of such a system may include UK and the United States, among all. Subsequently, it is briefly argued that this type of financing system is the most difficult to perceive and subsequently apply in case of a region and in the context of a regional economy due to the high levels of ‘centralization’ and ‘internationalization’ (Cooke et al. 1997) of the economic activities which are the most natural and inextricable attributes and properties of what we generally call ‘free markets’ or rather ‘free market economies’. This is totally understandable as within such a system with an abundance of extra-regional and extra-national actors present, together with an economic governance arrangement with very little or no tools (in the form of policies, regulations etc.) to have an impact on, and
influence, the implications of a free finance market, and where the financial exchanges are carried out in higher levels not accessible for regional financial jurisdictions, regional authorities are very unlikely to be of any significance or have any sort of ability to contribute to the shaping and development of a regional innovation system. In such a case, it can safely be concluded that where a market-oriented system is the prevalent mode of exchange in a regional context, a considerable share of the institutional aspects in relation to a regional governance will be rendered impotent and thus, irrelevant.

Next there are the first model of credit-based systems in which the (regional) government, or rather the financial governance system, has, and thus exercises, minimalistic control and authority in order to intervene. A credit-based, also called a bank-based, finance system, as referred to here, is a system in which “banks play the leading role in mobilizing savings, allocating capital, overseeing the investment decisions of corporate managers, and in providing risk management vehicles” (Levine, 2002) meaning the center stage, as Levine calls it, isn’t shared with securities markets as is the case with the free-market systems. At a national level, Germany and Japan could be considered as examples of credit-based systems. In regards to the effectiveness and performance of a type 1 finance-based system, there are a lot of similarities between this system and a free-market one due to the fact that regional government has a minimum of control over the dominant financial system, or rather governance of financial activities of the region, initially rendering it with very little ability to dictate policies or guide the development of financial services relevant to innovative activities. On the other hand, because banks are the prevalent providers of financial services in the context of the region, the development of the financial service sector can potentially be affected by one factor with regional significance. In fact, despite the widespread globalization and internationalization of banks and banking services, a lot of banks still reflect some spatial e.g. national, regional, local etc. attributes of the territorial domain they service in terms of the type and quality of the services and also the procedures followed thus there is a real likelihood and opportunity for indirect influencing the actions of those financial institutions and subsequently, governance of financial systems. In other words, if specific financial modes of exchange and routines have already deep roots in a territorial context, the incumbent small-scale financial institutions (in the form of local banks or credit
unions) must have developed in parallel with the mainstream financial traditions and routines and have already both influenced and are influenced by its development. In such a case, most probably the external newcomers e.g. national or international financial institutions will follow suit and offer identical or similar services under comparable arrangements. An obvious example is agricultural credit unions in the large agricultural aggregations with their existing finance arrangements which are the outcome of longstanding historic transactions and co-development of financial services with other aspects in a traditional sector. Another example is the difference in conditions of home loans between countries like the US and Australia, among all. This difference in terms of stricter conditions and financial background check partly contributed to Australia both not being heavily affected by the consequences of Global Financial Crisis at the time it happened and also leaving the later aftermath behind in a relatively safe position and with minimal financial ‘bleeding’.

The Third category, being the credit-based system with considerable government control and regulation, is the one in which the regional government has the strongest potential to influence, and can exercise some levels of authority over the development of financial system. In such a system, exactly as was the case with the previous category, the overarching role of banks and similar financial institutions, together with the fact that the regional attributes will potentially be reflected in the arrangement of the financial system, puts the regional government in a better position to influence the development of the system indirectly. In addition to that, in this case the government has the ability to control and regulate various aspects of a regional economy including financial services through introduction and adoption of policies and legislation. This can both be performed through direct regulation and control over the activities and policies of the banks and other financial institutions in regards to innovative activities or through policies and regulations that affect the actions, decisions and attitudes of such organizations towards innovation in general and firms’ innovative activities, specifically.

*Part 2, Budgetary*

Cooke and others, in the next step, turn their attention to budgeting and budgetary
systems in the study of the institutional setting of a region. Basically, they recognize three distinctive types of regional budget systems. This classification has been done on the basis of the level of regional (government’s) authority in budgeting issues and spending capacity compared to higher levels of government as illustrated in fig. 7:

Figure 7: Classification of the regional financial systems

Starting from the Decentralized Spending category, Cooke and others argue that this is the case where the regional government has the least capacity and potential to stimulate or support the development of a regional innovation system. In such a situation, the sole contribution from a regional government to the budgeting and subsequently, spending the corresponding revenue is to adopt an administrative role meaning it can only oversee the efficient, or as mentioned in the article ‘effective’, process of spending a pre-determined budget i.e. amount of money on pre-determined budget items e.g. projects that are in need of funding (Cooke et al. 1997). Needless to say that any contributions from the regional government to the formation and development of RIS or supporting an existing one totally depends on if the higher levels of government have entertained such ideas and have allocated necessary funds in the budget to the related activities.

In the Autonomous Spending category, though, the situation is different in the sense that, the regional government has the authority to make decisions, or at least heavily influence the decision making process in regards to how, and on what budget items the budget should be spent (Ibid.). In this case, it is very likely that the government doesn’t have much of a say in raising the revenue for, the amount of, or allocation of the budget itself. What it can do, though, is simply to decide how to spend it. Obviously, in such a case the
regional government can include necessary provisions for monetary contributions relevant for guidance, development and support of RIS in their financial planning and budgeting and even prioritize the corresponding activities over others in ways it deems appropriate.

Finally, regional governments who enjoy autonomous spending provisions and can also raise necessary revenues predominantly in the form of imposing and collecting taxes are the ones who have a wide range of tools accessible to influence the direction of innovation and innovative activities, for example, in the form of ability “to carry out proactive policies through public spending as well as through the fiscal system (for instance through benefiting innovative firms and institutions)” (Cooke et al. 1997). To put simply, those governments can both raise revenues and decide where to spend those so naturally, they are in the best position, compared to the other two categories, to initiate actions and assist the ‘grassroots’ activities already existent in the context of their corresponding spatial context (here a region). Such indigenous activities can span all levels of governance such as firms, cluster and local/regional government level and can manifest in an abundance of forms with a whole range of scopes depending on their corresponding source.

**Part 3, Physical Infrastructure (Investment and Management)**

Physical infrastructure, as referred to here, is described by Cooke and others as constituting of “the physical make up of the regional space and make possible the multiple relations that are established between the different agents in a regional economy” (Cooke et al. 1997). A more general description is presented by Fulmer in the form of “the physical components of interrelated systems providing commodities and services essential to enable, sustain, or enhance societal living conditions” (Fulmer, 2009). Considering each, it can easily be argued that physical infrastructure is both an integral and fundamental part of, and contributor to, any economy within all spatial contexts and the institutional aspects of it, namely the issues of investment in, and management of, it form an essential part of the overall institutional setup of the aforementioned spatial context e.g. regional.
Again, Cooke and others have classified regional authorities/governments into four categories based on their authority, control and influence over physical infrastructure expenditure, investment and management as illustrated in fig. 8:

![Diagram of regional control/authority over physical infrastructure investment and management]

**Figure 8: Classification of the regional governments based on their authority over infrastructure investment and management**

Starting from category one, not only the regional government has no control or authority over the level, the arrangement and the policies related to the issue of investment and financing of infrastructure but also it has no say in the implementation process, carrying out the actual plans or even management of it (Cooke et al. 1997). Naturally this can be the case of a territorial sovereignty with a central government having a total monopoly over infrastructure planning and management with very little authority left at the regional and local governments’ disposal to exercise. In addition to such cases, according to Cooke and others, even in political systems where regions, states or other territorial delimitations have a lot more autonomy and freedom in carrying out their own infrastructure planning and implementation, there are certain aspects, or rather sections, of the infrastructure for which central governments prefer to retain the control. Examples may include airports and some basic telecom provisions (Ibid.). In regards to the regional governance/government’s ability and potential to influence and stimulate the formation or development of RIS, this is obviously a worst-case scenario as the local authority is totally stripped of any tools through which it might have been able to initiate and boost the activities with potential to contribute to the goal of formation or support a regional innovation system.

In the second category the region, or rather the regional government has some degrees of
influence and can exercise some control over the implementation of infrastructure planning (which has been done in higher levels of government) and may even have the authority to manage them after the initial planning, design and execution phases (Ibid.). Clearly, the regional government is in a relatively better position here to try to assist and encourage the formation or strengthening the existing processes that contribute to the emergence of a RIS but still, its influence is, to a great extent, limited due to the fact that it lacks any real capacity in planning for the infrastructure deemed necessary. In fact, the only area in which it might have some influence is the management of both existing and planned infrastructure. As an example, the scheduling execution plans for specific communication infrastructure projects can be managed in such a way that will focus on, and prioritize, the areas in which technology parks or other industry clusters are either existent or planned.

Next is the third category in which the regional government shares the initial investment for the physical infrastructure with the higher level(s) of the governance, for example federal government. Clearly, in such a case the regional government is significantly involved in the high-level planning of infrastructure thus giving it a larger extent of freedom together with the authority to be able to affect the decision-making process and guide the direction of development for physical infrastructure in order to facilitate and support the emergence and growth of existing or potential RIS. Clearly, this is a direct consequence of its relative financial self-sufficiency, its capacity to raise funds independently and ability to invest, accordingly.

Finally, there is the case of the regional government having the full control over all aspects of the physical infrastructure from planning to design, funding, execution and management. It should be considered that, as Cooke also mentions, it is very unlikely that this would be the case with the large-scale infrastructure such as primary communication networks. Rather, intra-regional physical infrastructure such as local transport networks with their corresponding transport hubs or small-scale high-speed communication networks servicing a limited range of customers/clients within a limited locality are likely to be the plausible candidates to be considered as the physical infrastructure which can be planned, controlled and managed by a local/regional authority relatively independently and without much connections to the parallel infrastructure at higher.
levels.
It is worth noting that profiling of regions based on their regional government’s authority and jurisdiction over physical infrastructure planning, expenditure and management can, by no means, give a comprehensive picture of a region’s capacity to encourage and support innovative behavior in the firms or ability to contribute to the rise of a regional innovation system as a result of the relevance of an abundance of other factors involved. An example, as presented by Cooke and others, is the regions with highly developed physical infrastructure having the capacity to contribute to the region’s innovative capabilities with very little or non-existent input from the regional government (Cooke et al. 1997). Such a situation could happen due to a whole lot of reasons such as the lack of regional authority or the result of the effects of geo-economical factors at different spatial levels or political arrangements. An obvious example is metropolitan quarters in the capital cities of the centralized states/dominions.

*Part 4, Learning Infrastructure*

Cooke and others, in their 1997 article, mention three different analytical approaches under which the subject of learning can be investigated:

- Different perspectives of learning (e.g. learning by using, learning by doing, learning by interaction etc.)
- Changes involved and entailed in the process of learning meaning that learning-related changes are often accompanied by other institutional changes such as cultural, rules and habits and that is exactly why the process of learning could prove to be a somewhat difficult one and significant organizational changes might be necessary due to the existence of costs, incumbent routines etc. that accompany the process.
- Prerequisites of every learning process such as incentives and motivations, tools and means, and individual and organizational abilities

The authors then proceed to state that in studying the (macro) learning infrastructure in the context of a RIS, the second and third approach are of more significance and deserve
to be probed further (Cooke et al. 1997). To make it more clear, looking through these two perspectives, it can be realized how a regional government will be able to play a role in providing the necessary learning infrastructure which can, in turn, contribute to the innovative objectives of a regional economy. These innovative objectives can be realized under a variety of conditions and in a variety of forms one of which is the formation of an innovation system in correspondence with specific sectoral and spatial (in this case regional) contexts.

Following the above discussions, Cooke and others suggest three major roles to be adopted by the government at different levels including a regional one. Clearly, what has been suggested by the authors is initially taking place within the abovementioned perspectives thus reflecting the core concepts of those analytical approaches. These three roles comprise of:

- Equipping [the society] with learning tools and mechanisms through “public investment in the education of novelty” (Cooke et al. 1997)
- Upholding and recognition of science, technology and all that can be categorized under the general umbrella of ‘knowledge’ and “keeping technological options open (Ibid.).
- Diffuse and divide all different costs of change which can span a whole range of costs from personal to social and organizational

As expected, the government roles mentioned above can manifest in an abundance of (daily) routines, policies, rules and regulations etc. together with specific initiatives designed and implemented in order to tackle possible shortcomings and gaps to be filled in relation to dispersing of innovative activities in a given spatial or territorial context such as a region. Examples of these will be discussed in the following chapters as we investigate institutional setting in more detail.

**Synthesis**
A. From Cooke’s Macro perspective to a Micro One: A Change in Scale

Initially, Cooke and others in their study of the institutional setup of a region mention four categories from which the relevant institutions can be inferred at a system level. Translating these categories from this system level perspective, which we refer to here as ‘macro’, to a more focused level in which the individual firm is at the epicenter of the study, called a ‘micro’ level of analysis, isn’t necessarily a straightforward transaction. Obviously this is the case in any analysis involving a change in scale. In other words, the same principles and bases on which an analysis is performed might not necessarily have the potential to be ‘down-sized’ but there are instances that this could be safely performed. In this case, though, we will, justifiably, utilize the same principles and categorization of the larger scale analysis and infer distinctive focal points in terms of institutional setup in the process of adapting them to a much smaller scale.

As previously mentioned in the actual section on the institutional setting of a region, Cooke and others have categorized the overall institutional setting into four categories to which all the institutions observed belong to. Theses classes include, financial institutions, budgetary institutions, institutions affecting the investment and management aspects in regards to the provision of physical infrastructure and those which relate, in one way or another, to the learning infrastructure present in a specific region. Here, we will have a brief review of the categories and discuss the implications of the scale change for each in terms of its applicability and any changes that might be necessary before the aforementioned category can be considered for a similar analysis at the individual firm’s level.

Starting from the finance system, Cooke et al. present a general classification of the prevalent finance systems of different regions and how financial institutions of different regions differ from each other. Using the same basis, if a similar general category is to be applied in the case of an individual firm, it has to focus on how individual firms tackle the issue of finance when the need is there. In this regard, Cooke and others’ current classification which categorizes regions into ones with market based and credit based finance systems with varying levels of government control and regulations isn’t directly applicable to the individual firms. On the other hand, it could provide us with a basic
indications into the variables we need to look into when trying to classify low-level agents of an innovation system i.e. firms in terms of their financial preferences. Cooke et al. briefly mention two distinct categories of firms in regards to their financing behaviors. According to them the first category of firms includes those which “frequently resort to external financing” (Cooke et al. 1997) while the second category refers to those with dominant tendencies towards fulfilling the financing needs through internal sources of finance. Departing from these two basic categories, the behavior of the individual firm falling into either one can, of course, be studied and scrutinized in much more detail at the micro level. The micro level, as referred to here constitutes the internal transactions, various organizational aspects and managerial decision-making processes and naturally doesn’t include the external-to-the-firm factors being large scale institutional factors such as the effects of spatial context discussed in Cooke’s macro perspective. Overall, the financial choices of the firm, at micro level, is affected by a wide range of factors including management’s rationality in dealing with the question of finance in the face of an investment opportunity. Here, innovation and innovative activities can be portrayed as investment opportunities as the firm has to invest in tasks falling under one or more categories of functions and/or activities of the innovations system in return for the prospect of marginal gains. Needless to say these functions and activities of the innovation system are the same ones we have mentioned in the section 2 of the theory chapter as discussed by Johnson, White and Liu and Edquist. Externally-based sources of providing the revenue and initial investment for innovative activities mainly comprise of two methods: issuing stock and equity and raising debt through securing finance from financial institutions e.g. banks or credit unions. On the other hand cash, liquid assets and unused borrowing power, defined as the default-risk-free debt in the form of extension of existing credit with suppliers and cash advances from customers are considered to be the internal sources. The sum of all these sources is called a firm’s financial slack (Myers & Majluf, 1984). On this basis, the micro institutional setup of the individual firm in regards to the finance, in addition to the factors mentioned above, constitutes of a wide variety of other factors influencing it in its finance-related decision-making processes such as internal procedures in communicating valuable information between the management and the old and prospective investors, the amount of effort invested into ‘educating’
investors in utilizing the communicated information and also the level of interest from the management to share the ‘organizational knowledge’ they have acquired through their hands-on experience and involvement in actual running the firm (Myers & Majluf, 1984). To conclude, the organizational structure, the management’s rationality and managerial procedures and internal processes of the individual firm in relation to dealing with the issue of finance are the areas which have to be investigated to enable us pinpoint and identify the immediate institutional environment engulfing the aforementioned innovation agent (the firm itself) from a finance aspect at a micro level. As previously mentioned, in the context of financing, examples of these structures and procedures may include management’s attitude and preference towards external and internal sources of finance, the firm’s actual potential in raising the necessary funds from internal and external sources including the slack available and its financial relationship with other components of the supply chain (suppliers and customers) and the routines and mechanisms of communication and exchange of information between the management and existing and prospective shareholders. Ultimately a lot of the contributing factors mentioned here can collectively be considered either as part of the organizational structure or alternatively, organizational behavior of a firm.

The next institutional category in Cooke’s analysis is the issue of budgeting. Similar to that of the finance aspect, Cooke and others present a classification of regions in terms of their level of autonomy and control over the region’s budget and expenditure and their potential to raise revenues through the tax instrument. As discussed in the corresponding section, this classification categorizes regions into three distinct categories being regions with their authority limited to the level of overseeing efficient spending of a set budget both determined and planned for in detail at a higher level of government, regions with a higher level of budgeting autonomy in the sense that they have full authority to decide about spending the full extent of budget allocated to them and ultimately the regions that not only have the authority to decide about and prioritize their spending based on their individual needs, but also have the authority to raise revenue through imposing and collecting taxes. Similar to that of the financing aspect, this categorization lacks the potential to be applied to the smaller scale analysis of the budgeting structure and preferences of a firm thus transferring and adapting this perspective to the context of the
individual firm requires more than a mere re-scale procedure.

According to Bolton and Dewatripont, firms’ budget are mainly determined by a variety of factors including “the firms’ retained earnings, the net present value of its future investments, the quality of its management as well as the liquidation value of its assets” (Bolton & Dewatripont, 1995). Obviously, pursuing innovation and fulfilling one or more innovative functions and/or activities involves substantial investments in terms of manpower, cash, education etc. for the aforementioned firm thus it is clear that budgeting structure and choices have a major effect on the innovative output and efficiency. This is why the budgeting perspective, similar to the finance aspect, is a relevant outlook to be considered in the micro perspective of the institutional setting at the firm level. In this regard, individual firms can be categorized on the basis of their approach to the problem of budgeting. One such classification states that firms may choose to prepare their budgets on the basis of their specific priorities. As mentioned by Churchill, company budgets can be prepared in a manner that either prioritizes the planning function or the control function [of a budget]. Reciting from another article from the same source, he states that usually it makes sense for the larger firms to focus on the control function of a budget due to the significance of ‘operational efficiency’ for a larger organization while for smaller ones, it is better to prepare the budget with the planning function in mind (Churchill, 1984). As it might be expected, this prioritization certainly has implications for innovative activities and performance of the firm under study. Clearly, the same can be said about the other factors (referred to as ‘budget choices’ or ‘managerial concerns’ in the article directly translatable into categorization of budget structures) mentioned by the author in the sense that choosing and implementing each choice will have certain effects on the firm’s innovation capabilities and capacities. An example of such a choice is the ‘initiation and participation’ factor which categorizes firms on the basis of the direction along which the budget is initiated. Based on this, the process of preparing a budget for a firm can either happen as a top-down or bottoms-up approach) (Ibid.).

Apart from the abovementioned factors influencing preparation of a budget at the firm level, the type of budgeting system utilized by a firm also has the potential to affect its decision-making processes and consequently, the level of, and also its willingness towards, involvement in the innovative activities and ultimately the effectiveness and
efficiency of those efforts. The budgeting systems mentioned here include the fixed budget, the variable or flexible budget, the combination budget and the continuous budget ("Budgets and Budgeting", n.d.). Again as expected, adopting each of these budgeting strategies will have consequences for advancement of innovation at the firm level. A brief overview of these budgeting systems can offer a better understanding of the classification and the potential of these different categories in influencing a firm's perception and implementation of innovation.

Starting with the fixed budget, A firm utilizes this type of budget in cases when either no changes are expected to happen in regards to a specific activity or there is no need for reviewing the budget as the changes in a given activity will not affect the volume of work (and therefore the budget assigned to it). An obvious example would be the volume of tasks that fall into the ‘project management’ category associated with a set of activities. It is highly likely that in such a case one will not witness a meaningful change in the project management workload if the work itself increases by, say, 20 percent.

The next type of budget is the flexible, variable or dynamic budget. As can be judged from the denomination, this type of budget is not (or can’t be) fixed due to the fluctuations in the overall volume of activities for the firm. These fluctuations do not necessarily have to apply to all aspects of a firm’s performance as there will always be ‘fixed’ or relatively fixed elements in the activities related to the production processes of a firm such as parts of the overhead budget (e.g. administrative) not affected by the volume of work as previously described. Rather, the management makes a decision to avoid a fixed budget to be able to respond to frequently and rapidly changing provisions of the business environment.

This mixed nature of the activities has been specifically reflected in the next type of budget called a combination budget. The firms adopting this type of budgeting practice address this feature by developing a budgeting system that recognizes the difference and distinction between different elements of the overall budget and makes an effort to accommodate the requirements of both into one single ‘master’ budget, taking into consideration tasks which require no or very limited level of budget alterations and tasks which are in constant need for budget modification.

The next approach to budgeting in the context of a firm, known as the continuous
budgeting style, eliminates a financial or fiscal year (or any fixed time constraint) as the final milestone towards which a budget will be finalized and concluded. In this type of budgeting with every month coming to a close, another month will be added to the end effectively resulting in an infinite 12 months period which is being modified and altered constantly.

From this brief overview it can clearly seen that from an innovation point of view each budgeting approach has the potential to affect the innovative performance of a firm either in a positive or a negative way. The fixed or dynamic nature of budget and various budgeting processes in any given firm, when translated into the realm of innovative activities, will present it with both opportunities or road blocks when the firm prepares plans for, or enters the implementation stage of innovative activities. It should be noted that, though, investigating further into the relationship between the budgeting approach and/or the type of budget any firm may choose and its respective innovation performance, while having obvious ties with the subject under scrutiny here, is out of the scope of this study and can be considered as a study fully independent from what we intend to conduct here.

The physical infrastructure investment ad management is the next institutional category mentioned by Cooke and others in the spatial context of a region. Similar to other categories in the first step we need to look into is the adaptability of this categorization and its potential to be applied to the much smaller scale of the institutional environment of the individual firm. In this case our conclusion is that the Cooke’s classification of regions in regards to this specific aspect of the infrastructure lacks the capacity to be applied at the firm level effectively rendering it not relevant for the purpose of the current study thus we will skip it.

The final perspective mentioned by Cooke et al. is the provision and significance of learning infrastructure at the regional level. It must be noted that in regards to the learning infrastructure at the firm level, being the focus of the current study, Cooke’s contribution should be looked at in the more general context of organizational learning theory and practice and also its sister concept: learning organization. In other words, in order to be able to apply Cooke’s perspective to the current analysis, we need to broaden the view and add more insights to it. Therefore, justifiably, a brief look into the notions
and ideas developed in this specific field will assist us to look at various aspects of the subject matter in a much more clear way and have a better understanding of the overall conceptualization of ideas discussed here.

Starting with organizational learning, Maskell and Malmberg, in their article argue that the codified or explicit knowledge is more and more accessible all around the world resulting in the argument that “tacit, and spatially much less mobile, forms of knowledge are becoming more important as a basis for sustaining competitive advantage” (Maskell & Malmberg, 1999). Obviously organizational knowledge falls into the category of tacit knowledge as discussed in detail before. To explain this, as a rule, every organization, including a firm, constantly and regularly reviews and recreates the knowledge it has accumulated over time. This knowledge is stored in different layers of its structure and can take different forms such as “internal procedures, routines and the gradual building of a firm-specific culture” (Ibid.). Organizational learning can then basically be described as the process of accumulation of this organizational knowledge.

Huber, in his 1991 article, divides this process of organizational learning into four subprocesses namely knowledge acquisition, information distribution, information interpretation and organizational memory. Each of these four divisions are then again divided into more detailed sub-processes and elaborated upon. As an example, the ‘knowledge acquisition’ category consists of five sub-categories, or sub-constructs using Huber’s terminology, describing, in more detail, the routines, methods and procedures of acquiring knowledge i.e. learning: exploiting an organization (e.g. a firm)’s initial knowledge, learning through action (e.g. by doing and experimenting), learning through imitating the rivals, transferring knowledge external to the organization (most probably through merging and acquisition) and finally searching for information valuable to the organization in relation to its immediate environment and performance (Huber, 1991). Comparable and corresponding sub-processes have also been developed and mentioned for other processes of the organizational learning.

It is worth reminding that studying these processes and methods in detail isn’t, by any means, the focus here and mentioning them is merely an attempt to illustrate the complex and varied nature of institutions involved in the process of [organizational] learning.

From what was described above it can clearly be seen that the set of the processes briefly
mentioned here as contributing factors to organizational learning and their corresponding sub-processes will have a wide variety of organizational factors, properties and structural elements as their prerequisite or support factors. A thorough analysis of such structural properties and elements will definitely be necessary to assess the organization under study (a firm in this case) from a learning infrastructure perspective. The same can be said about the contributing factors discussed in relation to the (close but not identical) notion of a learning organization. While the straightforward distinction between theses two concepts is, as described by Ortenblad, of a content-based nature (Ortenblad, 2001), the latter (learning organization or firm) can be considered as the application of the former in a real world context. In fact, Sun and Scott have differentiated between the two notions using a different terminology effectively presenting an account of them as the descriptive versus prescriptive strains of the same concept (Sun & Scott, 2003). Further to this, to render the concept of a learning organization useful for this (and similar) analyses it is best to consider the corresponding contributions in relation to what constitutes a learning organization and Peter Senge’s seminal contribution is probably the best example in this field. According to Senge there are five fundamental characteristics which an organization has to possess in order for it to be considered as a learning organization: personal mastery, being an individual member’s (employee etc.) personal commitment to learning, (challenge and replacement of, if necessary) both personal and organizational ‘mental models’ in order to get rid of unproductive attitudes and routines and pave the way for a productive culture, shared vision, team learning and finally, (the existence and application of) systems thinking in the organization (Senge, 1990). With this brief theoretical background in mind, now we can look back into the Cooke’s final category/categorization with the intention of adapting it to the scale of a firm. Cooke et al. have suggested that a study of the general subject of learning can be done through 3 analytical approaches being different perspectives (methods) of learning, institutional changes associated with the process of learning and prerequisites of learning. Unlike the macro level discussed in their analysis which considered the second and third approach relevant for the study at the spatial (regional in this case) level and discarded the first approach, here, based on the theoretical background discussed here, we believe all three approaches are relevant and applicable when the context in which learning infrastructure
is investigated has been scaled down to the level of an individual firm. In such a context, the perspective of distinctive methods of learning such as learning by doing, learning by interaction etc. is relevant as it can be easily argued that theses methods are both applicable for individual learning (in relation to Senge’s personal mastery attribute for example) and the resulting collective/organizational learning such as the case with Huber’s learning through action sub-construct. Also the institutional changes approach has the potential to be considered and studied in this context as traces of such theoretical constructs can easily be found in ideas such as Senge’s (alterations to) mental models and also shared vision characteristic of the learning organization. Another example is “development of shared understanding” (Huber, 1991) as a part of Huber’s information interpretation construct and its immediate sub-construct of (variations in) cognitive maps and framing. As for the third approach being study of learning prerequisites at a firm level, it can clearly be observed in the theories discussed that the majority of the characteristics, properties, attributes and principles can be considered as prerequisites of initiating the process of organizational learning and/or prerequisites for transition and evolving of an organization (a firm in this case) into what can be called a learning organization. Again Peter Senge’s five characteristics can be considered as a prominent example. Following, Cooke and others mention a set of roles for the regional governance in regards to provision and management of learning infrastructure. These roles also have the potential to be translated into equivalent managerial provisions to encourage and set the stage for innovative activities in the context of a firm. These three roles include: I) providing relevant tools and mechanisms for learning which can be directly translated into a similar managerial role. These provisions are expected to support both the processes of individual and collective learning and in doing so, expedite the process of overall organizational learning; II) Although less relevant in this context, recognition and endorsement of science and technological solutions can be translated into a firm’s managerial attitude and enthusiasm towards adopting relevant new advancements (technological etc.) both directly and through indirect measures such as assistance in development of an ‘absorptive’ firm-wide culture with the potential to embrace change in different levels and III) diffusing the cost of change which, again, can also be applied in the context of the individual firm. In such a case, the relevant costs of any changes that are
required to happen in the process of learning will be diffused and distributed. These changes can be at personal, collective (e.g. departmental) or organizational level and the whole process of diffusion will be managed through managerial and administrative routines and procedures which would contribute to it either deliberately (in cases where specific policies and procedures are designed for the purpose) or unintentionally. In the following section, Cooke’s scaled-down theoretical construct, together with other theoretical contributions previously discussed will be utilized as raw materials for developing a comprehensive framework with the aim of re-scaling and adapting the overall theory and perspective of RIS to the much smaller and less far less spatially-dependent context of an individual firm.

B. Developing the Framework: From a system level to the agent level

As previously referred to, in this chapter we will put the elements borrowed from the RIS framework together and present our framework with a different content in its epicenter and ‘tuned’ and adapted to the distinctive properties and needs of it. Such a transition will shift the focus from higher levels of a whole system with spatially-dominant attributes to the a building block or component of the same system. These elements have been individually analyzed in order to verify their applicability in this different context. In the end, the final product i.e. the resulting framework is supposed to have the potential to be able to engulf and explain all sorts of institutions and organizations in the immediate institutional environment of the individual firm.

Similar to the widely accepted methodology in a qualitative research, here, the resulting conceptual framework is generated through analysis of relevant input. The difference here, though, is that in the general process, the totally new framework will be created and shaped bit by bit while ours has dominantly been the case of adaptation of an existing framework and re-aligning its focus to a different unit of study (again existent) at a lower level of the same system through analysis. The point here is that in the process of such an analysis the relationships and interlinkages between the examined elements are likely to change, potentially leading to shaping of a whole new theoretical construct which, we believe, could be the case here.
For the purpose of presenting our framework, we will start by putting forward the nucleus of it followed by suggesting a list of the areas of interest where the search for components should take place.

**Components of the Framework**

The nucleus of the framework, or the unit of study at the center of it is here the individual firm. This is the focal point in relation to which all the institutional linkages and organizational relationships are defined and explained. As mentioned before while reviewing the original Regional Innovation System framework, the individual firm is present as an organizational unit, together with other organizational elements in the RIS analysis.

Two other bodies of components in the framework are institutions, defined as the rules of the game and organizations as the actors. Again, it should be emphasized that the framework here will suggest a set of ‘areas of interest’ in which all the organizations contributing to the innovation and innovative activities in the immediate institutional environment are expected to be found in rather than listing the actual organizations which would obviously be an impossible task. The same is relevant for the institutional components for which an identical list of interest areas is presented. This list is also prepared with the intention of being able to gather all the institutions in ‘innovational vicinity’ of the individual firm under one roof and providing general explanations. In addition to that, both these categories constitute of, and cover components which we have categorized and dubbed as Macro and Micro categories in our previous analyses.

**An Overview of the Areas of Interest**

Starting with the Macro components the following are those mentioned by, and/or inferred from, Cooke’s RIS perspective:

- Finance: This is where the spatial context has to be investigated at all levels to determine the type of market (economy) from a finance point of view. As previously discussed, such a system could be one of (or a combination of) the
following: I) A full market economy in which the relevant (financial) organizations would be banks, securities markets in different forms and all the intermediary organizations which connect a firm with those e.g. finance brokers. As for the institutions, the mechanisms controlling the banks and securities markets’ relationship with the general body of firms, the regulating institutions and those that frame their actions respectively are the ones worth investigating in this case. II) A credit-base system with minimal high-level control in which the corresponding set of institutions will naturally be limited to those governing the relationship of banks and their firm-level clients. Obviously, the government-level regulating institutions take up a limited space in the list of relevant institutions as, by definition, the control and regulation function of a government in this case is quite limited. In regards to the organizations, it would generally include the same range of organizations present in the category 1 (the market economy) minus those dealing with the securities markets which are virtually non-existent here. And finally, there is the credit-based system with considerable amount of control exercised by the government. As it can be expected, the set of institutions and organizations here almost identically correspond to those of the previous category with the addition of organizations and institutions which help the government exercise its authority and control over specific aspects of the banks’ activities and their relationship with the individual firm in relation to provision of finance services.

- Budgeting: Similar to the finance, The significance of high level spatial context lies in the distinction between the distinct categories any locality may fall into in regards to the question of budgeting. On this basis, the specific spatial delimitation the individual firm is a part of has to be investigated in order to figure out which organizations and institutions are considered relevant. The aforementioned categories, based on Cooke et al.’s contribution include: I) decentralized spending in which the overall decision-making and budget planning (including those relating to the general issue of innovation and innovative activities of firms) occur at high levels of government thus emphasizing the importance of organizations and institutions active at higher levels of a government. Examples can include
national-level budgeting authorities (in different organizational forms) that are responsible for both large scale/general and detailed budgeting and the corresponding institutions such as constitutional and administrative law that officially delegate this duty to those organizations. Another prominent example could be national initiatives and institutional setup which prepares the scene for entrusting the authority for large-scale grants and assigning budgets for innovative activities in the hands of national innovation agencies and consecutively, their organizational counterparts in the form of dedicated innovation agencies which are popular in Scandinavian countries such as Vinnova in Sweden and Tekkes in Finland. Such organizations and their corresponding institutional background can be responsible for a wide range of budgeting activities from planning to detailed implementation. II) Autonomous spending is the case in which the lower levels of government (e.g. local, regional etc.) have more autonomy in expenditure of budgets assigned to them by the central planning authorities. Here the general lineup of the organizations and institutions that has to be looked at isn’t overly different those of a decentralized spending category but those are more likely to be found in lower levels of government such as state-level planning and budgeting ministries (in case of federal systems). It is worth noting, though, that the institutions that ‘connect’ the individual firm to the aforementioned organizations might still be of a higher-level nature in the form of the legal context which sets the stage for such delegation of responsibility to the lower levels of government and III) A spatial context in which the lower levels of government have the ability and authority to raise revenues (which can later be assigned to innovative activities at the authority's discretion) in addition to their autonomous spending capacities. Here, an addition to the lineup of the organizations and institutions contributing to the innovation and innovative activities of the firm would be those both directly and indirectly dealing with taxing and tax issues at lower levels of administrative divisions. While organizational examples can be as obvious as tax accountants and local tax agencies, the corresponding institutions comprise the more interesting cut and can include, among all, locality-specific imposed taxes or tax reliefs/incentives.
designed to stimulate innovative activities in a firm (direct influence) or as mentioned before, supply financial means for government-supported actions (indirect influence). Needless to say the organizations and institutions dealing with taxing are to be considered at all levels of government and mentioning examples of the such is, by no means, an indication of its stronger significance in cases where the individual firm is the ‘resident’ of a administrative division with higher levels of budgeting authority and autonomy.

- **Physical Infrastructure investment and management:** In regards to the infrastructure aspect, Cooke et al in their analysis categorize a regional government based on its level of control over planning, implementation and management of physical infrastructure. Similar to other categorizations mentioned before, this classification is also used to give an indication of the areas of emphasis when trying to map the organizational and institutional setup around the individual firm. Regarding this the categorization is presented as follows: I) Spatial contexts with no control over different stages of their physical infrastructure development are considered the ones in which high-level (government) organizations and the matching institutions comprise the majority of those affecting the innovative dynamism and performance of the individual firm. This effect and influence is exerted over it through high-level policy decisions, the executions and also ongoing management aspects, overall leading to availability, diversity and quality of physical infrastructure accessible to the firm. This is usually the case with strategic infrastructure where organizations at high level prefer to retain their control over such as communications infrastructure. II) Limited control over execution and management of physical infrastructure as the second category demonstrates a situation where lower level organizations and the institutions keeping them in place and supporting them have more influence on the individual firm’s innovative activities. Naturally, this influence is realized in terms of efficient and effective (or alternatively inefficient and ineffective) execution and management of the aforementioned infrastructure. Still, high-level components are of major significance here due to the limited authority of, among all, metropolitan, local, regional organizations and institutions. III) Shared
investment cases are generally similar to the previous situation with more stress put on the lower level organizations and institutions as a result of their heavier involvement in the planning stage in addition to the execution and management phases. An example of this category can be found in the organizations and institutional setup behind the public transport network in Australia for which the relevant organizations at the state and territory level are initially responsible. In this case the large volumes of investment necessary (generally available from the federal government grants) equips it with a strong leverage vis-à-vis the state and territorial governments and effectively renders it a shared investment situation with organizations and institutions from both levels of government that have to be accounted for. IV) Cases with full control over the whole process of physical infrastructure development. This is obviously the other extreme of the spectrum in the sense that low-level organizations and institutions have the upper hand i.e. maximum capacity to influence the individual firm’s innovation-related choices. Obviously here the lower levels of government are where one should be looking for relevant organizations and institutions although in regards to the institutions those higher-level ones which have initiated documented this delegation of authority to the lower government levels have to be taken into account as important institutional components.

- Learning infrastructure: Cooke’s analysis in regards to the learning infrastructure at Macro level puts forward three essential roles a government has to fulfill. As it can be observed here, these roles have the potential to enable us pinpoint the areas we need to look into to infer relevant organizations and institutions from. I) Equipping the society with learning tools for which the best way to figure out the organizations and institutions is to look for (mainly) public ones which “invest in education of novelty” (Cooke et al. 1997). At a higher level of government this will translate into all the organizations and institutions which directly or indirectly can influence a firm’s potential to engage in innovative activities through provision of learning facilities. Examples can include all the organizations responsible for, and dealing with tertiary and higher education. As for the institutions, government mandates, initiatives and, in general, the whole legal background, laws and
provisions for facilitation of higher level education such as free higher education principle or government loans/scholarships available to higher education candidates can be considered as prominent examples. II) The organizations and institutions that fall into the second category are those which are supposed to “keep the technological options open” (Ibid.) using Cooke’s words. Examples of higher and/or government level ones may include those involved in promotion of extra-national relations for the firms such as organization of industry-specific exhibitions or trade fairs or arranging for participation in such events at both domestic and international levels. III) The third role of the set, being about the distribution and diffusing costs of learning obviously points towards the institutions and organizations dedicated to the task of realization of the cost diffusion. Examples of such institutions (and corresponding organizations) include the ones responsible for reimbursement (either partial or in full) of training courses available to members of a specific industry organization e.g. Housing Industry Association (HIA), Construction Industry Training Board (CITB) etc. or members of a specific age group (youth etc.).

The other source to infer and extract organizational and institutional components from at macro level is the functions and activities perspective which will be discussed later. 

Turning to the Micro level component, we will again start from organizational and institutional components inferred form the scale-change analysis of Cooke et al.’s contribution as follows:

• Finance: In analyzing and ‘probing’ the finance aspect for organizational and institutional components at the Micro level we have considered two categories, or alternatively, areas of interest to deduce components from; being management rationality (towards finance) and the organizational structure and behavior which includes managerial procedures as well. As for the first area, a firm’s management attitude towards finance has to be investigated and institutional and organizational components extracted accordingly. As discussed before, a firm’s management can have a tendency towards either external or internal finance in relation to investment in innovation. In case of a preference for external sources of finance can consider two options: 1) Issuing stock (from its equity) and 2) Raising
debt from a financial institution. If the management decides to go for the former, stock markets in various scales and all the intermediary organizations including both private and for-profit ones (e.g. broker companies) and those defined as public and non-for-profit (e.g. regulating governmental bodies) which facilitate the process and enable the firm to realize its issuing of stock are the range of organizations that need to looked into and listed. In regards to the institutions all the supporting formal and informal institutions governing the process such as laws, regulations or (local and international) conventions and traditions guiding and regulating the whole process are to be accounted for. An obvious example could be the regulations defining the relationship between a firm and its shareholders or the guidelines outlining the prerequisites and conditions a firm has to consider and fulfill before it gets a green light to issue stock either to the public or a limited set of shareholders. On the other hand, if the latter option is the management’s pick, a whole body of financial institutions (used here in lieu of the term organization. Not to be mixed with the general definition of an institution in this study) with banks comprising the majority, again, together with the linking organizations which offer services such as brokering will be worth looking into as the organizational components while, similar to what was mentioned in relation to the former option, a whole range of laws, regulations and other institutions ruling over firm’s dealings with those organizations will comprise the institutional lot. If, on the other hand, a firm’s management mindset shows a tendency towards the internal financing of innovation then the options would include all the cash, liquid assets and the unused borrowing power a firm is able to ‘mobilize’ for which case the organizational and institutional components involved are discussed in the following. The second area of interest to look for the next set of organizations and institutions is the domain of organizational structure and behavior of a firm which will definitely have a substantial effect on its finance choices in regard to innovation and innovative activities. This influence will be exerted through two channels. First, through internal structure, routines and procedures that determine the amount of slack available to the firm. As mentioned before, the slack is defined as the sum of the cash, liquid assets and unused
borrowing power available to an individual firm at a given time. Obviously, in case of the first two, the dynamism of internal routines, procedures and decision-making processes of a firm is a significant determinant of the amount of a firm’s reserves/savings stored in the form of cash or liquid assets. As for unused borrowing power, a firm can utilize it in two forms: extension of existing credit with suppliers and cash advance from customers. Both of these methods are highly dependent on the relationship of the firm with other components of the supply chain i.e. customers and suppliers. These relationships, in turn, are the outcome of the interaction of internal mechanisms and structures within the firm with the external factors hence the significance of probing them when looking for organizational and institutional components in the close vicinity of an individual firm in relation to the finance aspect. The second channel through which the influence can be applied is part of the internal structure, procedures and routines of the firm which deal with the issue of communication between the firm, as an entity, and its current and prospect shareholders. The significance of the this part of the firm’s structure lies in the effects the intentions and actions of shareholders can have on a firm’s financial decisions and consequently, on its capacity to invest in innovations and take part in activities leading to innovative activities. Examples of these structural attributes can be found in all the routines and mechanisms that are utilized in the process of communication and exchange of information with the existing and future shareholders e.g. the ones governing the level and the quality of information to be disclosed to them.

- **Budgeting:** The next aspect to look into in search for organizational and institutional components is the budgeting realm. As discussed before in the section dedicated to the change of scale analysis, a firm’s approach to the question of budgeting can be classified on the basis of multiple principles. These include budgeting methods being fixed, flexible (variable, dynamic), combination and continuous, initiation and participation principle (top-down and bottoms up) and budgeting priorities being the prioritization on the basis of either the planning function or the control function (of a budget). These principles concerning the budgeting at the individual firm’s scale, although seemingly similar in terms of the
institutions and organizations involved in the process of development, may also have distinctions. An obvious example would be the initiation and participation principle on which basis the two different approaches may employ and engage slightly different organizational and institutional elements. While in a top-down approach it’s the higher levels of management who determine the overall direction of a master budget (which includes budgeting for innovation as part of it) mainly through their interaction with external to the firm agents (organizations) e.g. existing and prospect shareholders, their peers, influential characters within the industry expert communities and associations etc. together with the relevant institutional elements governing such relationships, the bottoms-up approach is significantly less dependent on such external influences and is basically initiated from lower levels of the firm’s internal structure. Similar analogies can be found relation to the other budget classifications.

- Learning infrastructure: In regards to the learning infrastructure, indications towards organizational and institutional components can be found in all three of the Cooke’s corresponding managerial roles. Starting with the first one, inquiring the tools and mechanisms facilitating the phenomenon of learning at different levels (individual, collective etc.) and through various means (action, imitation, active search etc.) within a firm’s internal structure can potentially yield an insight into institutional connections with corresponding external organizations that support the firm achieve its learning objectives. Examples include the individual firm’s relationship with public and private organizations offering training services either under some sort of a government initiative or with no support. The initiative and/or agreements (if existing) here comprise the institutional part. The same can be said about the second role in which recognition, endorsement and enthusiasm towards adoption of novelty and new advancement is eventually supposed to result in development of an absorptive culture and potential to embrace change in both internal and external realms. While in the internal arena this will hopefully be translated into institutional changes as in challenging mental modes and unlearning unproductive attitudes in addition to the direct learning outcomes, the external effects will certainly influence the range of organizations a
firm is willing (and strives) to deal with and accordingly, the institutions governing those relationships. And finally the diffusion and distribution of the costs within the firm environment which entails deeply institutionalized routines and procedures ruling the overall process. Obviously in this case the focus would be on these institutions and the institutional setting making this possible and the role of the organizational components (if existing) is not considered significant.

Following, another source to base the identification of organizational and institutional components on is the functions and activities perspective to which we have discusses the major contributions in the previous chapters. Here, we will have a quick review and summary for the purpose of utilization in identification of organizations and institutions relevant to the innovation and innovative activities in the individual firm. Starting with Johnson’s, here are the direct activities (functions by Johnson’s account):

• Pinpoint and identify technical, organizational etc. bottlenecks and problems:
  At micro level high-level regulating and standard-setting bodies (both public and private) have the potential to identify (often large-scale) problems in both technical and organizational senses. As an example a national regulator body for public tendering has the ability to identify an obsolete technology in any possible area and subsequently try to thwart or limit its application through introduction of relevant regulations though this aspect would most probably fit better in the scope of the Johnson’s supporting function (activity) 3. Examples of other macro level organizations performing this activity, possibly in more direct ways, are abundant such as Nordic government agencies dedicated to spreading and facilitation of innovation and innovative activities. Tekkes (the Finnish funding agency for innovation), for instance, has an active policy of restricting and discouraging a whole range of industry sectors from startups in specific regions (falling more comfortably in the supporting function 3 domain as mentioned) as a result of its ‘diagnosis’ and identification of a problem in the form of lack of enough resources to be allocated to the development of multiple innovative sectors (Undisclosed, 2010, pers. Comm.). As for the institutions, those in the form of laws and regulations defining the relationship between these high-level organizations and a
whole industry, a group of firms or and individual firm comprises the institutional setup.
 Turning to the micro level, this function can be served, as mentioned before, by the firm itself (turning the attention towards its internal structure and organization and the institutional relations within), other agents in the (relative) close proximity of the firm together with their institutional ties with the aforementioned firm. The concept of proximity, as utilized here, doesn’t necessarily refer to physical closeness. Rather, vicinity as a result of institutional correspondence is the essence. Based on this, a whole spectrum of other firms (e.g. suppliers, customers, etc.) along the supply chain and the intermediary organizational elements can be considered as the micro level organizational components while the relationships within the supply chain together with all the institutional elements (e.g. legal framework) governing the interactions of the firm with the aforementioned organizations will comprise the micro institutional components.

• To develop a solution/create new knowledge:
  Again, at the micro level, regulator bodies from both public and private natures, together with government actors of various scales with different levels of involvement in possible arrangements have the potential to be considered the macro level organizational components with the most prominent ones being public research-focused universities and public(ly funded) large scale research institutes such as Max Planck institute in Germany. Subsequently, the macro level institutional components would be the ones defining the relationship between those and the individual firm. In fact, in a lot of spatial contexts the majority of a firm’s innovative activities are channeled through such organizations and the institutions governing the connections are totally understood and well defined. At the micro level, in a lot of instances, it’s the individual firm that performs this function through a whole range of avenues to create knowledge which can vary from direct R&D activities to initiating relatively minor organizational changes, as explained before. Other than the firm itself, the function can be performed by a whole range of actors (organizations) along the supply chain including customer and supplier firms, domestic and overseas peers, multi-firm associations and
communities etc. and the institutional setup connecting them together, all of which can be investigated in order to identify the relevant organizational and institutional components in the immediate vicinity of the firm.

Following Johnson’s supporting functions are investigated in relation to their contribution in identifying the organizational and institutional components:
Provision of incentives for innovative activities to firms: Clearly, this function is predominantly relevant at macro level as the organizations that are supposed to partially cover the individual firm’s costs of innovation-related ‘endeavors’ exist at that level. Obvious examples include tax authorities at different levels of government system and also the agencies responsible for patent registration and intellectual property protection, claims and disputes. The same is applicable to all the institutions defining and ruling the relationships between the firm and the aforementioned (and similar) organizations. In actual terms, this area, as described by Johnson, has the potential to yield a whole lot of candidates to be taken into account when the task at hand is the identification of components.

• Provision of necessary resources i.e. funding and competence: Again, at macro level, a whole range of government bodies can qualify as the organizational components in this case. Major examples include organizations offering and administering general education (from primary to higher levels) to the general public, those which offer training and educational services tailored to the specific needs of firms under various high-level initiatives. In this regard, an interesting example would be an immigration department managing all sorts of skilled migrant programs to fill the voids in the necessary skills of the firms in a given spatial delimitation (national, regional, local etc.). Other notable examples may include government-initiated organizations that offer legal, financial or other similar consultation and advisory services. As for the institutions, examples as high as those defining a primary concept such as intellectual property to he simple institutions governing the intake of the immigrants can be argued to fall into the category of institutional components in direct relation with the individual firm in
an innovation context. At the micro level, private educational organizations offering all sort of professional development trainings and financial institutions (the term institution is used here interchangeably with the term organization) in their general definition are good examples. Naturally, the institutional component, again as an example, can comprise of those both defining the relationships and ruling over those relations between the individual firm and the organization providing the service e.g. laws and regulations governing approvals of the loans for the firms especially those targeted at facilitating and supplying the financial means for innovative activities.

- Guide the direction of search: At the macro level there are major similarities between the examples of organizational and institutional components potentially exerted from this function and the first primary function of identification of existing problems. In fact, the two examples mentioned for that function about the regulator bodies and Nordic innovation agencies can be considered relevant here as well. In such cases the next step after the identification was to inhibit or, in other words, arrest its development as it was explained before and this is exactly when the organizations and institutions involved have the opportunity to influence, or rather ‘guide the direction of search’ through the policies and/or actions discussed before i.e. introduction of new regulations or restriction and discouragement policies. At the micro level it’s the other firms that can perform the same function as the organizational components and together with all the institutional setup defining the mutual relationships. These include the whole range of customers, suppliers and peers which, through their interactions with the firm help determine its path in pursuing innovative activities. An obvious example is demands for specific product specifications and standards from customer firms that, upon communication with the individual firm, will act as guidelines for future product developments.

- Recognition and identification of growth opportunities: At the macro level the organizations and accompanying institutions that can be identified through this function are generally close to the ones pinpointed via the second and third
functions but it can also include examples such as trade associations and chambers of commerce and their corresponding relationship with the individual company in terms of supplying it with the relevant market information etc. It should be mentioned that, in this specific case, the macro level constitutes the less significant side of the story and it's the components at the micro level i.e. the individual firm and its immediate neighborhood of other firms inside or outside of the supply chain are obviously the more prominent agents that have to be investigated to help identify those that contribute to the advancement of this function. The same is, of course, relevant for the related institutions.

- Facilitate the communication and exchange of knowledge: Examples of macro level organizations fulfilling this function covers a wide spectrum of high-level (both public and private) ones that can contribute to the process of knowledge exchange and may include, among all, trade organizations and syndicates and, as mentioned earlier, all sorts of government-initiated panels and forums and, as usual, the relevant institutional connections between the individual firm and the aforementioned organizations. As for the micro level, the internal institutional arrangement of the firm including all the routines, procedures, rules and even traditions that contribute to (effective or ineffective) internal circulation of knowledge within a firm can be classified as institutional components. Similarly the institutions which do the same in relation to the intra-firm actors such as partner, customer and supplier firms and also shareholders fall into the same category. In addition, medium-scale organizations such as inter-firm alliances and partnerships, together with the range of institutions e.g. the legal framework defining the mutual commitments and responsibilities governing those relationships are an important part of the body of organizational and institutional components.

- Creation of new markets/stimulation of the existing ones: At macro level government bodies (ministries, ministry departments, agencies, joint task forces devised from various organizational constituents) have the capacity to fulfill this function through a wide range of institutions such as policies, regulations etc. At
the micro level attempts towards performing this function by the individual firm, or any association or agglomeration of firms requires dedication of significant resources and creation/utilization of significant institutional instruments. Despite this, creation/stimulation of markets as a task is successfully accomplished by a whole lot of organizations (predominantly emergent technology-intensive firms and multinationals etc.) in a lot of temporal and spatial contexts. Clearly, creation of new and/or modification of existing institutions is an integral part of such efforts.

• Reduce social uncertainty: Similar to other ‘Johnsonian’ functions, probing into the actors/agents performing this function can reveal organizational and institutional components at both the macro and micro scales/levels. At the macro level, the institutions performing this function are predominantly the ones dealing with ‘provision of useful information’ in the context of the individual firm’s interactions with other ‘environmental’ agents in relation to its innovative activities. These could include, as mentioned before, the entire legal, financial and corporate relations laws, rules and regulations and all the organizations involved in development and advancement of those. On the other hand, at the micro level, an obvious example would be institutions and organizations that have the potential to ‘reduce or eliminate the need for information’ in the context of a firm’s everyday activities (innovative ones, among all) such as those which offer financial and insurance services effectively reducing the risks for engagement in innovation as a whole.

• Curb the opposition in relation to the introduction of novelty: Macro level organizations could span a wide range of actors such as government ministries, departments or various public agencies that have the potential to serve this function through the administrative, legal etc. institutions. A simple example would be a regulating agency introducing or approving of a set of standards that can favor an innovation or an innovative product over an outdated one. Micro level agents, being an individual or any agglomeration of firms under different arrangements, on the other hand, can realize the same potential through
institutions such as advocacy and advertising campaigns with the intention to influence the public opinion.

The next set of activities to include in the framework are those presented by White and Liu in their 2001 article. To a large extent, their set of activities isn’t as detailed as Johnsonian functions and have limited scope of application but still has some potential to offer a different perspective in terms of organizations and institutions that could be inferred. Following the authors’ activities are briefly investigated:

- Research: All the organizational and institutional components and aspects previously discussed in relation to Johnson’s direct function of develop a solution/create new knowledge function is also relevant here, as White and Liu’s research function can easily be perceived as a part of Johnson’s function being a larger umbrella that gathers all methods for creation of knowledge under one roof, including direct research.

- Implementation: As explained before White and Liu’s list of activities is generally derived from, and developed for innovation in a production/manufacturing setting hence the implementation stage (or activity here) that naturally follows the research. What we need to be looking for here is the organizational and institutional components that the individual firm has to deal with, or those having the potential to exert influence, in the process of implementing a solution or a piece of knowledge. From this perspective, a whole range of organizations through a lot of institutional apparatus can potentially perform this activity. In this regard, the taxing authorities and corresponding institutions at the macro level and the firms along the supply chain, together with laws, regulations and conventions governing the relationship between the firms at the micro level are two examples from an abundance of similar organizational and institutional components.

- End use: In White and Liu’s context end use, as an activity (function, using Johnson’s terminology), can be interpreted into the task of dealing with and getting involved with the end users or customers of a the innovative product. In relation to the organizational and institutional setup ‘around’ the individual firm it can be
interpreted as identification of organizational and institutional elements that assist the firm in performing this activity of connecting to, and communicating with, the end user. Regarding this, there are macro level organizations which govern this relationship. An obvious example would be the government’s Consumer and Business Affairs agency or the Australian Competition and Consumer commission and all the institutions through which these organizations can regulate the individual firm-end user relations such as the process of filing and following up a complaint registered in any of those organizations. Even an institution as broad as the Internet and its search function, (together with all the involved organizations) falls into this category as it is heavily involved in governance of the relationship between a firm and its customers. As for the micro level the firms that play an intermediary role for creation and maintenance of this relationship e.g. advertising and public relations firms are prominent examples.

- **Provision and facilitation of linkages (for innovation to happen):** This activity and the components serving it can be investigated from two perspectives. The wider perspective in which all the interactions of actors that can result in bringing together the elements of the innovation process fall inside this definition practically rendering it too general for use for the purpose of identification of components. The other significantly narrower perspective can be considered as including organizational and institutional elements that directly and actively strive to bring all the elements necessary for the innovation together and facilitate the whole process. Adopting this viewpoint, the example of Nordic innovation agencies and the institutions connecting them to the innovative activities of the individual firm previously mentioned in the investigation of Johnson’s functions would definitely meet the definition of this activity.

- **Education:** Similar to the research function, the education activity mentioned by White and Liu can be perceived as a part of the more comprehensive Johnsonian function of provision of necessary resources so the component examples provided are applicable to this case.

The last set of activities discussed here, as a part of the framework is the one mentioned
by Edquist in his 2005 contribution as follows:

- **Provision of research and development and creation of new knowledge:** As with White and Liu’s similar activity, this activity mentioned by Edquist can be considered as equivalent to Johnson’s second direct function and thus the organizations and institutions discussed as examples for Johnson’s function are equally relevant here.

- **Competence building (mostly in relation to provision of relevant education and development of relevant skills):** Again with this activity, there has already been a comparable (and probably more comprehensive in terms of the scope) function in Johnson’s list namely provision of necessary resources. Based on this, all the discussion and the examples provided apply here as well.

- **Formation of new markets:** Another activity with an equivalent ‘Johnsonian’ function already present and discussed. The analysis and examples are fully transferable.

- **Articulation of quality requirements from the demand side in relation to the new products:** Although not under a separate heading, this activity has also been practically explored together with examples of organizational and institutional components, mostly at the micro level, presented under Johnson’s direct function of identify problems or bottlenecks and two supporting functions of guide the direction of search and recognition and identifying growth opportunities.

- **Creating and changing organizations required for the development of new fields of innovation:** At the macro level carrying out this activity is usually done by high-level governmental entities that will initiate the creation and development of new organizational components deemed necessary in the process of innovation. These organizations can cover a wide spectrum from those having dispersion (including funding) of innovation as their main agenda such as the Nordic innovation agencies already discussed to those, as Edquist puts it, encouraging entrepreneurship and starting new large-scale public research institutes. The institutional relationship of these organizations with the individual firm and the institutions they create constitutes the institutional aspect at the macro level. At
the micro level creation of new firms (through entrepreneurship and existing firms diversifying into new fields and markets) and also creation of new multi-member associations of firms under various contractual arrangements such as partnerships, joint ventures etc. and those assembled together to supply individual firms with financial and non-financial services necessary for innovative activities such as credit unions comprising of a collection of firms active in the same industry sector are good examples.

Network: At the macro level this activity should be regarded a prominent one in terms of identification of the components and is performed by all the high-level organizations that have the capacity to contribute to overall function (or goal) of any innovation system. An obvious example would be all the organizational elements that Nordic innovation agencies such as Vinnova or Tekkes, or any other government department, ministry etc. have to network with in order to pursue innovation goals or develop an innovation strategy. In this regard the institutional setup or the institutional links that enables them or facilitates performing of this activity by these hi-level organizational components will constitute the institutional body. At the micro level this activity should also be considered an important one through investigation of which organizational and institutional that are connected to the individual firm at lower levels and in a more direct fashion can potentially be identified. Naturally, as with the macro level, this will include a wide range of organizations and the related institutions with abundance of examples identifiable.

Creating and changing institutions: As already mentioned in the creating and changing organizations activity, at the macro level the new organizations created will be accompanied by new institutions, either vital to their functioning in relation to other organizational elements at macro and micro levels or the ones created by these new organizations to contribute to the advancement of function (goal) of the innovation system. The new institutions at both macro and micro level can also be created or altered by the already existing organizations to be able to contribute to a firm’s innovative activities in an effective way. At the macro level examples may
include introduction of new tax regimes or intellectual property rights while at the micro level forging new partnerships between two or more firms with advancement of innovation as part of its agenda is considered a good example.

• Incubating activities: Again, this activity can be considered as a part of the more comprehensive Johnsonian support function of provision of necessary resources as the description presented by Edquist interprets this function in terms of provision of “access to facilities, administrative support etc.” (Edquist, 2005) which, as mentioned before, fits perfectly into the scope of Johnson' function.

• Financing of innovation processes and related activities: Exactly the same case with this function as provision of financial services comfortably falls in the definition of providing necessary resources.

• Provision of innovation-specific consultancy services: Again can be studied under the larger umbrella of Johnson's provision of necessary resources making the analysis presented for that function applicable here.

In the next chapter, we will have a brief review of an actual case in the form of an individual firm in which we will take a look at a few organizational and institutional components and test if all of them can be explained under the functions and activities presented here.

Empirics

A. Presenting the Context

The regional context

The political system of Australia is constitutional monarchy and the country is a federation, administered under a federal system meaning the ruling and administrative powers and responsibilities is shared (and divided) between state and territory governments (six states, three federal territories and seven external territories) and the federal government (called the commonwealth of Australia). There are significant
differences, though, in the level of self-governance between these three constituents of the federation with the states having the most autonomy in regards to the legislation and exercise of executive powers and the external territories the least. South Australia is the fourth largest of the Australian states with less than 8 percent of the country’s population (ranking the fifth). In terms of the economy, South Australia ranks 7th in economic growth and retail trade between six states and two major territories showing a rather weak performance (Commsec, 2016).

As for its definition and conception as a region, South Australia with its capital city Adelaide (similar to other Australian states) fits comfortably within the definition of a region due to its rather independent ruling and state-level system of government and its distinctive economic attributes effectively rendering it as a unique institutional environment.

**The sectoral context**

As indicated before, Australia, as a country, has a federal political system with the legal and administrative rights and responsibilities shared between the 3 tiers of government being local, state and federal government. This, of course, includes the responsibility for planning, financing and execution of large-scale energy infrastructure e.g. electricity and gas. As for the electricity generation and distribution sector, based on the Australian constitutional law, the responsibility for planning and execution of electricity infrastructure (the provision of electricity supply to be exact) falls within the state and, to a lesser extent, local governments (Commonwealth, 2004). The commonwealth (i.e. federal government) though, retains significant influence over the whole process, largely, through two instruments of indirect funding to states and territories and most importantly, policymaking measures. Overall, the current arrangement is the outcome of interactions between government and other public sector elements with the market and the general society over a relatively long period of time, developing from a total ownership of electricity infrastructure by the government to a situation where the government has transferred ownership to private and state-level public entities and has voluntarily reduced its role to control and regulation, as the electricity generation and distribution sector has the characteristics of a natural monopoly, and limited financial
assistance. To manage this complex system, and to facilitate the process of Electricity infrastructure provision, the federal and state governments have introduced organizations and institutions. The most important of these institutional and organizational elements include National Electricity Law (NEL), National Electricity Rules (NER), National Electricity Objective (NEO), National Electricity Market (NEM), Australian Energy Regulator (AER) and Distribution Network Service Providers (DSNPs) which are private or public (state-owned) entities holding a region-specific monopoly on electricity generation and distribution (Druce, 2015). In the context of South Australia SA Power Networks (SAPN) is the relevant DSNP owning and operating the low voltage electricity distribution network while ElectraNet is the relevant TNSP (Transmission Network Service Provider) owning and operating high-voltage electricity transmission network.

The Firm context

Tenix Australia, as a firm, is the context of this institutional identification exercise. The firm was originally a part of a much bigger group comprising of infrastructure, engineering services, utility, transport, mining and industrial subsidiaries, active in Australia Pacific region and the US, before it was gradually sold to various private buyers. The final phase of these acquisitions involved the sale of what was left of the group (excluding Tenix Solutions) to Downer EDI group.

The engineering and infrastructure services division involved in the electricity and water infrastructure design and construction is where the author was a team member for 21 months mainly involved in the planning, design, and overseeing the construction of large-scale electricity infrastructure including substations and transmission lines. By the time the Adelaide office, being the planning and design hub of the company, had about 30 designers and draftspersons and about third time that number planning, construction supervision and field staff effectively falling under the classification of a medium-sized firm (taking only Adelaide office into account).
B. Institutional (and Organizational) Elements: An Example

In this section a sample of institutional components (at least partially) relevant in relation to the innovation and innovative objectives of a firm, as identified by the author in his 21 months of employment in the abovementioned firm, are presented. The rationale behind this brief exercise is both trying to show that firstly, significant organizational and institutional components can potentially be identified in the course of performing everyday duties and taking part in the routines of a (in this case) design firm, underlying the significance and importance of hands-on experience in the study of such cases and secondly, the identified institutions (and the corresponding organizational elements) can comfortably fit into the ‘areas of interest’ recognized before in the developed framework. This aspect of the exercise, according to Stebbins, can be considered fitting into the category of explanatory or confirmatory studies, usually performed at the later stages of a concatenated exploration although, as also previously mentioned, its extent here will be of a minimal nature due to the limitation of the scope of this study. Ultimately, these can be interpreted as an indication of the potential of the framework in the identification of institutional and organizational components in relation to the individual firm, should a proper identification methodology using the theoretical overviews presented as the summary in the last chapter be devised and developed accordingly.

As explained briefly under the sectoral context heading, in South Australia the TNSP (Transmission Network Service Provider) responsible for provision, operation and maintenance of high voltage electricity transmission infrastructure under a monopolist arrangement is ElectraNet. In order to maintain high levels of technical standards, contractor engagement and “promoting innovation and efficiency” (Strata & EMCa, 2012), Electranet had initiated creation of an institution in the form of a partnership called P4 comprising of itself and three contractors (dubbed preferred partners) being Tenix Australia, SA Power Networks (formerly ETSA) and Consolidated Power Projects (CPP). The governance structure of the P4 partnership incorporated two bodies of “Program Leadership Group (providing leadership and guidance), and Working Group (ensuring program delivery)” (Power Case Study – ElectraNet – Tenix n.d.). To evaluate the outcome of initiation of such institution theses two bodies assessed the results of the P4 formation
in terms of 6 KRAs or Key Result Areas. The list of KRAs consists of Safety and Environment, Innovation, Team Health, Stakeholders, Program Delivery and Quality and Functional Compliance. The rating system for KRAs utilized a five scale traffic lights symbology that span a whole range starting with Breakdown being the lowest score and continued through with Fail, Business as Usual, Superior and Breakthrough. Furthermore each Key Result Area was broken down into multiple KRAMs (Key Result Area Modules) which facilitated a more detailed assessment. Ultimately, the whole institution was considered an instrument that “identifies potential gains and considers how, once achieved, the gains can be shared in order to provide incentives for success” (Strata & EMCa, 2012). As for the innovation KRA, being our focus here, the three KRAMs included Continuous Improvement Initiatives, Innovations Identified and Innovations Implemented. In practice, this was translated into three assessment bases of identification of ideas, number of ideas generated and number of ideas implemented. (Ibid.). At the physical level, P4 implementation also involved regular weekly and monthly meetings for both groups.

As the intention here is not to go into more details about the actual institution we will only briefly discuss this institution in terms of an explanatory/confirmatory application meaning its potential identifiability through the analysis of ‘areas of interest’ previously mentioned in the corresponding chapter.

Starting with Johnson’s direct functions, the creation of P4 partnership institution can be identified utilizing the function of pinpoint and identify technical, organizational etc. bottlenecks and problems as, based on the description of the P4 arrangement, contractor engagement and promotion of innovation and efficiency were among the initial reasons ElectraNet decided to initiate he creation of the institution and both can be classified as organizational problems that have to be tackled.

This same institution can also be potentially identified through the Johnson’s supporting function of Facilitate the communication and exchange of knowledge as all three factors used as the initial grounds for formation of P4, as referred to previously, significantly rely on the level of communication and exchange of knowledge, as a function.

Turning to White and Liu’s set of activities the P4 institution has also the potential to be identified using the Provision and facilitation of linkages activity which directly relates to
the definition of P4 or any institution comprised of multiple members or elements linked together through a set of rules.

Finally, looking into Edquist’s set of activities, P4 institution can be identified on the basis of an analysis of a firm’s immediate environment using the both perspectives (or alternatively activities) of Creating and Changing Institutions and Networking.

**Concluding Remarks**

To sum up, here we will briefly mention a summary of the aim and objectives of the study. Subsequently, it would be followed by a quick discussion of the overall significance of the research and finally, we will present a suggestion for a possible future study (or studies) to come after.

In terms of the aim, this study has been an attempt in illustration of a more clear picture of the process of identification of organizational and institutional components in a given regional innovation system and proposing a framework in order to do so. Rather than trying to ‘point out’ those components explicitly and directly, which is considered to be a highly ambitious task given the vastly diverse and complex nature of the all RIS, the framework is expected to outline the ‘areas of interest’ which are supposed to be the clues in the form of search areas for the organizational and institutional components in any context. To achieve this, translated into multiple objectives, the general methodological approach of concatenated exploration has been adopted, based on Stebbins’s theoretical contributions on the basis of which, as also mentioned before, the current study, to a great extent, falls into the category of exploratory researches performed in the early and middle stages of the chain of studies in a concatenated exploration, of course with the (relatively minor) exception of the empirics chapter, belonging to the final stages of the chain, dubbed the exploratory (confirmatory using Stebbins’s terminology).

The desired objectives, as also mentioned previously, included exploring and analyzing the existing theoretical contributions to the RIS theory together with its related concept of functions and activities, performing extra adaptation and scale-change analyses and development of the framework for identification on the basis of those and the exploratory studies done in the previous stage and finally, carrying out a limited-scale explanatory
and confirmatory exercise in order to show the potential of the developed framework for future detailed confirmatory studies.

In relation to the significance of this study and similar ones and the methodological approach adopted, two points are worth mentioning here; First, as mentioned previously, the rationale behind the utilization of the functions and activities (or goals and functions by Johnson’s account) perspective is avoiding a general ‘map’ of an innovation system accompanied by a generic categorization of organizations and institutions. This is, largely, the situation Stebbins has mentioned as the second category of the conditions making the exploration “the preferred methodological approach” (Stebbins, 2001). This happens when a subject “has been largely examined using prediction” (Ibid.) (Which we believe is the case here) hence the justification for picking concatenated exploration over other methodological approaches. The second is the general applicability issue of the regional innovation systems concept. The organizational and institutional setup of any given system forms a vast and complex web of relationships and interdependencies which is very difficult to disentangle and analyze with the intention of identifying and isolating components from, both organizational and institutional. As a result of such inability, any attempts to utilize and apply the theoretical construct in real world is likely to be thwarted in the initial stages. By shifting the focus from the system level to the more prone-to analysis and accessible level of an individual firm in relation to identification of organizations and institutions, studies such as this one might have the potential to contribute to better and improved ways for application of the theory and increase the likelihood of developing of more effective identification processes.

Finally, future studies to put the developed framework to test could be the next step. Such a research is expected to check if the framework has the potential to explain, or rather fit, the lot of organizations and institutions identified via all sorts of methods inside the boundaries of the framework, defined as a collection of relevant areas on interest. This would be also be in line with the description of the explanatory and confirmatory set of studies in the late stages of a chain of studies of the concatenated exploration, as outlined by Stebbins.
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