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Innovation management in networked economies

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Abstract: Business network research, service-dominant logic and service system thinking all reflect an interactional interpretation of value creation as the fundamental approach to understanding modern economies and business behavior. This paper aims at contributing to an integrative debate about innovation and value creation by analyzing innovation management challenges in relation to the interfaces between innovations and their environments in complex business landscapes. Any innovation may be seen as an entity within a multidimensional business landscape where relatedness, dynamism and variety are key dimensions. The innovation is typically positioned within some partly visible, partly invisible business landscape where it needs (1) to activate and stabilize a complex set of relationships between activities, resources and actors, (2) to systematically handle reactions to friction forces across these entities, and (3) to maintain and advance the necessary framing needed to coordinate interactions across all the involved and affected business resources, activities and actors. A general conclusion is that systematic managerial efforts appear to be the main driving force enacting and coordinating across these complex interfaces. In order for innovations to materialize, there is a critical need for some type of multi-functional, managerial network capable of recreating simplified and conceptual unity and a sense of direction while also managing the complexity, extendedness, ambiguity and multi-contextual challenges across the many complex interfaces.

Keywords: Value co-creation · Innovation management · Business networks · System theory · Relatedness · Motion · Variety · IMP

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Introduction

This paper discusses what characterizes processes of interaction in innovation and/or value-creation oriented networked business settings. Business network research as well as the area of service dominant logic in marketing and service science in business development theory, all point to the expanding role of “networked” or “systemic” innovations in the global economy. There is a corresponding shift of perspective away from commodity based business strategies and their product and product-processing innovations, to a broader view on what constitutes value-creation as a more complex interactional production and consumption process in which products, services, technologies and other entities of the entire setting interact. Accordingly, innovation and business development is understood as interactional, networked and systemic phenomena that need to be conceptualized, investigated and explained as such. To do so raises a number of analytical challenges, of which we will address but a few.

There is a close kinship between the analytical perspectives and concepts within business network research of the IMP tradition (Håkansson 1982, Håkansson & Snehota 1995, Håkansson et al 2009, Ford et al 2010) and the service science tradition which combines a business network oriented service dominant logic (SD-L) in marketing thought (Vargo & Lusch 2004, Barile & Polese 2010, Lusch & Vargo, 2006:285, Håkansson & Prenkert 2004:91-92) with “service system” thinking (Sphorer, Maglio, Bailey & Gruhl, 2007). The service system theory is leading over to the more general system theories – in part associated with “Viable Systems Perspective ¨(Golinelli 2010). This way of characterizing the business world is in turn very much in line with a tradition of thought that can be typified by researchers such as Penrose (1959), Richardson (1972), Arthur (1989, 2009), Freeman (1982, 1991) and Powell et al (1996).

We believe that in order to explain how and why business networks and service systems have expanded to dominate the modern economy, we need to sort out the kinds of fundamental challenges business developers confront in their actual work. To embark on this, we depart from a dual characterization of innovation processes in between physical and economic rigidities and mental, creative flexibilities. The resulting interaction processes are typically located within business environments quite similar to a complex rain forest - such as depicted by Håkansson et al (2009), where both overview and visibility are limited and variable due to the relatedness, dynamics and variety of phenomena where interactions are fundamentally complex and complementary of nature. The basic logic of this business landscape will be formulated in a number of propositions, after which we focus more narrowly on the problems of connecting and interacting across entity-to-entity interfaces in a more distinct innovation management perspective.

Innovation in interaction

We acknowledge that studies of innovations and innovation management are being made and should be done in many different ways (Van de Ven & Poole, 2005). This paper aims at outlining and exploring analytical conceptualizations at a relatively

general level of analysis on the basis of an extended number of detailed business case studies and theory contributions over the years (Håkansson & Waluszewski, 2002, 2007, Håkansson et al 2009). Our ambition is to move from these many business network studies to explicitly consider the innovation phenomenon. What is an innovation process in the context of an economy that is generally perceived of as interacted, material and complex? And, what is actually the role of management in all of this? Is it possible to characterize, in some unified way, what innovation management is about by extracting from these many bottom-up, localized and detailed analyses of business activities?

To us, innovation processes have an interesting duality – almost like a Janus-face. On the one hand, they are the results of new ideas, for instance about new uses of materials, new combinations of resources, new ways to solve complex problems and so forth. They are the results of multifaceted creative processes containing substantial elements of exploration into the unknown, into the unexpected and quite often also into the impossible, the irrational and the apparently unlimited imaginativeness of creative entrepreneurs. On the other hand, they must also be the results of material and social interactions with numerous elements of their environments that are actually there doing whatever they do. These second kinds of processes are obviously constrained by whatever is actually given in the real world. In order to be economically viable, new innovations have to be systematically combined with already existing resources, activities and actors. In order to reach some kind of positive economic result, they even have to be systematically "built into" existing economic systems through numerous interactions.

This duality may be seen as representing the fundamental sub-processes of economic value-creation. The interactions of the two represent the creative evolution of economies; the interactions of the imaginative processes of human minds with the dynamic processes of the given, actual real life economies as represented by their already existing resources, activities and actors. We take this duality as our point of departure to suggest a conceptual framework for analyzing the *interfaces* between innovations and their immediate economic environments. The ambition is to portrait how this duality affects how these interfaces may be conceptualized from an economic point of view. From there we will discuss the role of the management function in relation to innovations, how their interfaces are developing within the business landscape and hopefully arrive at some understanding of how innovation management capabilities and capacities can be better understood.

The interfaces between innovations and their business landscapes

We assume that a realistic understanding of commercial innovations requires an understanding of their processes of emergence within their actual contexts. This necessitates an analytical conceptualization that takes into account that interactions between a new economic entity and those already existing are core to the understanding of what constitutes economically valuable innovations.

We base the following analytical suggestions on extractions from a large body of detailed case studies – of which we will use two as illustrations. These have aimed at understanding business economics from an anthropological research perspective. This work has envisioned business in practice as a world of highly interrelated and mutually interdependent activities (Håkansson et al, 2009, Wilkinson 2008, Ford et al, 2003). The business landscape they describe truly looks much more like complex rain forests with a huge variety of interdependent actors, activities and resources than a jungle in which the various species are essentially fighting each other (Håkansson et al 2009). It is fundamentally a world of complementarities where the survival and economic prosperity of any particular firm or business activity to a considerable extent depends on its relations to others. Innovations emerge through extended interactions. They become as a function of their growing relations to, interactions with and dependency on others. Their essence and economic value is somehow given by these emerging interdependencies as we will see in the following two illustrations;

The first illustration regards a case study of a new technology for analyzing DNA-sequences (Ingemansson 2010, Ingemansson & Waluszewski 2009). It is an interesting case as it became a scientific success – published in Science in 1998 and reported as one of the most important scientific achievements by the publication in 2006. It is rooted in scientific developments during the 1980s and early 1990s that build on the combination of two research traditions that had not previously been combined. It was a process where research tools and ideas were combined in a new way. However, it turns out to have become a business failure after it first had been seen as having tremendous commercial potential, as it emerged in conjunction with the HUGO-project at the time, where the full genetic content of the human being was being detected. It was accordingly a time when new practical methods to do DNA-sequencing were highly needed as the old method “Sanger” was perceived to be too slow and too dependent on manual procedures. At the early stage the technology was developed by a group of scientists together with the established company, Pharmacia Biotech – one of the world’s largest manufacturers of biomedical equipment. Due to a merger with Amersham, Pharmacia Biotech was later restructured and soon had to terminate its cooperation with the researcher group. The project then became re-launched as a new venture: “Pyrosequencing Ltd” in 1998, financed by the venture capital company Health Cap. The new owner forced the company to quickly define a prototype designed for a particular application focusing short DNA-strands where the technology had exceptional speed and high accuracy.

Already in 1999 the first product was launched. In 2000, Pyrosequencing went through an IPO and became a publicly listed company valued at nearly four hundred million Euros on the stock market, and it was awarded prizes such as “spin-off company of the year” by the Royal Swedish Academy of Engineering Sciences (IVA) It also became included in Forbe’s list as “best newcomer.” However, when the next stage aimed at widespread use was tried out, the results were not encouraging. There were not enough sales. This forced the firm to merge with another company in 2003, and the product was later sold to a German company. One reason for the problems was quite clear; the Pyrosequencing machine was designed as a stand alone unit, but to be bought by industrial users it had to be combined with other equipment in certain production lines. It had been developed in isolation, but it turned out that it had to be

used as an integral part of more complex production processes. Despite the excellent scientific merits, it could not find a suitable place in the commercial landscape.

Another illustrative example is the “Salma-case” (Hoholm 2011, Hoholm & Olsen 2012). It concerns a joint venture innovation project done by the Norwegian dairy company Tine BA and the seafood farming company Bremnes Seashore. The project departs from the idea that fish may be exploited to create world market fermented products similar to salami sausages, and Hoholm (2011) describes the innovation as it evolves through several parallel processes and stages. This involves patenting activities, early market research, business planning and organizing, laboratory experiments, mould and other technical challenges, various bacteria, milk proteins and fatty acids, partner contracts, a large potential Japanese customer, German high end retail chains, alternative partner contracts, fish slaughtering research and technology developments, extreme hygiene challenges, repeated board meetings and several financing rounds, reorganizing processes, new product ideas, local retailing partners, etc. etc. As such the case presents the multiplicity of parallel activities across very diverse interfaces that need to be resolved, adjusted, established and stabilized in order for the intended commercial product to become anything at all. Different managers and a broad range of expertise are involved in order to conduct all of this.

As the story emerges, it becomes clear that several of the envisioned partners and resources do not behave as hoped for, and the entire innovation project is forced into a different and converging trajectory. In the end, the fermented sausage idea is abandoned in exchange for an extreme high quality salmon loin product. The struggles with mould, hygiene, bacteria and slaughtering technology were finally exploited to create extreme freshness and purity rather than fermented conservation. Marketing focused on local retailing rather than world market players. The combination of what was actually there; advanced dairy industry which is particularly good at micro biology controls, and technical advancements in slaughtering technologies to maintain extreme freshness of loin quality, and already established interfaces with retailers, in the end became the core building blocks for a rather successful new fish product. The complexity and too loose relatedness when moving an unfamiliar product to an unfamiliar global market, turned out to be unmanageable.

In both these cases actors, activities and resources become related to each other through interaction in multifarious ways. Different social and natural resources are combined, interdependent activities are linked, and actors engage with one another to form collaborative structures. Resources are systematically related to activities and actors. Activities are using as well as producing resources and are performed by actors. Actors control resources and perform activities in order to reach economic goals. All of this is taking place within as well as across company borders (Håkansson & Johanson 1992). The businesses involved try to interact in multiple ways - forming commercially viable cross-functional business networks – but are more or less successful. Neither of the two innovations can be assessed without reference to a whole set of actors, activities and resources. In this way, we may perceive of historical innovations as outcomes of successful processes where involved actors have managed to expand their social and material relations to others – to include sufficient interactive capacities to provide for their existence.

In such a world, an innovation will have to develop and establish a large number of interfaces towards a variety of existing resources, activities and actors. It will have to find its place and its functionalities in between whatever is already there to the extent that it appears impossible to develop, produce or use an innovation without having established proper interfaces to entities that are already crowding the areas addressed. Thus, an innovation and its interfaces will be developed, produced and used by actors that to a substantial degree are already related to each other, are influencing one another and are engaged in a variety of activities that constantly evolve the business landscape into new layers of economic activities and configurations. Furthermore, it will have to relate to the communicative reality of these arenas, to various kinds of expertise, to whatever have become influential ways of thinking and behaving, to institutional arrangements of numerous kinds, and so forth. Most of these are outcomes of historical creations established through efforts by many over considerable periods of time.

Earlier attempts at characterizing the contextual dependencies of innovations

One early, simple but powerful representation of the importance of innovation interfaces was presented in the 70s by Utterback and Abernathy (1975). They used the notion “investments in place” to underline that an innovation may severely disturb an existing economic order and that the costs of such disturbances are typically extensive if and when already existing production systems have to adjust in substantial ways to the new innovation. Or in their words: “Unfortunately, the pay-off required to justify the cost of change is large while the potential benefits are often marginal” (Utterback & Abernathy, 1975, p. 644). The significance of the relationship between innovations and already existing activities and resources affected by them, becomes evident when focus is moved from the innovation itself to the wider system dynamics of the innovation setting.

The same basic issue was also central in several projects during the 1980s within the industrial network tradition where renewal and technical development were studied (Håkansson 1987,1989, Waluszewski 1989, Lundgren 1994, Laage-Hellman 1989, 1997). In all these, technical change both in terms of new facilities or processes and new products or services were studied as interaction processes creating resource ties and activity links between whole sets of companies, for instance in the steel industry (Håkansson 1987, Laage-Hellman 1990), the forest industry (Waluszewski 1989) and the computer based image analysis network (Lundgren 1994). In Håkansson (1989) a cross-sectional study involving 123 Swedish companies and their technical developments in relation to customers and suppliers were described and analyzed.

A similar phenomenon can also be seen at the core of the “lead user” concept (von Hippel 1988, 2008). The argument is that advanced users know more about the interfaces with other resources and activities in the user-situation, and thereby of how it should be formatted, than do others. Users should therefore be deeply involved in the innovation process. An innovation can never successfully be a stand alone entity.

It must fit into its immediate environments in order to convey its possible net benefits to others - by enrolling those others in the shaping of the innovation's interfaces. The process of becoming a commercial success can not be separated from such translational interactivity between the innovation entity and those others that need to be included in its actual exploitation. To remain a stand alone entity corresponds to not becoming anything to anybody.

Another important attempt to address this issue has been made through applying the visual image of a "rugged landscape" (Kauffman 1989, Bruderer & Singh 1995, Poole & Van de Ven 1995, Levienthal 1997, Van de Ven et al 1999: 86-88). Based also on detailed case studies, these researchers discussed the interfaces between the innovation activities and the business landscapes surrounding them as a highly demanding managerial challenge. They used the image of a "rugged" landscape to describe innovation journeys – in particular in their early explorative phases – as analogous to journeys to reach across dark valleys to some peak on the other side. Innovators need to explore such valleys to learn what routes could be possible. In order to succeed they need to explore a variety of possible paths, thereby building complex repertoires of action experiences, outcome preferences, contextual practices and creative connections between means and ends (Van de Ven et al 1999:88). Hence, the complexities and difficulties represented by the innovation for business landscape interactions necessitate highly demanding managerial capacities and skills. Without such managerial capabilities, the innovation will not only be costly. It is unlikely to reach the other side.

The above examples indicate that there is a similar type of interface between an innovation and its business context as has been identified between the production of knowledge and the research context (Latour 1986, Collins & Pinch 1993, Galison 1997). The main argument has been that scientific knowledge is not something absolute and neutral but very much a consequence of its "production" processes, including the tools and machines used to produce it. Thus, knowledge is something highly context dependent and is therefore always relational. In a similar way an innovation will be the outcome of its own production process within the context of its own development Håkansson & Waluszewski (2007). This will have incorporated certain features into it that reflect the processes of developmental interactions. The innovation then moves to the context of production where it needs to be fitted to other activities and resources as well. These might be so different that the earlier incorporated functional elements come in direct conflict with what is appropriate in the latter context. Next, the innovation also needs to adapt to various contexts of use. All together, the innovation typically needs to interact with things that are really not present in the immediate development and production contexts but are rather located in more distant contexts, such as with the customers' customer or the suppliers' supplier or in international trade regulations, in safety and quality control regulations, in customs declaration systems, in industry standardization agreements, or in anti-terrorist security systems. The number of such contexts a given innovation may have to adapt to may obviously be high – with a corresponding number of interfaces to be established and adjusted.

Business landscape as a “rain forest”

There is no difference between a jungle and a rain forest in a physical sense. However, the two words give quite different associations. A jungle is often related to the struggle, to the idea that the strongest is the only one to survive. The rain forest is much more associated with the idea of an intricate web of species and plants. A rain forest is full of interdependencies, full of life and thereby of movements (dynamism) and full of variety. The jungle has often been used to describe the reality of economic life, but we see the rain forest as a much better analogy.

If you view a rain forest from an airplane, it looks rather homogeneous; just green, dense forest. If you experience it from a car travelling through it on a road built through dense wooded areas, it shows a much more dramatic variation of trees, flowers, animals and typography. But still, it is rather easy to grasp. If you look at it while trying to walk through a not yet explored part of it, you may discover an incredible variety of plants, animals and modes of life. Finally, if you do the same during nighttime, you will experience other animals and activities. We would like to claim that a similar type of variety and partial invisibility characterize business including innovations - and thereby also managers in the business world.

One implication from this analogy is that visibility is not an absolute but a relative factor. What is seen of interdependencies, dynamism and variety varies with the viewer. The experienced, the engaged and the professionally equipped see more than the un-experienced and disengaged amateur. Some see a lot while some hardly discover anything interesting. Visibility is also dependent on the location of the viewer and on his/her movements relative to the landscape. Normally invisible activities may be “disturbed” or “interrupted” so that they start coming out of their shaded spots - to mark their territories, to secure supplies, defend interests or whatever. Movements and changes cause attention, tension, action, flight, and new noises caused by these reactions may trigger reactions quite distant from the original incident. To exploit advantages from mastering the variable visibility of business landscapes seems also to be an essential part of what innovation management and innovation strategy include.

A second implication is that nobody will have a complete picture of the interdependencies, the dynamism or the variety. Thus, actors with highly different images will engage with one another while continuously contesting the others’ image representations as well as their argued consequences by offering upgraded images, beliefs, theories and suggestions to the others. Furthermore, the ability to relate technically as well as socially, to interact and thereby to materialize an innovation is closely connected to this kind of abstract knowledge exchanges and the eventual alignments of images of the relevant reality. Because so much is hidden and so hard to interpret, the strength of an innovation, to a considerable degree, is reflected in the extension and quality of its observatory and interpretative capabilities; the extensions and alignments of its managerial interactions.

Applying the rain forests metaphor to the world of innovations suggests that the environment is typically complex, multifunctional and interdependent. This gives profound advantages to those who know the environment, to those with some overview and insight, those with multiplicity of connections and lasting experiences and to those with a capacity to discover, involve and influence others. To the

newcomer, only part of the landscape will be visible, while much of what really goes on will appear as in shaded spots - remaining inaccessible to them. Actors in such a world need to discover, relate to and interact with many of those entities and activities, and the processes of discovery will typically be marked by surprises. The world does not turn out to be as expected. This implies that there is an important discrepancy between the involved actor's perception and understanding of the business landscape and what may actually be important features.

In such a world an innovation such as the previously described fish salami or a DNA-sequencing machine has to interact with entities that are typically quite visible, such as firms, entrepreneurs, financial investors, technology labs, accounting firms, stock prices, other machines, and prototypes. But, apart from these, there are all those entities and activities which are much less visible that also will affect the process. Some of them might be discovered over time and may also be possible to react to in one way or another. Others might only be recognized in terms of unexplainable negative or positive effects. Much of what will be relevant discoveries contain highly specialized activities, resources and actors, and much of what those actually know and do will remain blurred or invisible to everybody else. They do things that you cannot easily interpret, replicate or avoid – even if you have some clue about who they are and what they actually do. Particular experiences, techniques and potential solutions to problems are often hidden and interlinked. They pull resources and feed activities without really showing what is going on.[i]

Three key factors: interdependency, dynamism and variety

Above we have described how interdependency, dynamism and variety are important ingredients in the existing complex business landscapes. These key factors are fundamentally affecting the emergence as well as the economic fate of any innovation. Interdependency is a key factor that was focused on already in the first IMP-study (Håkansson 1982). All the species in a rain forest are dependent on others in complex patterns which define their ability to survive and prosper. A similar pattern is a striking feature observed in empirical studies of economic activities in business landscapes - to the degree that it seems to constitute all economically significant phenomena as internally and externally relational and interdependent entities. This has been observed in the industrial network studies (Håkansson et al 2009) as well as in the service science studies (Barile & Polese 2010, Gummesson & Polese 2009)).

The second factor has to do with the role of dynamism (movement) in shaping the conditions and mechanisms for adaptation and co-emergence across multiple interfaces. If there is one common result from numerous innovation process studies, it is that "history matters". This is expressed in different ways, but the most common is that some type of path dependency (trajectory, reverse salient, etc) is at work (Hughes 1983, 2004, Rosenberg 1982, 1994, David 1986, Arthur 2009).[ii] Hence, the relevant motions/movements are those affecting interactions between the established and the new. There is always motion that in a number of ways both undermines the stability of economic relations and supports the ability of economic entities to expand, to interact

closer and to move resources, activities and actors in relation to emerging opportunities. As in the rain forest, there is birth, growth, death, but also movements and changes in relation to others - in space and time as well as in purely mental representations – to re-connect in new ways. Without movements, there can hardly be innovations.

The third factor has to do with the role of variety in constituting variable economic value. The variety is partly given by nature as in the rain forest, partly an outcome of the creative interactions in all kinds of processes of becoming of social-material entities in society. This evolving variety constantly offers new opportunities for actors to imagine and create additional unique combinations. The economic value of some created entity in this type of world obviously depends on which specific items it is being combined with. Thus, there are possibilities to increase the value of a given entity through finding other items to combine with that enhance their collective economic value. This is the essence of what constitutes a commercial innovation. Here our argument is very much in accordance with Cyert & March 1963, Alchian & Demsetz, 1972, Weick 1979, Economides 1996, and Uzzi & Spiro (2005).

These three factors represent the analytical starting point for a more extended framework for analysis of how the interfaces between the innovation and the environment influence economic outcomes (see Table 1). In the next three sections we will look closer at each of these with the ambition to answer three questions: (1) In what ways may the given factor represent a positive economic source? (2) In what ways do they affect the innovation and the innovation process? And: 3) In what ways do they relate to challenges that are core to innovation management?

In the following we will discuss each of these factors in relation to these three questions - with the ambition to suggest theoretical propositions as a first attempt to provide answers, before we conclude the discussion by focusing more specifically on the more general role of management in relation to innovation processes in complex business landscapes.

Table 1: Innovation in interaction: Three fundamental factors and their three analytical dimensions

Fundamental factors observed:	Economic source	Innovation dimension	Managerial issue
Interdependency	Relatedness of economic entities	Specificity	Activating others
Dynamism	Friction across interfaces	Adaptability	Handling reactions
Variety	Value combinations	Combinability	Framing value creation

Interdependency as a key factor

As interdependency is a significant attribute of economic activities and business landscapes, it will also be an attribute of innovation and innovation processes. The

emergence of an innovation can be described as the process of expanding, aligning and including more relationships to other entities and networks, to actors, artifacts like technology, symbols, things, texts, organizations, regulations, natural resources, money, contracts and partnerships, etc. There is no way that it may become without engaging in these many interactivities across multiple contexts. Numerous studies of innovations are full of descriptions of these many efforts to resolve what is needed to establish stable and effective interactions with others. In fact, innovations seem to emerge as a function of their increased relatedness with these many heterogeneous entities in their different contexts (Håkansson & Waluszewski, 2002, 2007).

The essence of this understanding is that the emergence of economically valuable entities, like commercially successful innovations, is a direct function of their internal and external interdependencies. It is through these interdependencies that the innovation becomes connected to and may be exploited by others. Interactions across boundaries are more or less constantly relating each and every item in the "internal innovation structure" to some other items in systematic ways. Thus, a first basic proposition is that:

(1) Relatedness is a core dimension of what constitutes an actual economic resource and is, therefore, a prerequisite for any innovation.

The more extended its relatedness to others, the more valuable it becomes. As interdependencies in no way are evenly distributed and developed, this results in an important variation in how each innovation is related to others, i.e. how well these relations are developed. Some interfaces become much more developed than others as a result of more extended interactions, adjustments and mobilizations. Some are much harder to align than others. Some will resist being engaged and adapted. Existing resources, activities and actors will obviously affect the ability to interact with new innovations simply by representing their already established interdependencies between specific resources, activities or actors. That is, existing resources, activities and actors propose interfaces to new innovations that are outcomes of their own historical emergences as interacted entities. The success of the innovation will depend on its ability to engage in possible interfaces to align them to those on the other side, to manage, utilize and compensate for the adjustments and the efforts involved in the making of such alignments.

The importance of interface development means that we have to acknowledge the economic effects of qualitatively variable mutual interdependencies between involved activities, resources and actors. Changes in one of them will trigger responses in the others – and vise versa. Sometimes the material substances of the things involved will offer particular responses themselves – in terms of output failures, decreased lead times, etc. At other times creative responses by involved actors may solve the problem by adjusting items affected by the troubled interface. But the particular solution to this may cause other challenges to some other parts of the world it interacts with. To include the degree of interface development characterizing the particular business landscape triggers a focus on the implicit demands a business landscape represents towards whatever aims at establishing itself within it. And it emphasizes that these demands are not located in some general characteristic of the environment, but rather

in the degree of development within and across numerous established interfaces across the particular business area.

To the innovation, this implies, and this is our second proposition, that:

(2) One critical feature of the role of innovation must be contained in the specificity by which it is related to some other entities – in this way creating a unique set of interdependencies within the business landscape.

The more developed the interactions across interfaces are, the more specialized and precise must be the functional offers represented by the innovation proposed. It is a requirement that it must be able to engage those others in order for it to materialize and succeed.

From a managerial point of view, this highlights all the work that is needed to actually enroll, activate and align with others. To acknowledge the importance of interdependency, emerging relatedness and specific alignments turn innovation management away from a focus on independent, strategic decision-making and turn it towards a necessary focus on advancing specific solutions that must be able to connect to, engage with and influence others. Because many of these interfaces will be with resources and activities that are controlled or dominated by others, the alignments become vital to the innovation's fate. Others will determine - or at least influence – the shape of as well as the success of the innovation.

Through its interfaces, the innovation is also influencing all these others. The specificity of the interface is always affected from both sides. In this perspective - and this is our third proposition - is that:

(3) A dominant feature of innovation management is to activate the important "others".

The creative capabilities of experienced and extended management appears to be what is needed to actually orchestrate these complex tasks, to engage in relating the innovation to others, in mobilizing interests, in adjusting propositional interfaces, in aligning interests, operations, routines, and market planning. Without substantial creative capabilities and energy represented by process management, there seems to be no way that an innovation may be able to actually establish itself within an existing business landscape – in between all the other business activities that are already engaged in one another. Innovation management is to manage the processes of interaction between the two processes that constitute each side of the Janus-face; the creative and the aligning.

Dynamism as a key factor

As dynamism is a typical feature of the business landscape that the innovation becomes part of, then there will be movements also in the relational interfaces between an innovation and its many interdependent counterparts. One could perhaps perceive of these movements as similar to what happens during the performance of a musical concert where the various players interact to perform a complex but perfectly

harmonious collective outcome. To some degree, this captures the essence of what we may observe when innovations have become stabilized as normal business. However, this is the outcome of rehearsals and interplays over long periods of time, and observing innovations as they seek to establish themselves and get their interfaces with others ordered, is more about trial and error and rehearsing than concert performing. Actors may come and go. Resources may be turned to other objectives. Unified activities may divert into different trajectories. Everything may move in disharmonious patterns. Multiple concerts and rehearsals may go on at the same time. At each and every moment the innovation may threaten to collide or dissolve.

In this perspective, an innovation seems to become and emerge as a function of its ability to establish some degree of harmonious, stabilized, collective unity across the many interfaces with heterogeneous entities. Harmonious interactions in “dynamic rain forests” are never given to you. But they may result from hard efforts at multiple frontiers over time.

When an innovation is incorporated into the existing business world, it is forcing change onto all the others. As these others already have invested in each other across existing interfaces, any such innovation will represent a challenge to these existing investments. At the same time there are other changes going on – both incremental and more substantial in terms of affecting others. As a consequence, all interfaces between different elements are constantly put under two opposing kinds of pressures. They are under the pressures of existing investments to keep whatever is established in their existing positions and roles. Secondly, there are the pressures from all suggested changes as proposed by different actors representing discrepancies in the existing solutions that cause another pressure on the established interfaces – pulling them apart, forcing them in different directions or transforming their internal positions, roles and patterns. The combination of these two forces is “friction”: recursive and reciprocal effects across the involved interfaces (Harre 1993, Nowotny 1993, Håkansson & Waluszewski 2002). Friction leads to the mobilization of efforts caused by disharmonious movements. This leads to our fourth proposition:

(4) *Uncorrelated movements of related economic resources are creating specific economic effects that can be captured by the concept “friction”.*

Friction causes a “creative economic struggle” between engaged entities to force relationships back into previous order (to defend already existing investments) or to force them towards some other ordering. Friction will obviously slow down some changes but might also accelerate others. If a suggested change is economically aligned with a set of other changes, this will typically contribute to mobilizing a more extended capability to redirect, to reshape and to improve the quality of interactions. In the opposite situation, friction forces will mobilize to move alignments back to the previous order.

Usually, however, interpretations are ambiguous, causing conflicts and additional trial and error excursions. An important implication of this is that friction triggers the mobilization of creativity – of additional entrepreneurial, problem solving processes represented by the interactions of mental creative processes with the material and social interactions initiated by movements.

As such, friction is a fundamental economic source needed for effective, efficient and stabilized harmonious economic phenomena to become and to improve their performance capacities over time. Friction is a concept that helps us to discuss "economizing" as creative efforts to utilize movements – which in turn makes it easier to explain and predict economizing trajectories. It is a way to understand how the development of existing and potential relationships create positive and negative economic effects for the proposed innovation and how these effects feed additional creative responses. The economic function of friction is to make all types of "reactions" important as triggers of diverse improvement seeking processes. Because friction contains controversy, it leads to mobilization of elements on both sides of the interface that are aimed at persuading interdependent entities to move, to re-stabilize or to change. Through these mobilizations, additional elements are being enrolled and aligned on all sides of the controversy, leading to more intensified, more sophisticated and more mobilized business activities.

This is our fifth proposition:

(5) *Friction forces innovation projects to advance the quality and adaptability of the interfaces they offer to other entities.*

The more mobilized the business landscape, the more it will influence and shape those innovation projects that aim at establishing themselves within it. Hence, innovations constantly face the dilemma that if they are moved into the more advanced and mobilized business areas to become part of more economically rewarding business activities, they may also have to accept being moved by others into roles and positions orchestrated by these others. If they are moved towards a less mobilized business area, they may become more influential, but the business area is likely to be less rewarding. At the same time, the less adaptive the innovation, the less mobilized business area it may successfully address in order to enroll others.

Our sixth proposition is that:

(6) *The consequence of friction for innovation management is the crucial importance of handling reactions across interfaces between the innovation and its many counterparts.*

Movements cause friction, which causes a constant managerial occupation with mobilizing resources, activities and actors to move activities towards more rewarding states and to resolve tensions, conflicts and disruptions. Hence, any stabilized, harmonious order across multiple interfaces is constantly threatened by new frictions across and within the various interfaces. There are so many sources and so many ways that innovation management will have to encounter these disharmonious events. There will also be multiple ways to react to these challenges – leading to substantial efforts to increase coordination capacities within the management function. Thus, management is usually fighting with too many possible interpretations and too many possible ways to react to too many friction forces. The situation calls for an extended management function with the capacity to overview and interact along a large number of interfaces with others.

On the other hand, frictions and mobilizations cannot - and should not - be avoided, only partially managed. A completely stabilized innovation will quickly be torn apart as a result of movements in its landscape. Accordingly, innovation management is about establishing entities capable of co-evolution in relation to the movements of others. The need for stabilization is not absolute, but relative to whatever it interacts with, reflecting the need for a widely extended managerial network. Friction necessitates managerial overview and the ability to mobilize efforts towards shifting interfaces over time, which requires participation in extended networks with observatory positions reaching quite far away from whatever may represent the core of a particular innovation project.

Variety as a key factor

As variety is a typical feature of the business landscape, it will also affect the interfaces between an innovation and its business landscape. Variety, in terms of relevant options presenting themselves in a given commercial setting, can have at least two very different sources. One is the social-natural variety in the world of already existing entities. The other is the variety represented by human ideas or propositions about potential socio-material creations more or less independently from whatever is of actual existence. The interactions of these two sources in relation to commercial use represent the world of actual creativity from where innovations and economic developments emerge. Variety follows from the vast number of possible combinations of all these entities. Hence, the number of possible propositional combinations is virtually unlimited, and as a result there is a constant flow of such imaginative suggestions. This says nothing about the economic value of any of these propositions. However, it tells us that the economic value must vary across different compositions, and as such they represent potential additive economic value to a given economic activity. On this basis, our seventh proposition is that:

(7) The variety in terms of an endless number of unique combinations of resources, activities, and actors gives the potential innovation large opportunities in terms of economic use but at the same time reasons to be highly selective

In the direct sense, this represents a third kind of economic source – associated with the role of “heterogeneous resources” in network-economic theory. The value of a resource is dependent on with which other resources it is being combined.[iii] Specific and mutual adaptations between directly related entities will generate specialized variations. These will represent specific values related to how they may take advantage of the existing heterogeneity represented in their business landscapes. Typically, only a very few out of the many possible propositional combinations will actually generate additional economic value, as compared to combinations already in place that are producing economic outputs every day. Most represent potential economic losses. However, unique combinations are an essential economic source of value creation, and hence a point of departure for all commercial innovations.

Consequently, they carry variable economic values, different abilities to convince others and potentially some ability to engage in new relations in the sense that others would want to relate to them in order to somehow take advantage of their properties. The two fundamental sources of variety and their interactions create a landscape where most entities evolve into highly specialized and complicated commercial connections – very similar to our perceptions of the complex interplays existing in a rain forest. In such an economic world, the challenge is to find yet another position where an innovation can make a living on the basis of some sophisticated specialization by which to exploit the particular specializations represented by others. Such a world will grow by including more and more specialized variety. This, we believe, is in fact a core characteristic of what we associate with the network driven economy.

However, the innovation may also be affected by changes in entities to which it is only indirectly related. This is what we usually associate with network effects, causing complex patterns of change and adaptations that result in alterations in value creation by means of adjusting combinations of already paired resources in unique ways. Hence, variety generates impulses that may roll back and forth in heterogeneous structures causing adaptations and re-combinations that will have economic effects. For instance, demand for product variation on the user side causes propositional variations leading to multiple and related adjustments of the production system to enable such variation in output.

The variety of unique combinations within a particular business landscape leads to a multiplicity of “potential combinations of entities” surrounding established interfaces. Hence, variety represents an important dimension of the interfaces we observe in business landscapes. Each interface is not simply between two items but is indirectly constituted in relation to the other potential interfaces presenting themselves as commercially exploitable options. This availability of multiple options causes substantial challenges that are typical to innovation management. The consequence of this, for the innovation to business landscape interfaces, is that the more variety represented by the particular business area, the more demanding will be the innovation’s ability to engage in more rewarding combinations than whatever is actually already present. Thus, our eighth proposition is that

(8) The innovation project has to build on a selected and combined unique set of interfaces.

The innovation has to offer opportunities that are distinctly unique and attractive as compared to other alternatives, and on the other hand it needs to enhance its ability to connect to a multiplicity of combinations of others. Over time, these highly complex processes may emerge into unmanageable levels of diversity, which causes friction forces that mobilize towards standardization of interfaces. Hence, changing demands for variability over time is a challenging dimension of innovation to business landscape interaction.

The managerial issue that follows from the observed variation factor is essentially the difficult continuous striving to avoid the chaos represented by a multiplicity of combinatory options: the striving to create and maintain some simplified conceptual

unity and sense of direction on the side of the innovation collectivity. It is to develop, adjust, upgrade, communicate and enforce particular conceptualizations that link the major elements together in such a way as to present a route to economic rewards. They are communicative conceptions of value creating models and processes that serve as ordering systems to coordinate and mobilize resources, activities and actors to reach perceived objectives and goals. These conceptions are typically mobilized entities at the frontiers of enrollment and interacting activities. In the managerial perspective the challenge is to manage an overwhelming complexity in the face of limited ability to actually evaluate the value of the various options without engaging in additional costly and time consuming trial, error and rehearsing processes in the shaded spots of the rain forest where nobody knows what problems may appear. The capacity to manage, investigate and develop is always tiny compared to what is needed to assess what is represented by the variation that presents itself to the innovation. Hence, and this is our ninth and final proposition:

(9) *In the face of substantial variation, framing of value creation processes becomes a core innovation management activity*.

Network processes as drivers of innovation

The application of a rain forest metaphor to describe business landscapes offers a different perspective on the role and character of innovation management. It becomes critical to expand the ability to discover, to access and to interact with a potentially large number of diverse and specialized entities that are already interacting with others. In other words, it is necessary to organize a network process. This includes to re-combine and to re-frame different user possibilities, to connect to others and to stabilize interfaces across these entities. It is easy also to acknowledge the importance of obtaining effective access to knowledge and to information about what is underneath the surfaces, hinting at the vital role of communication technologies in these network processes. The network process can be seen as the required organizing function needed to develop new business activities in such business landscapes, where the importance of others, the management of reactions from these others across multiple interfaces, and the ability to frame value creation processes in the face of crowdedness of already existing alternatives among the same users, are normal conditions of operation, decision-making and action. Let us now see how a network process can be related to the three managerial challenges identified in the previous discussion.

The immediate managerial consequence of interdependency is to acknowledge the innovation project's dependency on others. Entrepreneurial success depends on others who are never fully controlled by the single actor, nor perfectly adapted to fit to the innovation project. Innovation management accordingly necessitates a lot of organized and creative interactions with others in order to enroll, align, maintain and stabilize those others in their roles as participants in the innovative business case. Every new enrollment will cause some frictions within the already established interconnected business/innovation structure, requiring some realignments or

adjustments of whatever is already in place. Over time, the reactions to these demands typically force the network process to deal with the specifics of the different relationships - to upgrade the functionality, the effectiveness, the efficiency and the robustness of the interfaces involved.

The acknowledgement of interface movements as sources of friction forces directs attention to conflicts, discussions, rivalries and creative trouble-shooting as typically occurring at the frontlines of business creation processes. Reactions and counter-reactions throughout the interconnected innovation venture leads to mobilization of resources, actors and activities in additional sense-making and trouble-solving efforts to overcome technical and economic challenges. Again we need a network process to organize the complex patterns of incremental economizing where a “new innovation” has to find its economic place and role. Management of these frictions is a major part of what the network process has to conduct in order to maintain output oriented predictability and a sense of collective unity. An effective and efficient network process is not one that prevents friction forces but that addresses them adequately to further stabilize and improve the productive capacity of the innovation venture in relation to all of those on the other sides.

To utilize frictions requires conceptual and communicative framing activities. Eventually, most of the frictions caused by all kinds of movements and changes must be managed by many within the network - across multiple interfaces. In order to create necessary coherence, the individual framings of meaning, objectives, targets and methods have to come together in such a way as to shape a networked expectancy and discipline for what in the end can only be executed through some distributed trouble resolving managerial structure. Hence, the more complex the business environment that is connected and exploited, the more the network process will depend on particularly formatted, shared and stabilized management support technologies that help stabilize numerous interfaces. In fact, what we see is that the tremendous growth of information, communication and control technologies and the particular formatting of such systems, has become a major driver of successive new waves of interacted business innovations across the globe. These systems in a radical way expand the capacities and capabilities of network processes to manage reactions and to frame new business ventures “at the fringes” of the huge and interconnected production, logistics and infrastructure systems that are already there.

The rain forest metaphor also illuminates the complexity of challenges to network processes and the associated role of simplification. Different types of resources and actors, variable qualities, different quality/price mixes, different degrees of specialization requirements, and different knowledge bases offer a huge variety of potential contributors and combinations thereof. Such complexity forces simplification as an important and distinct organizational activity. Simplification is in itself also a creative activity, typically associated with mental holistic conceptualization, selection, focus, unity, strategy, goal targeting and standardization, but it is also mirrored in the organizing of the network process. Simplification fundamentally underpins the ability to organize communication in a productive way. In a business landscape marked by relatedness, motion and variety, simplifications are always like attempts at “freezing” a particular set of activities and resources to permit for more focused and deliberate interactions in more stable and constrained contexts - mentally, communicatively and

economically - by excluding complexity. Hence, the network process must include a simplification that is core to the ability of many to coordinate activities in effective ways, core to what we associate with economizing.

Network processes and smart systems

Zuboff (1988) explained how the computer and the successive development of new generations of software, rapidly and radically transformed both production and administrative work up to that point of time. The computer turned traditional bodily contained expertise within factories as well as around the management tables into intellectual practices interacting with the world through the new human to information system interfaces; the data screens and their abstract representations of underlying realities. As such, she presented and explained the critical role of these new interfaces in the practices and expertise requirements of modern work life. Furthermore, she showed the dramatic movement towards networked based managerial systems that permitted managers at multiple levels of operation and control to directly interact with and alter underlying production or administrative activities. The smart machine eventually distributed and decentralized managerial control and interaction possibilities as a consequence of the automatic production and information processing systems. What came out was a dramatic expansion of the capacity of many to interact with and take responsibility in relation to a lot more – through networked organizational systems.

Since 1988, we have witnessed a successive flow of new software generations in combination with radical systemic expansions – in particular with the establishing and growth of the global web (internet). Today, we are apparently in the age of “The Smart System”, where information technologies have generated a lot more layers of systemic interrelatedness which have radically expanded sophisticated human-machine interfaces to become integrated, networked ICT infrastructures reaching across the globe.

This “smart system” seems to be the perfect answer to the earlier identified challenges. Let us now first see if they are the answer to the problems identified in our two case illustrations:

In the first case the research on DNA-sequencing provided the starting point. The development was here characterized as a network of different specialized researchers that over time also established a relationship with a commercial actor – an expert on this type of biotech equipment. However, changes in the business network of the latter – a merger – destroyed the possibilities to maintain developmental network. Instead, the researchers together with a dedicated manager had to develop an independent company. In order to finance this company a venture capital company had to be involved. The requirements of this company made it more difficult for the new company to maintain its close contacts with the researchers – the company became instead a true spin off. It thereby became a rather isolated unit that had to engage in building up a new commercial network. And it failed to do so within the window of opportunity it faced at the time. The innovation became the victim of a too limited and

centralized network process. One important reason for this was that the process had to be restarted a couple of times due to unexpected events.

The second case is an illustration of a more successful process but that had the same problems during the early development phases. It started in research but went rather quickly into a commercial stage where severe problems emerged. Those had to do with both the production side and the marketing side. On the production side a necessary complementary actor was found, but it turned out to be more problematic on the market side. Despite substantial efforts to find complementary actors in various parts of the world, nothing stabilized as a working relationship. It was not until the "innovation" was forced into a reframing process that it became possible to find a marketing partner prepared to make the necessary efforts. This case demonstrates the need to have a "complete" network before it is possible to commercially succeed with any invention.

It is interesting to note that it is not the information dimension that is the core problem in either of the two cases – even though information processing and exchange were vital in both processes. Instead, the core problem was to find the economic model in which the involved actors could relate productively to each other – i.e. design the economic features of the innovation – so that all participants could adequately benefit from it. It is this economic logic that has to be found, and here the smart systems may be very helpful indeed by providing flexible and very extended technological platforms and infrastructures where more actors with large outreach capacity might interact and organize a lot more effectively.

The smart systems have two important roles. Firstly, they provide new arenas for technical innovations of a network type and have integrated and commoditized the information arenas – but perhaps even more importantly, they have made the relatedness, dynamics and variety of the business landscapes much more visible and accessible to economic actors.

This can be seen in the new generation of "smart systems" managing really big data, in their individualized user adaptations and automatic processing and production functions not previously seen. These systems are expanding into all major sectors of society. For instance in the financial and security industries they have been operational and thereby possible to innovate within for quite some time. They expand into the home entertainment industry, into energy supply industries, into complex remote control industrial operations and into traffic control systems to name but a few. All of these areas have also been hotbeds for important innovations. Nowadays, they are also expanding into the really big sectors of modern economies, such as health care, education, large scale real estate management and city life organizing and interacting. These technical systems are moving all kinds of entities, resources, actors and activities deeper into systemic and networked interrelatedness, interdependencies and powerful economizing advancements. This opens up new waves of opportunities for entrepreneurs to creatively combine entities that all of a sudden become accessible, manageable and moveable "at the fringes" of these new mega-systems.

The second role they have is that they radically expand the visibility of these interdependencies, the dynamism and the variety – in substantial detail – to a lot more actors, and in different ways make them accessible to people across the world. These activities generate "waves of new innovations" occurring at the interfaces between

systemic “interaction technologies” and numerous networked business innovation and economizing processes.

Based on our discussion, the fundamental characteristics of interface challenges, systems theory as well as empirical observations of the expanding smart systems, illuminate how large scale information systems radically expand the area for innovation – even if they alone do not change the capacity to do it. This capacity seems instead to regard the creation of economic network solutions that structure, simplify and stabilize the interfaces in combination with their ability to scale up their outreach to integrate a lot more of what is out there in the rain forest. Managing innovations can never be done by single actors but has to include a specific set of actors – an economic network.

Appreciating the interacted character of the economy and viewing it in an economic network perspective leads to an understanding of economies as something that needs to be rooted in “mutual use” rather than in individual choice concepts and theories. The user perspective is present on both sides of a relationship, and what the user is using is what s/he is connected to on the other side of the interface. As networks consist of connected relationships, the mutual use in dyadic relationships develops into multidimensional use in the network. The notion of economic networks (Håkansson et al. 2009) as well as the Service-Dominant Logic (SD-L) and Service Systems (Barile & Polese 2010) have been suggested to define the essence of what is being offered to the “counterparts” in these settings. They aim at characterizing the essence of the business growth processes by pointing at their capacities to radically enhance service provision - in broad terms. Hence, the underlying structure of the emerging “systemic S-D logic” businesses is a combined socio-technological and economic network of networks in which business actors interact mostly through their resource and activity capacities. As such, we see SD-L and Smart Service Systems theories as a reflection of a fundamentally interactional based interpretation of what goes on in “the economy” very much based on the understanding of IMP business network theory.

Conclusions

Somewhat similar to the two sides of a Janus-face, an innovation emerges as a unity of two different processes. One of these is very open, creative and full of uncertainties and fluctuations - essentially associated with the mental processes of mind and unconstrained by actual time and space. The other kind appears almost the opposite – a systematic process of combining, adapting and linking in order to fit the “creative new” into already existing activities and resources in an economically efficient way. This is a process constrained by whatever is already there in the social-material world in real time and space. Both “creative newness” and “real world economizing” are needed for an innovation to actually materialize and succeed. Based on this argument, we have explored a more thorough conceptual understanding of the world of innovations in their surrounding business landscapes. Using a rain forest metaphor gives us a basic image of how complex and multidimensional this relationship is. We argue that an innovation needs a whole set of very different interfaces relating it to

specific other resources, activities and actors. We see each and every such interface as the outcome of Janus-face like interacted innovation processes. Hence, the overall unified process may be seen as a conglomeration of a large number of linked micro-processes. To manage these is what innovation management is about.

We have identified three important factors dominating innovation management challenges in business landscapes: interdependency, dynamism (motion) and variety. Each of these is associated with a particular source of economic value creation. The importance of interdependency follows because economic entities are constituted by their relations to others. The importance of movements follows because these cause friction which again causes mobilization of creative micro-processes. The importance of variety follows because the value of a given resource, activity or actor depends on its combining with particular others. Hence, interdependency, friction and combinatory uniqueness are conceptual building-blocks in an economic theory that takes interaction as a fundamental feature of real economies.

Based on these, we argue that management of innovations requires a set of particular qualities that are needed to transform these economic sources into specialized semi-stabilized innovation entities linked to other entities in their business landscapes through a large number of particular interfaces. The three factors and their associated economic sources are represented within the interfaces. From there we have identified three important dimensions of these interfaces that need to be managed in order to secure the effective transformation of the economic sources into some kind of simplified collective unity with a sense of direction and a capacity for disciplined interactions. These are the specificity, the adaptability and the combinability dimensions of the interfaces.

It follows from this that to succeed in bringing a radical innovation from idea to economic prosperity will require some kind of multi-functional interrelated managerial network that is capable of constantly recreating simplified and conceptual unity and a sense of direction and collective coordination, while at the same time managing the extendedness of the operation and the many changeable, moving and complex interfaces in their different contexts, such as, for instance, represented by the context of development, the context of production and the context of using the innovation by others. Given these challenges, management and management action is obviously the most critical function in any innovation process.

In this perspective, we see the new dominance of service-innovations depicted by the emerging SD-Logic and Service System theorizing as networked managerial activity at the interfaces of business innovation practices and “smart systems”. As such, it brings business network theory and system theory together – as two sides of a different Janus face: the extended, structured, interacted and simplified information technology systems and the more messy world of interacting the social with the material by managers of innovation who economize and market processes that exploit the system side to advance their capabilities in still very complex and demanding business landscapes.

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Endnotes

i Studies of "complex systems" within areas such as management, physical and technological systems and innovation have applied complexity theory to study how these complex worlds coordinate and generate particular outcomes at the overall level of analysis (Amaral & Uzzi, 2007). This approach is complementary to the more micro-oriented perspective we apply in this paper

ii Path dependency defined broadly implies that the next step depends on the previous steps. Whatever becomes is dependent on things already existing. In economic theory, the notion of path dependency is used to argue that existing technologies have increasing returns in relation to new competing technologies, because they are already adapted by users and are baked into the competencies of companies. In addition to their internal superior capabilities, new technologies will have to overcome the costs of adaptation. Over time this is said to cause a potential problem of technological lock-in of suboptimal solutions. (Arthur; 1989, David; 1986, David & Bunn; 1987).

iii This is in accordance to the definition of heterogeneous resources in Alchian & Demsetz 1972