

**THE FIRM AS A NEXUS OF PRODUCT CYCLES: ORGANISING  
INTRAPRENEURSHIP IN THE INNOVATIVE FIRM<sup>i</sup>**

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## INTRODUCTION

A study undertaken by the McKinsey's researchers of the largest US companies included in the Standard and Poor 500 shows that the average lifetime of a company is rapidly decreasing from around 50 to 60 years in the 1920s, to around 15 years in the early 2000s (Foster and Kaplan 2001). Only 160 out of 1008 companies in the McKinsey's Corporate Performance database survived from 1962 to 2004. According to a Dutch survey, the average corporate life expectancy in Japan and Europe is now 12.5 years (Burns 2001).

Several factors may have contributed to this development, such as business cycles and structural changes in world trade. Furthermore, extensive sector variation implies that sector-specific factors surely also play an important role. Nevertheless, there is good reason to believe that innovation and transformation related to technological and commercial innovation is a central driver in an increasingly more knowledge-intensive competition in an increasingly more globalised economy.

This chapter focuses on the dynamic challenges that face the firm in an evermore demanding innovation economy with extensive pressure for transformation. As a supplement to the static efficiency focus implied in the core of neoclassical economics, the chapter also highlights dynamic innovation and risk as core business challenges.

The chapter further argues that value creation must in the long run involve interaction between both static and dynamic elements. The chapter therefore takes the product cycle as an analytical focus, as it highlights the inherent dynamic challenges to the enterprise as well as the interplay between creativity and efficiency considerations. With an analogy to Aoki, Gustavsson and Williamson's (1990) concept of the firm as a *nexus of treaties*, this chapter sees the firm as a *nexus of product cycles*.

With this focus the chapter argues that the firm must increasingly develop innovation or exploration capabilities to handle innovation challenges in the initial stages of the product cycle and at the same time compensate for shorter mid-cycle exploitation opportunities. The chapter further outlines the most important strategic and organizational challenges in each phase of the product cycle. However, the product cycle perspective has financial, technological and market implications besides the organizational challenges. The chapter therefore presents a brief overview of key issues related to financing, IPR and marketing for each of the stages in the product cycle.

From a financial standpoint, the product cycle perspective states that a company must both deliver on the traditional bottom-line in order to be able to achieve a positive cash-flow as well as create a financial basis for the innovation process. From a technological perspective, the company must have the ability to develop new knowledge and technology and take strategic control over it, but also to stabilize technology to achieve efficient operative performance. In other words, the company must be able to technologically and strategically innovate, and at the same time have the ability to secure technological control in order to harvest economic advantages from the innovation. From a marketing perspective, economic harvesting means that the company must be able to develop adequate market-relations for the product in different stages of the cycle from early pioneers to later volume markets. In addition, the company must adopt appropriate organizational models to handle management throughout the product cycle.

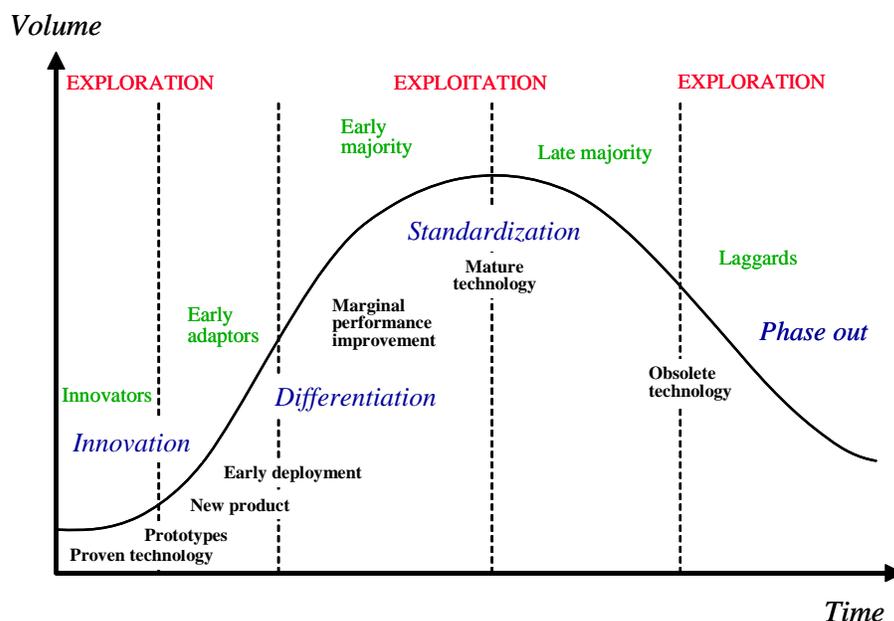
## **THE FIRM AS A NEXUS OF PRODUCT CYCLES**

The concept of dynamic product development is well established in several disciplines and in literature addressing technological innovation, international economics and marketing.

In technological innovation literature, researchers such as Foster (1986), Sahal (1981), and Utterback (1994) invented the so-called S-curve, which today is a standard reference of technological development, indicating how technological performance improves over time as a function of technological learning (Wene 1999). In international economics Vernon (1966) addressed a similar pattern of product evolution spanning five basic stages: innovation, differentiation, standardization and phase-out.

In marketing literature, several studies have focused on the diffusion characteristics of products in the different stages of technological/commercial development (Kotler 1967). For each stage they define a specific customer segment ranging from early innovators to adapters, majorities and laggards. A synthesis of all three approaches is presented in Figure 1.

Figure 1: Different Approaches of Product Cycles



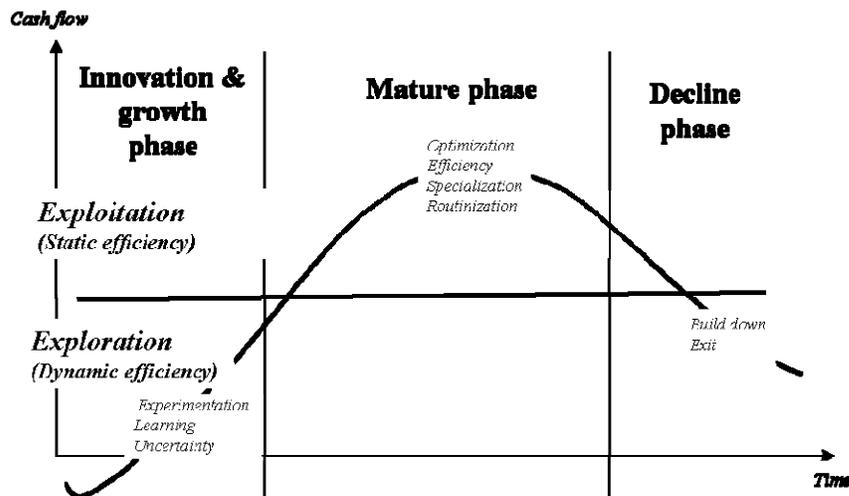
As mentioned earlier one of the core challenges to business organisation has been the tension between static efficiency and dynamic innovation concerns. In economics the core focus in mainstream neo-classical economic analysis has been on efficient allocation of economic resources between alternative deployments in an economy where both economic resources and technologies are given and scarce (Samuelson and Nordhaus 2001). The organisation theory correlate is the optimising (Lazonick 2002) or exploiting (March 1991) firm, which implies efficient consolidation of an existing business model, where cost-minimisation is of central concern.

An alternative strand in economic analysis, going back to Marx and Schumpeter focuses on development and growth as a function of innovation. Competitive pressure is also of central importance here, but in its capacity as a force to stimulate creativity rather than to spearhead cost minimisation (Edquist 2001; Lundvall 2002). The organisation theory correlate is the innovative (Lazonick 2002) or explorative (March 1991) firm, with a focus on the accumulation and transformation of capabilities and investment in a skill base that can carry the innovative strategy of the firm.

Whether the focus is on innovation, implicitly or explicitly, the capability to tie the innovation process to an efficient and effective production process is essential for sustainable value creation. The firm must therefore be able to, at the same time, to incorporate partly conflicting organizational “logics”. As earlier mentioned, March (1991) here makes a central division between what he calls *exploitation* of established solutions, to *exploration* of new possibilities. As March emphasizes, *exploration* entails an orientation towards search, variation, risk taking, experimentation, play and flexibility, discovery and innovation. *Exploitation*, on the other hand, implies an orientation towards production, efficiency, selection, implementation and improved performance.

With a “product-cycle-based” understanding of the firm, exploitation, which in many ways corresponds to static efficiency in economics, and exploration, which in many ways corresponds to dynamic innovation analysis in economics, can be reconciled. This is because each concept is allocated a legitimate position at different phases of the product cycle. This is illustrated in figure 2.

Figure 2: Static Efficiency and Dynamic Efficiency



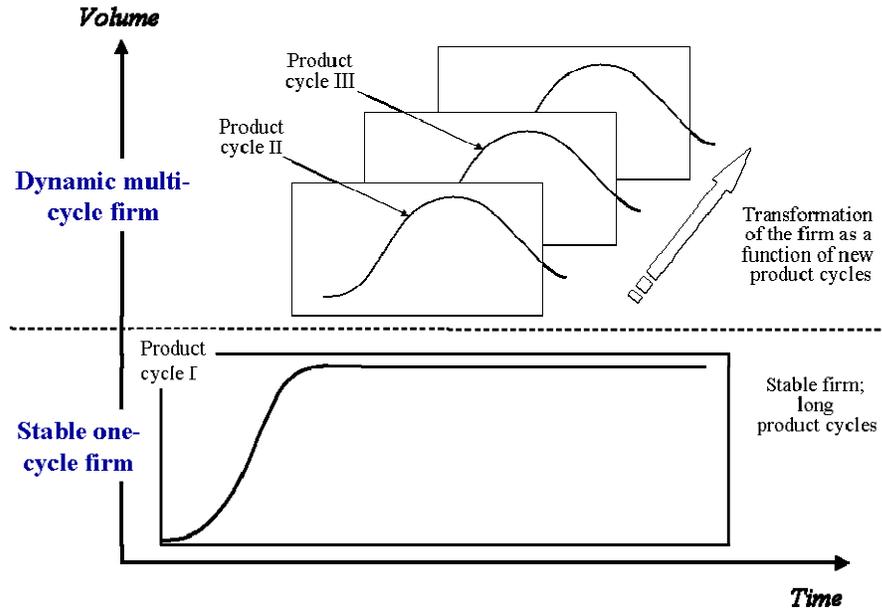
The first phase of product development and growth is most adequately addressed within an exploration or dynamic innovation framework, with an emphasis on experimentation, learning and growth.

The second phase of product stabilisation and maturation is most adequately addressed within an exploitation or static efficiency framework, with an emphasis on optimisation and efficiency.

The third phase of decline and withdrawal is most adequately addressed within exploration or dynamic efficiency terms, but this time with an added social dimension playing a major role, with an emphasis on transformation.

The ability to balance exploitation and exploration or static and dynamic efficiency becomes far more critical when the company must manage and process more than one life-cycle because new innovation characteristics are discovered to promote sustained revenue. Thus, whilst one life cycle previously sustained revenue over a fairly long period of time, several product life cycles are vital to secure revenue over the same time in the new era. This idea is illustrated in Figure 3.

Figure 3: The One-cycle and the Multi-cycle firm



It must be said, however, that the “multiproduct-cycle model” on the previous page may vary from sector to sector. The computer-and fashion industries are typical industries dominated by short-term product cycles. In the fashion industry the average product life cycle is 1 year or a 3-6 month season. This industry holds products that are fads of a specific time and as the trends change so does the demand for its products. According to the co-founder of Intel, Gordon Moore, the number of transistors on a chip doubles about every 2 years (Moor’s Law). Here rapid advances in technological performance seem to be the main driver.

In contrast, traditional natural-resources-based industries, such as the production of mineral fertilizers, are the same as it was when it first started. The CEO of the world leading producer of mineral fertilizers, Yara’s Thorleif Enger, claims that the composition of its main mineral fertilizers as well as the actual production process have not changed in any fundamental way over the last 50 years.

What is seen in industries with shorter product cycles is that this necessitates higher throughputs of products to maintain a given income stream over a given period of time (*centeris paribus*) whereas with long product cycles and secure patenting a company such as Yara (previously Norsk Hydro) could basically stabilize an efficient exploitation regime around a given product and retain a sustainable flow of income over several years. With shorter product life cycles, this is not an option and the only solution for the company is to remain innovative and

generate promising new products on a continual basis, which again might provide a sustainable revenue stream over time.

As already mentioned, the transition from understanding the firm with a focus on one single product cycle, to understanding it as a unit with several parallel product cycles, entails a shift from exploitation of established solutions to exploration of new possibilities. To find the optimal balance between exploitation and exploration is thus a central task for system survival and growth. Building on Schumpeter (1934); Holland (1975) and Kuran (1988) March (1991) argues that companies that excessively engage in exploration and tune down the need for exploitation will find that they carry much of the costs of experimentation without harvesting its commercial advantage. They produce too many underdeveloped new ideas and develop too few distinct competencies. On the other side, he argues, that companies that engage in exploitation but neglect exploration may find themselves locked into an unproductive stable equilibrium. As a result, maintaining appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity

Again, by adapting a *product-cycle-perspective*, one can effectively manage the balance between exploration and exploitation by relating each action to the set of technological engagements that the firm is involved in and the specific stage in which the technologies are at in the product cycle. In other words, by viewing the company as a nexus of product cycles, the firm is better capable to manage the conflicting logics –both to accommodate efficiency in mature technology and exploration in new emerging cycles.

## **THE PRODUCT CYCLE AND THE CHALLENGES OF PHASE-SPECIFIC NEEDS**

The *product-cycle-perspective* highlights the dynamic challenges or nature of processes within an industrial organization and implies that an organization should evolve according to the specific needs throughout the cycle of technology and business model development. This means; fostering creativity in early stages of new cycles, then moving on to fostering selection and growth, optimizing mature technologies, phasing-out and transforming old technologies and sustaining the transfer of resources –labour and capital –into new productive activities.

### **Fostering creativity: Initiating new cycles**

In the initial stages of a cycle, the firm must develop an organizational mechanism for generating new ideas. The analogy is often made to natural selection models, where an important precondition is that there is a “variety creation mechanism” in place to allow later selection (Campbell, 1986; Aldrich, 2006). This may include the development of an innovative organizational culture, encouraging creative thinking, risk-taking and initiative amongst employees. Management must motivate and welcome new ideas and there has to be sufficient reward systems in place that support the innovation-oriented company culture.

In some cases, the firm may choose to let creativity loose in a rather open manner to have new product/business ideas have emerged through what resembles “blind variation.” However, most firms stage systematic search procedures in order to identify and examine new opportunities before they settle for the most promising ones.

In businesses where blind variation is evident, it has most often been stimulated through a creative organizational culture or management has openly encouraged creative thinking and idea generation without defining any problem. The “post-it” notes by 3M are often described as a classic example of such “blind variation.” 3M researcher, Art Fry, originally wanted to make the world’s greatest glue. However, in the process of developing this glue, he discovered the world’s worst glue –a sticky substance that never would stick properly. Little did he know that his invention of the “post-it” note would become one of the most valuable discoveries in 3M’s history of product invention<sup>ii</sup>!

Another classic example is found in the medical field; when Alexander Fleming was studying the effects of mucus on Staph cultures in a laboratory in London. He forgot to clean his last batch before finishing the project and when he returned two weeks later he was caught by an amazing sight; a mold was covering the batch but the bacteria was dead. He had discovered the mother of all disease fighting drugs, Penicillin<sup>iii</sup>.

An example of a more structured process of generating new ideas and exploiting promising opportunities can be seen in a Norwegian production plant, where they had residual Quartz granules. Normally, granules less than 40mm would be dumped in the ocean. The firm entered a structured creative research process with the aim of finding a commercial use of the residual Quartz granules. A number of suggestions were generated, analyzed and examined

before the final solution was chosen; anti-slide for industrial floors (i.e. granules filled in flooring substrates).

A more structured process will typically comprise the following stages: problem definition, idea generation, idea selection, enrichment and solution. After preliminary screening, promising solutions will be taken to the next stage of “verification” and “development of a business model.” These possible new inventions or product cycles should now be diversified into independent projects, decoupled from ordinary operations.

At the same time, it is important that such projects do not live in complete isolation, but are able to exploit existing resources, knowledge and networks from mainstream operations. Having said that, it is important to be aware of the fact that management of new emerging product in the early phase of a cycle often experience resistance from management responsible for well established technologies in more stable and mature phases of the product cycle. March (1991) points out that this is particularly evident in cases where the new product cycle is disruptive with respect to the dominant technology, business model or existing practices. Christensen (1997) thus speaks about “disruptive technologies.”

In recent years, large companies have increasingly established an independent instrument dedicated to the process of innovation and new product/business development. Its main responsibilities include identifying, incubating, commercializing and funding new corporate ventures. Telenor New Business (TNB) is a good example<sup>iv</sup>; it is a commercial unit tied to the top management, which works in collaboration with the different business units within Telenor. TNB is responsible for the development of new technology and business concepts that support and/or extend Telenor’s core business. They normally identify new business ideas internal to the organization and process these ideas further into commercialization. A proposition of the required investment is then given to top management when the project is fully incubated and in need for substantial investments. Over the last three years, TNB has organized “business-idea-generating” competitions, Seed2003, Seed2004 and Seed2005, resulting in more than 750 business ideas.

### **Selection and development**

Limited competencies, managerial and financial resources, mean that only a limited set of ideas can be taken all the way through the incubation process and into production, i.e. to become the firm’s next generation of core products from which they will have their dominant cash flow. Typically, a selection of new technologies and/or business models must proceed through a

process of critical risk reduction involving feasibility demonstration, proving of the concept, technology testing, prototype development and trials. The feasibility study and proof of concept typically involves identifying the most critical factors and narrowing down the options, i.e. to separate those factors that are most crucial for success. Conceptual analysis and preliminary testing are critical steps in the earlier stages of screening of the new technology. In addition, commercial issues must also be considered, such as the project's ability to develop a realistic and feasible business plan which is most often vital to its success. Of the 750 ideas from Telenor's idea generation competition, most have been rejected and only a handful has been taken further to commercialization.

### **Testing and provision of prototypes**

Testing and provision of prototypes and trials with pilot customers is an important step in the business development process. At this stage, the focus is on product performance, both in terms of technological performance as well as pilot customer acceptance. Feedback from and close cooperation with pilot customers is of high importance. They might hold significant information about the different functions a new product should have, or underline areas for improvement or product modifications. Pilot customers may also have a positive influence on the commercialization process, by defining market expectations such as the products, adds-on and pre-post sales services. Obviously, supportive development measures must run parallel to the selection process as successful projects in each screening must be taken forward to the next phase and unsuccessful projects will be screened out.

Telenor Cinclus<sup>v</sup> was one of the few ideas that were selected from TNB's first idea-generation competition (Seed 2003). The company was a total supplier of solutions for automatic meter reading (AMR). The solution allows the electricity suppliers to read meters automatically at hourly intervals. The idea was coached through a selection and development process in 2003, a process for verification of the technology (Proof of concept) in 2004 and the development of a business plan in 2004. They delivered the first pilot supply of a 1000 units during the summer of 2005 to Skagerak Energi (Norwegian Energy Company) and are now ready for the growth phase<sup>vi</sup>.

## **Deployment and growth**

When the product has proven its viability it moves into the next phase of the product cycle, industrialization, up-scaling and growth. At this stage the focus is on exploitation. The critical challenge to be overcome at this stage is the “professionalism” and coordination of management across the various business functions. This stage involves a significant increase of production volume, new capital inflows and creation of strategic alliances, especially those that strengthen and increase the capacity of the distribution system, extend the market share and develop customer relations.

Due to scarcity of resources, increased demand on managerial capacity and cost, only a few innovations can be preceded at that point in time. This is the stage of the product life cycle when it is especially important to administer intellectual property rights, the ownership and licensing agreements in a way that gives the project increased prosperity, growth and profit.

Telenor Cinclus entered the deployment and growth phase when a contract of 50 million USD with Skagerak Energi was signed in the summer of 2005. The contract specifies that 1000 units of automatic meter reading will be installed during 2006<sup>vii</sup>. In order to successfully manage the growth stage, Telenor Cinclus has also involved its largest customer, Skagerak Energy AS, strategically by giving them a 35 % stake in the company. Moreover, in order to facilitate growth, Telenor has established different corporate venture funds directed towards the growth stage of the product cycle, i.e. for growth companies within the telecommunication industry. These funds are usually invested at the point when Telenor New Business ends its engagement.

## **Mature phase**

At the mature stage of the product cycle the focus is on efficiency, productivity and full exploitation of the innovation. Stability in terms of demand, technology and competition characterizes maturity. Strong market leaders should enjoy strong profits and high positive cash flows, and thus, a company is now able to cover all prior developmental costs as well as provide the shareholders with a return on investment. In addition, capital should be put aside and reinvested in the next round of innovations.

Innovation as such is less important during maturity. Innovations at this stage are usually incremental, so-called life-cycle extensions, characterized by product modifications or

improvements to the product, technology, the business model and/or the organization itself. Intellectual property rights are typically expanded with new application areas or new and more detailed patents are drawn up. Innovations in the mature phase are typically incremental.

The Norwegian dairy producer Tine is a perfect example of a company that has reached the mature stage. The company introduces about 50-60 new products a year. A maximum of two are regarded significant product innovation. According to A.C. Nielsen, only 130 of 9278 (1.4%) of new dairy products launched in Norway are “real” innovations. The large majority of product launches are copy-products and variations of existent products with respect to taste, packaging or design. Similar numbers from six European countries show that only 2.2.% of totally 525,000 dairy product launches (EAN) were “really new products.” As much as 76.7% were pure “me-to” or replica products (Ørjasæter 2003).

Resources, competencies, methods and equipment built up during maturity are important pre-conditions for later innovations in new product cycles. Networks with customers, suppliers and authorities from the mature phase may be decisive elements when new technologies are to be advanced and new business models are established. Resources, competencies and routines that are established in the mature phase of the product cycle can, however, also constitute a threat against creative innovation. The focus on efficiency and standardization and established routines may make significant innovations difficult, especially if these are in the periphery or outside of the core business focus and break with existing practices. Radical innovations therefore imply ambiguity as they must utilize existing resources and at the same time must be protected against them.

### **Transformation**

Innovations are often complete transformations. Old product cycles are dismantled and resources are reallocated to new activity. With respect to dynamics, the last phase of the product cycle therefore may be compared to the first. Uncertainty and ambiguity is evident. Efficient and constructive transformation at the end of the product cycle is perhaps amongst the greatest management challenges of all time.

When IBM was about to go bankrupt, due to a continued to focus on mainframe computers as their main activity, they were only able to change their faith at the last minute when shifting their focus to include desktops and laptops. The Norwegian equivalent, Norsk Data, did

not have as sufficient resources as IBM, and thus were unable to make this technological transformation.

Raionette Radio factory in Norway achieved great success with their radios in the 1950s. The sales topped in the early 1960s but fell dramatically at the end of the decade. Tandberg took over the company in 1972, but this did not influence the sales figures and in 1978 the company went bankrupt. In other words, management was unable to change the organization, to reinvent the business model and develop new attractive products. They were incapable of fighting the increased competition from companies that would constantly reinvent themselves and outsourced production to low cost countries.

Whilst incremental innovation is easier to implement and is embraced with more enthusiasm, radical innovations may not only challenge the management mindset but also break the organizational paradigm. In many cases, only the prospective and imminent loss of established business can justify such a shift in the business model of a company. It is most often regarded as impossible or irrelevant to top management when it is absolutely necessary in order to stay in business and remain competitive (Christensen 1997).

Nevertheless, some firms may have resources to master failures and change the course of action, even though they have been faced with hardship over considerable time, as illustrated by the IBM example earlier. In such situations, the firm must find ways to build on or exploit already existing resources to change according to the new environment. This may entail leveraging competencies in marketing and distribution to renew a firm's line of business in its chosen market. Or in a case where the market changes dramatically, the firm might build on its strengths in product development and manufacturing to address new markets.

Interestingly enough, new companies operating within the technology industry are often closer to the frontiers of progress than are established firms. Utterback (1994) points out that not many firms have the dexterity to retool their capabilities in order to survive consecutive waves of innovation. As a matter of fact, firms holding the largest market share in one product generation seldom appear in the frontline of competition in the next.

## MANAGEMENT CHALLENGES

The company as a nexus of product cycles raises questions as how to handle various product cycles, i.e. managing cycles within the same organisational framework that is in different stages at the same timeframe. The management must at the same time handle dynamic and static efficiency, i.e.

- The early development and growth phase is characterized by risk and radical changes.
- The mature product phase is characterized by stability and incremental improvements.
- The transformation phase is characterized by radical changes and transformation.

As shown in table 1 the challenges differ for given areas across these phases. Each phase contains its special needs for financing, for handling the intellectual property rights, handling the customer relations and competence and knowledge development. The challenge is as a total to find the right set of product cycles, and manage these throughout the phases so that they play constructive together. In the following some selected areas are described briefly and thereafter we have outlined some challenges these areas raise for management in different phases.

*Table 1: Management challenges throughout the different product phases*

Phase of the business cycle	<i>Early product build-up (generating new cycles, piloting, market entrance etc.)</i>	<i>Growth phase</i>		<i>Mature phase</i>	<i>Transformation phase</i>	
<i>Management/ Organisation</i>	<b>Exploration logic</b>	<b>Exploration logic</b>	<b>Optimization logic</b>	<b>Optimization logic</b>	<b>Optimization logic</b>	<b>Transformation logic</b>
<i>Knowledge and strategic control of the technology</i>	<b>Developing technology and creating IPR</b>	<b>Consolidating knowledge &amp; technology Managing &amp; defending IPR Facilitating spin-offs</b>		<b>Exploiting knowledge &amp; technology Exploiting &amp; expanding the IPR</b>	<b>Leaving knowledge advantages &amp; IPR</b>	
<i>Finance</i>	<b>Public finance Internal Finance Business angels, Seed capital</b>	<b>VC Venture Growth capital Transition capital</b>		<b>Regular Stock market Internal Finance</b>	<b>Transformation acquisition</b>	
<i>Customer &amp; supplier relations</i>	<b>Emerging customers/ markets</b>	<b>Developing customers/ markets/suppliers</b>		<b>Servicing established customers/markets/ suppliers</b>	<b>Developing market Solutions Leaving suppliers</b>	

### **Challenges with regards to knowledge and strategic technological control**

A fundamental question in regards to innovation is obviously how a company develops unique knowledge/technology and executes their strategic technological control and protects their intellectual property rights (IPR)<sup>viii</sup>. Having a strategic and active relationship to IPR throughout the whole product concept of the life cycle is essential to the business value creation. The ability to develop unique knowledge bases combined with strong protection gives the freedom to operate and is an important time-limited monopoly. This freedom to operate means that:

- the company gains a knowledge based competitive advantage,
- the company may gain substantial information and knowledge about other companies' technology through reciprocal use of each other's patents;
- the company has a "trade object" in case they need to get into other's patent territories;
- the company can exclude businesses from their patent territories;
- the company can make profit from the production concept outside the core operations through the licensing.

Strategic knowledge building and technological control can be extremely demanding and special competence might be required on a level far higher than what is available inside the organization. Additionally, the management of IPR and the strategic technological control can have varying character in relations to where one is located in the product cycle.

#### *Idea generation/Initial stages of the product cycle*

At this stage the focus is on development of the knowledge basis and IPR. Effective protection of the innovation concept may provide strong competitive advantage and prolong the product cycle. It may also be an important asset as a business moves further into the product cycles.

Moreover, it might be important to pull different strings with respect to effective protection of the IPR. Normally, the best protection of the business is through patenting. However, it provides a time constraint and in many cases companies opt to use alternative options when protecting their business. It usually takes between three to four years for the application to be approved. The protection can in some instances be strengthened by utilizing several methods in parallel, i.e. patents, trademarks and/or design protection.

For investors not only the development of unique knowledge/technology, but also the ability to provide effective protection of the business concept will be essential to their willingness to invest in the company/project. Registered rights will also be important factors for value creation of the product concept. Also, such a right will increase the attractiveness of the project to other chain members, suppliers, distributors and customers.

### *Growth*

During growth, the knowledge is consolidated and the concerns around IPR are focused more towards “the freedom to operate.” This is in order to support the company’s development of the product and market, with market penetration and up-scaling. The investment and risk is usually substantial at this stage. An effective protection of the unique knowledge/technology would reduce the risk radically as strategic technical control provides exclusivity. This again means that the company is able to charge a higher price of their product and more easily attract financing than without such a protection.

Furthermore, effective protection of the knowledge generated will increase its relevance with respect to important chain members, customers, distributors and banks at this stage of the product cycle. It provides the customer with increased security and higher acceptance of the product concept. In addition, the suppliers, distributors and banks get a new patent object and therefore increase their security in relation to their investment/engagement. Licensing of rights to players, who operate in other geographical markets or focus on other areas of use of the product, can be an effective way of penetrating the market and an important mechanism of growth.

### *Maturity*

During maturity the pressure from competition is usually intensified and substitute products or solutions are engaged. Thus, the technological uniqueness and the strategic technological control is weakened dramatically. Most often, the patent expires and cheap alternatives enter the market. This is particularly evident in the pharmaceutical industry where a substitute product usually is much cheaper than the original product. An important focus for the business during this stage is therefore to extend their protection through new initiatives. These might include;

- New and improved production methods
- Product modifications: added features

- Coordinated use of others' protection methods such as trademark, design and copyrights.

### *Transition*

During transition the technological uniqueness and the patent has usually expired and the strength of the protection from possible extensions of the patent and other rights are declining. The protection of rights will normally be reduced and ended and a focus on the development of a new knowledge/technology and IPR is apparent.

### *Examples*

While the resources involved in developing unique technological solutions may be quite substantive, the resources required to protect a technology at an early stage is often insignificant comparable to what is required to protect the rights at later stages in the product cycle. An important element of the development of a good protection is also the use of complementary protection mechanisms. Stokke Fabrikkers so-called Tripp Trapp chair (a specially designed baby chair) as well as "Uglestad kulene" are perfect examples of such protection of rights.

The Tripp Trapp chair<sup>ix</sup> was invented by a man named Petter Opsvik in 1972 and was commercialized by Stokke Fabrikker. Until now, it has sold over 5 million samples of this chair from the initial product launch in 1973. The specially designed baby chair achieved great success and today there are 500 known cases where companies have tried to copy their product. 130 out of these cases have been brought to court. In response to increasingly intensified competition Stokke has utilized several protection instruments, such as trademarks and design protection. During maturity they have also addressed cases for the Supreme Court in both Germany and Denmark which has given Tripp Trapp protection by copyright law. Whilst the design protection law lasts for about 15 years and patents about 20 years, copyrights last for 70 years after the death of the inventor and the trademark never expires.

In the late 1970s, Professor John Uglestad from the Norwegian Technological University (NTU) investigated how it would be possible to produce small, identical plastic balls. The first of a series of patents was given in 1978. He was later given patents for the development of magnetic particles and cavernous particles, as well as the use of these, especially within the field of medicine research and treatment. The original patents has at this date expired, however new patents are given for new and improved methods and application areas. Today, Dyno and Dynal

Biotech and MircoBeads have the commercial rights. A spin-off from Dynal Biotech, Conpart A.S<sup>x</sup> since 2002, has had the license to exploit the product technology within electronic applications. Nowadays, the company is applying for a patent that will protect the staining of the particles with electronic leading metals. What becomes apparent is that fact that old and obsolete patents can provide a basis for new patents and stimulate the development of new product cycles.

### **Challenges with regards to financing**

There are substantial costs associated with the development and commercialization of a new technology or product, usually bigger than expected. Due to the fact that a lot of costs occur prior to the first sales, there are major challenges with regards to financing.

The uncertainty is obviously greater in the initial stages of the product cycle. On the other hand, the need for capital is usually limited at this stage in comparison with the latter stages. The need for capital and financing varies however from business to business. In particular industries where much time is dedicated to R&D such as pharmacy, the initial stages of the product cycle require significant investments due to the demand for clinical testing and approval procedures.

### *Idea generation and new product development*

During idea generation and early product development start-up capital is needed to finance research as well as evaluate and develop initial concepts before the actual commencement of the new project. Usually, the brainchild of the innovation or the company where the new business concept transpired, covers the initial outlays. In Norway, public authorities support trade by giving direct financial incentives, usually through the “SkatteFUNN agreement” or various programs by the Research Council of Norway.

When innovations occur within a newly established company the owners themselves and the public authorities usually cover the need for capital. In addition to the financial support from public sources such as the Research Council of Norway and the “SkatteFUNN agreement,” specialized innovation agencies, such as Innovation Norway may also provide resources will assist during this phase.

When early development of new business ideas happens outside of an established company, a typical source of funding would be so-called “business angels” or wealthy individual investors.

These investors are usually successful entrepreneurs who want to see other people succeed in their business. They are normally in a better position to understand the value creation potential in early business concepts and not only support the company financially but offer their expertise, skills and knowledge. Their experience and competence assist in the realization of the new business concept.

“Business angels” build bridges where funding gaps from the owners (family and friends), venture companies or strategic industrial investors occur. “Business angels” have, especially in the US, stimulated innovation during the past ten years by recycling entrepreneurial wealth and knowledge both locally and regionally.

### *Growth*

Venture capital is an important source of funding to innovative companies in both the early and late stage of expansion. The companies usually have a weak but positive cash flow and need “growth-capital” for internationalization, distribution of goods to new markets and the strengthening of the companies’ IPR.

Venture capital consists of a fund which originates from the capital market. The owners’ intent is to achieve the largest possible return on investment through a rapid increase in value of the fund. The venture companies are normally interested in small and medium sized companies with a great potential for growth and they focus on independent investment projects’ market potential and IPR. Some funds specialize in certain areas or sectors, whereas others focus more on special development stages.

The venture capitalists always rely heavily on top management, and in many cases wish to replace the entrepreneur with a more professional management team. Venture capital is a relatively expensive form of investment as it normally requires shares with special agreements and rights above the other investors/shareholders.

Besides that, financing in the growth phase often involves “bridge-capital,” “growth capital” or “diffusion of sales” where investments are used to reconstruct the ownership before going to the stock market. However, European research shows that most small and medium sized companies in Europe cover their need for capital internally. In larger companies where the new technology/product development happens outside the company’s main business, external venture investments proves to be a great sources of funding. This is especially apparent in companies where the innovation has little or nothing to do with the core business. Semi-external investments

can also happen in strategic alliances with other larger companies where both parties invest financially in the new project.

### *Maturity*

During maturity the company's need for capital of the new investment is usually covered by equity, loans in ordinary financial markets and by initiating share issues. To obtain the right to offer shares to the public, the company must be listed through an initial public offering (IPO) at their local stock market. When listed, the issue of shares is now under public regulations and requires the open share of information about the company's financial situation and strategies.

Specialised public financial instruments such as financing through the Research Council of Norway and SkatteFUNN can also be used by mature businesses. The only requirement is that there is a substantial degree of innovation in the projects being supported.

### *Transition*

Transition can result in comprehensive financial changes. Increased pressure from substitute products and competition usually results in lower profit margins and a smaller market share.

The focus on production costs whilst under intense competition can cause management to move production to less expensive factories, or sales are directed at new target markets, which will be attractive when the technology is standardized. During this process other owners can be in a better position to relocate the resources and/or combine them with new resources. Such strategic changes will therefore often result in new ownership structures.

### *Examples*

In the initial stages of a product cycle, the business itself usually finances the development of the new technology, or if the new technology is a new business, the owners and financial resources from the public authorities bear the initial financial burden. The commercialization of the "Uglestad balls" within the industry of electronics was supported by Conpart and is a good example of this type of financing. Dynal Biotech financed the initial stages of the technological development. The development was then financed through the owners' resources, Innovation Norway's New Business Development Stipend and the Forny-program. In 2004 and 2005 the company obtained another three million NOK from two private investors and one American

“business angel.” All of them provided the company with their own experience, knowledge and competence, working for “sweat equity.” Public authorities have also given a significant financial help; about eight million NOK through Innovation Norway’s Industrial Research and development fund (IFU) and “high risk-loans<sup>xi</sup>.”

During growth, venture capital, industrial capital and/or capital obtained through the stock market are important. Opera Software<sup>xii</sup> was in 1994 a research project of Televerket’s (Telenor, a phone company in Norway) Research Center at Kjeller in Norway. The project became independent of Telenor in 1995 and Opera Software was established. The company develops and sells Opera Web net-reader and is today the third most used net-reader after Explorer and Netscape. At the beginning, the company was supported through the Forny-program (Innovation Norway and the research Council of Norway) and other funding programs of Innovation Norway. Telenor’s contribution was the offices and infrastructure. A couple of years later, the company acquired venture capital and other private capital for market development and up-scaling, and on the 11<sup>th</sup> of March 2004 the company got listed at the Oslo stock exchange. The company received its first operational profit in 2003, and in 2004, the turnover was as much as 187 million NOK.

### **Challenges related to customer and supplier relations**

Innovation projects are also faced with challenges with respect to customers and other market and supplier relations at the different stages of the product cycle. During introduction the main challenge is in identifying and developing the market, whereas the main concern during growth is to increase market share. Protection of market share is the main challenge during maturity, whereas companies during transition or at the decline stage are either concerned with reconstructing their business or vacating the market.

#### *Introduction*

At the introduction stage, the goal of most companies is to create awareness and develop a market for the new product. A company usually develops a brand and establish the quality of the product. The firm’s pricing strategy is determined depending on a variety of factors including the product’s value to the end user, how quickly it can be imitated by competitors, the presence of close substitutes and the effect of price on volume and costs. Skimming or high-price strategies are designed to obtain as much margin per unit as possible and enables the company to recover its new product investments more quickly. It is therefore particularly relevant in this phase to

develop niche markets where customers are relatively insensitive to price and whilst one still is in an exclusive situation with suppliers (Walker, Boyd and Larreche 1999). Only in later stages in product development is it possible to adopt low-priced strategies or so-called “penetration pricing” enables the company to strive for quick market development and makes sense when there is a steep experience curve (which lowers costs), a large market, and strong potential competition.

From a marketing perspective this phase requires special attention with regards to building awareness of the new product, establishing distribution channels and testing the market. It is highly uncommon to realize any profit during the introduction stage and the product has to be closely watched to determine its future growth potential.

### *Growth*

At this stage the company’s biggest challenge is usually to build up brand name preference and increase the market share. Important product improvements continue in the growth stage, but at a slower rate. Increased product differentiation occurs primarily in new product features and improved quality, which again increases the attractiveness of the product. The product line expands to address new market segments. It does so by offering many price levels and different product features. The growth stage thus starts with a sharp increase in sales as a result of increased demand for their product and limited competition. The price level still remains relatively high in the beginning and new distribution channels are established as the product reaches new markets. At this stage, the company usually invests significantly in marketing and promotional efforts in order to increase attractiveness of the product and to increase their market share. Closer to the end of the growth cycle, the company, especially the dominant one, makes every effort to extend the growth stage by adding new segments, lowering costs, improving product quality, adding new features and trying to increase product usage among present users (Walker et al 1999).

### *Maturity*

When sales plateau, the company enters the mature stage, which typically lasts for some time. Stability in terms of demand, technology and competition characterizes maturity. Strong market leaders, because of lower per unit costs and lack of any need to expand their facilities, should enjoy strong profits and high positive cash flows (Walker et al 1999). Their main goal is to protect market share and maximize profits. Thus, competition with respect to the protection of market share is indeed relatively intense.

Distribution during the maturity stage is more intensive and the company usually has to give incentives to encourage customers to buy their product instead of a substitute product of the competition. Such incentives usually consist of new product features, in order to differentiate the product from competition. R&D is usually directed towards market driven product improvements that will differentiate the product from competition and sometimes a company has to undercut the prices of competition in order to remain competitive. However, participating in a price war with competition can be very dangerous and is usually not recommended.

### *Transition*

Eventually most products enter transition or the declining stage, which may be gradual or extremely fast. The sales decrease and profit is shared amongst the remaining competitors. Products enter this stage primarily because of technologically superior substitutes (jet engines over piston engines) and a shift in consumer tastes, values and beliefs (cholesterol-free margarine over butter)<sup>xiii</sup>. As sales decline and costs increase, radical efforts are needed to reduce costs and inventories to remain competitive. As a result, companies might move production to less costly facilities or sales are moved to new markets which now are available due to low prices. The company has thus several possibilities;

- One can keep the product, but undertake product modifications by adding new features and create new product usages;
- One can attempt to cut production cost in order to obtain a lower per unit cost and thus continue to sell the traditional product within local niche markets;
- One can also stop production or vacate the business to concentrate on a new generation of potential product cycles.

### *Examples of challenges tied to customer and markets*

The traditional airline companies managed to keep their hegemony in the air for years. Sir Freddie Laker tried to break this hegemony with the launch of a low-priced “Skytrain” in-between London and New York in 1977. The Laker Company at that time met a lot of resistance from the air industry and went bankrupt four years later. Sir Freddie’s lower price concept did however mark the beginning of a new way of thinking about the air industry. With a more open and fair competition several new low-priced companies entered the market. The low-price concept challenges the traditional customer relationship with simplicity and the removal of all expensive service elements, i.e. purchase of plane tickets over Internet, removal of or paid

catering onboard, simplified luggage services etc. The low-price concept has had enormous growth and now challenges the more traditional concepts. Ryan Air has experienced an enormous growth from its start-up in 1985 until today. Their customer base increased from 1,6 million passengers in 1996 to 5,4 million in 2000, 24,6 million passengers in 2005 and they are aiming at transporting 70 million passengers in 2012. The well established airline companies are now responding to the tough competition from the low-priced companies and are restructuring and adapting similar concepts (SAS happy flights).

## **OVERRIDING LEADERSHIP AND STRUCTURING**

The managerial challenges with respect to organizing and structuring different stage-specific and functional needs are extremely complicated. Diverse functions such as financing, IPR and marketing demand special competence and skills, which again result in functional segmentation of the organization. At the same time, the different stages in the product cycle represent different logics, resulting in “phase specific” organisational structures and strategies where the company will have to continuously manage the various business areas according to a set research-, optimizing and restructuring logic. When different phases demand shifts between the logic of exploitation and exploration, this raises particular challenges, whether financing, technological development or market-relations are concerned.

The overruling organizational governance must therefore build organisational parameters that enable the company to release potential synergy across specialization, tasks and challenges at the different stages in the product cycle, and at the same time allow for necessary autonomy for functional and phase-specific specialisation.

### *Means of differentiation*

Differentiation or organisational decoupling in order to aid the coexistence between research, optimizing and exploration logic can obviously be done in several ways. Volberda (1998) states that flexibility and differentiation as means to foster innovation can be done either by initiating a top-down or bottom-up strategy.

When establishing a top-down strategy, top management are assumed to operate freely and initiate new product cycles, whilst the rest of the organization remains focused on effective production of the company’s core product(s). In this case, innovation is a question of top-management and the organization itself does not get involved until management wish to implement promising innovations.

In a bottom-up strategy, innovation is decentralized and supported by reward systems to encourage innovative business ideas or technological development. 3M is, as previously mentioned, well known for this. Management of 3M successfully obtain effective production of core products and at the same time encourages creative thinking and innovation to foster new business ideas and product development.

Differentiation in order to handle contradictory exploitation and exploration logics can also take place across traditional functional business units. Large companies typically have separate production departments, focusing on effective and efficient production processes and marketing departments which operate more flexibly and according to the need of the customers. Innovation, will under functional specialization, typically be allocated to independent R&D departments and is usually accompanied with a “technology push” model of innovation<sup>xiv</sup>. This type of structuring usually characterizes traditional governmental infrastructure-companies with a long-term and stable regulating framework.

The last form of structuring will effectively protect innovation processes from dominating production processes. It thus protects vulnerable innovation ideas from being exposed to running operational considerations in the company and enables the business unit, dedicated to innovation, to accommodate financial, technological and managerial solutions for premature development. At the same time, this type of structuring might isolate the innovation process from competence and simulating challenges that exists within the production system of the company’s core products and from the company’s general marketing systems.

Differentiation can also take place through establishment of project-based ad-hoc structuring across the main structures of the organization. Innovation can, in this case be initiated and organized through various projects gathering competence and resources relatively freely and on an ad-hoc basis. A good example of this is Telenor, the Norwegian telephone company, which practices a form of informal project-structuring around new ideas, where a network between relevant expertise-environments is established to develop and commercialize new ideas and concepts. In these networks Telenor New Business functions as the catalyst.

Differentiation however, can also take place in time. Observing the larger changes in technology, Noteboom (1999) developed a cyclic theory of business-structuring, where the company consolidates around a dominating technology and business model, which has to be dissolved when the technology is outdated and undergoes fundamental organisational changes, to again become reconsolidated around new products/technologies with a new business model.

IBM’s dramatic change from selling only workstations to offering personal computers and then consolidating around network-competence and e-commerce is a great example. The

company's traditional business model with focus on delivering "hardware" up till 1990 resulted in a loss of eight billion dollars in 1993. When this happened, the company went through radical changes in their business model to focus more on information related to technological innovation. Based on this, IBM played an important role in the development of e-commerce<sup>xv</sup>.

### *Differentiation across organizational boundaries*

The company can also search for solutions to differentiation challenges across its organizational boundaries. Taking an established company that is focusing on production in a mature technology as an example, there are two obvious cross-organisational options: "Insourcing" and "Outsourcing" of products and business models, both of which may take place at different stages of the product cycle

When we are dealing with an "Insourcing" situation, the initial stages of innovation occurs outside the company and are then "in-sourced" or integrated with the company for further incubation and product development before meeting a demand in the market place. The company's competencies, business processes and production systems then become a part of the innovation only after the idea has been conceived and possibly also taken through external early stage development. This model may be particularly relevant when the innovation does not consist of primary upgrading of existing competencies or of new ideas that fit directly with existing business models, but involve more radical innovation. By being a receiver or selector of new concepts and ideas from the outside, the company not only increases the variation of new ideas, but also avoids tensions that an internal creative unit could entail.

Telenor Seed functions, as previously mentioned, as a yearly instrument to promote new technologies and business concepts where both internal and external contributions are included. Another form of "Insourcing" can come from the business supply chain. There are plenty of examples of this within the petroleum industry (Midttun and Ørjasæter 2003, 2004). Statoil's "supplier-development-program" is a great in-sourcing example.

Outsourcing usually appears at the later stages of the product cycle. In many instances, it happens because the innovation interrupts the main business activity or does not fit into the company's core strategy. Parts of the production cycle are thus outsourced to other players in the marketplace.

Outsourcing in the later stages of the product cycle has become more and more common and is partly driven by international division of labour. Sturgeon (2002) regards the modular production network as a growing American model of industrial organization, where leading companies concentrate on the creation, penetration and protection of end-products and to a certain

degree also on services attached to the product, whereas production is allocated to globally organized suppliers of end products. This model consists of work allocation not only across the production cycle but also along the functional areas. The Western company looks after market- and service functions as well as concept innovation and the operative leadership of these functions, whereas the Eastern/Southern suppliers are responsible for technological development and production. The textile/fashion industry has for a long time functioned under this model and the IT industry is seemingly following the same path.

### *Balance between differentiation and integration*

Differentiation to allow for product cycles in different phases and functional needs to be addressed according to its stage-specific logics is just a part of the solution. As mentioned before, top management must create integration across product cycles to promote synergy amongst the various strategies at the business level of the organisation. Such synergy can occur at several dimensions: financial, technological, legal, accessibility of customer markets, suppliers, power in negotiations etc. where the organizing at the mature stage typically supports early stage innovation up to future business possibilities.

According to the Boston Consulting Matrix (Stern & Stalk 1998), mature technology and business models represent potential “cash cows” for funding of promising innovation at initial stages of the product cycle. Some of these innovations can be developed further into “star-projects”, future growth-stage technologies and found the basis for future business models for the company. Central elements in favourable market positioning can be a combination of sufficient early stage investments based on the financial strength of the company’s core products combined with access to marked channels and customer network already built up by mature core products.

Similar perspectives are also shared in the portfolio and risk-management traditions. Quinn, Mintzberg and James (1988) thus argue that, integrated structuring can be justified with the need to spread risk across different markets and to secure a stable and positive cash flow. By occupying positions in mature industries and obtaining a stable profit, the company is better able to support new and up-coming product cycles that are unable to generate sufficient profit to cover costs.

The car industry is a good example. Significant investments are now made in developing so-called hybrid-models, where car industry seeks to meet tomorrow’s market demands. Hybrid cars are to a large extent, financed by the production of established product models and draw their

expertise from existing business operations. The new hybrid-cars are then assumed marketable through the brand of the car's regular marked channels and customer network.

Telenor's more informal innovation model builds a bridge between informal innovation networks and formal line-operations in order to exploit synergy by increasing the accessibility to resources and the market for implementation. When business ideas are ready to be commercialized, the implementation process is run by line-management in formal positions in Telenor's main organisation.

If they accept the project it is passed on for further implementation or sale through already established channels within the organization and through the organizations regular sales network. The involvement of potential and interested line managers early in the innovation process is one of the strategies that is utilized to support the transition between the innovation network and Telenor's formal structure (Riksen 2006).

Foster and Kaplan (2001) stand for one of the most radical solutions to the balancing act of integration and differentiation. They support a financial portfolio approach for innovation. The challenge with rapidly declining product cycles of large companies suggests, according to them, that financially strong and mature companies should become holding companies that buy promising innovative companies at the growth stage and guide them through part of the mature stage before they sell them and engage in new growing product cycles. Multi-brand companies like the Warner Group in Norway operating within the fashion industry and perhaps to a greater extent, Orkla, operating in the media industry have both adopted such a model, having a portfolio of market concepts in which they reap great profits from the successful companies and get rid of the successful ones.

#### *Innovation management as a complex and dynamic balancing act*

The product perspective on innovation leads us to a dynamic and complex balance-oriented perspective on management; it emphasizes process-like parts of structuring by pointing out that the company must manage the different needs that transpire at the various stages in the product cycle. It also highlights the differences in quality demands at the different stages. In doing so, it fosters a more focused analysis of the managerial questions, by relating the managerial issues to the different stages in the product cycle and how management addresses the specific needs occurring at each stage.

The dynamic product cycle perspective on leadership has implications for other functions such as financing, strategic technical control, market development and general structuring. It also highlights the need for top management to coordinate the different phases in the cycle and their

organizational engagements across the whole company and across the strategic network the company would be a part of. The product cycle perspective encourages dynamic and multi-dimensional thinking, but at the same time it supports fruitful compromises between specialized and over-ruling management.

Innovation oriented organisations have to be relatively open and allow early stage research and late stage transition to be apart of traditional production processes. As previously mentioned, the balance between differentiation and coordination can vary from one industry to another, as well as from one company to the other. However, due to increased pressure for innovation a company must give the balance and process perspective a central place in top management and organizational structures.

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<sup>i</sup> Norwegian version under publication in Tor Hernes og Anne Louise Koefoed (eds): Innovasjonens odysse: Innovasjonsledelse fra idé til marked (The odyssey of innovations, from idea to market) Fagbokforlaget 2006

<sup>ii</sup> <http://www.3m.com/about3m/pioneers/fry.jhtml>

<sup>iii</sup> <http://cactus.eas.asu.edu/partha/Columns/04-16-AccidentInvention.htm>

<sup>iv</sup> [http://www.telenor.no/new\\_business/om/](http://www.telenor.no/new_business/om/)

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<sup>vii</sup> [http://presse.telenor.no/PR/200506/-1000899\\_1.html](http://presse.telenor.no/PR/200506/-1000899_1.html)

<sup>viii</sup> Intellectual Property Rights – IPR include patents, trade marks, design protection, copyright and other rights like business name and domain name.

<sup>ix</sup> <http://www.grip.no/okodesign/produkter/eksempelsamling/tripptrapp.htm>

<sup>x</sup> <http://www.conpart.no/>

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<sup>xiii</sup> Marketing Strategy Planning and Implementation, Walker, Boyd and Larreche, 1999 The McGraw-Hills Companies

<sup>xiv</sup> There is a distinction between “technology push” (technology driven) and “market pull” (market driven) innovation.

<sup>xv</sup> [www.IBM.com](http://www.IBM.com)