

Managing innovation successfully: a complex process

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Abstract

In this paper we bring forward a new way of thinking about innovation and the relation between innovation, culture and management. As opposed to what we label traditional ways of thinking about organisations and innovation, which are mainly based on Newtonian equilibrium theory and scientific principles of management developed by Taylor (1911), we regard innovation as a complex process. This means that, metaphorically speaking we view innovation as a complex adaptive system (CAS). According to Holland (1995) complex adaptive systems exhibit emergence and self-regulation.

Innovation is conceptualised as a structural and “mental” knowledge process and as a consequence defined as *a process in which knowledge is absorbed, assimilated, shared and used with the aim to create new knowledge*. Following on Genelot (1992), the assumption is additionally made that two aspects contribute towards the success of an innovation process: the capability to produce new ideas, and the capability or skills to transform these ideas into a successful proposition. We will argue that in line with these thoughts, this is an emergent process in part engendered by the culture of the organisation, in addition to three key principles identified by Morin (1996): the principles of dialogue, recursion and holons.

Keywords: Innovation, Complex Adaptive Systems, Culture of the Organisation, Learning, Adaptation.

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Introduction

According to Genelot¹ (1992) “*L’innovation ne se limite pas à la création de nouveaux produits et de nouveaux services. A un degré encore supérieur, ces innovations dans les méthodes d’organisation et de production sont elles-mêmes conditionnées par les découvertes scientifiques et par les évolutions de la pensée*”. In this definition innovation not only refers to a new product or service, but it defines innovation in a broader sense and at a higher level of abstraction, namely innovation in management and production facilitated and conditioned by scientific developments and evolutionary thinking.

In line with these thoughts, in this paper we will argue that innovation is embedded within a certain organisational theory (*i.e.* management thinking) and complementary organisational context and cognitive processes. This affects the:

- 1) definition of innovation
- 2) modelling of innovation
- 3) place of innovation within the organisation
- 4) role of culture in the innovation process

It will be argued that, as opposed to what will be labeled traditional ways of thinking about organisations and its effects on innovation, we regard innovation a complex process and as such, metaphorically speaking, it resembles a complex adaptive system (CAS). A complex system is “a system that cannot be fit in a fixed model, whatever the complexity, the sophistication, the size of the model, the number of its components and the refinement of their interactions... The concept of complexity implicates

¹ D. Genelot, Manager dans la complexité, Réflexions à l’usage des dirigeants. Préface de J-L- Le Moigne INSEP Éditions, Paris 1992

unpredictability and possible emergence of unprecedented events.”² According to Holland³ (1995) a complex adaptive system exhibits *emergence* and *self-regulation*. This means that the outcome of a process is the result of the interaction among a variety of people (*agents*) that pursue better performance in co-evolutionary co-operation and collaboration with each other. Emergence can best be defined as the behaviour that surfaces out of interaction of a group of people, whose behaviour cannot be predicted on the basis of individual and isolated actions (Coleman, 1999). Following on Genelot (1992), the assumption is additionally made that two aspects contribute towards the success of an innovation process: the capability to produce new ideas which in our view is *learning*, and the capability or skills to transform these ideas into a successful proposition, which according to us refers to *adaptation*. In line with thoughts of Morin (1996) we will argue that this is a “bottom-up” process that starts at the individual level, has an emergent character and is stimulated and engendered by the culture of the organisation. Three principles play a key role in this process: “*le principe dialogique, le principe de récursion organisationnelle et el principe hologrammatique*”⁴. What this implies will be explained in the course of this paper.

Innovation defined

We will start by defining innovation. In most cases innovation refers to an invention, which can either be a new product or service. Innovation processes refer to the stages an invention has to go through before it is launched in the market (*e.g.* Utterback, 1994). Sources of innovation can either be incremental technological advancements or radical breakthroughs, or customer needs, preferences and wishes.

These definitions are grounded in Newtonian equilibrium theory and subsequent traditional managerial thinking that can be traced back to Taylorism (1911) and his thoughts on principles of scientific management. These thoughts were later taken up by Henry Ford and affected management thinking till the eighties. Then new ideas started to

2 J.L. Le Moigne, *La modélisation des systèmes complexes*, Dunod, Paris, 1995

3 J.H. Holland, *Hidden Order: How adaptation builds complexity*, Reading, MA: Addison Wesley, 1995.

4 E. Morin, *Introduction à la pensée complexe*, ESF éditeur, Paris, 6^e tirage 1996, (Avant-propos)

emerge, amongst which those of T. Peters (1982), author of the book “Thriving on chaos”, which influenced organisational theory and thinking. Evolutionary theory and organic models of organisations emerged as a consequence. Companies were compared with living systems that evolved according to biological rules.

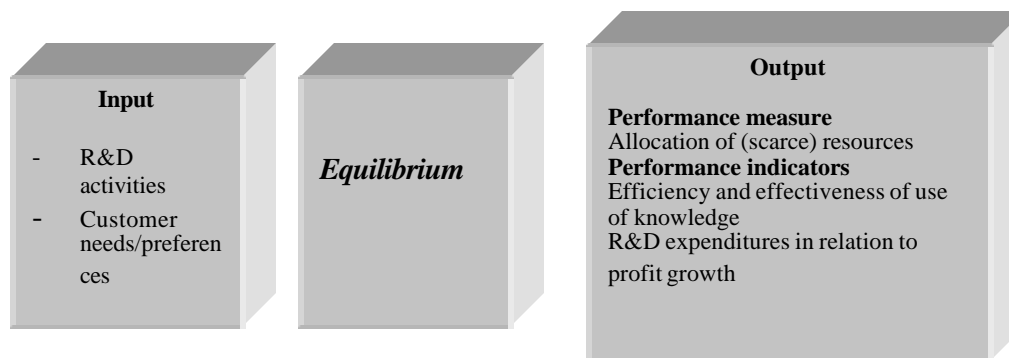
Parallel to these developments, thoughts about innovation changed over time, whereby in our view the transition that took place from an industrial economy to a knowledge economy, was the most important development that affected the conceptualisation of innovation. In a knowledge economy, knowledge as an asset grows significantly in importance in accordance with the growing importance of the owners of that knowledge, the so-called knowledge workers. This affects the definition of innovation significantly. Whereas innovation traditionally relies heavily on input factors, which are mostly tangible in nature, *i.e.* land, labour and capital, the input in a knowledge economy is intangible, namely knowledge. This means that innovation can then be regarded as *a process wherein knowledge is absorbed, assimilated, shared and used with the aim to create new knowledge*. This new knowledge then becomes embodied in new products or services. Takeuchi & Nonaka (1994) lay the foundations for this definition of innovation, which they predominantly saw a process of knowledge creation. We will carry their thoughts further by arguing that additionally this is a complex process subject to rules underlying complex adaptive systems.

It is important to note that definitions act as conceptual frameworks for the design of organisational processes and decision making. Innovation defined in the traditional sense, *i.e.* as an invention, is for instance reflected in the design of descriptive sequential models of innovation like for instance the NPD funnel model of Cooper (1987). Innovation is broken up into parts, phases and activities in a sequence from idea to launch. The assumption being that the input sources are either R&D, or customer needs and preferences. Success parameters are defined in terms of market share, volume or profit growth in relation to investments. Innovation defined as a knowledge management process and complex adaptive system will affect modelling accordingly.

Modelling of innovation

Models are simplified representations of reality based on a definition and understanding of that reality. Traditional models of innovation are grounded in traditional economic theory reflected in rational entrepreneurial models of organisations like the earlier mentioned NPD funnel model. In these models organisations are viewed as entities where people are organized in a hierarchical context which excludes external influences, and behaviour is goal-oriented. The relation between input and output is furthermore a linear one, and the main objective is to reach an equilibrium.

Figure 1: A static model of innovation (adapted from Lundvall, Harkema 2001)



As mentioned earlier, innovation defined as a process in which knowledge is absorbed, assimilated, shared and used will affect its design. Whereas prior models were mostly static, innovation defined in this sense is a dynamic process of interaction and learning. Lundvall (1992) argues that the most important success parameter in a knowledge economy should be the extent to which knowledge is efficiently created, shared, and transformed. He contends that from the standpoint of equilibrium theory, predominantly underlying rational mechanistic models, the main performance dimension of innovation refers to the more or less efficient allocation of resources; with R&D expenditures in relation to company performance (measured in terms of market share, ROI, or profit growth) as the main performance indicators. Alternatively according to him the most relevant performance indicator to measure innovation by, should reflect the efficiency and effectiveness in creating, sharing and transforming knowledge. Innovation then

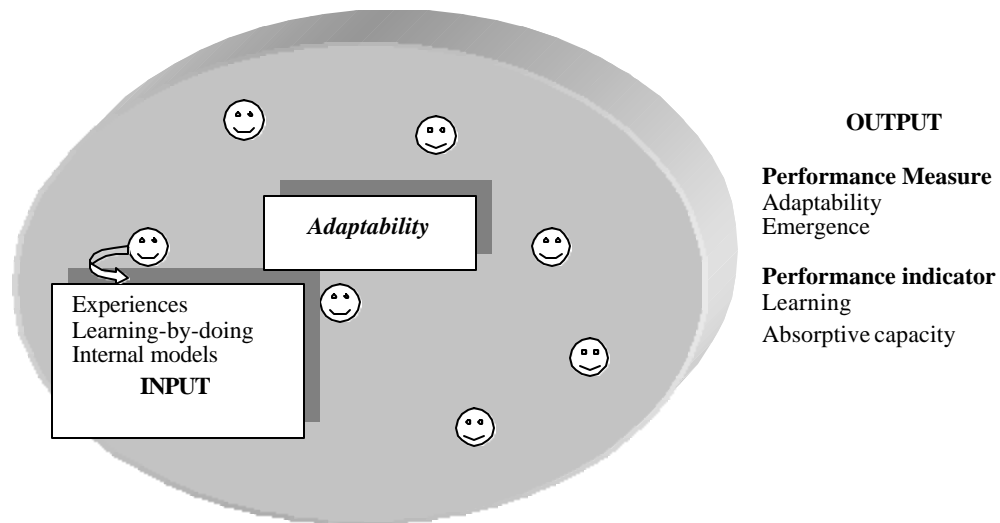
becomes an ongoing process of learning, searching, and exploring which results in new products, new techniques, new forms of organisations and eventually new markets. The main performance measure subsequently becomes the ability to adapt, instead of the ability to reach a certain equilibrium point.

In addition innovation defined as a complex process will also affect its design. According to Morin (1996) “*L’inspiration dominante qui convient au développement de l’innovation relève de la pensée complexe, c’est-à-dire une autre façon de penser qui ne cherche pas à compliquer mais à ouvrir la pensée vers d’autres champs conceptuels et progresser vers la compréhension du complexe*”. What are the elements of a complex system? Anderson (1999) identifies the following characteristics that complex adaptive systems share:

- 1) *A group of agents with cognitive schemata*. Agents can be individuals, groups of employees, managers or customers. Each agent’s behaviour is dictated by a schema, a cognitive structure that determines what action an agent takes given his/her perception of reality. Cognitive schemata are mental representations of reality defined in terms of norms, values, principles, rules and models (Sherman and Schultz, 1998). Agents are connected to each other via an intricate web of relations.
- 2) *Self-organisation and emergence* refers to the way agents interact with each other and the outcome of that interaction. Self-organisation results if people are let free to network with each other and interact whereby they are not restricted by organisational or functional boundaries. The assumption is that this will influence the outcome in a positive way since interaction will not be constrained by rules and regulations. Emergence is what results from this way of interaction, *i.e.* behaviour that cannot be accredited to the individual actions, but becomes manifest in the outcome of the group behaviour.
- 3) *Co-evolution at the edge of chaos*. Living systems tend to operate at their most efficient level in the transition phase between stability and disorder poised “at the edge of chaos” (Kauffman, 1993). The same applies to people organized in a network: a network that strives for equilibrium and reaches an equilibrium state is in principle a “dead” system. People have to stay poised and alert “at the edge of chaos” since it fosters creativity, collaboration and team-spirit.

- 4) *Recombination and system-evolution* refers to the way the system can evolve under the influence of changing circumstances like different agents, or different circumstances.

Figure 2: A dynamic model of innovation (adapted from Lundvall, Harkema 2001)



These four aspects in combination with each other, illustrate the dynamic character of innovation and subsequently its complexity. Models can be regarded as metaphors of reality, which when applied are used as a regulatory mechanism to guide processes. It is in its application that models come to life and this raises the question how the application of principles of complexity will affect the innovation process?

Complexity thinking

According to Morin (1996: 99,100) “*L’innovation est, nous l’avons vu un processus complexe. Ce processus s’accorde mal avec les modes traditionnels de management. La pensée traditionnelle est trop simplifiante pour être satisfaisante, son ambition se limite au contrôle et à la maîtrise du réel, alors que celle de la pensée complexe est “de rendre compte des articulations entre les domaines disciplinaires”⁵. Ce qui s’adapte particulièrement aux sciences de gestion qui rassemblent des domaines multiples.*

L'approche de l'innovation doit se faire par le biais de la complexité qui en son principe reconnaît les liens que notre pensée doit distinguer mais pas isoler". As indicated by Morin, innovation is a complex process, which does not harmonize well with traditional management thinking. Traditional management is too much geared towards control reductionism, whereas complexity thinking "takes into account the links between different disciplines".

Morin continues as follows: "*Comment penser la complexité? Je propose trois principes qui peuvent nous aider à penser la complexité*":

- *Le principe dialogique nous permet de maintenir la dualité au sein de l'unité. Il associe deux termes à la fois complémentaires et antagonistes.*
- *Le principe de récursion organisationnelle. Un processus récursif est un processus où les produits et les effets sont en même temps causes et producteurs de ce qui les produit. Les individus produisent la société qui produit les individus. L'idée récursive est donc une idée en rupture avec l'idée linéaire de cause/effet, de produit/producteur, de structure/superstructure.*
- *Le principe hologrammatique est présent dans le monde biologique et dans le monde sociologique. L'idée de l'hologramme dépasse, et le réductionnisme qui ne voit que les parties et le holisme qui ne voit que le tout. Dans la logique récursive, on sait que ce qu'on acquiert comme connaissance des parties revient sur le tout. Ce qu'on apprend sur les qualités émergentes du tout, tout qui n'existe pas sans organisation, revient sur les parties. Donc l'idée hologrammatique est elle-même liée à l'idée récursive, qui elle-même est liée à l'idée dialogique en partie.*

L'innovation est un processus complexe et doit être traitée comme telle. C'est en appliquant ces trois principes qu'on peut mettre en évidence les liens qui relient l'innovation, la culture, et le management ainsi que leur interaction."

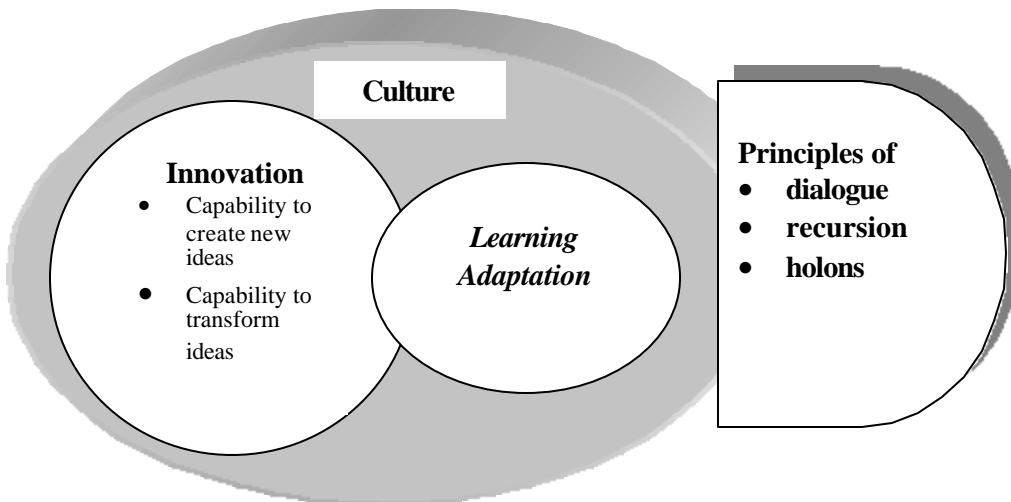
Summarising his thoughts we can conclude that Morin distinguishes three main principles which can help us understand complexity and which we can then subsequently apply to organisational problems; in this case organisational innovation:

- The principle of dialogue that offers the opportunity to maintain duality (*e.g.* between subject and object or agency and structure) while at the same time transcending that duality and creating a unity of the whole.
- The principle of organisational recursion, in which causes simultaneously are effects. Individuals create the society which in turn creates the individuals. This is a recursive process, and as such this breaks with the idea of linearity and a causal linear relationship between input and output which underlies most traditional organisational thinking.
- The principle of holons which goes beyond reductionism, that only sees the parts and holism, that only sees the whole. Holons or whole/parts are entities that are both wholes and parts of ever greater wholes, simultaneously and at all times. Holons are both autonomous and dependent structures at the same time (Van Eijnatten, *et al* 2001). This principle represents the idea of emergence, which implies that the parts are more than the whole and understanding of the whole cannot be derived from an understanding of the parts.

Morin argues that these three principles are intertwined and that they are linked to each other. It is via the application of these principles that the linkage between innovation, culture and management becomes apparent. If we relate these principles to the two conditions that Genelot (1992) sees as primary to innovation, (the capability to produce new ideas which in our view is *learning*, and the capability or skills to transform these ideas into a successful proposition, which according to us refers to *adaptation*), how will that affect our understanding of innovation?

Innovation and culture

We argue that the capability to produce new ideas and transform them into successful propositions is fostered by: 1) the culture of the organisation, 2) learning and adaptation. Furthermore, we will argue that the fundament for learning and adaptation to take place, is formed by the three principles of Morin (1992). What we will bring forward can be graphically represented as follows:



The culture of the organisation

Where can we place culture within an organisation? Referring to Thévenet⁶ (1999:10), we see culture as an aiding mechanism for organisations to deal with management problems:

“Dans tous nos travaux de terrain, il n’est jamais arrivé de voir une entreprise s’intéresser à la culture pour elle-même mais toutes travaillent sur la culture pour résoudre des problèmes concrets: problèmes de stratégie, de fusion, de mobilisation du personnel, de restructuration, voire de communication. La culture n’est qu’un moyen de mieux traiter ces problèmes...”

If culture can be regarded as a tool to help solve managerial problems, how can we then define culture? Schein⁷(1990) defines organisational culture as “(a) a pattern of basic assumptions, (b) invented, discovered, or developed by a given group, (c) as it learns to cope with its problems of external adaptation and internal integration, (d) that has worked well enough to be considered valid and, therefore (e) is to be taught to new members as the (f) correct way to perceive, think, and feel in relation to those problems”

Refining this definition, we may propose that, if the organization wants new ideas to emerge from the group, it has to create a certain climate, a *“mobilité mentale ambiante une culture en quelque sorte qui favorise les rencontres de personnes et d’idées, facilite la communication entre les gens et tolère les transgressions créatrices. Une culture aussi*

⁶ M. Thévenet, La culture d’entreprise, PUF, Paris, 3e édition, 1999.

⁷ E. H. Schein, Organisational culture, American Psychologist, February 1990

ouverte sur l'environnement extérieur. C'est cette culture de l'ouverture, la communication et la démarche prospective qui en se conjuguant, incitent les esprits au désir de l'innovation et à l'émergence des idées". Thus a culture has to be created favouring interaction between people and their ideas, facilitating communication and tolerating and stimulating creative transgressions. A culture that is open to the external world.

In this definition openness is crucial to favour the generation of ideas, facilitate communication and allow influences from the external world. An organisation is then in part bounded by rules and processes but only in as much as they offer the possibility to transcend these boundaries via dialogue and an open culture. The capability to produce new ideas then depends not so much on the rules, regulations and procedures, but on the ability to create an environment wherein people are allowed to self-regulate and the emergence of ideas is left to arise "bottom-up", *i.e.* stemming from the individuals within a company: the owners and creators of knowledge.

The capability to produce new ideas and transform them into new propositions

In the nineties Nonaka and Takeuchi (1995) lay the foundations for the thoughts of what they called the "knowledge creating company" and the distinction between tacit and explicit knowledge. According to them knowledge is intrinsically related to human beings who own knowledge, combine it in their own mind to form new knowledge, share it, and re-convert it into new knowledge which may eventually lead to the creation of something new or different. Knowledge creation, *i.e.* innovation, then becomes more than anything a process based on a learning attitude. Whereby we regard learning as a way to develop knowledge which starts at the individual level.

How does this work, *i.e.* what is knowledge in essence, and how does learning occur? Generally speaking people have models in their mind, which determine how they perceive reality. Anderson (1999) calls these models cognitive schemata. Partly these models are based on ideas, values and norms which may be inherited or may develop

through experiences, and partly they are based on what Hofstede (1980) calls organisational practices (symbols, rituals, routines, heroes). Practices in concurrence with a certain mentality reflect the importance of culture in “setting the scene” for knowledge to develop. The capability to produce new ideas then becomes closely intertwined with the context of the organisation laid down in the structure and culture of the same.

The principle of dialogue plays an important role in this process, since it is through dialogue and interaction that people learn and culture emerges. This principle also permits the association of contradictory notions to conceive the same complex phenomenon.

It is also in a dialogue between people that tacit knowledge becomes explicit. Also through dialogue the duality between subject and object or agency and structure can be transcended. Dialogue creates the possibility for people to share their ideas and in so doing transcend the borders and limitations of their own mental models. This dialogue however has to take place in a culture of openness for self-regulation and emergence to arise. Instead of defining the borders of the system through constraints that act as control mechanisms, the system should be left as much as possible open to external and internal influences that transcend these borders. 3M has understood this and as a consequence people are let free for 15% of their time to “be creative” and come up with any idea they can think of.

It is then that the *principle of recursion and holons* comes to life, which is in fact a co-evolutionary process of interaction as described by Anderson. An individual and the context wherein he or she operates then cannot be disassociated from each other, but simultaneously becomes cause and effect of changes in the environment and mental processes. Varela (1991) calls this *embodied mind*, which refers to the fact that an individual enacts the environment of which he is a part, *i.e.* he creates it while at the same time he is re-created by the environment which he has changed through his actions. A product then becomes the embodiment of knowledge. Metaphorically speaking this process can be compared to a holon. Every holon possesses both an interior essence as well as an exterior surface it presents to the world. “Holon” refers to the ‘both...and’ character of entities: both part and whole, both content and process, both exterior and

interior, surface and depth, order and chaos, structure and culture, objective and subjective.

It is important to note that parallel to the application of these principles, learning and adaptation takes place. Whereby we see learning as a process prior to adaptation, since in the latter case both cognition and context have been recreated and as such adaptation has taken place. As in a holon, part and whole cannot be de-coupled, and this process does not stop at a certain point, but is continuous. We therefore suggest, in line with Lundvall (1992) to speak of adaptability instead, because it stresses the dynamism of the process. According to us, the extent of adaptability of the members of an organisation (*i.e.* the individual), and eventually the organisation (*i.e.* the collective), forms the breeding ground for the emergence of capabilities to transform ideas into successful propositions.

A new way of thinking about management and innovation

Complexity thinking is not only a new way of thinking about management, but also about innovation. We have defined innovation as a complex process for several reasons:

- Innovation consists of a group of people, *i.e.* agents, that interact with each other and in so doing share ideas, create new knowledge, and re-create both knowledge and the context of that knowledge.
- Interaction is a process of learning and developing new knowledge. This process is not linear but subject to non-linear dynamics. Knowledge exchange is subject to continuous *feedback loops* between agents and between agents and the external world. These feedback loops are represented by customer knowledge influencing the process, or other internal knowledge sources, which can either be knowledge from a colleague, but also from other stakeholders within the organisation.
- In the process of interaction between people and between the internal organisation and the external world, alternatives are sought out, and either selected or discarded to the extent that there is “fitness” between the individual mental model and the new piece of knowledge. Knowledge exchange can thus be viewed as a process of strategy selection and choice based on adaptation. Metaphorically speaking this process takes

place on an “adaptive landscape” represented by “peaks” and “valleys”, whereby optimal fit is achieved on a peak, and sub-optimal fitness in a valley.

Genelot (1992) advocates a new method of management to be able to cope with the complexity of reality and, more than anything, to harness that complexity. According to us the most important conclusions that can be drawn in relation to organisational innovation are:

- 1) To view innovation in a broad perspective as a process of structural and mental “knowledge flows”: at the structural level it refers to information flows, procedures and decision making; at the cognitive level it refers to what people think, perceive, feel, and sense.
- 2) To create a culture of openness and establish a climate wherein dialogue is stimulated, and thus the ability to transcend the gap between structure and cognition.
- 3) To accept chaos as a transition phase important for creativity and collaboration.
- 4) To allow for diversity and variety, since they foster creativity and form the breeding ground for people to open up and share their ideas.

Conclusion

We have tried to bring forward a new way of thinking about management, culture and innovation in the assumption that these three elements are closely intertwined. Innovation is the key to the continuity and sustainability of a company and therefore a key process for survival. Contrary to traditional ways of thinking about innovation, we have argued to define innovation as a *process wherein knowledge is absorbed, assimilated, shared and used with the aim to create new knowledge*. In so doing we transcend traditional ways of thinking about innovation as a process in which a certain input leads to a predicted output. Innovation described in this way relies strongly on the ability of an organisation to create a culture of openness and diversity. This forms the breeding ground for dialogue and interaction, which we see as the basis for new ideas to emerge. For these ideas to be transformed into interesting and commercially viable propositions, this way of thinking has to be laid down in the structure and culture of an organisation. These should however

not be imposed from the top, but should be the reflection of a recursive process of learning and adaptation between individual and context and between organisation and the external world, who simultaneously create and re-create the environment of which they are a part and which they simultaneously give form.

Our aim has been to bring up thoughts about management and innovation based on this way of thinking, which Morin (1996) calls "*pensée complexe*". Further research will have to give insight in what the precise effects will be of application of this new way of thinking for managers and organisations. Both authors are doing PhD research in that field: M.J. Browaey is focussing on the culture of organisations and S.J.M. Harkema on innovation. With this paper we have also tried to demonstrate that complexity thinking allows us to look beyond the borders of our respective domains.

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