INNOVATION SCENARIOS
GENERATING A STRUCTURE FOR A TOOLKIT

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1   Introduction

The industrial management challenge of coping with product innovation can be described as being a configuration problem with a high number of process variables that when combining them into one scenario have unclear or contradictory influence on the total performance. There is an urgent need to establish an integrated view of the whole product innovation process to avoid sub optimization in selected parts.

From a research perspective, innovation is generally perceived as the process of turning opportunities (inventions) into ideas and putting these into (widely) used practice. However, since innovation research is a relatively young and unconsolidated field, research studies tend to originate from different domains, and represent a wide spectrum of viewpoints. To have their research result published the individual researchers or research groups need to narrow their focus which leads to a huge diversity and as yet there are no established protocols with which to facilitate comparison and accumulation of findings between research communities. This diversity results in the published findings of the studies being circulated and recognized mainly within their original domains, and points to the necessity of synthesizing the knowledge that exists in innovation research communities to be useful for a wider community.

From an industrial perspective, the narrow focus and lack of comparison between research findings strongly contradicts the need to establish comprehensive understandings of the nature and variables of the innovation process. The problem related to the innovation challenge of the industrial manager can be described as being a configuration problem with a high number of variables, having contradictory influence on the total performance. In general, industrial managers need a rich and transparent repertoire of comprehensive views (scenarios), so as not to be imprisoned by any particular one. Examples of such comprehensive views can be found in Mintzberg et. al. *Strategy Safari* [1] and Morgan's *Images of Organizations* [2].

Morgan proposes a number of comprehensive and multi-perspective views on the phenomenon of organization. The multi-perspective views termed "images" present their own understanding of the organizational problems, solutions and daily patterns of interaction building on a blend of theories, from philosophy through sociology, biology, anthropology and history. From a management perspective the images can be viewed as a multi-disciplinary "toolkit" supporting design and improvement of organization.

The aim of this paper is to propose a framework that provides a structure for a similar "toolkit" to support configuration of product innovation processes. The framework will be based both in management practice and academic understandings.

We regard our effort as a long-term process requiring substantial empirical exploration and verification. Consequently, this paper only reveals the overall framework and a few case descriptions.

2   What is Innovation

In its broadest sense the term "innovation" comes from the Latin *innovare*, meaning "to make something new". We find it important to make distinctions between *invention* and *innovation*. Whereas invention is the creation of a new idea, innovation is more encompassing and includes the process of developing and implementing the new idea. Porter [3] stresses this broad meaning of innovation by stating, "Companies achieve competitive advantage through acts of innovation. They approach innovation in its broadest sense, including both new technologies and new ways of doing things".

The novelty of the idea may be relative. It may be a recombination of old ideas, a scheme that challenge the present order, a formula or a unique approach that is perceived as new by the individuals involved [4]. Innovations may be radical [5] as well as incremental [6]. Also most innovations involve new technical and administrative components [7]. Understanding the close connection between technical and administrative dimensions of innovation seems to be a key part of understanding the challenges of management of innovation. In this paper, we interpret innovation in this broader sense.

3   Methodology

The focus of our research is on trying to identify and elaborate integrative models of innovation which offer the hind of scenario ambitioned above. Our research process consists of five main activities: literature review, case studies in industry, action research in industry, workshops in industry, and laboratory studies. All activities are continuous, and add to our basic understanding of the innovation process as illustrated in Figure 1.
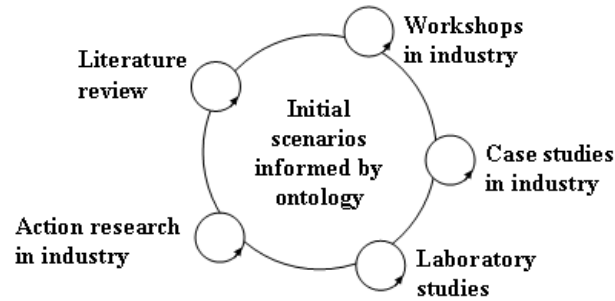
Figure 1. Research set-up

The research activities are conducted in parallel. We engage in different network activities, and since they mostly have long-term goals, each activity will be informed by the outcome of the other parallel activities.

The nature of the research activities is quite different according to the scientific rigor. In our industry related activities we have to acknowledge the empirical limitations determined by nature and complexity of the studied phenomena [8]. In our laboratory studies we can follow strict scientific rules but have to accept the fragmented theoretical nature of the results [9]. By applying the different types of activities we feel that we can balance between "fragmented theoretical contributions" and "comprehensive empirical contributions".

4   Developing a Terminology

In our prior work, we have primarily been focusing on the process dimension of the wider innovation term [10], [11] and [12]. The original aim has been to develop a product development ontology. The motivation for adopting an ontological approach is founded on the recognition of the problem, that especially empirical studies of the product development process often lack cumulative quality and transferability from one context to another. This is due to the specific terminologies adapted by different research communities. By adopting an ontological approach we generated a framework that can facilitate more consistent communication between research groups without necessarily operating on a globally shared theory and terminology.

However, the process view is only one – though important – view of the wider innovation term. Additionally, organizations have to manage a number of different aspects in the process of turning ideas into successful reality. There are several comprehensive frameworks attempting to capture this problem.

Van de Ven et. al. [13] uses the metaphor "Innovation Journey" and bases their work on an empirically grounded model. They point to six important sub-concepts to the wider

innovation concept: *Ideas, People, Transactions, Context, Outcomes*, and *Process*. Based on their fine-grained empirical approach, they are able to challenge the mainstream views of innovation in the more popular part of the academic and professional literature (se table 1).

Table 1.   Assumptions and observations about core innovation concepts [13]

	Literature implicitly assumes	**Empirical observation**
Ideas	One invention, operationalized	Reinvention, proliferation, reimplementation, discarding, and termination
People	An entrepreneur with fixed set of full-time people over time	Many entrepreneurs, distracted fluidly engaging and disengaging over time in a variety of roles
Transaction	Fixed network of people/firms working on details of an idea	Expanding, contracting network or partisan stakeholders who converge and diverge on ideas
Context	Environment provides opportunities and constraints on innovation process	Innovation process creates and constrained by multiple enacted environments
Outcomes	Final result orientation. A stable new order comes into being	Final result indeterminate. Many in-process assessments and spin-offs. Integration of new orders with old
Process	Simple, cumulative sequence of stages or phases	From simple to many divergent parallel and convergent paths. Some related, others not

The empirical observations of Van de Ven et. al. fit well with our empirical experiences.

Tidd et. al. emphasize two different frameworks to support the operational work with innovation [6]. One framework aims to broaden the scope of innovation to be more than product innovation. This framework is named 4P-model pointing to four different ways innovation can be targeted:

> P1   innovation to introduce or improve *products;*
>
> P2   innovation to introduce or improve *processes;*
>
> P3   innovation to define or re-define the *positioning* of the firm or products;
>
> P4   innovation to define or re-define the dominant *paradigm* of the firm.

We will not elaborate further on the implications of this framework in this paper.

The other framework is intended to be applied in managing innovation [6]. It proposes five dimensions that are similar with the sub-concepts proposed by Van de Ven et. al. The dimensions are: *linkages, strategy, organization, learning,* and *process*. According to Tidd et. al. the innovative organization need to:

- establish <u>linkages</u> with their environment (internal and external). The linkages provide triggers for innovation or provide support during the innovation process;
- <u>strategically</u> select from this set of potential triggers for innovation those things which the

organization will commit resources to doing. The critical issue being conscious about what and how to prioritize;

- having chosen an option, <u>organizations</u> need to resource it - providing the resources to exploit it. This includes both the specific organizational setup and the various elements of organizational culture;

- and – optional – to reflect upon the process and review experience of success and failure in order to <u>learn</u> about how to manage the process better, and to capture relevant knowledge from the experience. If done properly the following projects will take off at a higher level;

- and finally, all activities belong to <u>processes</u>.

Given the close similarity of the two different empirically derived frameworks we have chosen to continue our consideration with outset in the framework proposed by Tidd et. al. [6].

The five aspects together describe a complex and highly interrelated whole. Figure 2 illustrates the five concepts and depicts the mutual interplay between the aspects. In this initial model we have chosen to place all concepts in one dimension. We will reflect on this in on this in the concluding part of the paper.

We initially define a specific configuration of the five aspects in a specific company as an innovation scenario.
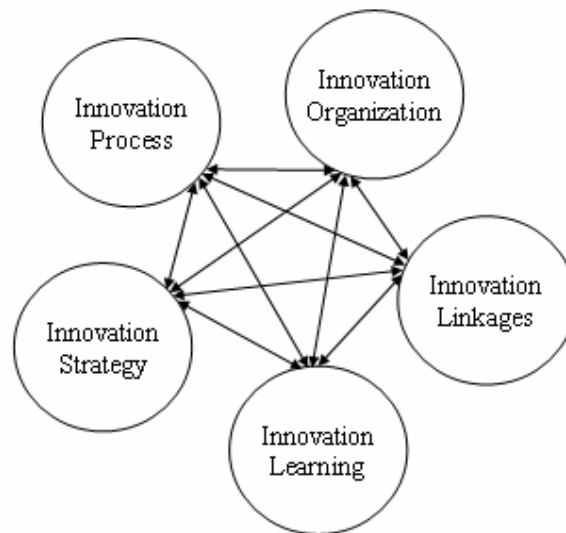

Figure 2 - The five aspects of an Innovation Scenario, adapted form [7]

In the following paragraphs we will shortly describe the five aspects individually.

The *Innovation Process* aspect refers to the sequence of activities or phases in the innovation

process. These might be formally or informally described by the specific company. In order to succeed organizations need *effective implementation mechanisms* to move innovations from idea or opportunity through to reality. This process involves systematic problem-solving and works best within a clear decision-making framework which should help the organization to stop as well as to progress development if things are going "wrong." It also requires skills in project management and control under uncertainty and parallel development of both the market and the technology streams. Moreover, it needs to pay attention to managing the change process itself, including anticipating and addressing the concerns of those who might be affected by the change.

The *Innovation Organization* aspect refers to having a supporting context in which creative ideas can emerge and be effectively deployed. Building and maintaining such organizational conditions are a critical part of innovation management, and involve working with structures, work organization arrangements, training and development, reward and recognition systems and communication arrangements. Above all, the requirement is to create the conditions within which a learning organization can begin to operate, with shared problem identification and solving and with the ability to capture and accumulate learning about technology and about management of the innovation process.

The *Innovation Strategy* aspect refers to three essential ingredients:

1. The *position* of the firm, in terms of its products, processes, technologies and the national innovation system in which it is embedded. Although a firm's technology strategy may be influenced by a particular national system of innovation it is not determined by it.

2. The technological *paths* open to the firm given its accumulated competencies. Firms follow technological trajectories, each of which has distinct sources and directions of technological change and which define key tasks for strategy. We identify five generic trajectories in the book.

3. The organizational *processes* followed by the firm in order to integrate strategic learning across functional and divisional boundaries.

The *Innovation Linkages* aspect refers to developing close and rich interaction with markets, with suppliers of technology and other organizational players. Linkages offer opportunities for learning—from tough customers and lead users, from competitors, from strategic alliances and from alternative perspectives. The theme of 'open innovation' is increasingly becoming recognized as relevant to an era in which networking and inter-organizational behavior is the dominant mode of operation.

The *Innovation Learning* aspect refers to the ability to capture and accumulate learning about technology and about management of the innovation process. Such a learning process can be assisted by inputs to the learning cycle through:

- Experience sharing, learning from and through the experience of others of both success and failure

- Introducing new concepts, new ideas about tools and techniques

- Experimenting, trying different approaches to the basic problem of innovation management

- Structured reflection, examining and reviewing how innovation is currently managed

In the following section will describe how the five aspects can be combined into scenarios and how they are interrelated.

5   The formation of an Innovation Scenario

The challenge of defining the innovation scenario poses a constantly mutating puzzle to companies. The challenges of configurating the specific innovation scenario fits well with the challenges as defined within the area of "general systems theory" when dealing with complex systems. Simon defines complexity as the main problem of handling systems [14]: "Roughly, by a complex system I mean one made up of a large number of parts that interacts in a non-simple way. In such systems the whole is more than the sum of the parts, not in an ultimate, metaphysical sense but in the important pragmatic sense that, given the properties of the parts and the laws of their interaction, it is not a trivial mater to infer the properties of the whole.

We may be able to spot a number of routines or examples of excellence in a specific company that explain part of their innovation success. According to the more popular part of the management literature, "visionary leadership" seems to be the driving force to innovation success. But if "visionary leadership" is so critical to the development of excellent innovation organizations, then who is the charismatic visionary leader of 3M? 3M has been widely admired as an innovative company for decades, yet few people can even name its current CEO, or his predecessor, or even his predecessor, and so on [15].

Welch is often seen as the visionary leadership element behind the success of General Electric. But Welch is also a product of the systematic leadership development at GE and this can be traced back to the early 1900s. Visionary leadership can not be seen independently; it needs to be viewed in relationship with both external and internal factors with an evolutionary perspective.

As stated above, we believe that the acknowledgment and understanding of "complexity" must be the main driver in configuration of innovation scenarios. The mental model of "what we are searching for" may be explained by Simon's parable of the Ant on the Beach [14]:

When you watch an ant follow a tortuous path across a beach, you might say, "How complicated!" Well, the ant is just trying to go home, and it's got to climb over little sand dunes and around twigs. Its path is generally pointed toward its goal, and its maneuvers are simple, local responses to its environment.

Suppose there is a storm that wipes the beach clean. Then we watch the ants randomly explore the beach for food. Later, we see the ants go directly to the food sources. Have the ants gotten smarter? No, but the functional system has. How? The activity of the ants has *modified the environment* (through worn paths, pheromone trails), so the simple ants now accomplish more than they could just after the storm. Given the properties of the functional system parts and the laws of their interaction, it is not a trivial mater to infer the properties of the whole.

In our particular case, the functional system is the innovative organization and "the properties of the whole" is the ability to generate innovations, to ensure that these innovations are aligned with the strategy of the company, that the organization is kept innovative, that the innovation process is efficient, and that the organization learns from mistakes and gains experience from successful innovations.

This is truly not a trivial mater, but in order to discuss and ultimately configure the functional system we need to acknowledge complexity and generate a comprehensive understanding of the functional system.

6   Industrial Cases

During our empirical studies related to this research, we have tested the wider understanding of innovation in 11 different companies. The companies differ in size and operating industries. These studies have been organized as one day interviews with a follow up presentation and discussion with management.

The aim has been to map the innovation activities according to the five aspects and to discuss the scenario that emerges with respect to strengths, weaknesses, and potential improvements.

We will report one critical element of each innovation aspect in order to illustrate our framework.

6.1   A Television Broadcasting Company - ALFA

ALFA is a large television broadcasting company that has gained significant success with their drama series in the past years. In the past eight years they have frequently won international prices with their drama series. Their own evaluation is that, for the time being they have a close to perfect innovation scenario.

The *Innovation Process* aspect: The process is divided in a writing phase and a production phase. Broadcasting of the first episodes takes place shortly after the production. Normally, the process from initiation to broadcast of the first episode spans two years or more. After broadcast of 6-8 episodes, there is usually a need for radical changes in the following episodes.

The *Innovation Organization* aspect: One critical aspect of organization is the formation of the core team consisting of producer, authors, and instructors. The different roles are clearly defined in terms of responsibility. The motto for the management activities is: "Not in control – but in charge of". This is to avoid this risk of making consensus decisions that might "blur" the original ideas – the mantra is "One Vision".

The *Innovation Strategy* aspect: One critical requirement in the writing process is to form a ground rule. This ground rule forms the foundation for judgments regarding the design of the drama series. An example of a ground rule taken from a specific drama production within the crime genre is: "You hunt a beast – but catch a human".

The *Innovation Linkages* aspect: There is a frequent circulation of instructors and authors between the external movie industry and ALFA. In some cases, instructors and authors have been lend to competitors to keep them sharp in periods with less activity. The crews are shared across the different departments within ALFA – and sometimes also with external partners.

The *Innovation Learning* aspect: A strong mechanism in the learning process is a so-called "Dogma Document." The document carries the title "From high quality to excellence". The idea behind the document is to capture the critical elements of the innovation process and transforms these into relatively simple rules. The rules concern all innovation aspects.

6.2 A Toy Company - BETA

BETA is an international toy company operating mainly within the segment of construction toys. Recently they have been facing increasing competition from producers of electronic toys and computer games. Their own evaluation is that they have to improve on their speed and their ability to hit the trends in the market.

The *Innovation Process* aspect: The process has until recently been a traditional stage-gate-process. Due to competition on both cost and product concepts the process is now evolving to a more differentiated structure. The aim is to cut the development time from two years to less than a year. One particular change is a much more intensive use of prototypes during the early phases of the project.

The *Innovation Organization* aspect: The main organizational issue is the formation of core management teams. These teams consist of three people from marketing, concept development, and project management, and focus on only a single project at a time.

The *Innovation Strategy* aspect: The main strategic issue is to focus on the use of platforms. Each product development project is evaluated in the light of platform maturity. If the necessary platforms are available and mature, the projects can be accelerated significantly in terms of time to market. The focus on platforms is also utilized to avoid sub-optimization in the pro-active work prior to project launch.

The *Innovation Linkages* aspect: In the early project phases rapid prototypes are used facilitate discussion with retail customers as well as internal partners. Initially prototypes are decoupled from existing platforms but as product projects get close to accept prototypes are aligned with existing platforms. These might be internal platforms or external platforms at suppliers.

The *Innovation Learning* aspect: The project management organization is an independent professional unit. This means that this unit is supposed to organize learning activities and that the learning is to be anchored within this organizational unit.

6.3 A Medical Company - GAMMA

GAMMA is an international market leader within a niche in the medical industry. The company has experienced continuous growth in relation to turnover and profit for its entire lifetime. Their own evaluation is that their market will shrink due to radical improvements within medical research.

The *Innovation Process* aspect: GAMMA has been in a stable and very lucrative market for at long time. This means that 90 % of new product development projects are categorized as incremental innovations. Consequently, projects are run in a fairly traditional stage-gate-model. There is an increasing awareness that they have to change this setup to a more diverse model.

The *Innovation Organization* aspect: There is a strong emphasis on telling the good stories about successful projects. The stories circulate and are well-known since the product development employees are co-located. Different innovative products or part-solutions are on display in one large product development room. Generally the management put more emphasis on establishing a strong innovation culture than communicating the overall strategy.

The *Innovation Strategy* aspect: The main strategic aspect is the continuous work to identify and develop core-technologies. These are formally identified, assessed, and communicated to

the organization.

The *Innovation Linkages* aspect: GAMMA has built a strong network of nurses and doctors with whom they are working to improve and further develop their products.

The *Innovation Learning* aspect: Much of the formal and informal learning is embedded in the network as described under innovation linkages.

7 Implications and Further Research

The above cases briefly illustrate the innovation scenarios at three of the case companies. However, we believe that they are descriptive of the performance variables of the innovation systems in the companies. In our experience, these initial innovation system representations do not change significantly when the details of the innovation system is further explored. We interpret this as an indication of the generic character of the innovation aspects outlined in Section 4.

In the following sections we will reflect upon the cases and consider their theoretical and pragmatic implications.

7.1 Theoretical Implications

The empirical testing made it clear that the five innovation aspects are not in the same dimension. It has been made clear that the Process Aspect and the Learning Aspect have to be viewed in a separate perspective.

The process aspect seems to be the core of the scenario. This is where the other aspects are coupled and the specific solutions emerge. Also, the process differs in the sense that it can be measured. Processes take time and incur costs. Consequently, we can set specific goals for the performance of the processes and benchmark with processes in other companies or industries.

The Innovation Learning aspect seems to be referring equally to the four other aspects. The specific learning effort can be directed towards the innovation process, the means of the innovation strategy, the means and character of the innovation organization, and the means of the innovation linkages.

The innovation aspects have been rearranged to reflect our empirical findings in Figure 3
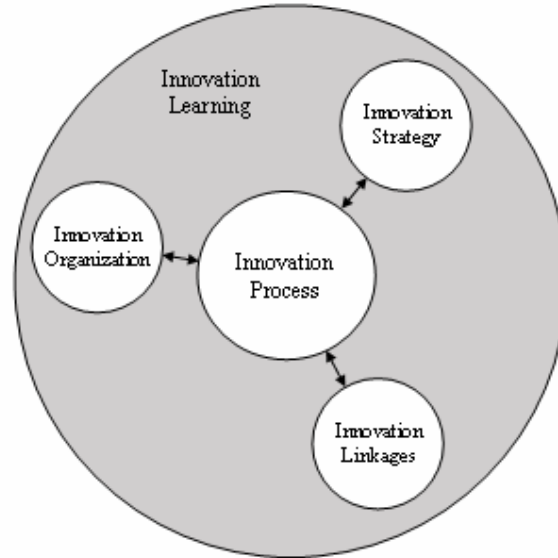
Figure 3 The arrangement of elements in the Innovation Scenario

This understanding suggests that, in future research, the primary focus should be on the process dimension and the complex interplay between the five aspects.

7.2 Pragmatic Implications

Companies need to apply the findings according to aspects with imagination. Building an innovative organization is a design problem and successful designers leverage general principles, not mechanical ten-step methods. Any specific how-to will almost certainly become obsolete. But the general concepts – adapted to changing conditions – can last as guiding principles.

The five innovation aspects depicted in Figure 3 can be qualitative evaluated by using either self assessment techniques or benchmarking with external organizations. This auditing approach has considerable relevance and potential for improving innovation management practice [6].

8   Conclusions

In this paper, we have argued for a more comprehensive but systematic view of the challenges of managing innovation. We have explored some significant challenges companies face in their quest to manage innovation successfully. We have proposed a set of basic building blocks and an innovation framework for addressing these challenges. We have argued that the framework is descriptive of the performance variables of the innovation systems in organizations, and that it can be used to rapidly generate innovation system representations

that do not change significantly when the details of the innovation system is further explored.

References

[1] Mintzberg, H., B. Ahlstrand & J. Lampel, "Strategy Safari", Prentice Hall, 1998

[2] Morgan, G., "Images of Organizations", Sage Publications, 1986

[3] Porter, M., "The Competitive Advantage of Nations", McMillan, London, 1990

[4] Rogers, E.M., "The diffusion of innovations", Free Press, 1995

[5] Christensen, C.M., "Innovation and the General Manager", McGraw-Hill, 1999

[6] Tidd, J., Bessant, J. & Pavitt, K., "Managing Innovation ", John Wiley and Sons, 2005

[7] Leavitt, H.J., "Applied organizational change in industry: Structural, technological, and humanistic approaches", in March (ed), "Handbook of organizations", Rand McNally, 1965

[8] Gubi, E. & Hansen, P.K., "Explicit Product Architecture as a driver for Improving Supply Chain Design", Conradi Research Review, Vol.1, No. 1, 2002, p3-23

[9] Carrizossa K., Eris, O., Mabogunje, M., Andrew, M., Leifer, L. "Building the Design Observatory: a core instrument for design research", Proceedings of Design2002, Dubrovnik, Croatia, 2002

[10] Eris, O., Hansen, P.K., Mabogunje, A. & Leifer, L., "Toward a Pragmatic Ontology for Product Development Projects in Small Teams", Proceedings of the 12th International Conference on Engineering Design", Technische Universität München, München, 1999

[11] Hansen, P.K., Mabogunje, A., Eris, O. & Leifer, L., "The Product Development Process Ontology: Creating a Learning Research Community", Proceedings of the 13th International Conference on Engineering Design, Glascow, 2001

[12] Mabogunje A., Hansen, P.K., Eris, O. & Leifer, L., "Product Development Process Ontology" proceedings of the International Design Conference, Design 2002, Dubrovnik, Croatia, 2002.

[13] Van de Ven, A.H., Polley, D.E., Garud, R. & Venkataraman, S., "The Innovation Journey", Oxford University Press, 1999

[14] Simon, H., "The Sciences of the Artificial", MIT Press, 1996

[15] Collins, J.C. & Porras, J.I., "Successful Habits of Visionary Companies", Random House, 2000