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Innovation Practice

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Networks on networks

Connecting entities through networks – in technological, societal and personal terms – enables telecommunication. Networks occur on different levels, form parts of larger networks, and exist in numerous varieties. The artist Odd Andersen visualises the networks on networks by drawing interconnected lines with different widths. Curved connections disturb the order and show that networks are not regular but are adapted to the communication needs.

Per H. Lehne, Editor in Chief

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Guest editorial – Innovation management as a research area

BJØRN ARE DAVIDSEN

Bjørn Are Davidsen works in Business Development at the Fixed Lines Residential Market, Telenor Norge

Writing on innovation management is a daunting task. To some this means leaving the safe harbour of technology and telecom standards, to seek the stormy seas of market, money and management. Some even seem to think that innovation is about doing research or being creative. And there are those who insist that innovation and creativity can neither be measured, nor managed.

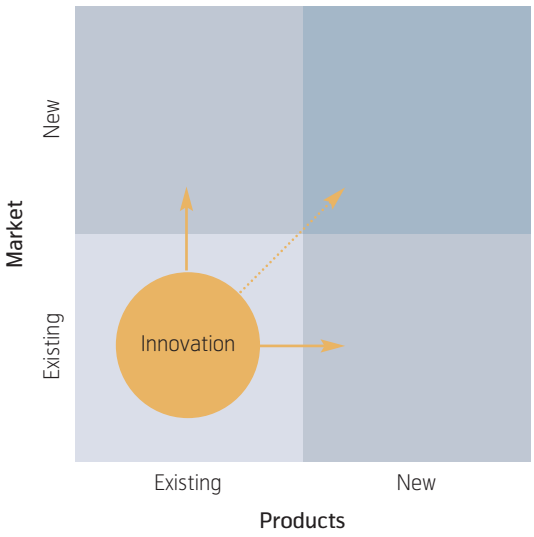
The area of innovation is almost as full of myths as our understanding of Medieval Europe. These myths frequently prevent managers and senior executives from building a case for innovation with their organization. There is a tendency to imagine innovation as something that is nice to do, though not essential for business survival, especially in the face of urgent priorities like reaching sales targets. While this may seem sensible and pragmatic, it also reflects a short-term and rather limited perspective on the drivers of business success. One reason behind this is a misunderstanding of what innovation actually is and what it requires.

Innovation is something companies need to do – and to study. Innovation management as a research discipline has been growing the last twenty five years. One of the pioneers in this area is Norwegian. Knut Holt established the field of Technology Management at the Norwegian Institute of Science and Technology (NTH/NTNU) in 1949 and is the founder of ISPIM, the International Society for Professional Innovation Management. It is only fitting, then, that this issue of the Norwegian telecom magazine *Telektronikk* is dedicated to this field, and with a special focus on innovation in the Telecom business.

Product innovation, or new product development (NPD), is a discipline of its own. The aim is to increase profit and grow business through satisfying customers by managing products (goods, services and bundles) through their lifecycle, integrating marketing knowledge and technological expertise. It is difficult to grow business through cost cutting or better accounting methods. Innovation is also about cultural aspects, related to change processes needed for the development of a market-oriented culture with customer needs as a major focus area.

To build a proper understanding of innovation it may help to dispel some lingering innovation myths, not the least by research on what it takes to succeed with new products.

Bjørn Are Davidsen



- *You can only cost cut a company into profitability. Growth requires innovation.*
- *Innovation is about introducing new products or entering new markets with your existing products.*
- *Sometimes opportunities arise for "radical innovation", entering new markets with new products.*

From the Ansoff "Product-Market-Matrix"

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Some myths and facts about innovation

Myths (may change over time)	Facts (may change over time, depending e.g. on results from research on innovation)
It relates only to technology	Innovation may be about anything, from products to processes, as long as it creates a success in the market by doing something new. You can innovate through e.g. • Selling new inventions successfully, or products that are improved in key areas • Selling products in new ways, or through new channels (process innovation) • Finding new market for your products (market innovation) • Introducing products and concepts from other industries
It is research and development	While ideas often start in R&D, they also often stop there. As true innovation is to succeed in the market, the challenge is to integrate R&D initiatives and analysis with product development and commercial success.
It is best done as spin offs and new business units	Successful innovations happen at least as often within large companies as in small companies and spin offs.
Innovation and creativity are the same thing	Creativity is the art of thinking differently, and may lead to new ideas. Innovation is a systemic discipline for acting on new ideas to create value. Creative people do help, but it requires a team – and sometimes a sustained effort for years – to bring an innovation to completion.
It is only about something revolutionary	Innovation is far more often about the discipline and competencies necessary to grow small ideas big.
Innovation is an individual effort, for "the chosen few"	One of the most important ingredients of innovation is teamwork, whether in research communities or as a cross functional development project.
Innovation is primarily about "products" (goods)	In today's businesses, goods quickly become commodities. Because of this there is a need to pursue innovation in services, processes, whole business concepts and strategies, changing the rules of the game.
A good process is 90 % of the battle	Leadership, culture and process are a three-legged stool for success. While an innovation process is important, there is also a strong need for motivation, funding, vision, support, organisational culture and a leadership that "walks the talk".
We have a good methodology for evaluating ideas	This is probably true and will not drive innovation. Innovation is not about good ideas. It is about driving the very best ideas to market success through an optimal commercialisation process.
It is costly	Sometimes it may be. However, as long-term financial performance is associated doing innovation, change and new ideas are essential ingredients in the recipe for success.
Customers want less expensive products, not innovations	Though price is a driver, customers are increasingly demanding for innovation. As they experience innovations in e.g. banking and online transactions, their needs become more complex. Customers must be continually satisfied to remain loyal.
It is about brand new things	The rate at which competitors copy and re-modify a product is alarming. Some companies have two types of teams, one to work on improving a current product, and the other to develop a new one even before competitors copy existing versions. The question is no longer "Should we innovate?" but rather "How fast can we innovate?".
We know what works	In a more and more complex world, what used to work doesn't anymore. All products have a life cycle and we need to change to improved versions to avoid becoming a thing of the past.

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Section 1 – Innovation and industrious cultures

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There is no magic to innovation, though there may be some magic in a culture. And there is little doubt that one of the most fascinating aspects of innovation is the cultural side. However, as this is difficult to measure or study without bias or preconceived notions, it is unfortunately an area of much contention. There is almost the feeling that either one appreciates a culture and praises it too much, or one does not feel at home in it and portrays it rather negatively.

The Norwegian Social Anthropologist Arne Martin Klausen defines culture as "the values, rules, norms, codes and symbols that a human being receives from the previous generation, and which he tries to bring on – often a little changed – to the next generation." A business culture is related to this and consists of everything from the specialised language in the business, to long-standing rules of thumb and matter-of-fact attitudes or prejudices. Some parts of a culture are visible, some parts are hidden or invisible, some expressed consciously. Clothes, food, jewels, religious customs and traditions are all visible symbols of a culture. What is expressed through values, ideas, norms, and attitudes constitute the invisible part.

Schein's (1992, *Levels of Culture*) provides a useful framework to identify business culture. Examining culture in an organization involves the levels at which this concept operates:

1. *Artifacts*, the visible organizational structures and processes, as well as the architecture, office layout, decor and attire.

2. *Espoused values*, the strategies, goals, philosophies and justifications in an organisation, the talk and the walk, as well as the kind of anecdotes, heroes and "scoundrels" one holds.

3. *Basic underlying assumptions*, the unconscious, taken-for granted beliefs, perceptions, thoughts and feelings in an organization.

Different sets of value can coexist among different groups of people in an organization. Not all people will fully agree about which values and norms are dominant. Innovation is about tapping into the cultural potential in an organization, and about developing the culture(s). It is discovering which new products, new business models, new ways of working and which new values that our customers have that we should focus on serving. Culture may be seen as the "mental matrix" which our actions are based upon – included those related to innovation. It is the sum of experience, knowledge and values we carry with us. All people have a high intrinsic value and creative ability, regardless of nationality, language, race or gender. However, it is important not to use this understanding as a basis for saying that all cultures are just as conducive to innovation. This is why we have provided an overview on some cultural straits that more easily may lead to innovation, in our article "Beyond the Protestant Work Ethic".

In the same way business culture may vary. Just as external forces like the market situation, competitor strength, global trends, hypes, trade barriers etc. are important when discussing innovation, it is important to be aware of the fact that some business cultures are better at innovating than others. And that there is no simple solution. While some kind of creativity may be achieved in one meeting, real innovation requires an unpredictable number of interactions.

It is also important to note that there is no single road to results. Countless amounts of Euros – or more often Dollars – have been spent to map what poet

Artifacts	These are highly measurable. One of the reasons why studies of history so often are about external factors like climate, trade and economics, is that these are measurable. Hence cultural issues tend to fall below the researcher's radar.
Espoused values	These are measurable to a degree, and reflect the basic assumptions.
Basic assumptions	Indirectly reflected in the above, may also be discovered through interviews and by challenging assumptions

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William Blake called “the crooked road ... of genius.” What is required is a culture that really supports creativity and innovation, as well as a flexible process related to different kinds of business initiative. To stay in business one must foster a culture that understands the need for continual change. Companies that master the art of continuous innovation are the ones that will grow. Innovation is not a project. It must become part of the organization’s everyday culture. And this is why the issue of “Creating a creative company” is so important. Even if a phase oriented way of working and funding is necessary, they are not sufficient. Capital is always related to a culture. Innovation is the challenge of channelling capital and competence in a creative culture to customers’ delight.

For a presentation of the author, turn to page 2.

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In memory of Johannes H. Berg (1956–2004) – You knew all the details

Beyond the Protestant work ethic
– Why some cultures innovate – Learning from history

BJØRN ARE DAVIDSEN

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This introductory article is intended to set the tone for a magazine on innovation. While the other articles are about present and future issues, this one is concerned with the past. It is indeed intended as an innovative and contemplative step outside of today's hectic business life. The target is to provide a cultural perspective on the history of technology and innovation, in order to stimulate some thought. To do that, it is important to go into detail in some areas, and even become something that perhaps is a bit unusual in a technological magazine: concerned with the world of the mind as well as that of economics and technology. To some readers it may come as a surprise that in order to evaluate the cultural factors that seem to be most conducive to innovation, it is necessarry to look closely at Medieval Europe. Hopefully this may provide valuable learning, even if everyone does not agree on the angle or the arguments.

1 Abstract

In many circles Max Weber (1864–1920) still holds the dominant paradigm on cultural drivers for Capitalism and the Industrial Revolution in the 18th century. He argued that there was a strong connection between Protestantism and Capitalism in the West. Newer studies, however, indicate that Weber did not take a sufficiently long and global view on the forces involved. To understand the cultural drivers for innovation, attention should be given to the "cultural mutation" in early Medieval Europe, which led to an industrial revolution also in the 12th century, as well as to consider the global context, or the "world system". Concepts like Progress (the belief that there is a better secular future ahead of us), and discoveries such as the one that *inventions* may become productive *innovations*, that technology should be used for the common good, and that labour is valuable, led to the acceleration of innovation that characterise the modern world. As we will discover, it is difficult to understand how these concepts could become ingrained in any culture, without also considering which mental model was conducive to creating and sustaining a culture of innovation and industry.

Today it is mandatory not to lose contact with the deeper roots that led to innovation, while at the same time strive for an even better understanding of what really constitutes progress and "the good life". From this one may take some relevant and applicable learning for today's companies.

2 Historical roots of innovation

This article aims at providing a summary of recent studies on *cultural* factors facilitating innovation. By doing this, the intention is not to say that other forces at work, like economics or ecology, are of less importance. If nothing else, it may stimulate interest in the history of technology. Hopefully, it may also provide an educational experience, even if some conclusions are provocative. At least this has been an interesting journey of discovery to me, after having had the great honour and pleasure of following professor Helmer Dahl's course on "Technology, Culture and Society" in Trondheim in 1981.

As a visionary and pioneer in the development of modern electronics, Helmer Dahl had a deep fascina-

Helmer Dahl (1908–1999) was a leading figure in the research and development of post-war technology in Norway. During WW2 he worked on radar technology at the Admirality Signal Establishment in Great Britain. In 1946 he had a leading role in the founding of the Norwegian Defence Research Establishment (FFI) and led the department on Radar Technology the first years. Later Dahl played a major role in developing modern telephony in Norway and became Director at the Chr. Michelsens Institute in Bergen. Dahl was for a period also chairman of the Central Committee for Norwegian Research (*Hovedkomiteen for norsk forskning*). In 1978 he began a series of lectures on the social role of technology, at the Norwegian Institute of Technology (NTH), based on a life long interest in this field. According to Dr. Nic. Knudtzon who founded Televerkets Research Institute (TF) in 1967, if not for Dahl's inspiration, TF might not have become a reality.

For Notes to this article, please turn to page 22.

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tion for technology and innovation. His university course certainly made a deep impression on a young student.

Even if Dahl did little original research in this area, his broad knowledge provided an opportunity for students to learn that productive innovations have a long history. No-one doubts that the 18th and 19th century were filled with groundbreaking inventions of fundamental sociological impact, from the steam engine to the telephone. However, this drama of inventions and innovations did not suddenly begin with e.g. James Watt's major improvement of a Newcomen steam engine in 1769. The drive for innovation is not something that appeared out of thin air one year. And it all existed in a global context of world trade and technological diffusions.

As a term innovation is found in French in the 13th century, and it was later used by Dante, Luther and Shakespeare. It first came to be widely used in the 15th century. Its modern use as mainly about technological developments, stems from the early 20th century. The roots are in the Latin *innovatio*, "renewing" or "alteration" (Tertullian, 200 AD), used invariably as a negative term in matters political or religious. If you wanted to innovate in these areas, you had to pretend you were getting back to the original state of things, to ancient custom. This of course is also a reminder that one should not view any innovation automatically as positive. Besides the rather obvious issue that inventions not always have been used for the common good, it is also important to keep in mind unintended side effcts, e.g. as related to environmental issues or exploitation of people or cultures.

What is innovation?

Innovation is about the introduction of something new, a new idea, method, or device. *"It is a change effected by innovating, a change in customs; something new, and contrary to established customs, manners or rites"* (Francis Bacon). And in most businesses today knowledge and new ideas constitute a competitive advantage. It is necessary to create new technologies, products, services or markets. Innovation is a successful utilization of new – or old – ideas. It implies creativity and dynamism. However it is not necessarily about making completely new inventions or major breakthroughs. As in Medieval Europe it means more often that artisans, merchants and enterprises are looking for improvements in – or better ways of utilising, producing or trading – products and services. When a culture or economy is more innovative, it is more open to new ideas and technology, and new ways of deploying them. Such increased flexibility can lead to improved productivity and competitiveness and a higher standard of living. This is a vital ingredient in businesses and organisations.

Innovation and inventions are related, though not the same

Innovation	The successful introduction in the market of an improvement or invention
Invention	A creation (a new idea, device or process) resulting from study and experimentation

However difficult it may be to agree on one definition of the term, most people today seem to view innovation as a "natural law". Innovation is something that *does* happen, will *continue* to happen, and *should* happen, as a matter of fact. In some areas this has even been made into a formula, as with Gordon Moore's observation in 1965 on the exponential growth in the number of transistors per integrated circuit. The press called it "Moore's Law" and the name has stuck. At the moment this doubling of data density happens approximately every 18 months, and it is expected to continue for at least another two decades. We observe the same kind of "law" in e.g. analyses which show the general S-curve function for the introduction and penetration of new products in the market (Wulff, 1993)[1)].

Cut down to its most basic aspect, innovation is today about making money. But it must be equally clear that making money far from always is due to innovation. It may be tempting to some companies to downplay innovation, as it tends to have high initial cost and rarely is profitable in the short term, especially at times when it seems hard to find new ways to innovate, or it seems at least even costlier than earlier[2)]. It does not help to inspire more innovation in industries where competitors spend even less, or it is all perceived as a "marketing game".

Innovation is often reckoned as a child of capitalism. New technologies and products are developed, deployed and commercialised better and quicker in a "free market", than in any other economical system. Still, despite this "natural law" and a "free market", not all companies or cultures succeed equally well. To understand more of the deeper structures that facilitate innovation we will take some time to reflect on the roots and reasons behind technological growth.

Adam Smith's analysis in the 18th century may have constituted the philosophical foundation of capitalism and free trade. The classic analysis of how capitalism evolved is of course by Max Weber (1864–1920), in *The Protestant Ethic and the Spirit of Capitalism* (1904–05). His essay focused on the differences

Max Weber (1864–1920)

between religions and the relative wealth of their followers, based on Weber's economic studies of early 20th century Germany. In contrast to Marxist interpreters of history, Weber maintained that profound cultural currents had notable effects on economic systems. He described how the notion of work as a duty laid at the core of the capitalist spirit that arose in the sixteenth century: *"This peculiar idea, so familiar to us to-day, but in reality so little a matter of course, of one's duty in a calling, is what is most characteristic of the social ethic of capitalistic culture, and is in a sense the fundamental basis of it. It is an obligation which the individual is supposed to feel and does feel towards the content of his professional activity, no matter in what it consists, in particular no matter whether it appears on the surface as a utilization of his personal powers, or only of his material possessions (as capital)."*

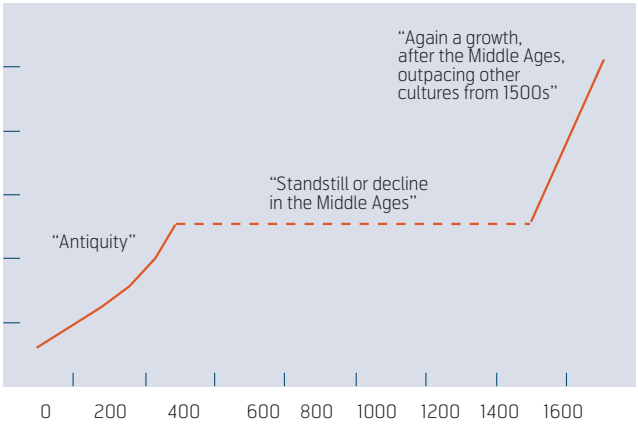
Weber argued that the work ethic taught by Protestants from the sixteenth century on, furthered this. The goal was not to make money, one worked because it was right. He used this attitude to show a strong causal connection between ascetic Protestantism and the rise of capitalism in the West. Weber's analysis has been considered a masterpiece and has gained widespread acceptance, especially in sociology. It has almost become self evident, almost like "The law of innovation" mentioned above. It is a nice theory with just one thing that goes against it. There is too little evidence.

Contemporary scholars – including economic historian Jacob Viner and sociologist Gordon Marshall – have shown major flaws in Weber's argument and a lack of evidence. There are even direct statistical errors in Weber's work, and it is disturbing that it has taken so long for someone to discover it. Despite valuable insights by Weber, his thesis does not quite hold, also because it focuses at too short a time frame, even if he is aware of longer historical lines and some global aspects.

So that leaves the question, if it is not the Protestant Work Ethic, then where does capitalism, and even more important as it is the subject for this article, innovation stem from? Analyses the last decades show that to understand more of this, we have to go a long way further back in history. The roots stretch far beyond Protestantism – and Europe.

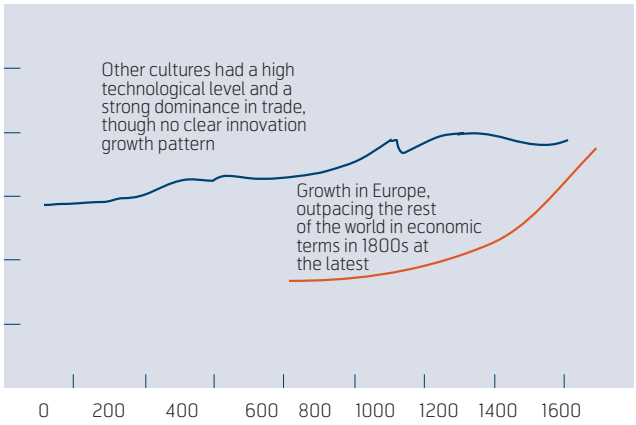
Climate, culture and creativity

The puzzling thing for historians of technology and science is how Europe came to have such a position. Is this just a result of luck, climate, roothless imperialism or "better guns", or may it have some deeper reasons? Is it even possible that we have to destroy the Myth of the Dark and Dismal Middle Ages[3)]? Unfortunately polemics from the Enlightenment in



The perceived picture

Myth: The Renaissance & Protestant Reformation started again the growth in science and technology that had stopped in the "Dark Ages"



A more realistic view

Reality: There was an exponential growth in Medieval Europe, also in science and exploitation of technology, bringing Europe into contact with the world system of trade and creating a growing demand for goods and resources

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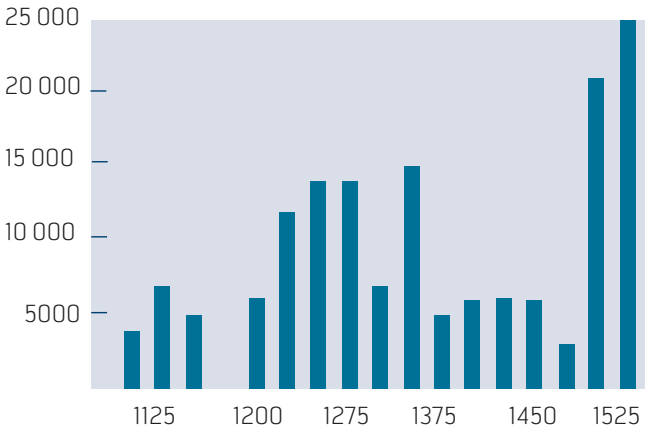
the 18th century still seem to influence attitudes in this area, despite a great number of new studies and historical sources formerly not available to scholars. Fortunately, groundbreaking works by e.g. Lynn White, Gimpel, Cipolla, Kranzberg and Dumas have contributed to a major shift in the scholarly world in the last half of the 20th century, even if some of these scholars now are somewhat outdated and they did not take a sufficiently global view.

It has become clear that the technological and scientific leadership of Europe has far older roots than the "Industrial Revolution" of the 18th century or the "Scientific Revolution" of the 17th century. In fact, even these terms are no longer very useful and obscure what really happened. In reality the first industrial revolution – which was culturally more significant than what happened seven hundred years later – started at the latest around the year 1000.

It was even perhaps *"200 years earlier that the West began to apply water power to industrial processes other than milling grain. This was followed in the late 12th century by the harnessing of wind power. From simple beginnings, but with remarkable consistency of style, the West rapidly expanded its skills in the development of power machinery, labor-saving devices, and automation. Those who doubt should contemplate that most monumental achievement in the history of automation: the weight-driven mechanical clock, which appeared in two forms in the early 14th century. Not in craftsmanship but in basic technological capacity, the Latin West of the later Middle Ages far outstripped its elaborate, sophisticated, and esthetically magnificent sister cultures, Byzantium and Islam"* (White, 1969).



Number of European scholars

Note that the growth rate from around 1050 has been fairly constant, except for the sharp decline by the Black Death. By the time of Copernicus, the number of scientists had again grown to the same level as before The Plague, and scientific activity could again start to flower (from Mclellan III and Dorn).

Also modern natural science has older roots; in the Islamic world[4], in the work of Abelard (1049–1142)[5], and even more in the revolutionary natural philosophy of a Buridan and Oresme in Paris around 1300[6], who took the first major steps toward discarding Aristotle's physics. This was to lead the way for the physics of Newton. Studies on the development of the Physical Sciences have to face up to why the three great ancient cultures (China, India, and Egypt) display, independently of one another, a similar pattern vis-a-vis Physical Science. The pattern is about still-births, that some kind of Physical Science gets started, and then stops after some years, even if they all had the talents, the social organization, and peace which make up the standard explanatory framework for sociologies of science. The great historian on China, Joseph Needham, takes considerable time to discuss this, as he realizes that *"Broadly speaking, the climate of the Chinese culture-area is similar to that of the European. It is not possible for anyone to say (as has been maintained in the Indian case) that the environment of an exceptionally hot climate inhibited the rise of modern natural science"*. Hence he finds that *"The answer to all such questions lies, I now believe, primarily in the social, intellectual and economic structures of the different civilizations"* (Needham, p. 190)[7]. It is interesting that he concludes some hundred pages of discussions on the Chinese and European modes of thought with focusing on the difference in their view on the Laws of Nature, *"historically, the question remains whether natural science could ever have reached its present state of development without passing through a 'theological' state"* (Needham, p. 330).

The high growth rate in the number of scholars since before 1100 also meant an increase in the number of possible contacts between researchers. A 3-fold increase in scholars results in a 9-fold increase in their possible contacts, as we see for the period from 1100 to 1300. The dramatic fall in the number of scholars during the Black Death then led to an even more dramatic fall in the number of possible contacts. It was not until the time Copernicus started his university studies in the late 1400s that the number of scholars exceeded the level of the mid 1300s.

A European mutation?

While in no way downplaying the genius of Greek, Roman, Chinese, Indian or Arabic cultures, not to mention that of Africa and South America, it is possible to find major differences between these cultures and Europe after the Roman period. Some has even called it a mutation.

"Such, in fact, was the precocity, diversity and importance of medieval technics that one is inclined

to believe that a mutation, philosophical or spiritual, had occurred, so that medieval civilisation was sharply and basically different from all those that had preceded it. The technics of the period were precocious in that they often ran far ahead of the very limited scientific knowledge available. They were diverse in the vast range of activities they were concerned with and they were important, not merely by virtue of their cumulative effects on the economic development of society but also because several medieval inventions decisively and fundamentally changed man's outlook on the world. Very few subsequent inventions had the same universal significance in this respect as did the weight-driven clock and the printing press. Modern society is still basicially conditioned by these two medieval inventions" (Cardwell, 1972).

Even if Cadwell does exaggerate here, an important change happened in Europe. In order to understand what this "mutation" is about, and how it may have come to be, it is important to look at tendencies and technologies in different cultures. When doing this it is especially valuable to focus on factors which in some way facilitate or inhibit continuous technological innovation and modern science.

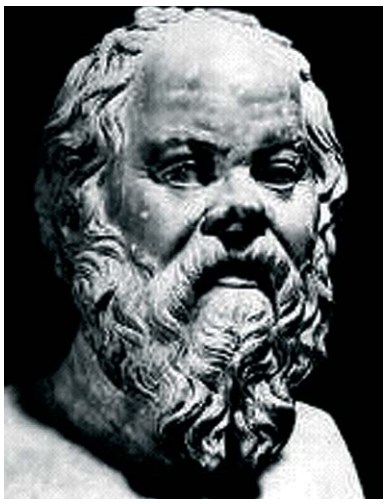
In many cultures we see a strong reluctance to change. While this is only natural, most ancient cultures took this very far. *"We have seen that the Egyptian solution entailed an aversion to change. Things as they stand may not be perfect, but any change is likeley to be for the worse. The Egyptian carried the principle farther than any other people ever has"* (van Doren, 1999).

Religious or philosophical beliefs in an arbitrary world, with no meaning or inherent order, may also have been less than helpful. Humans seldom investigate carefully what they do not think really exists, or what the gods or nature herself will change unpredictably at whim.

Negative attitudes

In several cultures there have also been a negative view on discovering something new. In the later Graeco-Roman period intellectual labour was *"increasingly directed less toward discovering new knowledge than toward preserving old knowledge. This state of affairs gave rise to generations of compilers and commentators"* (McClellan III & Dorn, page 92).

Negative attitudes towards manual labor did not make things better. As Xenophon presents Socrates saying, *"What are called the mechanical arts carry a social stigma and are rightly dishonoured in our cities, for these arts damage the bodies of those who work in them or who act as overseers, by compelling them to a sedentary life and to an indoor life, and, in some cases, to spend the whole day by the fire. This physical degeneration results also in deterioration of the soul. Furthermore, the workers at these trades simply have not got the time to perform the offices of friendship or citizenship. Consequently they are looked upon as bad friends and bad patriots, and in some cities, especially the warlike ones, it is not legal for a citizen to ply a mechanical trade"* (from Oeconomicus, quoted by Dahl, 1982, page 65).



Socrates (469–399 BC)

To Aristotle society had progressed so far that one was now liberated from the need for new technological inventions. *"At first he who invented any art whatever that went beyond the common perceptions of man was naturally admired by men, not only because there was something useful in the inventions, but because he was thought wise and superior to the rest. But as more arts were invented, and some were directed to the necessities of life, others to recreation, the inventors of the latter were naturally always regarded as wiser than the inventors of the former, because their branches of knowledge did not aim at utility. Hence when all such inventions were already established, the sciences which do not aim at giving pleasure or at the necessities of life were discovered, and first in the places where men first began to have leisure. This is why the mathematical arts were founded in Egypt; for there the priestly caste was allowed to be at leisure"* (from Metaphysica).

This is the attitude of someone who has put technology behind himself as something trivial. *"However, one may perhaps rather realise that even if they had all the things necessary for material and spiritual growth, they were diverted by a very peculiar way of looking at the relationship between spiritual and physical work"* (Dahl, page 67).

It is no coincidence that to most Greeks science was about geometry, something which had to do with a world of thought, rather than about physical experiment, which had to do with nature and matter. When the Romans became rulers of the Mediterrean world, the situation grew even worse. Even if the Romans were among the greatest civil engineers ever, building high-quality roads[8)] and aqueducts, Roman science lagged. *"There was a remarkable lack of interest in science and technology"* (Van Doren, 1999).

There was also no clear social role for science and careers in science, since there was little ideological or material basis of support for that field. It did not help that a dominant ideology was that natural knowledge should not be applied to practical ends, and the flourishing of anti-intellectual cults like Mithraism in Late Antiquity. *"Historians of technology have asked why no industrial revolution developed in antiquity. The simple answer seems to be that there was no need, that contemporary modes of production and the slave-based economy of the day satisfactorily maintained the status quo.The capitalist idea of profit as a desirable end to pursue was completely foreign to the contemporary mentality. So, too, was the idea that technology on a large scale should be harnessed to those ends. An industrial revolution was literally unthinkable in antiquity"* (McClellan III & Dorn, page 94).

The Greek heritage, especially from Alexandria, provided important inspiration for mathematics and astronomy in the Western world. However, it also had an *"abstract and somewhat mystical attitude that was more of a hinder than a help"* (Dahl, 1982). A concept of time that tended to believe that the future repeated the past, made a motivation for progress difficult. This bred an attitude of complacency, hindering the development of science[9)].

Different ways of using technology

As Helmer Dahl indicates, this also had to do with different ways of using technology. There is a strong difference between science and technology, and in the way technology has been used through history.

Dahl distinguishes between the Symbolic, the Military and the Productive use of technology.

While the symbolic and military use of technology changed from period to period, and from culture to culture, the productive use remained largely the same for millennia in the world of Antiquity. Tools and machinery kept their simple forms, and improvements were rare. Most major developments *"happened in prehistoric time, and then the "useful" technologies seem to have stalled. Whether about weaving, working in tree or stone, tanning or coloring, mining of salt or ore, the tools remained simple throughout the whole ancient period. They were not much different in Babylon or Rome. While kings came and went, and styles and religions changed, handicraft remained mainly the same, until the newer European development started in the Middle Ages"* (Dahl, 1982). One reason is that in Antiquity more effort and resources were put into a Symbolic and Military use of technology, than into a Productive one.

Evaluations like these are necessary in order to understand the role of technology, even if they may seem unfair. The style and set of norms of a culture should be respected as valid expressions of that culture's genius. Still it is important to realize that the history of technology is not about a long series of gradual improvements. Progress is not inevitable in a culture. History teaches us that the rule seems to be that cultures quickly reach a pinnacle, then a kind of stasis prior to degeneration. Based on their own aspi-

How science and technology are defined in this article

Science	A series of systematic studies, observations or experiments leading to testable/falsifiable hypotheses and theories – set within an explanatory, theoretical framework and organized by general principles.
Technology (mechanical inventions)	Practical tools and machines for facilitating work. Until about 1750, improvements and inventions of mechanical contrivances were done unrelated to any scientific work, or with technology sometimes leading the way to scientific discoveries, not the other way around.

Which purposes technology has been used for (Dahl)

Symbolic	Pyramids, temples, castles, cathedrals, art, decoration, jewelry and clothing.
Military	Weapons, armory, fortresses, warships, strategic roads and harbors.
Productive	Tools for handicraft and agriculture, means of transport, mines, irrigation works, roads and harbors, goods storages, houses and machines.

rations, ancient cultures did not fail or had a primitive technology, *"rather they developed it almost to the perfect"* (Dahl). Their technology was just as they wanted it to be.

However, this was also due to their vision of life. The idea that most people ought to lead a good life was not recognized. The Greek, Roman and Arab societies were major slaveholders. In Athens almost half of the population were slaves in 400 BC. One did not view productivity in light of a concern for the common consumer. Technology was viewed as a means to bring about the beautiful and the overwhelming with little interest for efficiency.

The value of productivity

The singular factor in the culture that emerged in Europe after the fall of Rome is that it perceived productivity in a new way. *"Europe developed technology to such a powerful instrument because one had different values and goals than the classical cultures. The most important difference is that one now started to view production as something purely material that should be made available to those producing. Traces of this view is to be found early, and have gradually spread and become clearer"* (Dahl, 1982).

Like in the Greek and Roman world, science was divorced from technology in medieval Islam. Technology and industry gave so little to and received so little from science. And while Arabic science and technology in many ways represented improvements on that of late antiquity, especially in astronomy, medicine and optics, there was a standstill or general decline some five hundred years after Mohammed, even if it is not to be denied that there were some golden moments later. Scholars have several explanations for this.

The main thesis is that after the initial flowering, religious conservatives triumphed. As Islam emphasizes submission before the divine and unknowable nature of God/Allah, secular philosophy tended to be viewed as suspect[10]. Despite the large libraries and schools, scientific learning seems to have remained peripheral to mainstream Islamic society. It always remained the "Foreign Sciences", and was never sanctioned or naturalized as in Medieval Europe. With increasing intolerance Islamic science was lost. War and disruptions played a major role, in Islamic Spain (Almoravids and Almohads in the 11th and 12th century), as well as in the destruction of Baghdad (by Mongols in 1258) and Damascus (by Tamerlane in 1402), and in the reinforcing of strict orthodoxy. The economic decline when the Islamic world lost its monopoly on East Indian Spices in the late 15th century led to less resources available to support scientists. However this was about more than economic setbacks. The Muslim world seems not to have had a sufficient constructive support from its theological, cultural and institutional fundaments for the long term survival and growth of science.

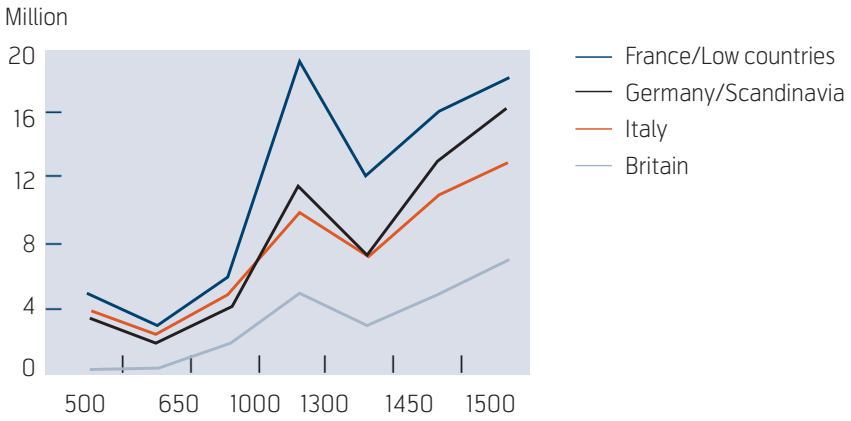
Of course it is a bit unfair to suggest that modern science and continuous innovation somehow "ought" to have developed in a culture. Still, in order to facilitate and support science and innovation, it is important to understand their cultural roots, as well as to reflect upon those factors that may have inhibited innovation[11].

No industrial revolution in China or India

Outside the Arabic world, China was a dominating scientific and technological power for centuries, not to mention its role in world trade. As the sophistication of Chinese science has become more evident the last generations, it is even more puzzling why there was nothing like modern physical science or an industrial revolution in China (Needham), though China up to the 1700s in most areas was superior to Europe. There are several different explanations, from the complexity of written and spoken Chinese that made it less than an ideal medium for expressing science, to China's unhelpful feeling of superiority and inward-looking culture. There was no reason to change its traditional views or look at "barbaric" knowledge, especially as China continued to dominate trade and technology for so long a time.

Another obstacle was that Chinese "modes of thought" did not facilitate objective scientific reason in the same way as it did in the West. One tended to think analogically or associatively, rather than analytically. Instead of interpreting nature in quantitative ways, it was interpreted qualitatively. And even if numbers had a high symbolic significance in China, metaphors seem to have been more important than measurements when it came to the Physical Sciences.

Further, traditional Chinese thought did not put the same emphasis on the concept of "laws of nature". Unlike Medieval Europe, there was little notion of a divine, omnipotent lawgiver who issued fixed commandments for humans and for nature[12]. It did not help that the state for long periods had a rather monolithic bureaucratic control, with no free markets for ideas nor for entrepreneurs. Even if the first emperor, Shi Huangdi around 200 BC, did not encourage new learning, from about this time three precepts were found necessary for ruling a nation as large as China. These included a bureaucracy based more or less on merit determined by learning[13], a strict control of the economy, as seen in mass construction projects that employed all surplus labor, and the idea that most



Population growth in Europe
Note the high growth rate from 1000 to 1300, the sharp decline due to the Black Death, and then again a high growth rate from the 1400s (Cippola, 1972; Dahl, 1982)

knowledge is dangerous. *"The major totalitarian regimes of our time have engaged their people in massive construction projects, partly for the glory of the regime, partly so that no one should suffer – or enjoy – the restlessness of the unemployed. And every tyrant in history has attempted to insulate his people from all kinds of knowledge except the most practical"* (van Doren, 1999). Innovation has never come easy in totalitarian regimes.

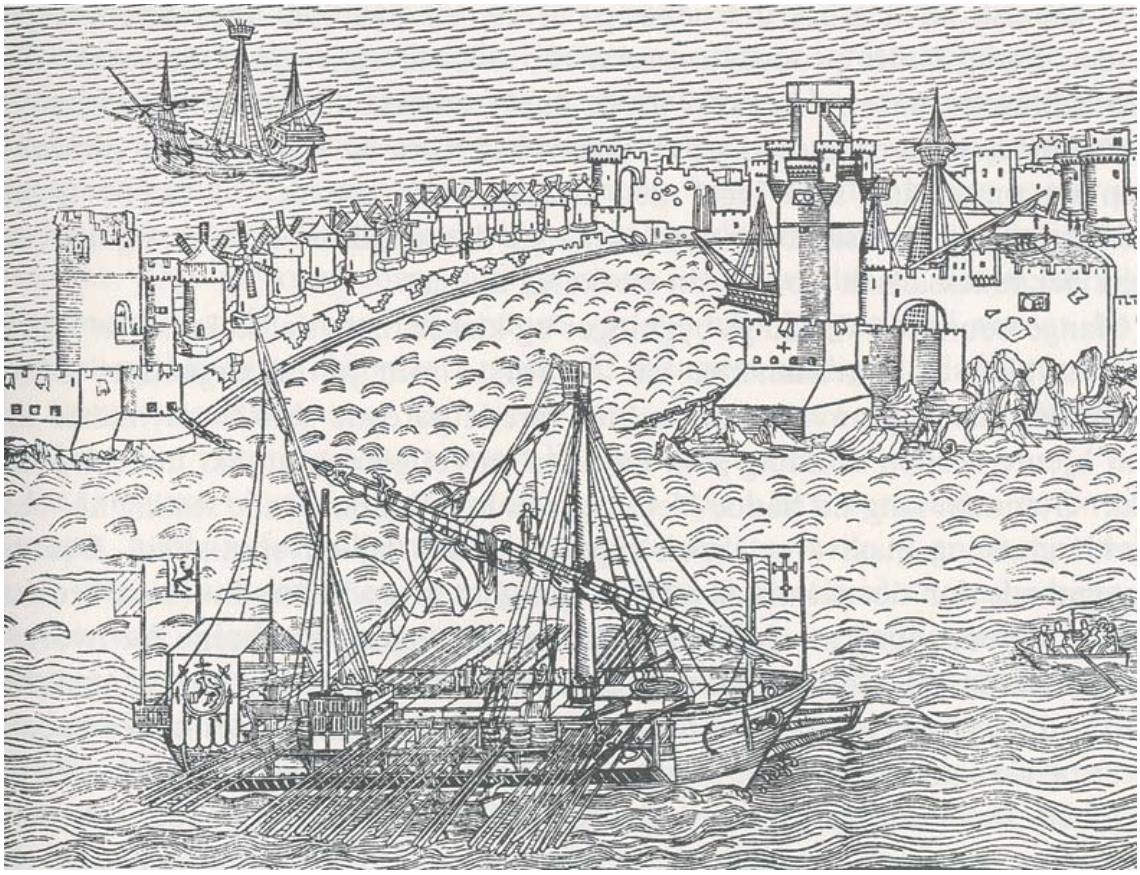
While this may be true, and the Chinese mind and regimes did not facilitate experimental science, the Chinese have an impressive array of inventions. Many Western innovations have their basis in China, like printing, several agricultural technologies, clockwork, paper, efficient horse harnesses, and gunpowder. As mentioned, this led historians like Joseph Needham, the foremost English-language scholar of Chinese science and technology, to ask why these inventions were so revolutionary in Western Europe and not in China (even if they had more impact than is commonly believed). While one must also consider economical and ecological factors, it is difficult to avoid the conclusion that even if perhaps Europe did not become more technologically advanced than China until the 1700s, European technology continued to progress due to a cultural impetus favoring innovation, while the Chinese increasingly seem to have believed that innovation was a bad thing (Mack). Where one in the Song dynasty (969–1279) sees a series of groundbreaking inventions, the Ming dynasty (1368–1644) led to an increase in a totalitarian tendency stifling innovation. When the Industrial Revolution arrived in the late 1700s, China was left behind for a long time.

Compared to China and the Islamic world, there were far weaker traditions of technology and natural science in India. The reason seems at least partly to be that the otherworldly, transcendental character of Indian religions did not encourage direct study of nature. Major Religions like Hinduism, Buddhism and Jainism tend to view the material world, everyday life, as a grand illusion (Maya). There is no direct link between what things look like (appearances) and what things really are. Nature and technology was neither very important, nor about anything fundamentally real. The goal of knowledge was not so much to understand or to improve the world around us, as to see beyond this world and escape its karma in order to reach a higher level of existence. While this level may contain spiritual riches, it rarely stimulates material riches through technological development and innovation. Still, it is important to realize that India had a strong economy and trade, primarily based on cotton production till about 1800.

The belief in progress

How, then, did the West differ from the great and far richer Civilizations of the East? For a long time it was not by any kind of impressive studies or science, not to mention trade or technology. After the decline and fall of the Western Roman Empire, Europe was left in poverty and – on a relative scale – ignorance for centuries. For example, the population of Italy, once the center of the empire, dropped by 50 percent between AD 200 and 600, not the least due to "the Plague of Justinian" in the 540s.

Any legacy of Europe may instead be found in a belief in progress and a linear view of history. The world had a beginning, it had a solid reality, it was valuable and it would have a significant history before coming to a definite end. And man should strive to improve the present world, based on his graciously given reason and talent. One may argue that the center of any great civilization is its religion, and this religion animates and gives it a sense of pur-



The importance of "power machines" is indicated in this illustration that shows the number of windmills in a harbor area in the 1400s – upper left (from Dahl, page 103, originally from Deutsches Museum in Munich)

pose. Without denying negative aspects of church history[14] it is possible to find in the break with earlier religions an explanation of the "European mutation" mentioned above. *"[T]he victory of the Church in the 4th century was not, as so many modern critics would have us believe, the natural culmination of the religious evolution of the ancient world. It was, on the contrary, a violent interruption of that process which forced European civilization out of its own orbit ...". It was the work of the new philosophy, as represented above all by St. Thomas, for the first time to break with the old established tradition of oriental spiritualism and Neoplatonic idealism, and to bring man back into the order of nature ... He taught that human intelligence is not that of pure spirit, it ... finds its natural activity in the sphere of the sensible and particular"*[15].

In short, the root of the mutation seems to be found in the worldview that was so influential in Western Europe[16]. Over a period of several hundred years it provided an impetus toward a different mental framework from classical cultures. This new worldview seems for several reasons to have been especially conducive to creating and sustaining a culture of continuous innovation. When this had been set in cultural and institutional motion, it proved impossible to stop.

To understand more of this, it is important to recognize how much progress and innovation really were new cultural concepts. It is difficult to find the notion of progress in Hinduistic, Arabic, Japanese or Chinese thought, not to mention in Celtic, Viking, Mayan or Aztec. The idea of change and improvement is found in some Greek thinkers, however it was to flower fully first in the Medieval West (Nisbet, 1994).

What role did scientific thought play in this European development? The answer may come as a surprise – almost none. The gunners, foundrymen, smiths, shipbuilders, engineers and navigators all did their work and made their inventions and improvements with the aid of experience, skill, intuition, rules of thumb and daring, not to mention a solid belief in the possibility and value of progress. It was not until the 17th and 18th century that a flow of knowledge started to go from science to technology and not primarily the other way.

To avoid shooting myself in the foot here, it is important to clarify that even if technological innovations mostly were by artisans and not scholars, Western thought and theology were not irrelevant. While also Muslim, Chinese and Hindu artisans continued to

The innovations that changed Europe

This table indicates how inventions from different parts of the world[17] became major innovations in Europe. Any new invention merely opens a vista of possibilities, it does not compel anyone to employ it for the greater good or to increase productivity. The acceptance, rejection or use of an invention depends as much on the kind of society it is introduced to, and the imagination of its leaders and investors, as upon the kind of invention as such.

Invention	When	How this became an innovation in Europe
Stirrup	400 AD	Stirrups spread from China to Europe (700s) and provided an easy way to mount a horse, lateral stability while mounted, and made it much easier for mounted warriors to strike with a sword without falling off. Historians like Lynn White proposed that the rise of "feudalism" in Europe was caused by the introduction of stirrups. However, this has been challenged, from attacks on the idea that technology could have any major influence on social history at all, to doubts about White's linguistic and archaeological evidence. Despite White's idea being brilliant (and endorsed by e.g. Helmer Dahl), it seems now, after more examination of the evidence, that it is not quite right. Still, stirrups seem to have had a major impact (DeVries 1992 p 95ff)[18].
Heavy plow and the three-field system of crop rotation	700s	While mentioned in 50 AD (Pliny), it did not become much employed until a broader use of nailed horseshoes and harness to pull the plow. Unlike the traditional Roman plow, the medieval one had, in addition to a vertical knife, a horizontal shear to slice under the sod and a moldboard to turn it over. This ensured (White, 1962) that (1) the clods could be handled with such force that there was no need for cross-plowing, thus saving labor and increasing the area of land a peasant might cultivate. (2) The shape of fields changed from squarish to long and narrow. The new way of plowing led also to each strip becoming a long low ridge, assuring a crop on the crest even in the wettest years, and in the furrow in dry seasons. (3) It became possible to exploit the rich bottom lands that would give far better crops than the light soils of the uplands and the more arid southern regions around the Mediterranean. Along with the introduction of the three-field crop rotation, this almost doubled the harvest. This surplus of food was a prerequisite for population growth, specialization of function, urbanization and the growth of leisure in Europe.
Horse harness and nailed shoes	800 AD	While formerly a team of horses could pull just 500 kilos, with the new harness the same team could pull four or five times as much. In Antiquity horses seem to have been harnessed in a "singular inefficient way" (White, 1962), with a neck-strap that tended to suffocate the horse and cut off the flow of blood to its head. The new harness with a rigid padded collar resting on the shoulders of the horse permitted free breathing and circulation of the blood as well as being placed in such a way that the horse could throw its full weight into the task of pulling. As horses are 50 percent faster than oxen and can work one or two hours longer each day, this also led to an increase in how much could be plowed per day. The combination of the heavy plow, the three-field system of crop rotation and the new horse harness completed the pattern of a new and vastly more productive system of northern agriculture from the 1100s.
Watermills The cam Trip-hammer		Applying first the cam (a small projection on the axis of a waterwheel) and then the crank to convert rotary motion to reciprocating motion, medieval millwrights adapted the waterwheel to new tasks like fulling cloth, preparing tanning bark, shaping metals, crushing ore, producing paper, sawing wood, and powering bellows. A location near falling water became important for many industries. When fulling was mechanized in England in the 13th century, the center of the English woollen industry shifted from its traditional centers in southern and eastern England to northern and western England (Volti, 1999). It is unclear where and when watermills were invented, though they were in use in Roman time. However, in Europe it was like many other inventions exploited far beyond its original use. In England there were about 5600 watermills in 1086 (about two per village, probably the same as in Central and Northern Europe), three hundred years later there were perhaps half a million across Europe. The trip-hammer transforms rotary motion into linear thrust, and vice versa. Mills with trip-hammers made it possible not only to increase production of felt from raw cloth but also the more effective breaking up of various mineral rocks. One result was a truly transparent glass that made possible the invention of eye glasses (Jaki, 1995). The introduction of mechanical saws is one example of the use of cams. *"In 1444 a great Greek ecclesiastic, Bessarion, who had gone to Italy, wrote a letter to a prince in Greece. He is amazed by the superiority of Western ships, arms, textiles, glass. But above all he is astonished by the spectacle of waterwheels sawing timbers and pumping the bellows of blast furnaces. Clearly, he had seen nothing of the sort in the Near East"* (White 1967)[19]. Bessarion is a witness to the technological superiority of Western over Eastern Christendom at that time, and also over the Muslim (Ottoman) world he was so well aquainted with.
Vertical windmill	1100s	There are two basic kinds of windmills. The horizontal mill revolves in a horizontal plane around a vertical axis. Such mills are known from the 7th century AD in the region around modern Iran and Afghanistan. The vertical or post mill has vertical, revolving around a horizontal axis. The post mill seems to be a purely European invention developed independently of the horizontal mill. While the first surviving mention of one comes from Yorkshire in England in 1185, by 1195 they were sufficiently common that the Pope levied a tithe on them. The post mill was introduced to the Middle East by participants of the Third Crusade (Mokyr, 1990).
Tidal mills	1100s	These were built in low-lying areas near the sea. Dams with swinging gates were built along shallow creeks. As the tide came in, the gates swung open inward, away from the sea. Water filled the area behind the dam. When the tide turned, the gates swung shut, forcing the water to flow seaward through the millrace of the tidal mill. As the time of the tides shifts every day, the millers had to work hours dictated by the tides. There were far fewer tidal mills compared to water mills and windmills (Gimpel, 1976).

Triangular lateen sail and other marine technology	1200s	The development of the deep keel, the triangular lateen sail for greater maneuverability, and the magnetic compass (discovered independently or imported from China in the 13th century) made sailing ships the most complex machines of the age. A school was established by Prince Henry of Portugal (1394–1460) to teach navigators how to use these machines effectively, perhaps more than did Copernicus' astronomical theories, Prince Henry's students changed humanity's perception of the world (Merrit, 2004)[20].
Weight driven clock	1271 AD	The pivotal part of such a mechanism was a double-feedback device whereby the gravitational pull of a weight was made to act at regular intervals, preferably measured in seconds or half-seconds. The widespread use of weight-driven clocks meant that people would no longer live in a world structured primarily by the daily course of the sun and the yearly change of the seasons. It was also an immense aid to navigation, and the precise measurement of time was essential for the growth of modern science.
Eyeglasses	1285 AD	Spectacles with convex lenses seem to have been invented in Florence. This led to more longsighted people being able to read, and older scholars being able to work for more years, and it all contributed to the possibility of even more accumulation of knowledge.
Typographic printing and the concept of the printing press	1450s	The invention of printing as such is older, however as with other inventions, it was used differently in the west as it was based on the development of casting identical single metal types at any number. *"The combination of die, matrix, and lead in the manufacture of multiples of identical durable typefaces was one of the two necessary elements in the invention of typographic printing in Europe. The second necessary element was the concept of the printing press itself, an idea never conceived of in the Far East"* (Backer). The moveable metal types of Gutenberg made possible test printings, easy lay-out and mass production of both religious and secular works[21].

invent and improve, and dominating world trade, the mindset and sociological structure of their culture seem to have inhibited an exponential growth such as the one witnessed in Europe.

Natural crisis?

Due to an early isolation, relative to what had been in the Roman world, and a low population, the western world from about 500 to 1500 was forced to solve most of it problems on its own initiative. *"In doing so it transformed an agrarian society based upon a subsistence economy into a dynamic society with increased productivity, sustaining trade, industry, and town life on a steadily growing scale[22]. This was primarily a technological achievement, and one of considerable magnitude"* (Buchanan). Lynn White even went as far as to blame this for creating a *"moment of crisis in mankind's relation to the natural environment"* (White, 1967), something which despite several analyses to the contrary still seems to be a tenet of the modern ecological movement[23]. The question has in many ways not become *whether* a Christian view of the world had a decisive impact on technological progress, as that by many now is taken for something granted, it has instead become one of whether progress and growth constitute a *danger* to nature[24].

However that may be, the long held belief that medieval man was uninterested in nature or its reshaping is nothing less than absurd. The period from the tenth to the start of the 14th century should rather be seen as a great, inventive era. *"All the essential attributes of culture were present in the Middle Ages so far as proper context of belief in human progress on earth was concerned. There was – how, amid all the activity of the age could there not have been? – consciousness of change and innovation taking place everywhere in western Europe; there was a vivid awareness of the Greek and Roman past. As one historian has put it well, whereas the aim of the Renaissance (in Italy at least) was imitation of Graeco-Roman luminaries, the aim in the Middle Ages was that of absorbing their ideas and then building on them. Finally, despite the apparently ineradicable myth, even among professional historians, of single-minded concentration upon the spiritual and the hereafter, there was the deepest and widest interest in the economic, political and social matters which concern life on earth. To which I add the words* – future *life on earth. Roger Bacon in the thirteenth century foretold a future that would be shaped by science in large measure, one in which ships would operate without sails or oars, in which vehicles would move at high speed on land, and without animals to draw them, in which even 'flying machines' would cross the skies. And Roger Bacon was far from being alone in such forecasts of the future"* (Nisbet, 1980)[25].

One of the most influential books in early Medieval Europe was St. Augustin's "The City of God" from AD 430. Besides other reasons, it had a great significance in recognizing that a physical and practical life is a prerequisite for a social life. The first major monastery movement started a hundred years later by St. Benedict of Nursia. And as the monks were to live in secluded monasteries, they had to be productive. Their ideal of the duty of work became a pattern to be followed. *Ora et labora* – pray and work – as it came to be called some centuries later, was a deeply held motto that very much defined a lasting attitude in Medieval times. There is a world of difference

A water wheel from the 12th century. The illustration shows a trip hammer. Notice how the cams on the horizontal axis lift the hammer which then falls down heavily as the cams lose their grip due to turning (as used in Dahl, page 101, originally from Deutsches Museum in Munich)

between a society where the cultural heroes are beggar monks, and a society where the heroes are industrious.

"The Greek and partly the Roman Cities had as their ideal a citizen who did not work. The cities in the Middle Ages had as their ideal citizens who worked, and who ensured the prosperity and security of the city. Leisure time was not the goal for happiness or social quality, "the industrious spirit" was instead viewed as a virtue in itself" (Dahl, 1982). Work started to become a religious duty, a thousand years before Weber's "Protestant Work ethic", even if the Protestant focus on this from the 16th century in many ways meant a reawakening of, and new impetus for, these ideals. In a Christian culture it was hard to escape the fact that God had worked for six days in order to create the world. And when God both could work, and praise work, it was impossible to insist that it had little value. Laziness – and moral excuses for it – exists in all cultures. It makes a difference when laziness – sloth – is one of the mortal sins, as in Medieval Europe.

Still, Europe made two important discoveries that also freed people from manual labor. The first was that slavery was an inefficient form of production. Replacing a treadmill with a watermill – which is almost as easy to construct – could save forty slaves, and was far cheaper to keep than slaves which had to be fed and cared for, even when ill. And the windmill is a natural development for areas far from a river. The other discovery was that machinery and tools could amplify labor to a high degree. This did not happen overnight, but it seems to have been no coincidence that is was so conducive to a worldview that perceived progress, productivity and work as valuable (Dahl, 1982).

While Max Weber may have taken too narrow a view on the roots of capitalism and innovations, his work still indicates that "Christianity", and, behind that, Judaism, shaped human expectations in ways favorable to economic development. And in all there was a broad contact with the far richer and more advanced societies of the East. Jan Guillou has exemplified this in his popular novels on how the fictional Knight Templar Arn Magnusson introduced new technologies to Sweden about 1200 AD. This is meant to illustrate how the "international system" of Cistercian monasteries, with a significant part of their technology imported from the Middle East, produced several important characteristics of an early capitalist economy in Europe at that time. After earlier orders having lapsed from their ideals, now the keynote was a return to St. Benedict's rule from the 6th century. This included a return to the ideals of manual labor, and especially to field-work, which became a special characteristic of Cistercian life.

"Their [the Cistercian] emphasis on action rather than ritual made them economically productive, while their asceticism prevented them from investing in consumption and display and motivated them to plow back their gains into further expansion. The Cistercians are a case of the Weberian Protestant ethic in Catholic and corporate guise. Their monasteries became large landowners, buying up intervening parcels and consolidating properties. Their rationalized agriculture spilled over into wool production, mining, mills, and ironworks. The Cistercians were the most spectacular organizational expansion of the period, but monastic growth was

An example of Medieval engineering: A replica of the heavy lifting Warehouse Crane at Lüneburg harbour, first mentioned in 1332. This crane towered above most buildings in the city and was driven by thread wheels as seen at the bottom. Large cranes were also known in Roman times

shared by other new orders. Taking advantage of a new market economy, they become a major impetus in economic expansion" (Collins, 2000, p. 456).

By 1150 the Cistercians were at the cutting edge of hydropower and agricultural technology, from watermills to running water for cooking, washing, and bathing, and sewage disposal. These monasteries were the best organized factories the world had ever seen. They were versatile and diversified. Their engineers spread their technology throughout Europe during the 12th and 13th centuries. As the number of Cistercian monasteries continued to grow, they were major agents of the changes that completely altered Medieval and European life[26)].

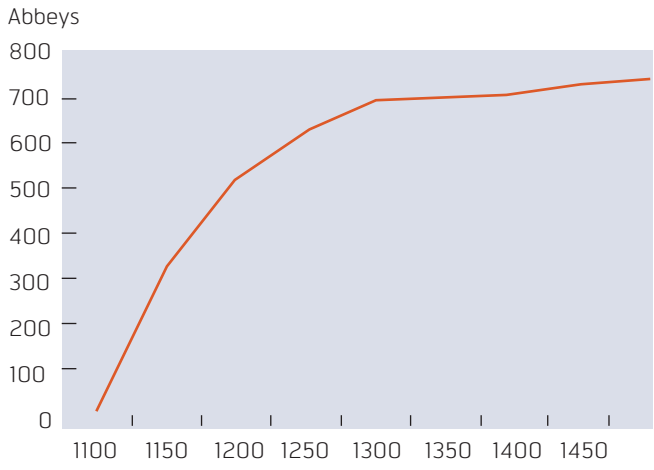
Institutions, ideas and innovation

The factors that led to a different type of development in Europe than the rest of the world also included a diversified political structure in a mostly unified, though dynamic and changing, religious culture. As the New Testament was congruent to a separation of church and state, Europe, in contrast to the great Islamic nations, developed a cultural dynamism also in this area. A set of legal, economical and monasterial institutions facilitated growth in a way a totalitarian regime or monolithic culture never did. The European university was a unique institution. In contrast to the Muslim college (the madrasa), *"the universities of Europe were legally autonomous corporate entities that had many legal rights and privileges"*[27)]. They could even make contracts, sue and be sued.

In many ways, despite a ban on usury for a long time, it seems to have been the church, more than any other agency, that put in place what Weber termed the preconditions of capitalism: the rule of law and a bureaucracy for resolving disputes rationally; a specialized and mobile labor force; the institutional permanence that allows for investment over several generations and for sustained intellectual and physical efforts. This went hand in hand with the accumulation of long-term capital, not to mention a zest for discovery, enterprise, wealth creation, and new undertakings.

Medieval Europe found its most effective instrument in the vertical waterwheel, which was the primary energy source prior to the invention of the steam engine. *"Neither Roma nor Chine succeeded in harnessing its power to the extent that medieval Europe did"* (Giles and Giles, 1994, page 288). The modern factory system of the Industrial Revolution in the 18th century has its roots here. *"There were no sharp breaks between the water-powered fulling and iron mills of the Late Middle Ages and the textile mills of Strutt and Arkwright*[28)]*"* (Giles and Giles, page 289). From the Middle Ages, innovation and science have been speeding up ever since. It is not to be denied that this was facilitated by the resources made available for European exploitation during the colonization period after the Mediveal period, and hence Europe's growing role in the world system of trade.

Without painting too bright or naïve a picture of European impact on world history, it is at least possi-



Growth in number of Cistercian monasteries

After the founding of the Cistercian order in 1098 the number of abbeys grew rapidly (Collins, 2000, page 457)

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ble to indicate that in the last hundred years or so this accelerated drive for innovation has spread to other cultures. The best example is Japan's impressive ability both to adapt, improve and innovate technologically from the 19th century, much in the same way as Europe in the Middle Ages (see also Nakaoka, 1979) – while Japan like other nations also has a long history of technology prior to this[29].

When all this is said, it is difficult to measure the relative role or effect of individual factors, whether we are talking about ideas, institutions or innovations, not to mention ecology[30], trade and colonization[31]. And while the worldview one finds with the Benedictines, Cistercians and early Protestants seems to have been a *necessary* factor in this growth, as Weber has indicated, and certainly contributed significantly to speeding up other trends, it is difficult to say whether it may also have been a *sufficient* one. In all probability factors of ecology and economy contributed strongly to make the cultural impetus continue, though in many areas these factors were not that different from other cultures.

By the end of the twelfth century Europe had come a long way since the fall of Rome. And of all the changes in Western Europe, from castles and cathedrals[32], to waterwheels and universities, the most impressive lay in the realm of commerce. This led to ever more pack trains and wagons being on the road, not to mention ships. *"Behind commerce, industry flourished, an industry that still fashioned articles one by one, by hand, but an industry vigorous, growing and with potential for the future"* (Gies, 1995).

Though still a long way to go before reaching the levels of trade of China, India or Ottoman Turkey, the rest – as they say – is history. While Europe in the 1500s still was behind in trade, it had already surpassed oher cultures in most technological areas, not to mention science.[33]

3 Concluding postscript: How to facilitate an innovative company culture

It is important to understand the extent to which cultures find innovation something that should be done at all. In Europe it has long been an underlying assumption that innovation is crucial and for the common good. What now, in the early days of the Third Millennium? Do we still believe in progress and innovation? Do we feel with Aristotle that we have progressed so far that we do not need to focus much on technological inventions? Or to put it in modern business terms: Is it all a marketing game, or do we also need to focus on developing new products and services?

Based on this study of the factors involved, it is hard not to conclude that innovation – in spite of having taken on a kind of "automatic performance" in today's world, as symbolized in Moore's law – also is about belief, in a non-trivial sense. In order to innovate we need to believe in the possibility of real progress and the value of introducing new and different technologies, processes and products. To stimulate modern companies to continue innovating, it is important to reflect on the possible parallels to how we organize and think about our business. Even if we should be conscious that the factors involved are more complex than the following table indicates, it may hopefully lead to some thinking on the possible applicability of historical ideas and institutions for present businesses.

Why such a circumstantial story in order to arrive at something many in today's world would think is rather "obvious"? One reason is that innovation is not obvious. It tends to go against the grain of "practical" or "pragmatic" people. Studies of finance and bookkeeping rarely or never give attention to it. There is a tendency to focus far more on business organisation and economics, than on how to invent and bring a new product successfully into the market. It may be more tempting to milk the market than to create something new. It is easier to measure cost cutting than long term innovation. There is less risk in reducing fixed costs than in maintaining or incerasing investments. And there is a tendency to view these things as mutually exclusive.

For this reason it is mandatory to understand how much innovation is about a culture of creativity. Especially in a post-modern world which does not put much stock in History, it is important to realize which factors that have contributed to the technological revolutions so many enjoy so much. If not, we may end up like some non-western cultures began to feel in the 1500s.

Basically about beliefs

In order to translate this to a business world, to a modern company it is important to develop a supportive culture of "proactive optimism". You have to *believe* that you can improve your future, and that learning and changes are intrinsically desirable. You have to *believe* in the value of research and product development, also within existing business units. As we have seen, not all cultures automatically assume that innovation and improvement turn out well, even if the difference between Eastern and Western practical economics may be exaggerated[34].

Some historical ideas facilitating innovation	Possible parallel/applicability for companies
Linear view of History – belief in the possibility and value of progress, as well as the value of the past	• Creating a sustaining vision and long term goals for innovation • Be careful not always to let "monthly measures" be more important than building for future growth in a business or industry – this may have the same effect as a cyclic view of history • Having systematic ways of stimulating creativity and positive change
Belief in an ordered world	• Maintaining and "preaching" consistent processes and non arbitrary ways of viewing value creation • Keeping a clear view of which principles create innovations and increased productivity
Faith in reason and in the kind of scientific and scholarly knowledge that can come from reason alone	• Ensuring that formal decisions are made on the basis of systematic analysis, knowledge and reasonable criteria
Belief in the intrinsic importance and worth of life on this earth (also)	• Ensuring an environment and management philosophy that provide valuable feedback and recognition of individual work
Acceptance of the worth of economic and technological growth	• Practical recognition, e.g. through funding and yearly budgets, of the importance of innovation and new market successes

Some historical institutions facilitating innovation	Possible parallel/applicability for companies
Laws ensuring common practice	• Common processes for innovation and product development • Common types of measurements to better compare business units
International religious institutions ensuring a transnational vision and a longer view	• Cross company HR focusing on corporate culture to ensure a common vision • Benchmarking of practices, also internationally
Guilds facilitating artisan competency	• Frequent training programs and recognition of (e.g. technological) competencies
Local independence creating diversity and dynamism	• Relatively autonomous business units
Monasteries with a high view of work as a duty and a ministry	• Co-localised project teams with common vision and team spirit
Institutionalized holidays and celebrations	• Kick offs and milestone celebrations
Beatification and canonization – recognizing saints	• Focusing on best practice and innovation heroes
Long term capital accumulation	• Besides obvious economical applications, this also goes for intellectual capital. The creation of a learning organization requires both the recruiting of the best and brightest and keeping a strong view on accumulated learning. Letting newcomers or consultants always "know better", may lead to unhelpful breaks with good practice, while letting tradition always win may lead to unhelpful complacency and rigid conservatism

There has to be a feeling that all stakeholders in a company matter, not just the owners or stockholders. A number of research projects suggest that really great companies that have survived for a long time have never taken the position that the only people who count are the owners or stockholders. Successful companies take the position that they should be just as concerned about customers, employees, suppliers, and the surrounding community. Somehow, the needs of all stakeholders must be integrated, or the company will become too biased in one direction (Jonash & Sommerlatte, 1999).

An innovative organization must fundamentally believe in people and the possibility of progress. Innovation comes from the individual creativity of people, however much research and opportunities in terms of time and resources to work on the ideas also are needed. This is about avoiding a totalitarian regime, a heavily top-down managed company that punishes individual creativity or encourages unproductive camp followers.

This also shows the need for trusting relationships. That will facilitate innovation as creative thinking

and new ideas are produced by interaction between people. If one is in a competitive relationship with one's fellow professionals, it's hard not to undermine each other's ideas instead of building on them.

The real learning of how to do something better comes not just from formal education, but also from sharing know-how with colleagues working in similar areas. Competency networking and sharing of experience is of great importance in order to stimulate new thinking.

It is also important for companies deliberately to create diversity. This is not only at the individual competence level, but also at the sub cultural level. An organization whose units have developed different sets of norms and skills, is able to draw talent from these units to build the required cultures in order to meet new challenges.

And through it all one needs to see innovation in a global context. Globalization is nothing new. Diffusion of technology has not stopped, whether going from the East to the West or vice versa. Large scale innovation cannot take place without considering the world market.

What we have attempted here is not to set up some kind of smug Western superiority[35)], or to make an excuse for Western exploitation of other cultures. Instead an overview like this should lead us to a sense of humility and awe at what humans have achieved throughout history, given certain conditions and cultural traits. As these conditions and traits continue to change, it is important to keep in mind factors facilitating innovation, both on a cultural, global and business-oriented level. At the same time as we look for ways to improve how technology and productivity may be used to help people everywhere to get a better future, including a healthy environment.

Fridy as well as Sunday

What we experience is also that modern technology may liberate us from the "Friday-oriented" culture of "Weber's Protestantism" and enter a more "Sunday-oriented" culture of leisure and joy. Not by behaving like every day is a Sunday, but by striving to continue to set up a society and an industry where we may have both a sustaining growth and a sensible balance between the industrious and relaxation. To some, work has always been more than a calling, it has also been a joy in itself. Companies that create a culture of – and a deeply held belief in – creativity, innovation and progress will have a better chance of survival and a sustaining income, than those merely focusing on survival and profit.

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Notes

1) *A more thorough analysis of long waves theories of development is found in e.g. Schumpeter and Freeman, see Buland, 1996, pages 32–37.*

2) *William Baumol ("The Free-market Innovation Machine: Analyzing the Growth Miracle of Capitalism", Princeton University Press, 2002) rejects the view that the way capitalism benefits society mainly is through price competition. He sees instead an "arms race", and inter-firm collaboration, where no firm in an innovating industry dares to fall behind the others in new products and processes. Baumol stresses that large companies use innovation as a prime competitive weapon. However, firms do not want to risk too much as innovation is costly, and can be made obsolete. So firms split the difference through the sale of technology licenses and participation in technology-sharing that pay huge dividends to the economy as a whole – and thereby make innovation a routine feature of economic life. Baumol views this process as the reason behind the unparalleled growth of modern capitalist economies.*

3) *E.g. most people still think that scholars in Medieval Europe believed the earth was flat, that dissections were illegal until the 16th century and that scientists were systematically persecuted. This is sometimes even said in basic school texts and popular magazines on Science and History, not to mention under-researched potboilers such as Dan Brown's "Angels and Demons" and "The Da Vinci Code". In Norway even a magazine on History – "Levende historie" – recently published an article by the novelist Kjartan Fløgstad, explaining that Magellan's (1470–1519) circumnavigation of the globe proved that the earth was not flat.*

4) *Especially Ibn Sina (Avicienna, 980–1037) and Ibn Rushd (Averroes, 1126–1198). Averroe was considered controversial in Islamic Spain, however he had a great impact on Western-European thought. In Islamic lands, where orthodoxy and al-Ghazali's intuitive and mystical sense of the Divine was influential, Averroes' rationalism did have less of a following than in Europe. Muslim scholars reached great heights in Medicine, Astronomy and Optics, however science was never institutionalized as in Europe. Natural science was always considered as the "Foreign Sciences" in the Islamic world.*

5) *Abelard's influence in the thirteenth century was great, mainly through his pupil Peter Lombard. Even if it is an exaggeration to represent Abelard as* "the first modern"*, the founder of the University of Paris, etc., he was an enlightened continuator of the Carolingian revival of learning and inspired later science and literature.*

6) *While White's "The History of the Warfare between Science and Religion " (1895) is singularly unhelpful, the last decades a growing number of works have left the conflict paradigm. New sources and new research indicate that modern experimental science and physics grew out of an outlook that believed in natural laws (as there was a Lawgiver) and that affirmed the wisdom and virtue of studying nature (as it was a valuable and reasonable creation, not an illusion one should look beyond in order to escape this world). And that one should not decide this by a-priori philosophy, but by experiment (the Creator should not be limited by any philosophy, the only way to discover what God had done in nature was to study it, through observation and experiments). This led to a strong insistence on logical coherence and experimental verification. Even if these were present in a qualitative way among the Greeks, the vital contribution of Medieval Europe was to strengthen and refine them into a more effective union. This included a quantitative precision by using mathematics in formulation of theories, and then verifying them by observation* and *precise measurements. This transition was achieved principally by Robert Grosseteste (1168–1253). An official condemnation in 1277 of philosophical statements that limited the power of God, contributed to the number of natural philosophers that began to look beyond Aristotelian philosophy and paved the way for empirical science, rather than primarily building on philosophical deductions. See e.g. Stark's illuminating development of this (Stark 2003). The Alexandrian theologian and scientist John Philoponus in the 6th century anticipated such later developments. However, the first modern physicist may have been John Buridan, professor at Sorbonne around 1330.*

7) *Another take on this is "Guns, Germs and Steel" by Jared Diamond (1998), using a more direct biological approach. While interesting, and in some areas illuminating, the tendency to look at external forces as (fully) deterministic factors tends too much to downplay differences in mental models between various cultures, or make mental models fully depending on biology and economy. Any historical explanatory model using one type of parameters only, e.g. external factors, suffers from onesidedness. It may be a sign that Diamond realizes this as he towards the end of his book admits that* "These examples illustrate the broad range of questions concerning cultural idiosyncrasies, unrelated to environment and initially of little significance, that might evolve into influential and long-lasting cultural features" *(page 419).*

8) *The high standard of the surviving Roman roads led to land travel being faster in Medieval Europe, than in the 1700s.*

9) *Ideas like reincarnation and the transmigration of souls reflect this view of time.*

10) *In contrast to this, and to popular opinion, in Europe the medieval university provided to all students an education essentially based on science. In fact, for the average student it "laid far greater emphasis on science than its modern counterpart and descendant" (Huff, page 180). Even if Islamic libraries contained books on natural science, and some scholars studied and did important improvements, in Islamic society there was a prohibition against* teaching *the natural sciences. "The upshot was the exclusion of the sciences of the ancients from the curriculum of the schools of higher learning" (Huff, page 151). And it did not lead to a conducive clime for doing science, despite great individual geniuses in Islamic culture.*

11) *One interesting study that challenges preconceived notions is Andre Gunder Frank's "ReOrient: Global Economy in the Asian Age" (1998). Frank considers the world system of trade and indicates that Europe has been rather peripheral, up to the early 1800s, compared to the central role of China and India. However, as he fails, for political reasons one feels, to distinguish between "culture" and "race" (saying that some cultural factors have led to better developments is "racism" to Frank (see page 4), downplays e.g. the impact of technology like the steam engine (page 296), and seems to misunderstand Shapin's views on the Scientific Revolution (page 190), his thesis does not quite convince. Still, in important ways he shows the need for a change away from too Eurocentric studies.*

12) *In Europe this even led to court cases for animals, as e.g. field mice and locusts sometimes were considered to be breaking God's laws and hence subject to prosecution and conviction. This high view of natural law, and the laws of nature, contributed strongly to the rise of modern science. As belief in statistical regularities is a foundation for science today,* "The problem is whether the recognition of such statistical regularities and their mathematical expressions could have been reached by any other road that that which Western science actually traveled. Was perhaps the state of mind in which an egg-laying cock could be prosecuted at law necessary in a culture which could later have the property of producing a Kepler?" *(Needham). Based on a different view of God, Muslim legal scholars never went for universal laws. Instead the Muslim legal schools are about a long series of particularisms. There is no one authoritative version of Islamic law, only competing interpretations of Islamic requirements. (Huff, 2003)*

13) *Paradoxically, this merit-oriented bureaucracy selecting the best and brightest from every generation also seems to have inhibited innovation and capitalism.* "A predominantly mercantile order of society could never arise in Chinese civilization because the basic concept of the mandarinate was opposed not only to the principles of hereditary aristocratic feudalism but also to the value-system of the wealthy merchants. Capital accumulation in Chinese society there could indeed be, but the application of it in permanently productive industrial enterprises was constantly inhibited by the scholar-bureaucrats." *(Needham)*

14) *It is important to distinguish between Church* "Politics" *(which sometimes were rather terrible) and the church as a* cultural *factor, over time providing different mental models and attitudes toward e.g. work, progress and nature than other cultures.*

15) *Dawson, 1929, page 126 and 137.*

16) *In important areas this was different from the Christian view in the Byzantinian culture, which as an unbroken continuation of the Roman Empire was much more aligned to the classical culture.*

17) *It is difficult to distinguish how particular innovations were introduced to Europe, as many inventions of the period had been developed independently in other civilizations. The problem is important as there is a conflict of interpretations about the transmission of technology. To the* diffusionists *all innovations have moved westward from other civilizations. Another school is about* spontaneous innovation *that looks at social need as bringing about technological innovation. Scholarship has so far been unable to solve the problem for the Middle Ages because information is missing. Still, it does seem that at least key inventions like the windmill and gunpowder may have been developed "spontaneously", or at least just from hearing it was possible to make such things.*

18) *White, in "Medieval Technology & Social Change" (1962),* "essentially invented the modern field of medieval technology" *(Paul J. Gans). He showed that technology has had a profound influence on everyday life in the Middle Ages. To understand medieval Europe one needs very much also to understand its technology.* "Another point: the battle over the origins of feudalism has had a rather strange outcome. Rather than settling the issue, the notion of "feudalism" as a single entity widespread in Europe (if not elsewhere as well) has crumbled. Land tenure and military obligation has turned out to be a complex issue varying widely in time and place. So strangely enough, the major casualty in the great stirrup debate has turned out to be feudalism". *See Paul J. Gans' site: http://scholar.chem.nyu.edu/tekpages/texts/strpcont.html*

19) *White goes on to say that* "By the end of the 15th century the technological superiority of Europe was such that its small, mutually hostile nations could spill out over all the rest of the world, conquering, looting, and colonizing". *Whether one agrees that this is a valid perspective of Modern History from the Renaissance or not, there is no doubt that White and others have shown conclusively that something special happened in Western Europe, prior to the colonization period – and even making that possible, whether one is talking about Europeans in the Americas (from roughly 1500), India (from roughly 1750s) or China (from the mid 1800s).*

20) *The great Chinese naval expeditions of Zheng He (1371–1433) to the Indian Ocean, going at least as far as the east coast of Africa, came to a halt through political intervention, in the same period as Portugal and Spain entered the age of discovery.*

21) *The area of the printing press is a significant sign of differences between cultures and politics. Because of fear for what would happen if the common man gained access to printed materials, the Muslims (the Ottoman Sultan Bayezid II) banned the printing press within three decades of the first printed book in Europe, in 1485. This was repeated and enforced by Selim I in 1515. Printing was not allowed again in the Muslim world until the nineteenth century (Huff, page 231–32). Neither did the Chinese allow free use of the printing press, and the appearance of the movable types in China did not lead to any cultural renaissance or burst of innovations (Huff, page 342). In the 19th century the printing press even had to be reintroduced in China from European models.*

22) *The relatively autonomous towns increased the cultural dynamism as its commerce and guilds provided space for different thought patterns, and other applications, than the more political mindsets of those in power.*

23) *One is Noble (1997) who provides a good overview of religious motivations for scientific and technological progress in the West the last two thousand years and shows that especially inspiring to these scholars and inventors have been apocalyptic expectations and the impulse to recreate the original relationship between God and man in Eden. However, his argumentation is rather weak when he insists that religion is inciting dangerous developments in modern fields like genetics and artificial intelligence. See also Wilkinson (1991). That White's indictment of Christianity as the root of exploitation of the earth has been recognized as oversimplified for some time, is evident also in Theodore Roszak's analysis of how diametrical opposite attitudes like the semi-heroic "unyielding despair" of the logical positivists (e.g. Freud and Russel) in the face of a meaningless universe easily may have become a basis for ecological destruction (Roszak, 1992).*

24) *There are records of many forest conservation initiatives in the Middle Ages, e.g. the enclosures established by the Cistercians in 1281 to protect seedlings. Shortly after, an Italian commune mandated tree planting (Giles and Giles, 1994, page 290–91).*

25) *The twelfth-century William of Malmesbury recorded an event around AD 1000 about a monk of Wiltshire Abbey:* "Eilmer ... was a man learned for those times ..., and in his youth had hazarded a deed of remarkable boldness. He had by some means, I scarcely know what, fastened wings to his hands and feet so that, mistaking fable for truth, he might fly like Daedalus, and, collecting the breeze on the summit of a tower, he flew for more than the distance of a furlong [about 200 meters]. But, agitated by the violence of the wind and the swirling of air, as well as by awareness of his rashness, he fell, broke his legs, and was lame ever after. He himself used to say that the cause of his failure was forgetting to put a tail on the back part". *There are even accounts that indicate that a successful glider flight was made AD 875 by the Moorish Ibn Firnas, in Cordoba. Both these inventions occurred in intellectual environments that fostered invention. Ibn Firnas lived in the Golden Age of Islamic science, and Eilmer belonged to the Benedictine order, which saw God Himself as a master craftsman. See White, L., Jr., "Eilmer of Malmesbury, An Eleventh Century Aviator" in* Medieval Religion and Technology. *Los Angeles: University of California Press, 1978, Chapter 4.*

26) *Monasticism is virtually absent in Islam. There are ascetics and groups of devotees, but they do not form property-owning corporations, and religious groups lack autonomy. There is no parallel to the dynamic role of the monasteries of Europe, in amassing wealth and power for an autonomous church sector and in providing a base for intellectual networks (Collins, 2000, page 459–60).* "With an effort of the imagination, one can guess what the institutions of Modernity might have been like if it had developed, for instance, in Islamic society ... The nation-state, with its constitutionalism, its particularist characters of rights and responsibilities, stems from the corporate conceptions of Medieval Western society. From the very different legal conceptions of Medieval Islamic society, with their abstract egalitarian universalism, there might well have developed, instead of the nation-state, some international corps of super-ulama, regulating an industrial society on the basis of some super-sharia code" *(Hodgson, 1993).*

27) *Huff, page 179.*

28) *In Venice there were even an early assembly line for the equipping of war galleys, as observed by a Spanish visitor in 1436 (Giles and Giles, 1994, page 271).*

29) *Japan was the world's leading sword producer in the 16th century. By 1600 there were probably more guns in Japan than in the rest of the world. However, a strong political reaction followed as firearms discounted individual bravery and eroded the status of the warrior class. Hence the production of firearm was centralized, smiths given honors and salary whether guns were produced or not, and orders for guns were systematically scaled down.*

30) *Perhaps the most plainly deterministic of all economical studies is Parker (2000). Based on theories by Montesquieu and others, he puts forward statistical indicators to show that income, investment, technology, production etc. are strongly influenced by physiology, particularly on the hypothalamus. To Parker, long-run growth depends on variances in*

hypothalmic activity, related to geography. A country's latitude (distance from Equator) explains up to 70 % of cross-country variances in per capita income, according to Parker. It is noteworthy to see how different he is from other rather deterministic oriented works like Diamond or Frank. If the factors explaining innovation basically are deterministic or at least external to cultures, it is a long way to go before there is agreement on which they are.

31) *There are notable studies in this area by e.g. Collins (2000), Wallerstein (1974) and Pommerantz (2001). However, some start their analysis too late in history, and all seem to underestimate effects of differences in worldview (though Collins provides valuable information on e.g. the effects of the Cistercians).*

32) *Since the Romanesque (c 800–1100) period, the stylistic period before the Gothic (c 1150–1400), a number of devices were rediscovered that again allowed buildings to be constructed on a grand scale. The Romans had borrowed from the Egyptians, Greeks, and the Babylonians and used, for larger projects, semicircular arches and thick walls. However, new methods were discovered that allowed buildings to be of a large size without great thickness of walls. Semicircular arches could not bear the weight that medieval architects placed on them, so the ceilings were vaulted, which allowed them gracefully to descend into thinner columns. This entire system was possible only through the use of pointed arches, which were able to bear the weight of tons of stone. The flying buttresses that on the outside walls of the cathedral also helped to guide the pressure of the weight from the roof to ground. In the cathedrals, three main innovations of the revolutionary Gothic style come together; pointed arches, ribbed vaults, and flying buttresses. In addition, these cathedrals were designed with enormous stained glass windows that flooded the cathedral with light. It is difficult not to see that some of this had to do more with an adventurous spirit, than with any pure utilitarian or economic side. Looking at France only, in the period from 1100–1400, the total volume of stones cut out, transported and used for cathedral construction was more than all the stone used for every temple and pyramid in Egypt (Dahl, 1982).*

33) *It seems to be a common impression that the reason why some cultures have had difficulties developing a sustainable science and high tech sector, not to mention human rights, is that they have not yet lived through "the Enlightenment" in the way Western Europe did in the 18th century. Our study indicates that there may be a deeper reason – the lack of a Medieval legacy. The many important developments in institutions, universities, autonomous bodies, and legal thought in Medieval Europe set up a basis for sustainable science and a productive use of innovations. The whole world view and mental model made a difference. The European development from the late 1400s was not a break with the past, rather it was in many ways a logical continuation.*

The reception of the printing press is a telling example of the different attitudes. In Europe it was used to print and spread mass literature from the time of Gutenberg in the 1450s. In China it was mainly used for official documents. In the Islamic World it was suppressed until the 19th century. By 1480 in Europe, there were printing presses in 110 towns. In 1499 there were 250. Ten million books were in print by 1500. The first cheap mass-market books were printed by Aldus Manutius of Venice (d. 1515). This led to a vast increase in literacy, as well as a rapid dissemination of ideas and knowledge. The Enlightenment seems to have been more an effect of the European tradition than a cause of it.

34) *Not the least as traders and rulers rarely adhere to the most traditional forms of their religions, and tend to bend the tradition in their favor. Today there is little difference in innovative drive between industrial societies.*

35) *One example of the opposite reaction is Teresi (2002) who goes almost out of his way to show how science and technology in the West really is just a copy from other cultures, without analyzing the different dynamism in Europe, nor understanding e.g. the mathematics of Copernicus. See also the review by Levitt.*

For a presentation of the author, turn to page 2.

Creating a creative company

TY FRANCIS

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Creativity provides the spark of enterprise and is the engine of innovation. In a knowledge economy, there is a direct co-relation between developing the creative potential of a business and the development of financial wealth. In addition, creativity is at the heart of intellectual and social capital processes. In exploring how to harness these various dimensions of wealth, this article focuses on the related elements of creative leadership, creative strategy and creative culture as key determinants. The critical point is that creativity is a natural process to be unfolded and enabled rather than a mechanistic skill to be over-engineered and controlled. The secret of developing a creative company lies in supporting the strength of great ideas by getting things out of their way en route to market, rather than putting elaborate processes in place.

Creativity can be disastrous for business. This was the rather astonishing conclusion that Theodore Levitt arrived at in an article he wrote in 1963 for the Harvard Business Review. His belief was based on the idea that creative people are little more than whacky thinkers and theoreticians who lack the practical insight to run companies, and may lead organisations into flowery talk and nonsense instead of fruitful action.

Thankfully the Harvard Business Review – and leaders of commercial and public sector organisations alike – have come a long way since then. Writing in the HBR about 'The Weird Rules of Creativity' as recently as 2001, Robert Sutton acknowledged that "what does foster creativity doesn't look at all like rational management to most experienced executives" but that creativity – the ability to bring forth brilliant ideas – is essential to help move businesses forwards into the future. In addition, the entrepreneur John Kao has turned Levitt's dictum on its head by stating that "The traditional managerial mindset is analytical. In a creativity-driven environment, a traditional managerial mindset could do damage."

Kao's comments show the extent to which times have changed. Other writers such as Seth Godin have pointed out that now, the idea is father to the factory. Twenty years ago the top 100 companies in the Fortune 500 either dug something out of the ground or turned a natural resource into something you could hold. Today less than half of the Fortune 500 top companies do this. The leaders make profits by trafficking in ideas. Yahoo's market capitalisation, for instance, is 99 % due to creating a brand, a sizzle, a certain quality of leadership based on creativity and other 'soft' attributes.

Creativity is a natural part of the DNA of every business. It takes organisations 'beyond the box', helps them step outside their normal boundaries to reach for some magic. The trouble is that creativity is so cryptically encoded into the brand, the strategy, the business model and the culture that most companies do not know how to manifest their latent creative potential. They try to control and over-engineer it, rather than to construct the conditions for creativity to manifest and express itself more naturally.

There are three common mistakes companies make when engaging with their creative potential. The first is to turn their attention to creativity when they are stuck. When analysis doesn't work, and a problem still needs solving, creativity is seen as a last resort. But the power of creativity is not in putting energy into what you *don't* want (like a problem) but into what you *do* want (like a more vibrant future).

Secondly, many businesses focus on collecting and deploying a creative toolkit (doing something) rather than on becoming innately more creative (being something). While tools and techniques undoubtedly help with incremental and short-term issues, they don't usually support deeper transformational shifts that can help move markets. Most corporations also have a very impoverished understanding of creative tools, that rarely goes further than 'head-crunching' approaches such as brainstorming and scenario planning or lateral thinking exercises such as 'What If' or Mind-Mapping. The consultant and journalist Anneke Ellwes suggests that the most creative companies see themselves as agents of change rather than as hoarders and purveyors of creative tools and techniques.

Finally, creativity is often seen as a good thing in its own right, rather than as an intrinsic part of a process that can produce organisational health and wealth. For example, just as you need a spark, fuel and oxygen to make a fire, so you need to combine creativity with innovation and enterprise to get a dynamic and viable

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business. By itself, creativity does not deliver unless it is linked to customer need, related to competitor positioning, part of an organisational learning curve, strategically aligned, connected to the business model and in service of the business purpose and vision.

There is no blueprint for creating creative companies. They come in all shapes and sizes, across public and commercial sectors internationally. While there are lessons to learn from companies in traditionally creative industries such as advertising, fashion, television and new media, creativity also thrives in retail, pharmaceutical, engineering and financial companies ...

Whether you are interested in designing a creative company from scratch, or in unleashing the creativity from an existing corporation, the basic principles remain the same. You need to focus on the critical dimensions of creative leadership, creative strategy and creative culture ...

Creative leadership

Creative companies have creative leaders. Yet it is surprising how seldom this is recognised as being important. There are few training programmes about 'creative leadership' on offer, for example, despite the acknowledged importance of creativity at all levels of a business. What are the hallmarks of a creative leader?

Creative leaders act with a strong sense of purpose that can win hearts and minds as well as pockets, motivate people inside and outside the organisation, and inspire innovation. This purpose is usually a purpose beyond profit – adding an extra percent to the share price is important in a competitive market but it rarely gets staff out of bed in the morning, nor by itself does it automatically excite investors as it once did. We are working in a time when intangible assets such as corporate values and activities such as social enterprise win customers and loyalty and therefore add to the bottom line as tangibly as trading figures.

In this sense, a clear and compelling corporate purpose is much more important than vision or strategy. A strategy without a vision is like re-arranging the deck-chairs on the Titanic, while a vision without a clear and compelling purpose (beyond profit) is empty. Creative leaders stand for a purpose that is bigger than profit, bigger than ensuring total shareholder return. They understand that the brand can be a gateway to higher experiences – what Disney calls 'transformational experiences' that are not only enjoyable but that help customers and staff change themselves for the better. According to a recent report by The Future Foundation, companies that add value to people's personal development will reign supreme. This is backed up by research undertaken by Interbrand, one of the world's leading brand specialists. Based on evidence from over 2,500 brand studies around the world, Rita Clifton of Interbrand believes that the greatest brand characteristic of the future will be based on the quality of leadership – and that leaders that create relationships and new experiences will also create futures.

Creative leaders also know how to inspire people. They don't offer answers but provide support for exploration instead. They offer insights, not solutions. They create focus not control. For example, most organisations are tight on strategy, loose on vision. Creative leaders unlock the potential of the organisation by being tight on purpose and vision, loose on strategy.

They also know how to develop key innovation competencies in people, like non-linear thinking, emotional intelligence, risk-taking, playfulness, relationship building, influencing group dynamics, constructive questioning, working with uncertainty and creative tension… In this way creative leaders are innovation activists. They don't worry about getting buy-in as much as on forming relationships.

Writing about Leadership Without Easy Answers, the Harvard University professor Ronald Heifetz, believes that creative leaders also know how to generate heat and how to take heat. They have to develop the capacity to surface, orchestrate and stomach uncertainty, even conflict, in themselves and among their teams. They challenge taken-for-granted views that dominate their own and their organisation's thinking. People rarely thank them for this – exercising any kind of leadership generates resistance of course, but creative leaders improvise with greater confidence and understand that persistence with passion breaks down barriers. They get on and get results. This quality of collaborative improvisation is exactly what John Kao calls 'jamming' – for him, the critical element of creative leadership.

Creative strategy

In conventional approaches to strategy development, creativity is 'front loaded' into the initial generation of ideas and possibilities which are then subjected to a series of analyses. It is as though ideas are sieved through a strategic funnel which eliminates possibilities by considering the amount of commercial risk, financial viability, competitor activity, brand conformity and other parameters. Those ideas which survive often have their creativity compromised.

The strategic sieve

It isn't that companies should avoid rigorous evaluation of ideas. It's just that by itself, this 'strategic sieve' promotes a mindset that can kill creativity. Another approach is to consider a 'strategic spiral'.

The strategic spiral

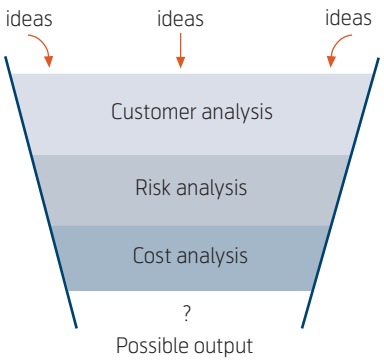
This approach is based on the principle of guided emergence rather than mechanical reductionism. It uses the question 'why shouldn't we?' rather than 'why should we?' and has multiple points of entry for people to engage with rather than being top-down. Crucially, creativity is possible at every point of the spiral rather than being considered only at the beginning. With the strategic sieve, the quality of the idea is vital to success whereas with the strategic spiral, the quality of energy that gathers progressively around an idea is vital to success.

In creating a creative company, the point is that organisations need to hold critical conversations about the nature of their strategic planning. The established, top-down models are not enough any more, for a number of reasons: a problem-solving mindset prevails (rather than a 'create the future' mindset); stakeholder involvement is narrow and controlling (instead of inclusive and engaging and energising); communication is one-way (tell-and-sell instead of consult-and-co-create) and planning and implementation are sequential and laborious (instead of simultaneous and direct). The choice is between merely predicting the future from the drift of trends, based on yesterday's data, or crafting it in line with tomorrow's vision.

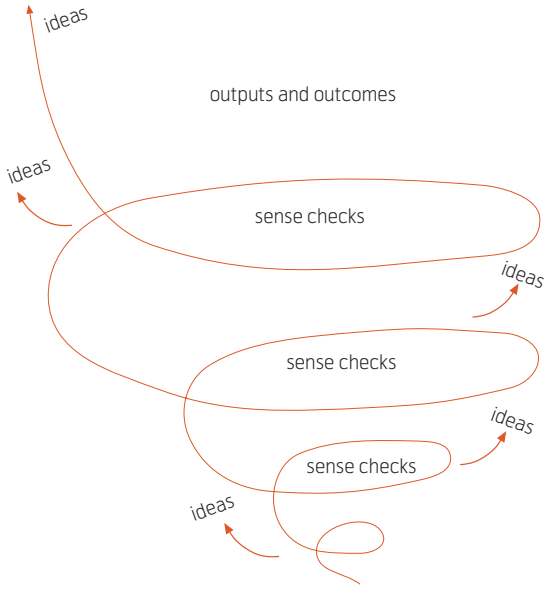
More and more companies such as Nokia, Shell, Unilever, Virgin and others are turning to these very different ways of developing strategy. More dialogic processes such as Future Search, Open Space Technology and Real-Time Strategic Change help companies capture, harness and craft creative ideas from a range of stakeholders inside and outside the business. These processes work, because as strategy specialists Bunker and Alban state, 'people support what they help to create.'

Creative culture

Companies like Sony and Disney that are serious about creativity make it a corporate discipline. They don't treat it like a flash-in-the-pan one-off nor send executives on a weekend's training programme. It is something that they pay continuous attention to and stimulate in different ways.



The strategic sieve



The strategic spiral

For example Coca-Cola does not outsource its creativity by hiring a big advertising agency. Instead, it has built a network that includes the Creative Artists Agency in Hollywood, which is a talent agency. Such partners help the company to assemble talent teams who can work with in-house staff quickly and easily on a global basis. Such partners help build a culture of creativity that is infectious yet very practical and flexible. Innovation can happen in the space between teams with complementary disciplines, skills and abilities.

Creative businesses have cultures that support innovation at a number of different levels. Generally speaking, innovation can be described as anything that is beyond the current capability of the business to deliver. In practice, however, there are four kinds of innovation, as shown in Table 1.

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Product Innovation	Generates new goods, services or technologies	Changes the sales mix
Strategy Innovation	Generates new approaches or business models	Changes the company
Business Concept Innovation	Generates new ways of doing business	Changes the market
Cultural Innovation	Generates sustainable ways of doing everything differently	Changes the rules of the game

Table 1 Four kinds of innovation

Infusing creativity into the culture of the business ensures benefits at all levels as it helps organisations continually reinvent themselves and change markets, companies and consumables. Yet few companies manage this, and when they do it is often a one-off exception. They find it difficult to develop innovation-friendly cultures. Nokia is an exception – it has transformed itself spectacularly several times, even from a manufacturer of rubber 'wellington' boots into a global communications company. Virgin is another example of a company with a creative culture. Despite occasional criticism for a lack of brand focus, Virgin's creative drive has enabled it to enter and dominate an amazing array of markets.

Developing an innovation-friendly culture depends on encouraging people to examine orthodoxies and 'sacred cows', and on finding ways to reward play and experimentation. This is particularly true in change management approaches. Smart organisations these days are using 'whole systems' approaches to change, where the emphasis is on consulting/communicating across multi-disciplinary teams throughout the many levels of the corporate hierarchy. Infinitely preferable to the old-style 'command and control' approach, whole systems approaches can improve speed, communications, commitment and ownership within an organisation. By themselves, however, these sorts of whole systems approaches may not go far enough in supporting and sustaining profound innovation because they may not look outside the organisation. Too often, whole systems approaches to change treat the organisation as a closed system.

The more organic open systems approaches introduce greater diversity – an essential ingredient for creativity – and draw directly on the complex web of relationships that exist between the people inside the organisation, as well as the different communities of interest outside – suppliers, strategic partners, shareholders, customers, competitors, as well as organisations in other sectors and groups in the world at large. The result is a more inspiring, radical, flexible, tailored innovation curve, where personal, organisational and social change happens with less effort, where people are more aligned and where the development of products and services flows more naturally. Open systems approaches treat organisations as organic rather than mechanical, and achieve results because they re-energise, rather than re-engineer things.

Building creative capital

In summary, these elements enable you to build the creative capital of your business, not just the intellectual capital. Developing *creative capital* does not mean acquiring new creativity tools, however helpful these may be in limited ways. Creativity and innovation are not just about techniques, but about deepening self-knowledge (harnessing personal and corporate identity, cultivating personal and corporate uniqueness), working with group dynamics (trusting other people as well as what emerges between people), welcoming novel experiences (which create novel insights) and exploring creative processes with openness.

Cultivating creative capital has to do with stimulating a deeper organisational change process, one that is both driven and determined by the innovation imperative. Too many companies tell people to innovate rather than inspire them to innovate. Too many companies move away from what they don't want – problem solve, rather than move towards what they do want – creating a purposeful future. Too many companies nudge forward what they know rather than take creative leaps into the unknown.

We are not just talking about helping companies develop creative processes, but how we can use creativity to help companies develop.

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Section 2 –
Leading innovation in the telecommunication industry

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The informed reader is of course aware that the Telecommunication Industry is innovative. But "why, how and where"?

First, let's try a few tentative but working definitions:

Invention
A unique idea with potential for value creation.

Innovation
Utilizing any idea successfully in practice, creating value.

Telecommunication
The branch of electrical engineering concerned with the technology of electronic communication at a distance.

Leading Innovation in the Telecommunication Industry thus require discipline to succeed. Most Telecom operators are in one or several of the following businesses:

- Mobile
  - Voice
  - SMS/MMS
  - Data
  - Internet
  - Payment services
- Wireless
  - Broadband IP Hotspots
  - Radio link systems
  - Military systems
- Fixed line
  - Voice
  - ISDN
  - Mail services
  - xDSL
  - IP telephony
- Network services
  - Interconnect
  - Build Operate Transfer services
  - Leased lines
- Business Services
  - Computing services, delivery & hosting
  - Exchange
  - Trunk
  - Security
  - Payment services
- General services
  - Directory services
  - Conference call
  - Entertainment
- Virtual operators
  - Line capacity
  - Payment services
  - SMS
- Terrestrial Broadcast
  - TV
  - Radio
- Satellite
  - TV
  - Radio
  - Data
  - Meteorology
- Financial
  - Portfolio investments
  - Strategic investments
  - Joint ventures
  - Property holdings

Strategies relating to staying in the Telecommunication Industry vary. But although most businesses stay within the defined scope, some do stray into services enabled by telecommunications, such as entertainment. This is perhaps OK for providers of Telecommunication technology. But for Telecom Operators it is not very innovative. And the list above is clearly supply-based and focuses on technology, not market.

A market orientation would lead "Communication Operators" to help people or businesses communicate, and thereby also offer forums for human relationships or perhaps advertising and marketing services for business.

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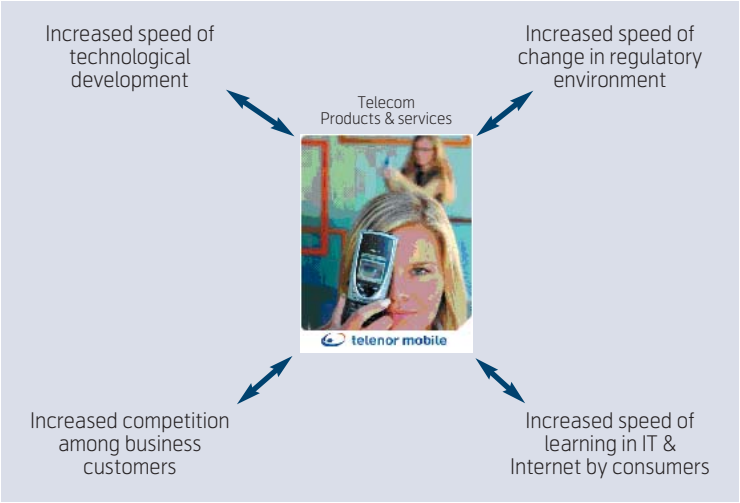

In order to lead, a firm must be excellent at matching technology, services, delivery processes and sales & marketing towards serving market needs in new ways. Such is the stuff of which innovations are made.

The increased speeds of technological development, of change in regulatory environment, of learning in IT & Internet by consumers, and competition among business customers, demand a continuous stream of new products and services. Innovation is about creating value in practice for customers, utilizing any idea that successfully contributes to this goal. There is no technological component inherent in innovation, and although uniqueness in products is helpful, it is not necessarily required in services. Still, even if it at times may be very much a "marketing game", innovation is a key factor in staying abreast of competitors in utilising new technologies and trends.

As the articles in this section show, implementing a best-in-class innovation process is just one part of the game. In order really to meet customer expectations one also needs to have e.g. a culture that facilitates innovation, a strategic technology management that understands the issues involved as well as practical tools to evaluate future options.

The customer is king, and a strong customer focus is thus mandatory in a competitive market. Knowing what has value for the customer is a crucial competitive differentiator. Telecom operators likewise have to create good business intelligence systems to discover and understand new technologies and organizational forms as well as to motivate leadership and incentive systems. Whoever can better and quicker implement internal processes to take advantage of such knowledge towards providing value to the customer will be able to attract required capital to succeed in the game.

And the Telecommunication Industry consequently needs only follow the best operators, if they are able to determine who they are, in time ...

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From R&D to strategic technology management – Evolution and perspectives

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The paper sketches the evolution of the R&D concept from the contingency theory until the beginning of the nineties. The change of paradigms in R&D Management is then discussed through the findings of a research project run in 1996/97 on "Innovation and R&D Management: are new paradigms observable?". Lastly, the emergence of a new perspective, the one of strategic technology and innovation management, is illustrated both from a theoretical point of view and using the results of a specific survey run in 1998/99 on "Strategic Technology Management and evaluation systems: a comparison between the experiences of German and Italian companies".

1 R&D Management: from quiet to turbulent environment

1.1 The task environment of R&D

To have a brief historical outlook at the evolution of R&D, it may be worthwhile to recall a few essential features of the *organizational contingency theory*. I will do this using the statements of the two well known fathers of this theoretical approach: Lawrence and Lorsh.

Their classical work "Organization and Environment" [1], based on a field research (ten Companies of three different industrial sectors: plastics, containers and food), was aimed at identifying reasons of and tools for the efficiency.

The starting hypothesis of L&L was that different environments produced different organizational configurations.

According to their findings, this was true first of all for Companies as a whole: different organizational forms were observed in the three sectors studied.

But it was also true for the differences among departments in the same Company: each department had its own specific environment (the so-called task environment). This task environment implied an internal (to the Company) differentiation process, whose counter balance should be ensured by an integration process.

The most efficient Companies were those who succeeded

- in achieving the higher degree of adaptation of each department to its specific environment, by decentralizing the decision making process closest to the point where the environment knowledge was highest (differentiation)
- in solving, simultaneously, the problems that arose from this differentiation setting specific mechanisms and tools to coordinate the activities of different departments and decision makers (integration).

The findings of the L&L research were certainly applicable to the R&D department (as a matter of fact it was specifically quoted as an example of different organizational orientations due to "task environment").

1.2 The organization of R&D

L&L wrote their book in 1967: how was the Companies' environment at that time in the industrialized world? And how did it affect the Companies' organization and, more specifically, R&D?

In the second half of the 1960s the external environment of Companies was still characterized by a high degree of economic, social and technical stability.

Substantially controlled by a few oligopolistic Companies, markets experienced even relevant changes, but they were still predictable and their pace of change was (relatively) slow.

Borrowing the concepts used by Emery and Trist [2] the environment reacted to a moderate turbulence.

On the organizational side, to answer to the second question, the prevailing macrostructural model was the *divisional one*. In this model multiproduct Companies grouped their activities around product lines, considering specific organizational requirements of different technologies and/or markets. It introduced some forms of differentiation, but was still compatible with stability and predictability.

In this quiet environment R&D departments were normally considered a special part of the Company, a sort of Heaven. There, specialized scientists and engineers were almost totally involved in research

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and studies with none or small correlations with the current activities of the Company. They had a very high degree of autonomy and, according to the dominant concept of innovation, they were essentially focused on developing the so-called "big one", a major breakthrough that would have completely changed the current capabilities, creating an entirely new kind of products and/or processes.

Jay Galbraith could say, referring to the R&D organization model implied by this situation, that in a Company, there should be clear boundaries between routine and innovative units (R&D departments), and that the latter should be kept physically, financially and organizationally apart from the former [3].

1.3 The changes of the seventies

In the following decade three main factors determined a turnaround in the described Companies' framework: the changes in the relationships among people, strongly fostered by social movements that were active in the environment, the big oil crisis and the increasing application of microelectronic and informatics to manufacturing and management tasks.

The change processes determined by these factors were characterized by pervasiveness, continuity and impredictability; they rapidly modified the previous situation in which Companies lived. The new environment was highly segmented, with many groups of social actors strongly interacting, new rules of competition and a pace of change never experienced before. Consequentely innovation, once considered an issue specifically pertaining to Companies strictly focused on searching for excellence and technological leadership, became a strategic factor for all industrial and service Companies, even if committed to policies of mere consolidation of market share, or survival. At the same time the very concept of innovation changed: from the focus on radical product innovation (by definition punctual and discontinuous), to the phase of relevant process innovation, to the emergence of an innovation concept based on interactive connection among products, manufacturing and organizational processes, largely incremental and continuous.

How has (this kind of) innovation changed R&D organization?

2 The paradigm shift

2.1 Characteristics and mission

A lot has been written during the eighties and nineties to describe the change process that affected the R&D department. Two essential issues were involved in this debate: organization and management on the one hand and focus and contents of this activity on the other.

As far as the first issue goes, a few points were illustrated by Steele [4]. If compared with the previous situation, this author says, new elements characterize the R&D at the beginning of the nineties:

- R&D configurations are strongly dependent on Company structures, sectors and technology;
- R&D is only one of the factors that contribute to the innovation success in the Companies. By consequence it must be integrated in the Company system;
- The traditional autonomy must be reduced in favour of more internal cooperation, shared targets and market-driven R&D.

Some years later, on the second issue, Amidon tried to identify what she called the characteristics of a new R&D mission [5]:

- Originally, she says, R&D was mainly focused on technology and its acquisition;
- In contrast, the present *fifth generation R&D* is essentially based on knowledge acquisition and its diffusion;
- Networks of partners, suppliers, stakeholders and clients are crucial for the development, learning and innovation in a new Strategic Business System.

2.2 Are new paradigms observable?

Starting from the debate on these two areas of interest, an effort was made, in the second half of the nineties, to define a set of conclusions on the state of the art of innovation oriented R&D. It was based on a review of the international literature and on a field research project run in 1996/7. It concerned the innovative and R&D behaviour of 169 large industrial and service Companies. The assumption this project started from was that effectively new paradigms in R&D can be observed as a consequence of:

- the external environment with its characteristics of turbulence, high differentiation and contemporary high interdependence among its many segments;
- the specific characteristics of the dominant type of innovation, that means essentially connection between new products – new processes in the innovative process, and continuity.

The new paradigms can be identified as follows (Chiaromonte, 2002) [6]:

- A shift towards the adoption of more decentralized structures for the R&D department;
- A shift towards a "buy" solution, as opposed to a "make" one, in the innovation oriented R&D;
- An increasing integration of R&D Management in the global Management process of the Companies;
- The emergence of new concepts and orientation for R&D;
- An increasing focus on both inputs and outputs evaluation criteria for the R&D activity;
- New and diversified professional profiles for R&D people.

Did the findings confirm the hypothesis?

2.2.1 Innovation and R&D: make or buy?

The point we wanted to stress using the word "buy" was the development of an innovation activity not based on processes of internal generation (of ideas, tools, prototypes, etc.), and substituting this latter with an external research (of these elements) and a subsequent acquisition.

As a matter of fact, this phase of technological change seemed characterized by the emergence of an "innovation market" where Companies looked to acquiring (elements of) innovation, instead of committing themselves to producing them.

The answers of our Companies' sample on this specific topic are shown in Figure 1.

A consistent 15 % devote more than 75 % of their innovation expenses to external acquisition; on the other hand, approximately 42 % spend less than 25 % of their total innovation expenditures on acquisition; all in all, an average of 39.2 % out of the total innovation expenses is aimed at buying innovations.

What is more, the highest percentage of innovation buy expenses (43 %) is aimed at know-how acquisition.

The findings on this specific point give support to the hypothesis of our research project, concerning the emergence of a process of externalization of the innovative activity.

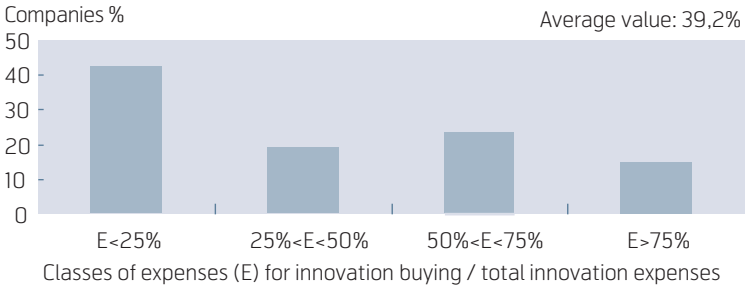

Figure 1 Innovation buying expenses (% distribution of companies)

This process appears not confined to the "supplier dominated" Companies that, by definition, do not have resources aimed at internal R&D processes, and for this reason are externally oriented. Also the so-called highly innovative Companies (with relevant internal R&D expenditures) often show this new orientation. This latter seems in conclusion a strategic choice, determined mainly by different modes of innovation management, in their turn determined by new pressures for the efficiency and effectiveness of R&D.

2.2.2 Decentralization and diffusion

The observable trend is that the central structure of the R&D department is downsized, while at the same time decentralized smaller structures are created at single unit level (with business and/or geographic location).

Decentralization: 60 % of the responding Companies report that there is a process of decentralizing decision-making in the innovation area. Out of this percentage, 85 % report a medium degree of decentralization, while 11 % say it is high.

But in addition to the decentralization, we realized that another process of change was taking place. Very often the research and development activity was not solely run by the R&D department, but with relevant contributions from other departments. It can be said that a kind of co-makership has developed among these departments and R&D; the latter often acting as the pivot of this process, but in some situations as a catalyst, under the leadership of other departments.

We propose to call this process *diffusion* of research activity within the Organizations. It is due to at least two concurrent circumstances:

- More and more the achievement of functional objectives of different units implies a certain amount of resources devoted to know-how acquisition or exploration of (technological) opportunities;

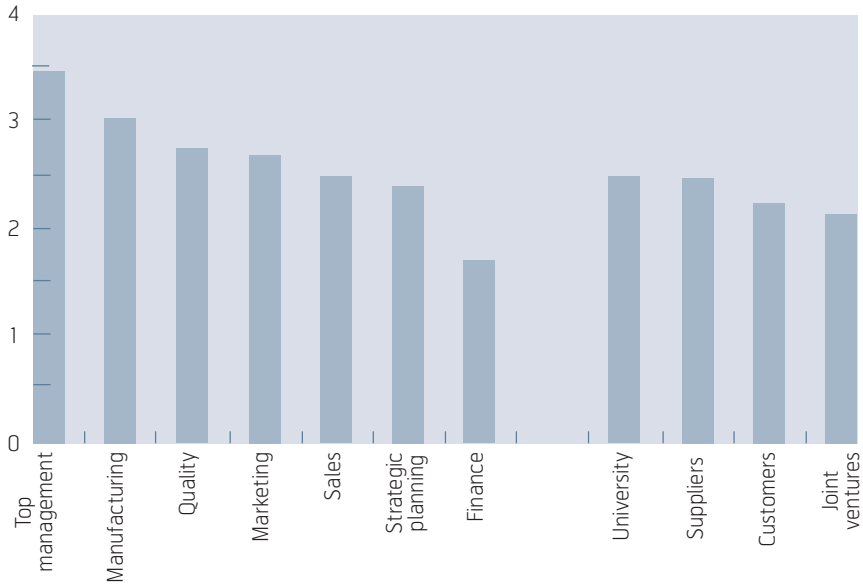

Figure 2 Integration degree among R&D/Design and other units (internal/external)

- At the same time, the achievement of R&D objectives requires more and more active involvement of organizational units other than the traditional R&D department.

However, due to the fact that a few different organizational units take part in the innovation process in different areas of the same Company, a strong need arises to coordinate the many innovative activities: this need is often dealt with by setting up a specific coordination unit.

Our research sample showed that 51 % of Companies had an organizational position in charge of the innovative activities coordination tasks. Very often this position has been specifically designed (75 %), while in other cases these tasks are assigned to an already existing unit (mainly R&D).

2.2.3 Integration processes

Although the diffusion process, described in the previous paragraph, was *per se* quite clearly a mechanism to integrate different Company departments in the implementation of research and development activities, part of the questionnaire we used was devoted to specifically analyzing the integration process. The analysis studied both the internal and external integration. On a scale from 1 (minimum) to 4 (maximum), Figure 2 shows the results of our research.

The higher value of internal integration is assigned to Top Management (3.46); immediately followed by the Manufacturing department (3.0), then by Quality Insurance (2.75) and Marketing (2.67). All the above exceed the average degree of integration which has a value of 2.63.

On the external integration side the highest degree is assigned to Know-how producers (Research Centers and Universities), and to suppliers (2.48 and 2.44 respectively). The average degree of external integration being 2.31, the integration with clients has an almost similar value (2.21).

In average values, the integration process intensity has increased in the three year period covered by our project, both for internal integration (21 % of Companies) and for external (18 %); and is forecast to still increase in the period 1996–99, again both for internal integration (36% of Companies) and for external (34 %).

According to the answer of our sample a specification can be made. As far as the internal integration is con-

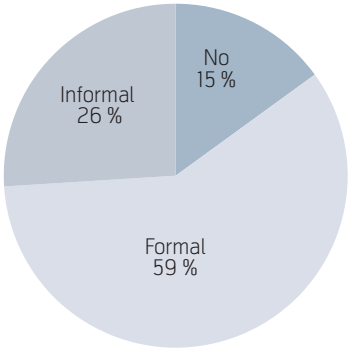

Figure 3 R&D projects evaluation mechanism

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cerned, the increasing trend of integration intensity is mainly due to the development of R&D – Marketing integration processes (essentially looking at the future perspectives). Speaking of external network, the driving feature of the positive dynamicd is represented by an increasing number of Joint Ventures or Alliances.

In conclusion the picture of the situation in 1995 shows that there still prevails a "hierarchical" type of integration (Top Management), followed by a "technical" one (Manufacturing). These can both be considered "traditional" forms of integration in the Management of Innovation processes. From the same picture however we can also observe an "innovative" form of integration with different organizational Units: Quality and Marketing.

More specifically, forecasts for the future show an increasing relevance of the R&D – Marketing integration process in a large majority of our Companies.

2.2.4 Evaluation

The emergence of formal or informal mechanisms of evaluation of R&D projects was one of the so-called new paradigms.

This evaluation was done by 85 % of our sample. 59 % of the sample had formal mechanisms, while 26 % used informal ones. The remaining 15 % did not have any evaluation mechanism of R&D projects, see Figure 3.

We tried to ascertain how this evaluation was made: the general parameters and the specific criteria used for evaluating individual projects, and the existence of systems for the evaluation of the whole R&D portfolio. Figures 4 and 5 show the results obtained.

Finally, only 38 % of responding Companies reported having implemented systems for the portfolio evaluation of R&D.

Summarizing, the following trends were identified as paradigm shifts:

1. As an alternative to the internal production of innovations, Companies develop an activity of buying innovations from the outside (market);

2. The innovation focused R&D activity has new contents and goals compared with the traditional one;

3. From an organizational point of view, Innovation and R&D show a simultaneous process of centralization and decentralization;

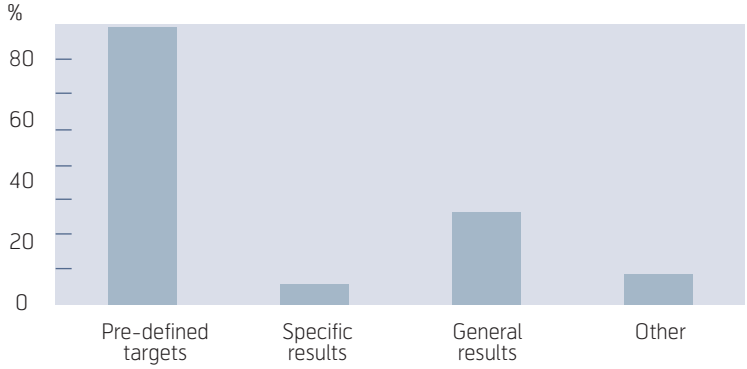

Figure 4 Main parameters used for evaluation of the projects (multiple answers)

4. Innovative Units show an increasing trend of integration with other departments of the same Company, and with external entities (internal and external integration);

5. There is a development of evaluation mechanisms of the results of R&D and Innovation activities; this development is clearly observable at individual project level, while still a weak point taking the perspective of the whole R&D portfolio.

3 Further on: the strategic technology and innovation management perspective

3.1 Theoretical background

In conclusion these findings confirmed the hypothesis that this R&D perspective went beyond the development of a new specialization, with a set of new and autonomous techniques. It pretended to constitute a new management paradigm based on the evolution of two concepts: the Management of Technology (the so-called MoT) and Innovation Management. The

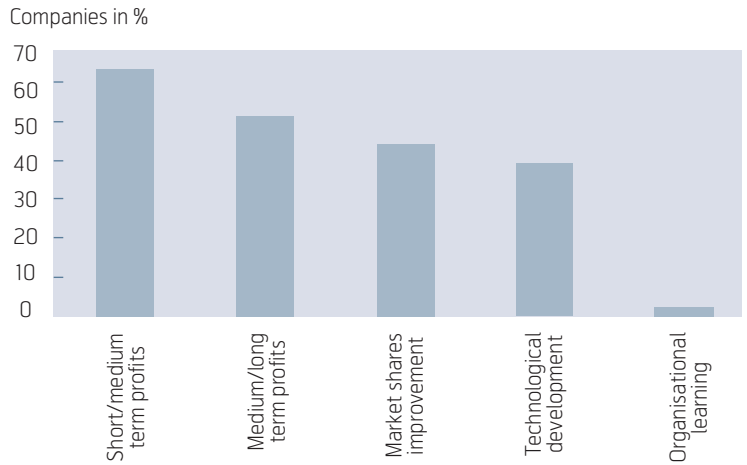

Figure 5 Main criteria used for evaluation of the projects (double answer)

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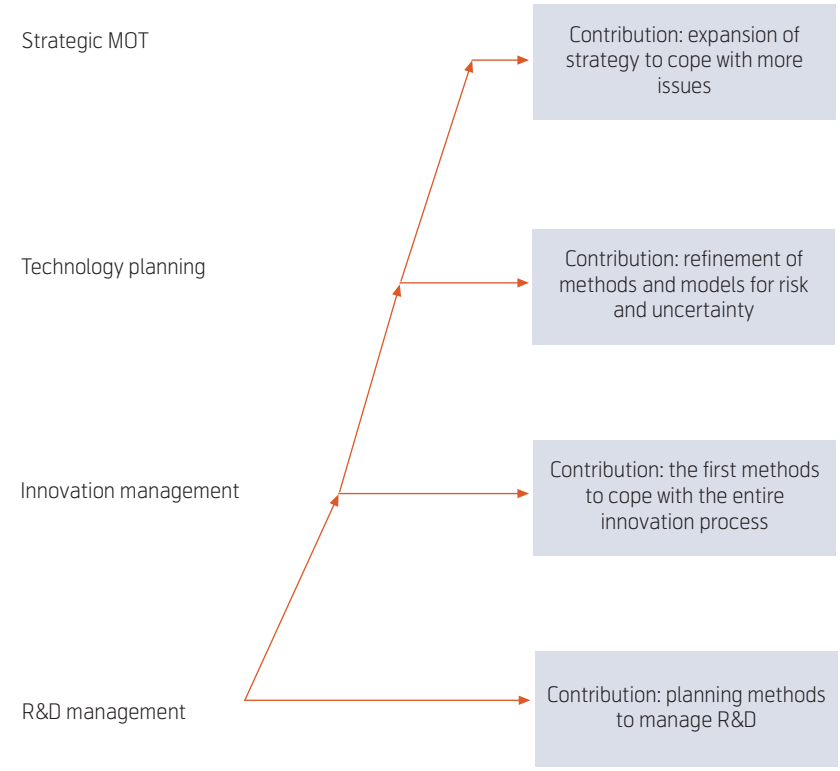

Figure 6 The conceptual framework for the evolution of MOT (adapted from Drejer)

starting point of this process was the widespread recognition, developed in the second half of the nineties, that technological change in itself does not imply successful innovations. As a matter of fact, success comes from the Companies' ability to simultaneously manage a complex set of factors related to the process of introducing new technologies and their implications [7]. These factors are partly dependent on the changes in the environment, and partly derived from the strategic choices of the Company itself. A few other scholars – discussing R&D, Innovation and Technology – reached similar conclusions.

Birchall and Chanaron, summarizing and commenting the different contributions to the Fifth International Forum on Technology Management [8], developed the concept of Management of Technology Theoretical Diamond. They noted that it was possible to identify four different approaches to the so-called MoT: The first one was focused on the behavioural aspect of the innovation process, the second on organizational and institutional driving forces, the third on scientific and technical knowledge, the fourth on a strictly managerial and strategic point of view. They concluded that "the great challenge was how to integrate or at least to make compatible these different approaches".

Jones, Green and Coombs [9], recognizing the necessity to adopt a strategic approach for Technology Management, were on the other hand aware of the opportunity to maintain a critical perspective in connecting technology management with strategy. There is otherwise a danger that "embracing a technological rationality might obscure the broader social and environmental issues which need to be considered".

A thorough analysis of the changing approach to R&D Management from an historical point of view was carried out by Drejer [10].

Four schools of thought were identified: the R&D Management School, the Innovation Management School, the Technology Planning School and finally, the Strategic Management School. They are sequentially connected as illustrated in Figure 6.

Concluding on this point, let me underline here the main trends of this debate:

- A shift from a mere Management *of* Technology perspective, to an holistic Management *with* Technology one;
- The recognition of the strategic relevance of this Management with a technology perspective;
- The emergence of a new concept of *Strategic Technology and Innovation Management*.

3.2 Crucial issues for the new perspective

Starting from this perspective another research project was started in 1998/9 [11], aimed at identifying:

- crucial issues for the Strategic Technology and Innovation Management approach;
- how the Companies deal with these issues.

It was carried out on assignment of OMIT (the Italian Observatory on Management of Innovation and Technology), in cooperation with DIFI (a network of German Companies committed to Innovation Management problems analysis). Five issues were identified as crucial:

- Strategy technology connection;
- Systems to implement the connection;
- Systems to monitor and enlarge the technological know-how;
- Core competencies development techniques and methodologies;
- Systems for the evaluation of Strategic Technology Management.

A group of international experts and scholars were asked to comment on the above five issues, in the framework of Strategic Technology and Innovation Management; while in the second phase a structured questionnaire was sent to a sample of managers belonging to 49 large Companies. The following are among the main findings [12].

3.2.1 Strategy technology connection

90 % of the respondents to our survey agreed that matching technology with strategy was extremely important for competitive Companies. This percentage rises to 100 % and the degree of agreement rises to "very high" for the TLC component of the sample.

At the end of the 1980s, technology, although very important, was still often not considered in the process of strategy formulation. This was essentialy due to the generally longer period of time that the function 'technological development' takes, if compared with the other functions of the companies (for example marketing) (Bulgermann and Maidique, 1988) [13].

Since then, however, many changes took place during the 1990s. Specifically, a new concept of company strategy has been developed: the so-called 'total strategy'. Within this concept technological elements are taken into account at the same level as the other elements of the strategic process (essentially marketing and financial elements), so that technology does not appear to be relevant only in the implementation phase, and is considered, at the same time, as a competitive priority and one of the main levers of the strategic managerial action. The answers to the sample survey we are presenting seem to be totally aligned with this trend.

3.2.2 Systems to implement the connection

A vast majority of our sample said that there were problems finding ways and mechanisms to implement the necessary connection between strategy and technology.

The most quoted motivations are:

- A gap exists inside the Companies between technological development and business management that is mainly oriented by financial considerations;
- The uncertainty and lack of information related to the potential of technologies.

Both of them could find theoretical and practical explanations. As a matter of fact, technological development is a creative task and for that reason it cannot be planned as easily as business management and strategy need to be [14]. For this reason, introducing technological considerations into strategy considerably increases the uncertainty of that process; and by consequence, an integration effort of the different paradigms of strategists and technologists is needed [15].

3.2.3 Systems to monitor and enlarge the technological know-how

Again 90 % of our respondents expressed agreement with the view that the development of the Company's technological know-how is an important tool for the strategy technology connection. Knowledge is considered a critical weapon for competitiveness, and the process of acquisition, diffusion and transfer is reported as an essential element of knowledge management.

Two observations can be made. First of all the soft feature of the technology (know-how and skills) seems to hold a dominant position against the hardware. Second, the focus of the analysis is shifted to the monitoring systems both within and outside the companies.

Taking a 'learning organisation' perspective this means focusing more on the 'learning how to learn'

attitude than on the learning itself (learning a specific technology).

3.2.4 Core competencies development techniques and methodologies

A step further in the area of knowledge development was made discussing the relationship between strategic technology management and core competencies development.

Although a consistent percentage of the sample says that "they (core competencies) are part of the wider process of strategic management" the hypothesis that core competencies development systems are essential for strategic technology management is not as widespread.

This is likely due to the fact that the core competency theory traditionally has been considered an issue pertaining to the human resources management area [16], while this perspective only recently has been enlarged to considering core technological competencies [17].

3.2.5 Systems for the evaluation of Strategic Technology Management

The orientation towards the efficiency and effectiveness of the R&D activity has recently implied the emergence of a necessity for evaluation systems and tools [18]. The same trend can be observed for technological development and innovation in the broader sense. Since technological leadership (among the possible innovative strategies) has been demonstrated to lead not necessarily to success, a research trend has been developed on the best tools to measure the return of different strategies of technology management.

While the necessity for systems for the evaluation of strategic management of technology is agreed on by a vast majority of our sample of respondents, nonethe-less 90 % of them are convinced that the lack of effective implementation of these systems is still a weak point of the whole process. These two percentages are significantly higher for the part of the sample belonging to TLC Companies. This result seems perfectly coherent with the state of the art.

A survey managed by the Industrial Research Institute in Washington DC (IRI) has recently ascertained that only 20 % of R&D department managers in large companies are able to evaluate the productivity of their departments [19].

In the same direction our survey on 169 large companies, already quoted, showed that only a few among them have systems for the evaluation of their research projects' portfolio.

Consequently companies seem unable to plan a systematic evaluation of their strategic management of technology. As a matter of fact, this is a complex process where the evaluation of individual projects might be linked to the evaluation of the whole portfolio of innovation projects and more to the global innovation process of the Company as a core component of the business strategy.

4 Conclusions

The emergence of Strategic Technology and Innovation Management as new managerial perspectives has been confirmed. It has the advantage of fully integrating different perspectives once essentially separated: the one of technological development, the one of Innovation Management and, last but not least, the one of business strategy.

This new perspective is based on a few crucial points:

- The strategy – technology connection;
- The development of knowledge (and knowledge management);
- The evaluation of the process as a whole.

A few weak points are still present, namely:

- Systems and mechanisms to realize the connection between strategy and technology;
- The process of core technological competencies identification;
- Systems and mechanisms to effectively implement the evaluation process.

Further developments of studies and analysis on these points are needed.

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Creating an innovative organisation

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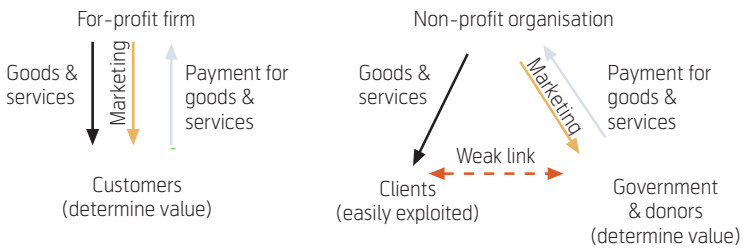
This article aims to provide some basic thoughts and general ways of thinking on innovation, based on eight years of experience as an innovation consultant in the telecom business, and before this, 12 years in R&D. There are several guidelines one should adhere to in order to increase the probability of succeeding with innovation. This is especially important as innovation may be the most cross-functional activity that can be performed in a firm. But most important is to remember that the only way to have true sustainable competitive advantage is to be better than the competitors at renewing oneself.

Creating an innovative organization is a challenging and exciting task companies tend to underestimate. Not the least important is creating a culture for innovation. But what does this mean in practice? Can everyone do what they want? Certainly not, as all employees must maximise their own contribution of value to the firm. As each company has its own challenges, history and culture, creating an innovative organisation is very much about first analysing present level of competence, strategic focus and special interests of internal powerful individuals. But first it is important to note that not everyone wants an Innovative Organisation. Joseph A. Schumpeter wrote in 1975 in "Capitalism, Socialism and Democracy" about capitalism and competition causing a history of revolution, which *"revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one"*. Innovations thus by its very nature threaten the power of those who built their position on the past. Resistance to change is fundamental, and often only those on the bottom rungs of the ladder embrace it, as an opportunity for personal growth. Very few organisations seem to have an internally based urge to become innovative. Innovation initiatives are most often the results of external forces such as changes in the competitive situation or changes in technologies leading to declining profits and sales.



Who determines the value of what you provide?

What is this thing called innovation?

In general, innovation is about utilizing any new idea successfully in practice, creating new value. The idea does not have to be an invention, but must be new to the organisation in question. Such a definition assumes that there is someone to be the judge of utility and to determine what has value. And luckily, for most organizations there are, and they are called customers. In the case of for-profit firms, it is fairly easy to determine who your customers are, because they pay the bills and determine whether what the organisation provides has value. In such firms, innovation often focuses on how to provide new real value to (new) customers, and how to let the customers perceive that such value exists.

For non-profit organisations or government agencies it is far worse to determine what kinds of value that innovation should provide, because most often the intended beneficiaries of their products and services do not pay the bills directly. A typical example here might be a healthcare service directed towards patients but paid for by the state; in this area innovation happens painfully slow! The main focus of non-profit organisations is therefore often shifted towards marketing and targeting the funding institutions or donors, and trying to satisfy *their* needs, which often do not correspond to the needs of the clients. For such organisations innovation often focuses on a combination of client exploitation and marketing, as well as providing a different kind of value to those who pay the bills. Such practices are widespread and are in grave instances deemed to be characterised as corruption. Some would claim that these descriptions might suit the recent history of incumbent telecoms, but deregulation has definitely introduced harsh competition which has shifted the focus clearly towards providing real value to end users! The telecom industry today is therefore probably among the most innovative industries.

Why such a solemn introduction to innovation? Well, it is important to realise that innovation itself is not

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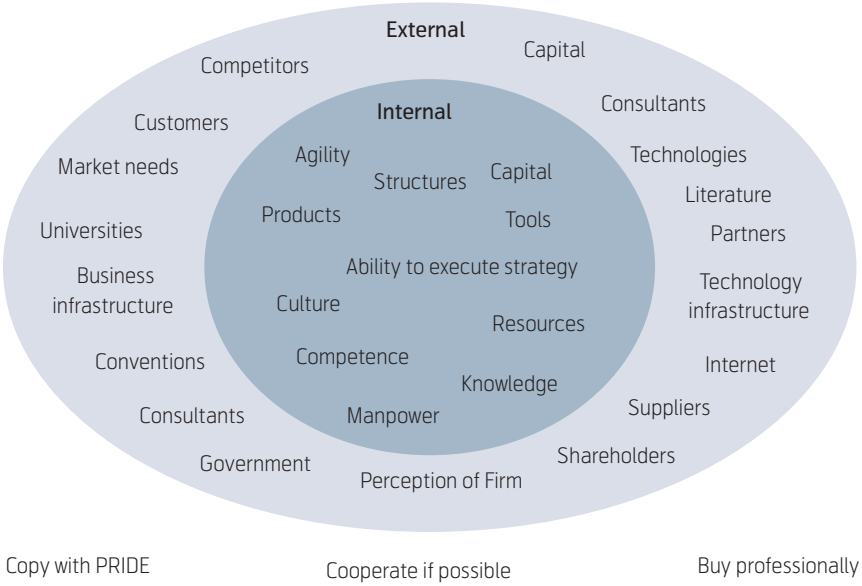


Leveraging for innovation

moral. Hitler was very innovative, but not all might agree with his priorities and values. Using innovation towards the greater good of society is the responsibility of each single innovator, and something which the culture for – and institutional/economical system of – innovation in any society should support!

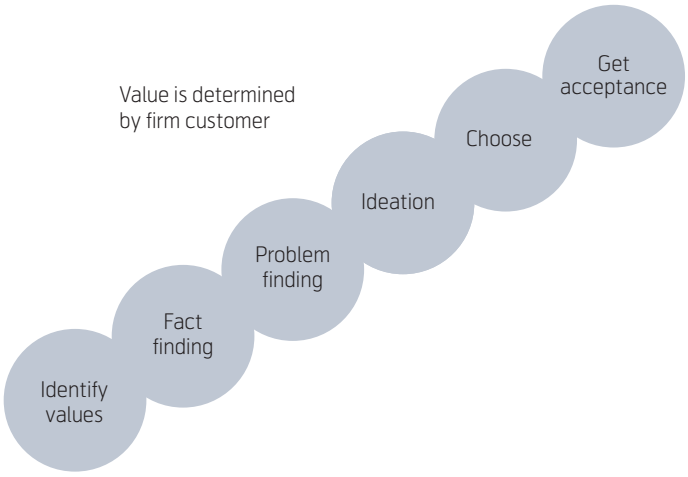
Thus, to simplify, the starting point of innovation is to identify customers that are in a position to judge a product or service to have value for them and to be able to provide monetary value in exchange. There can be no innovation without customer focus. These basic rules too often tend to disappear in the turbulence of new technologies, regulatory regimes or creative competitors, especially in the telecom business where the situation at the moment seems to be perceived as a marketing game.

After having identified customers with means to buy products and services that they deem valuable, this knowledge must be converted into said products and services. Here, if you have an excellent business intelligence system, you may copy others' ideas with pride. Most businesses do what everyone else does anyway, and a 5–10 % perceived superiority can lead to a ten-fold lead in volume or turnover. But perceived superiority is just as much about having a strong brand as it is about factual "bangs for bucks". And creating a stronger brand is in itself an innovation, as long as it creates (perceived) value for customers. But it is far easier and quicker to create a great new product or service than it is to create a great brand.

Therefore, new entrants to a market need to be especially innovative regarding product and service uniqueness. But unique ideas are hard to come by. They are either closely guarded or patented, and gaining free access to such ideas would require the use of illegal means. Civilised firms cannot steal, and in an increasingly transparent world, it becomes tougher all the time. Such ideas can, on the other hand, often be procured or rented through licensing.

But if required uniqueness cannot be bought, there is a strong need for value-based creativity.

Value-based creativity firstly requires some factual framing in addition to continuously studying market needs. On this foundation experienced people might be able to pose the right questions. And good questions will lead to good answers.



Value-based creativity – The ability to purposefully conceive new ideas with potential for value creation (adapted from Osborn-Parnes-Isaksen)

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Management

- Create an environment of care, trust, and sharing
- Must provide learning opportunities to attract and retain talent
- Continuous questioning of assumptions and established truths
- Larger difference between managing status quo and leading change
- Create alignment between organisational and personal values and goals
- Understanding of the nature and contribution of knowledge and competence
- Focus on incentive systems and the processes of interaction and value creation
- Balance between short and long term goals; Sustainability and Shareholder Value
- Empowerment of people and communities through diffusing and distributing control

Knowledge workers

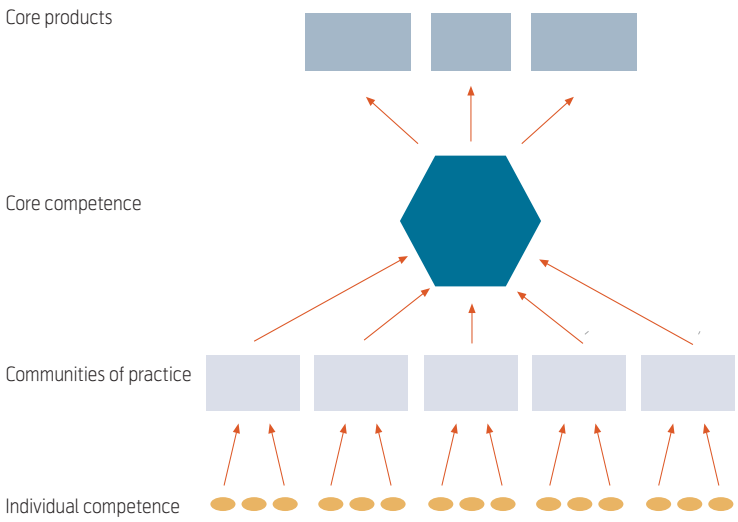
- Lifelong learning
- Increased flexibility
- Increased interconnectedness
- Increased learning on demand
- Shorter time to respond to changes
- Increased need to master complex behaviour
- Increased use of IT and learning technologies
- Shorter time for exploration and experimentation
- Willingness to accept responsibility for own actions

Required for success (adapted from Carlsen, Syed & Välikangas (1999): Knowledge Collectives as Complex Systems, SRI Business Intelligence Program)

We must find ways to foster intellectual capital that becomes inextricably bound to a sense of personal meaning.

– John Seely Brown (1999), Sustaining the Ecology of Knowledge, Leader to Leader, No. 12

Need for meaning



Organisational core competence

Innovation is about utilising an idea. If there is an idea which describes a real market need, one must judge if one has resources to develop the product or service and to get it in front of customers. On the one hand, such resources could be tangibles such as money, property, machinery and infrastructure. But intangibles such as competence and organisational capabilities are equally important and require deep insight into the knowledge and competence of individual employees and inside the employees as a collective.

The art of leading knowledge based firms, Knowledge Management, is rapidly gaining ground, though unfortunately, there has been some unwise hype and hope in this area. The main difference between leading traditional firms and knowledge based firms is that productivity in a knowledge based firm depends more on the utilisation of the mind of the employees than the hands of "the workers". In traditional firms, one worker could be somewhat more efficient than another, and negative motivation, the "management by fear"[1)], is a viable management strategy. Management focus will then be on designing efficient work processes where expert managers teach and manage the troops. In knowledge based firms, on the other hand, productivity is primarily dependent on the optimum utilisation of every expert employee's mind. Here, management is about facilitation and empowerment. Whoever contributes the most value must have the power to execute. Motivation is both internal and peer based, whereby individual and group values and goals need to be aligned with firm values and goals. The employees need to believe in the contribution of the firm towards markets and its impact on society in general. Incentive systems must be in place so that what's good for the firm is good for the employees.

But the strange part about knowledge work is how dramatically the knowledge workers differ in efficiency. One person may be ten or even a hundred times more productive than another who is equally formally qualified. It then becomes crucial to identify, attract and retain these talents and enable them to produce what they are capable of. This requires transparency in processes and towards decisions and value contribution accounting systems. Only if systems are in place for measuring contributed value can such talents be identified and rewarded in a fair way. These people must form the cores of value creation processes, with other people with such talents supporting and enabling the extraordinary people to maximise their contribution. Only with measures of productivity will such a system be perceived as fair and thereby add to a constructive motivational system.

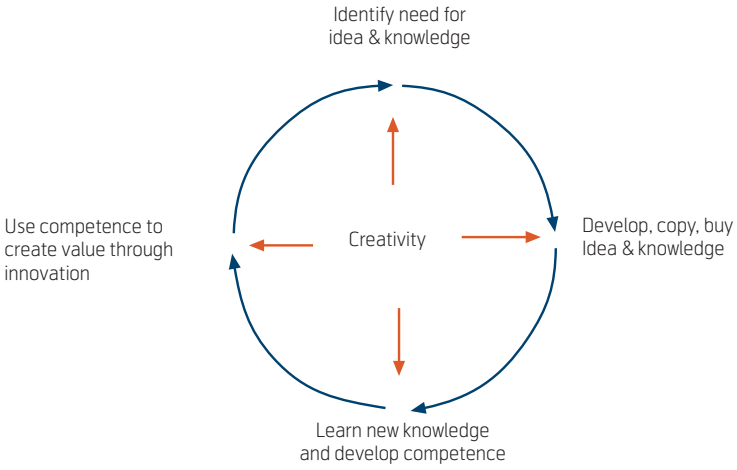
1) *For a series of excellent studies of this, and of other dysfunctional leadership styles, check the Dilbert comics.*

Such communities of practice will consist of one or more individuals who carry the organisational competence in each individual subject area. Competence can be viewed as a person's ability to use knowledge, talent, skills, experience, personality and other "tacit knowledge" for value creation, whereas knowledge can be explicitly codified and described, and thereby disseminated through books and information technology. It is vital that individuals within a community of practice share knowledge with each other and transfer competence through practice and work. Such a willingness to share the main means of personal productivity again requires a system for acknowledging such contribution, and that managers really must care for the individual employee for such trust to permeate the organisation.

This way, best practices can be shared and developed. However, best practices of today – many of which are well documented in this edition of *Telektronikk* – quickly become the required practices of tomorrow. Therefore continuous innovation must be performed within each practice community, incrementally improving practices, competences and knowledge.

Though workers now own the main means of manufacture, the capitalists are in control, as before, because capital pays salaries. And firm owners still own the structural capital whereby value is created through the use of competence, the relationship capital and the firm brand. But the difference is still huge. Capitalists can now only maximise their investments by treating the employees in a fair manner.

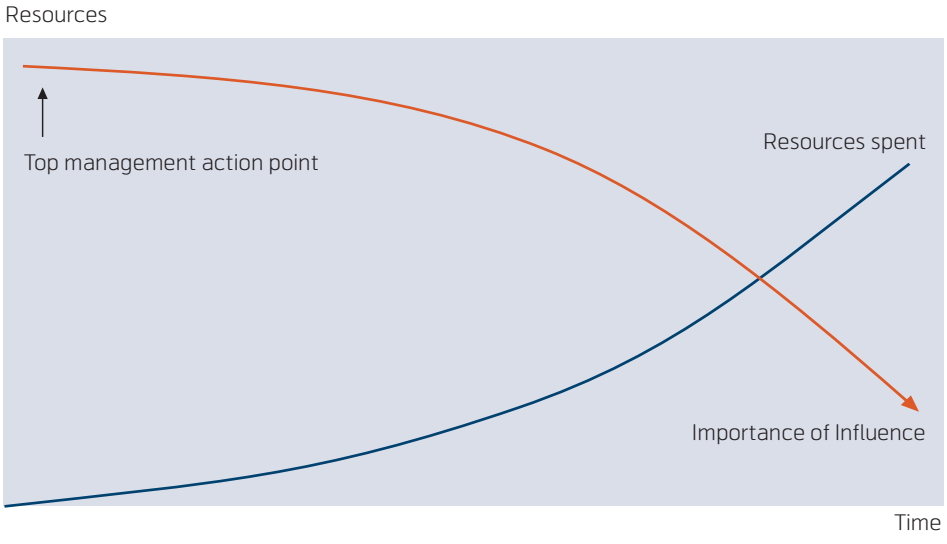
Top management must make sure to design the organisation in such a way that the sum of all communities of practice, by cooperative value contribution in sum forms the organisational core competence which differentiates the firm from its competitors. Core Competence is a sustainable and differentiating organisational ability to utilise the competence of its employees for systematic value creation.



Value creation through creativity and innovation

In this way, creativity, innovation, knowledge and competence are intertwined; first one must identify a need, then get ideas, learn this knowledge and develop competence, and then utilise this competence through innovation to create new value. Everywhere in this circle, creativity is required.

Having looked at internal resources, an optimum match should be found with external resources and



Influence on innovation projects

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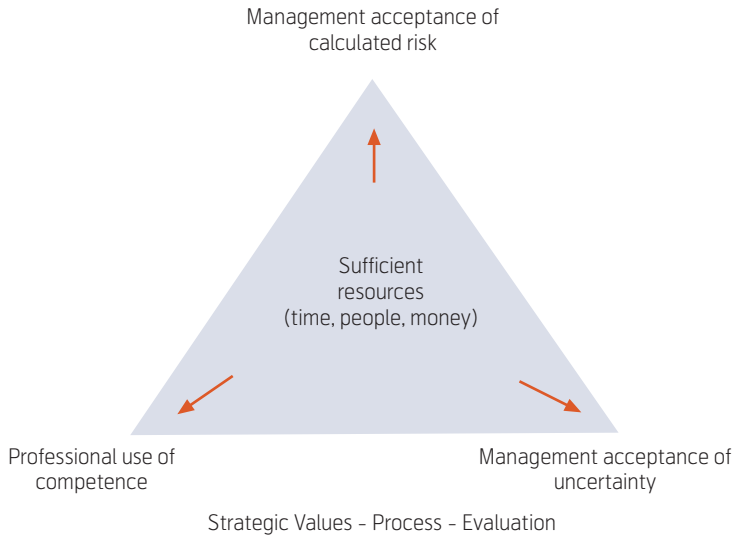


How can innovation projects succeed?

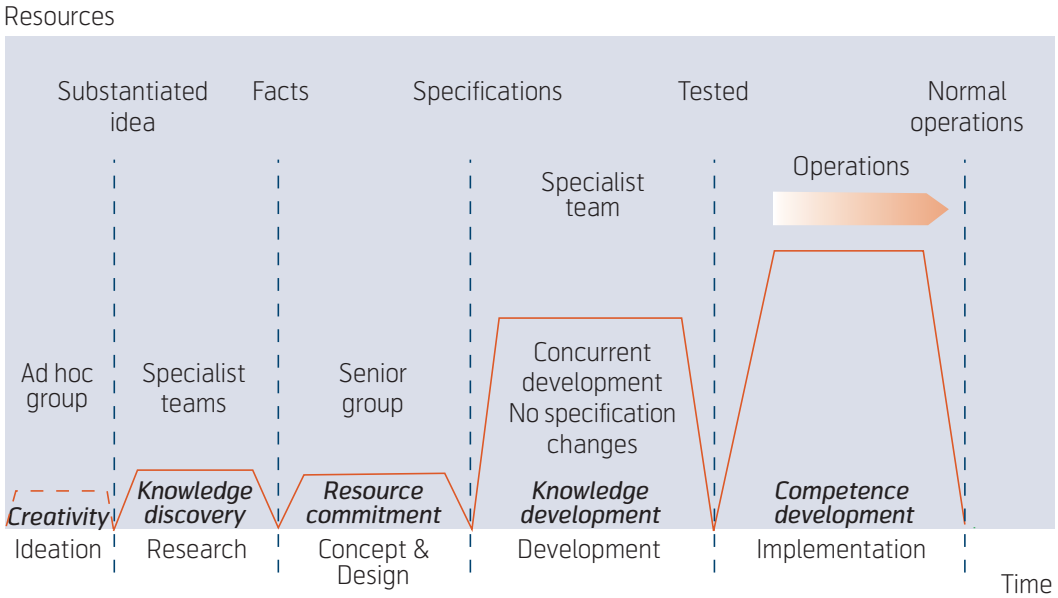
forces which can be leveraged by cooperation or trade to act synergistic with internal resources.

All innovation requires top management support, as they control resources. But top managers also have a responsibility towards assuming responsibility! In innovation projects, this means that they must have some thoughts on which portfolios of products or services fit with the strategic aims of the firm. Top managers must therefore formulate and communicate policies for acceptable and desirable innovation projects.

Developing a culture for innovation is important. But what does this mean in practice? Can everyone do what they want? Certainly not, as all must maximise their own contribution of value to the firm. Does this mean that everyone can take wild risks and be pardoned if the enterprise fails? Should mistakes be tolerated? No, another wrong, to keep to a rather rhetorical and non academic style! It should only to a very limited degree be a culture of tolerating mistakes. But there should be a culture wherein innovation projects are allowed to fail. But only if a post-analysis of such failed projects is performed – and incentives set up in the organisation for really learning from this.

Innovation projects can fail for a number of reasons. If a failure happens within the parameters of calculated and accepted risks, it should be OK, and likewise if the project fails because of an "Act of God". Such causes of failure are management responsibilities. But failures caused by incompetence should not be tolerated. If management initiates projects that are knowingly under-funded, it should not go unnoticed. If team members do not contribute as they have committed to, it should cause repercussions. What is vitally important is a culture of transparency and professionalism. If there is a culture of randomly assigning scapegoats to failed projects, only risk-seekers will participate in innovation projects. There is little evidence towards supporting a strong correlation between risk-seeking and genuine competence. Top management must assume responsibility towards strategic choices and the acceptance of risks, and employees must be responsible for professional use of own competence.

An innovation project must be supported by a strong innovation process. Here some elements must be serial, whereas others can be parallel. Ideas are con-



Innovation process

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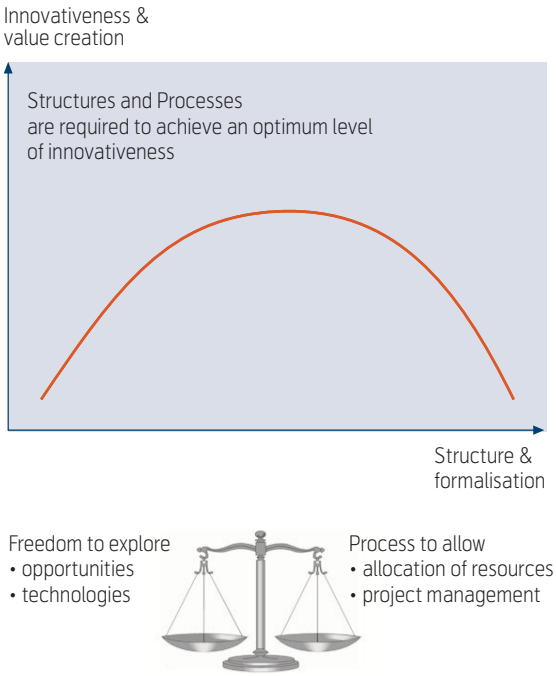
tinually popping up, or created using structured techniques. When evaluating the potential of such ideas, it is important to use objective measures. Pet projects of managers more often fail than projects which have undergone rigorous procedures. But everything according to context, as there is an optimum level of formalism, before too much is too much!

Only after a product or service concept has been decided can development be performed in parallel, with simultaneous development of technologies, logistics systems, marketing material and delivery process. It is important for a minimum number of people to participate throughout the project and let other resources participate "on order" only where applicable. You will want to involve as few people as possible, and those that you do involve, you would like to utilise fully. An individual employee needs to focus, and to be immersed into the problem issues. Involvement in too many simultaneous projects reduces efficiency. The same is true on firm level; better with few simultaneous short projects than many long ones.

There are several guidelines on succeeding with innovation. These are important and should be adhered to. Innovation is probably the most cross-functional activity that can be performed in a firm; creating an unknown which matches the capabilities of the present, and thereby demand both knowledgeable and experienced people. But most important is to remember that the only way to have true sustainable competitive advantage is to be better than the competitors at renewing oneself!

And finally, as innovation is very much about utilizing hard-earned knowledge and competence through very hard work, as an individual, why do it? Personally, I experience real "flow" while designing and formulating new concepts. Creating ideas with potential for value contribution is a great experience. Thereafter developing and implementing these ideas are thrilling, and very little routine, as there are certain to be many unforeseen problems, no matter the level of research, analysis and planning. And as Innovation really differentiates between contributors and exploiters, there is a certain pre-selection of participants, giving you brilliant people with whom to share and enjoy each day at work.



Structure is necessary

1 New Product Team accountable for results
2 A positive climate for innovation exists
3 Adequate resources allocated from functional units
4 Voice-of-customer and Market input activities in place
5 Quality of execution of predevelopment activities
6 Product & Concept uniqueness in creating value for customers
7 Portfolio management practices in place
8 Quality of execution of marketing activities and launch
9 New product stage-gate process in place
10 Quality of market information available to project

... and as always: Top management Commitment!

Important best innovation practices (from Cooper, Edgett & Kleinschmidt, 2003: "Best Practices i Product Innovation")

To achieve *sustainable competitive advantage* we want a self-renewing organisation by means of Knowledge & Innovation Management.

We want to be self-renewing (adapted from Fahey & Prusak (1998): The Eleven Deadliest Sins of Knowledge Management, California Management Review, vol 40, No 3

For a presentation of the author, turn to page 32.

Future development of mobile services and applications examined through the real options approach

JAN EDELMANN AND JOUNI KOIVUNIEMI

Jan Edelmann, researcher and PhD Student at Lappeenranta University of Technology (LUT), Finland

The present ICT industry indicates that the mobile services and applications are going to change radically in the future. The future evolution of mobile applications and services means seamless integration both technologically and on application and service level towards more attractive solutions for users. The attractiveness of mobile applications and services in the future relies heavily on comprehensive fulfillment of user needs. In our view, applications and services are bundled together, called Integrated Mobile Applications and Services.

The business environment related to a new paradigm in mobile services and applications is highly uncertain. An individual firm in the mobile industry has to make choices concerning its investments to be prepared for the contingent future. The Real Options Approach tries to explain how a firm is able to achieve the most from the opportunities offered to it and how to avoid the downsides.

Jouni Koivuniemi, Project Manager and PhD Student at Lappeenranta University of Technology (LUT), Finland

1 Introduction

The competitive situation in telecoms is going to change in the countries where the mobile markets are maturing and the competition will make the traditional business models of mobility less attractive. Companies need to seek turnkeys to new sustainable business models, since many of the practiced models have and will become obsolete. At the same time telecom companies' interests in integrating users and their needs more tightly in the development processes have increased. New business opportunities may lie in the area of integrated mobile application and service development, which takes users' overall needs more closely into account.

The Nordic ICT-industry, e.g. Nokia, TeliaSonera, and TietoEnator (in Nets seminar, 2003), have expressed their remarks about the integration on different technological levels expecting that there will be radical convergence in technological layers. We can expect integration on the application and service level as well. This reflects the industrial expectations about the future, where the current way of doing business might become unprofitable.

The development of mobile applications and services in the future may require companies to open their innovation and product development systems more in order to enable close cross-organizational linkages and formation of trustworthy collaborative networks. As the number of collaborative linkages to be managed increases, companies might also need to alter the philosophy of their application and service development from their current internal strategic management and decision-making point of view.

In the new kind of development environment, strategic options thinking might bring a valuable framework for guiding strategic management decision-making and investment analysis in internal development programmes and collaborative undertakings to recognize strategic opportunities and the means for answering them. In this paper we will explain the existing problems in the current mobile applications and services illustrating the future development on a route to a vision of taking the user needs more into account.

The triple play between business, users and technology (see Figure 1) is very important when considering the strategic future options of a firm. A comprehensive view of users' role specific needs may beget a new paradigm in the mobile business – we call it *Integrated Mobile Applications and Services (IMAS)*.

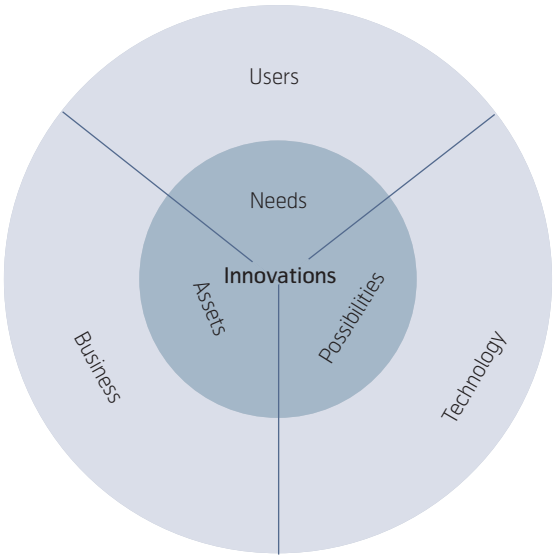


Figure 1 Triple play between business, users and technology

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The user needs are only a part of this triple play, however. To achieve our vision, extensive cooperation to create standards and platforms for integrated mobile applications and services is most probably needed. A working triple play model is important to guarantee novel mobile experiences, killer experiences for the users. The approach where companies seek *killer applications* is argued to be wrong; it is just too technology oriented. Companies should seek *killer user experiences* instead (Advani & Choudhury, 2004). Accordingly, the IMAS should be designed based on the user needs, not on the industry needs.

The leverage of cooperation and collaboration over the user, business and technological domains has not been fully utilized. We see that there has been a lack of genuine collaboration in the development of mobile business because the companies' strategic thinking is still too much focused on their own core business, and this does not foster positive future development in the mobile industry from the collaborative point of view.

From the mobile industry companies' point of view the vision about integrated mobile applications and services is one possible future scenario among others. The current dominant way of doing business, i.e. building single applications for specific user needs, may continue, if the users are willing to fund it. From a technological point of view this could be called 'building silos'. On the other hand, successful bundling of services and applications to integrated offerings may increase the users' experienced value so much that the old way of making business may become challenged and obsolete. The problem concerning future development is what kind of steps would be appropriate a) from a single firm's point of view and b) from the point of view of the whole industry towards integrated mobile applications and services?

The Real Options Approach (ROA) may enlighten the issue. Through this thinking the business can be opened up so that the strategic opportunities can be seen and evaluated more naturally than with the widely used capital budgeting methods. The alternative future possibilities can be illustrated and evaluated with the help of ROA, imitating the actual decision-making process.

2 Current mobile services and applications – user perspective

There are a great number of mobile services and applications provided for users, but a very common characteristic among them is that they are separate and not sufficiently interlinked (see Figure 2). The current mobile business is based on different kinds of services and applications: phone calls, text and picture messages, icons and ringing tones, location-based services, mobile device environments, just to mention a few examples. Mobile applications and services are designed more or less from a technological perspective, not from a genuine user perspective.

In recent years the industry has noticeably concentrated on the so-called rich media (including videos, audio, and pictures), which the industry has expected to be the next money-spinner. From the user's point of view there might not be any sense in concentrating only on a specific communication method because the real user needs probably exist somewhere else. The ultimate need of the user may not be to look at a picture of the other speaker – the need may be for instance to check if the child is at home. Showing a picture could be a part of a full service solution combined with information about the child's body temperature and location.

From the user's point of view a dispersed range of applications and services results in applications and services that are difficult and arduous to use (a multitude of applications for the same purpose, different terminals and devices with limited features), and an isolated set of different network and access technologies with severe problems in interoperability and openness. There are also services and applications

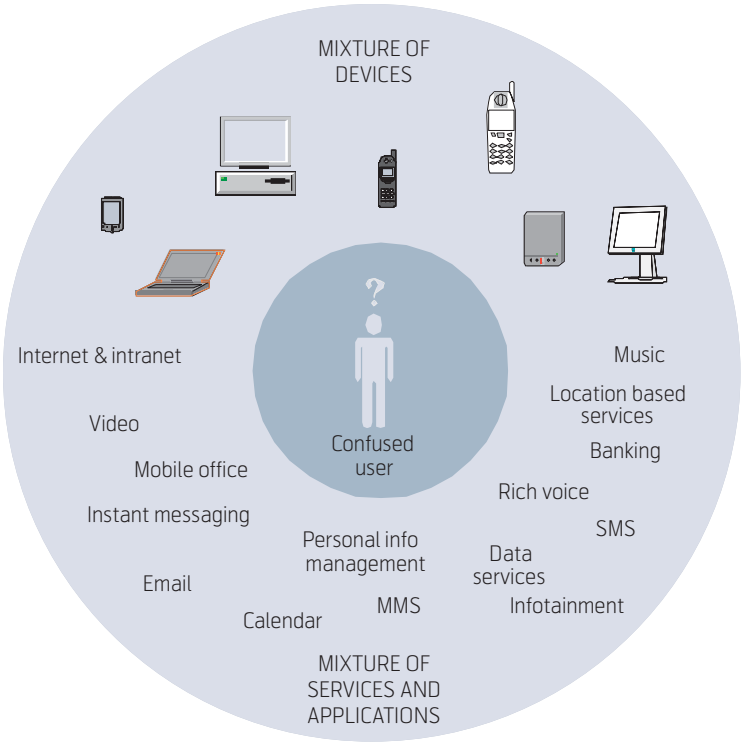

Figure 2 Current service and application space

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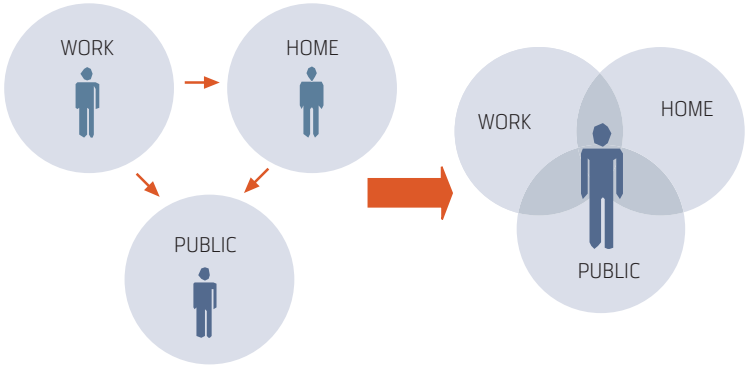

Figure 3 Different user environments and overlapping need areas

that are separated and overlapping even though the same person uses them for the same purposes (e.g. calendar and reservation services). Often the same or interlinked information in different applications and services has to be entered several times (e.g. subscription information in any web service).

When the number of distinct applications and services increases, the situation will get worse – the user's confusion about appropriate applications for his needs may increase. Workable interconnections and interoperability between access technologies, operating systems, applications and services are needed and the users should be offered appropriate applications and access while 'being mobile' – acting actively at work, home and public environments. We claim that the existing applications and services are mainly targeted to fulfill only particular needs in particular areas or environments without the concern of comprehensive understanding about the users' real needs over different environments.

Good examples of separate services are communication services, such as SMS (Short Message Service) and MMS (Multimedia Messaging Service), as well as location-based services which often fulfill only one part of the overall user need, whereas the combination of these services could fulfill the user needs better. Just to illustrate the situation, consider a business traveler starting his journey from Helsinki city center to the airport, and his flight being two hours late. In the normal scenario he would not know about the delay until arriving at the airport terminal. But, by connecting the flight schedules with the location-based information about the user, he could have received an SMS/MMS message while still staying in the city center telling him "Your flight will be two hours late. There are several fabulous restaurants in the area …". These kinds of services are just about to emerge in a large scale.

The existing business divides customers basically into two groups: business users and consumers. In reality there are no such groups. There are people who are either working or in their free time, but a combination is also possible, i.e. working at home. Nowadays, the mobile services, devices, and applications are targeted to these groups mainly in different price categories. Very often business users are offered mobile devices by their employer, and depending on the firm policy the user is probably allowed to use the same devices for private purposes as well. However, it is not uncommon that people carry many mobile devices, even several of them both at work and at home.

3 Comprehensive understanding of user needs

Users act as members in different kinds of environments (see Figure 3, where they carry out tasks and activities in different roles (e.g. policeman at work, father at home, soccer player in his free time). The users' needs, which can be either manifested or latent, are derived from the users' roles and role specific activities. Comprehensive understanding of the users' needs is crucial in order to develop full service solutions for them. Defining the users' needs is essential to foster the emergence of easy-to-use integrated mobile applications and services.

The present approach is that the user is offered services distinctly in each user environment instead of an individual approach. Personalization and customization are important aspects in integrated mobile applications and services.

To fulfill the needs it has to be understood how the person could easily use mobile services and applications in everyday tasks in different roles. The roles and needs and their sum may show that the needs and requirements are overlapping in many areas.

The concept of a multi-channel communication model (Henttonen & Blomqvist, 2003) may enlighten the problem. In two different roles, people have different needs based on the external requirements. They could need different types of communication channels even at the same time. They need specific information in specific situations and at specific times in different forms.

4 Future development of mobile applications and services

In the future scenarios the mobile technology enables the integration and bundling of services together in a way that was not feasible earlier. This should lead to

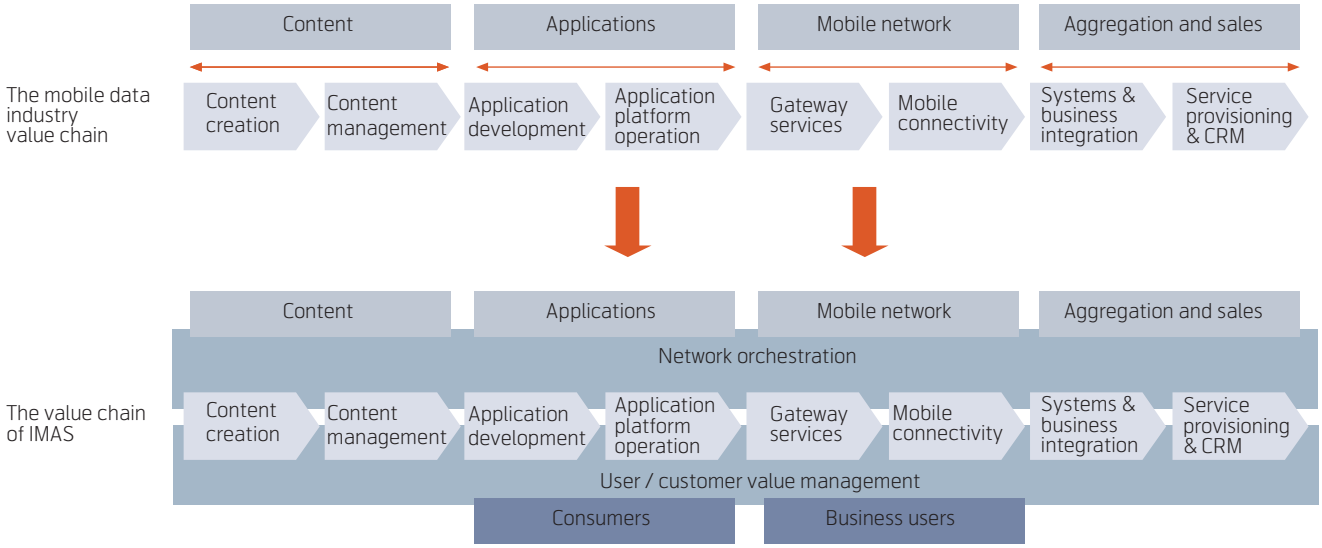

Figure 4 Transition from a mobile data industry value chain to a value chain of IMAS (modified from Karakanovsky, 2003)

more user-oriented business and changes in the current value network. The sustainability of mobile business models in the future is strongly based on the companies' ability to combine the user point of view with a right set of technological building blocks. The scenario may include strategic options for individual firms, which are examined below through the options perspective.

The situation may be that a fundamental prerequisite for IMAS development is a mutual agreement among value chain stakeholders to form collaborative networks, which would lead to 'integrated knowledge spaces' that enable the development of IMAS. In practice this would mean working e.g. in different standardization bodies and formations of heterogeneous development communities. Cooperation makes the integration of internal and external innovation possible, preparing the way for evolutionary and revolutionary development in terms of technology and applications. Another possibility is for a firm to start development work alone and try to develop a solution for this by itself. One single player, even a market leader, may be too weak to do this alone.

The IMAS scenario emphasizes the need for a new kind of players in the value system. The upper part of Figure 4 presents the current mobile data value chain (Siemens, 2001). First, the user value in the IMAS scenario would be the concern of the whole value chain. This would probably be best served by an intermediary actor whose main responsibility is to transform the needs and requirements from the user or customer side to the other value chain actors from the very beginning until service provision and CRM (Customer Relationship Management). On the offering side, the orchestration of the development network becomes crucial, as unified strategic conceptions of the underlying technological building blocks (e.g. platforms, open standards, protocols) and effective service development and provisioning are needed to provide integrated mobile applications and services.

There will be a transition from a mobile data industry value chain to a value chain of integrated mobile applications and services.

The new value chain with a new kind of actors would be better tuned to bundling applications and services together in the form of full service solutions that are capable of maintaining users' access to required services and information in any way, anywhere, and at any time. End-to-end management of applications and services would be easier as well, as a single actor takes the responsibility.

The value chain of IMAS emphasizes the fact that the fulfillment of users' needs should be the dominant factor – not the development of technologies even though the technological development is important in the fulfillment of user needs. When the number of services and applications increases, overlapping increases and the competitive business position can be improved by the full service way of thinking. Understanding the user and new unexpected uses of technology is a major continuous challenge and possibility for all companies in the mobile services business.

The development of integrated mobile applications and services requires challenging integration on many levels. Technological integration is needed in order to structure the platforms for applications and services

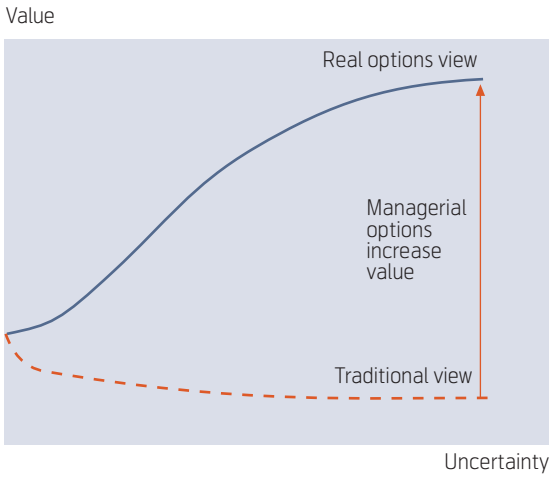

Figure 5 Uncertainty increases value

to ensure interoperability. To link applications together, there has to be common interfaces on different technological layers. The mobile market player and the whole industry require platforms and standards which enable an easy bundling of functions and components of services and applications. To create new technological platforms and standards, the industry can agree upon building a platform together or compete in building it. For instance, OSA, Open Service Architecture is one possible way to approach integration in mobile environment. The OSA specifications define an architecture that makes it possible to service application developers to make use of network functionality through an open standardized interface, i.e. the OSA APIs (ETSI, 2003).

The technology architectures behind the telecoms are so huge, rigid, and heavy that it is very difficult for one player to do anything else than try to live with it. The telecom operators have been in the position of a doorman. They have controlled critical network functionalities very effectively. For this reason the operators have a crucial role in promoting the development work of integrated mobile applications and services, as well as in the provision of the required technological backbone. This is a strategic option where the right steps and timing are critical. It may take years or decades, depending on the efforts of the whole industry.

5 Decisions about the future

A sporadic strategic investment may radically change the entire business environment. The business and the firm may be at the source of something unequalled, which may offer better or worse possibilities from the perspective of the company's current stage. When a possible new business model is presented, the decision maker may feel somewhat insecure. A strategic investment may create possibilities that were not detected earlier – because of the human incapability to follow a complicated and slightly accidental path that will become apparent in the future.

Technological development often depends upon the path of the past – despite the fact that there are discontinuums that have radical influence on history – at least in a short time scale. A threat that a decision maker may face is that a new business concept or a business factor may have a radical influence on their current business. This is hard to evaluate beforehand, because there is nothing that it could be compared with, or data that could support the decision.

A new technology platform investment in the ICT industry may be a strategic investment whose value lies in growth opportunities or options. To be able to see the business opportunities and the options that the firm has, one has to understand the strategic perspective and opportunities that can be achieved through the innovative investments. The key question is to identify the opportunities and their possible value for the firm.

The decision-making concerning strategic future investments is difficult to rationalize on the basis of accurate information, because that is not available. A common situation is that the decision-making is based on qualitative information and strong intuition only (Kyläheiko et al., 2002). A common situation in business is that a great idea or invention is seen as a great possibility for the firm, here IMAS – a strategic opportunity. The traditional budgeting and pricing methods are incapable of properly binding the possibilities and flexibility in calculations. Figure 5 illustrates how the traditional view operates the uncertainty versus the real options approach which says that when uncertainty increases, the value of the managerial options increases.

An increase in market uncertainty and technological uncertainty increases the real option value (Boer, 2000; Perlitz et al., 1999). As an example we can say that the greater the variance in the possible market value, the greater is the possibility to achieve great wins or losses. If the technological uncertainty is high, the risk can be decreased only by investing time and money. On the other hand, high technological uncertainty will not increase the possibilities to be successful in the current business, but will increase the potential upside.

6 Real option approach theory

The real option[1)] approach is a language to describe the possibilities the firm has so that the world can be opened up as a map of opportunities. On the other

hand, the ROA is purely a real world option valuating system to define mathematical values for alternative courses of action.

This approach is about investing now to exercise the right to develop a technological and market competence portfolio in the future (Vasudevan, 2001). Real options are options that are entrenched in real assets where the firm may have an option to expand a project, abandon it, or defer the investment, for instance.

6.1 Mathematical perspective

Through this thinking the business can be opened up so that the strategic opportunities can be seen and evaluated more naturally than with the widely used capital budgeting methods, such as the Discounted Cash Flow (DCF) (e.g. Zhu, 1999), which ignore the inborn flexibility the management carries out all the time (Campbell, 2001). Myers (1984) suggests that the ROA can be a helpful tool between finance and corporate strategy.

According to the Black-Scholes model, when there is high uncertainty and flexibility to respond to uncertainty, real options are important. Very often the real options value is high when the Net Present Value (NPV) shows that the value is close to zero (Copeland & Antikarov, 2001).

Dai et al. (2000) argue that the option pricing methods help management properly evaluate the opportunities that IT-investments create, and they also state that these methods are suitable for assessing the value of different types of IT-projects, including infrastructure projects, software prototyping, decision support systems, and technology standard-based projects.

The real options related to strategic IT-investments are usually so-called compound options (a combination of options), and only the Binomial and Geske models are able to handle these kinds of options (Perlitz et al., 1999). A common feature for all these models is that they are unrealistic from the managerial point of view. To value the options accurately, they should be reliably identified. They expect the manager to know for instance the maturity of the option, which in the case of real options is usually impossible to know beforehand. The models also require that the cash flows and expenses are known exactly.

So far the ROA has not been as simple and streamlined as most of the known decision-making and evaluating methods, and the option value may be based too much on uncertain estimates, which decrease the reliability of the calculations. The dilemma of the estimates about cash flows and volatilities must be solved before the valuation method can be absorbed directly into the firms' strategy process. We claim that the philosophy behind the ROA has a lot more managerial value than solely the option valuing, at least nowadays.

6.2 Philosophical perspective

The ROA helps the management to take into account the multiplicity of the future, in contrast to the traditional investment evaluating systems. The management is usually more capable of identifying threats than opportunities, and the ROA helps to see whether an investment contains some exceptional possibilities. To have option value, the investment project should be sizeable enough, strategic by nature and it should not consist of an up-front, irrecoverable cost (Brabazon, 1999).

The ROA is a way to tackle uncertainty that is related to the investment proposals where greater uncertainty means a possibility of greater wins or losses, meaning that the ROA offers flexibility through restricting the downside risk while preserving access to the upsides (Belanger, 2001). Flexibility is what matters. Keeping the options portfolio unbound and recoverable, the management may have a possibility to attain the goal. The ability to delay and wait for further information before making an irreversible decision has value (Herath & Park, 2001). If the investment would result in a loss in any likelihood, the opportunity to delay the decision of keeping the option alive has value (Dixit & Pindyck, 1995).

The ROA also allows the management to try things out and wait when the alternatives seem too uncertain. The small steps made may give the firm an advantage over competitors by being better prepared for the future than them. The logic behind the real options approach is illustrated in Figure 6, which is a way to communicate and even argue different alternatives and decisions of the firm.

When an opportunity is detected in the firm, it has to make decisions on future actions. It has different kinds of real options, for instance the option to defer or stage the investment in smaller steps. If the real options are bypassed, the firm will probably commit itself to the investment totally.

6.3 Classification of options

The firm can have different kinds of real options, some of which have been listed in Table 1. There are

[1] *The real option is a right but not an obligation to take action at a predetermined cost called the exercise price, for a predetermined period of time, which is the life of the option (Copeland & Antikarov, 2001).*

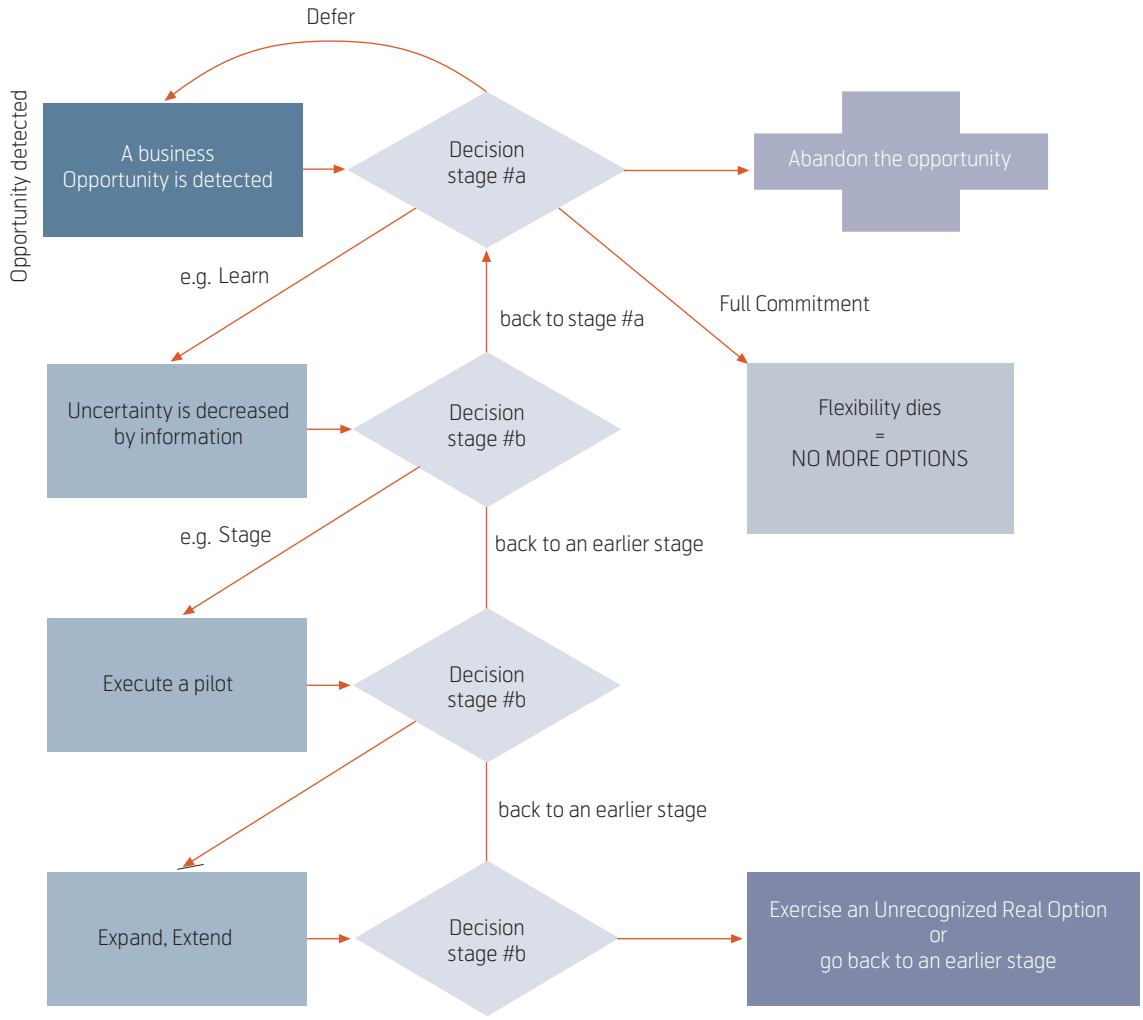

Figure 6 The logic behind the real options approach

options that the firm has in all situations (Määttä, 2002), such as *deferral* and *abandonment options*, meaning that the investment can always be deferred for instance in order to learn *or* the investment can be abandoned to avoid further *ex post* costs. *The option to contract, option to expand, option to extend*, and *option to switch* are options where the investment project can be scaled, switched, or scoped up. More complex option types are *switching options, compound options, rainbow options* and *compound rainbow options*. Instead of this classification, Latimore (2000) divides options simply into *growth options* and *flexibility options*. The first group concerns how the firm is able to increase its future business and the second group concerns how the firm is able to change the course of its plans in the future.

⇒ Deferral option	⇒ Switching options
⇒ Option to abandon	⇒ Compound options
⇒ Option to contract	⇒ Rainbow options
⇒ Option to expand	⇒ Compound rainbow options
⇒ Option to extend	

Table 1 Different types of real options (Copeland & Antikarov, 2001). The firm may have different kinds of real options for each decision situation

7 IMAS and ROA

The question of what kinds of real options the firm may have concerning the IMAS scenario is very relevant. We will now take a closer look at the options the firm may have when thinking about investing in IMAS. When the firm has a right to delay the investment or the investment can be temporarily set aside, the firm owns *a timing option* (a deferral option) to accumulate its knowledge to reduce the uncertainty instead of committing itself (Brabazon, 1999), remembering that additional information combined with prior information does not completely eliminate the uncertainty (Herath & Park, 2001). Because the integration of mobile applications and services is technically difficult (the possibility of success is low)

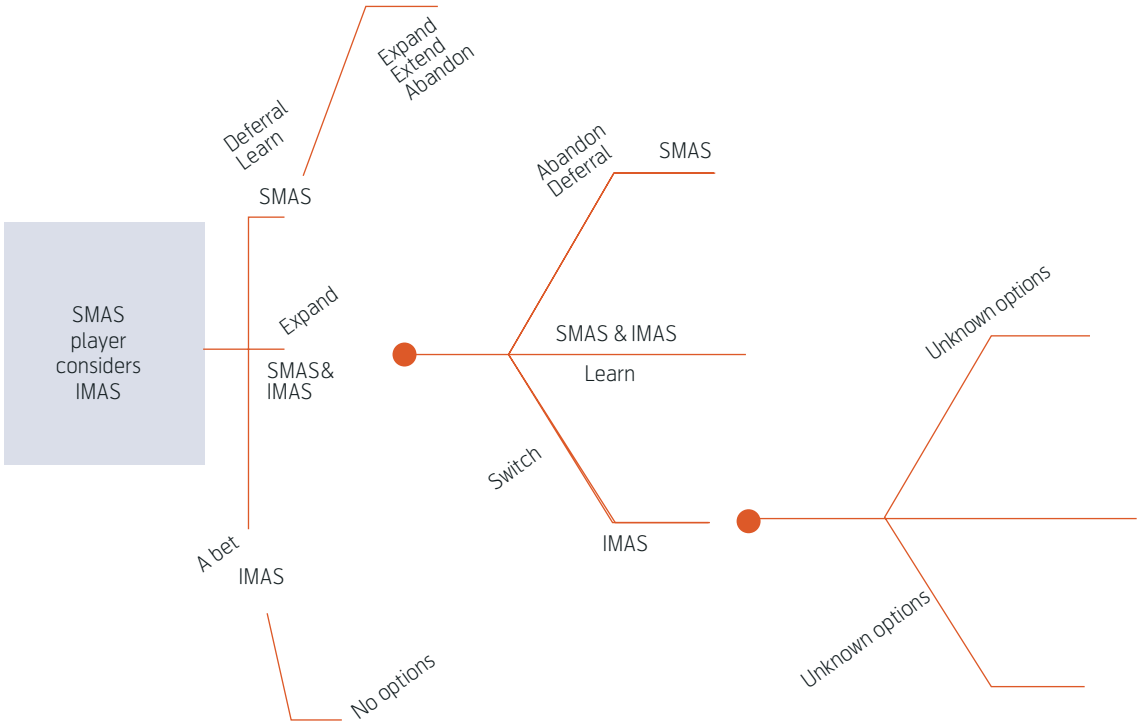

Figure 7 Illustration of some options the SMAS player may have SMAS player is considering taking the IMAS in the business portfolio. It can form a map of its options as presented in this illustration

the value of deferring and learning is high. Learning more about IMAS can lead the company to form a coalition with another firm to think about IMAS, for instance.

It is a question of *growth option* when an investment can be scaled up if new, favorable market information emerges. This kind of option means that the firm has already found out how the IMAS works. If it has had some successful pilots, the firm is able to extend its investments. This means that the firm will later extend or expand its business to new areas.

When the firm has an ability to switch the inputs to or the outputs from an investment, we say it has particularly valuable *switching options* in a situation where competitor actions and market demand are difficult to forecast.

When the firm has an opportunity to shut down the project before the end of its lifetime the firm holds *an abandonment option*, having an ability to prevent any further losses. This option is crucial as the IMAS is concerned. The chance of success in a relatively short time is not likely but possible. The experiences may lead to a success, but on the other hand, the firm has to be prepared to abandon the idea for an indefinable time. An abandonment option may also be executed if the market potential of the selected application area of IMAS is considered infeasible.

In the case of the firm having a bundle or a sequence of merged options we can talk about *Compound/ Rainbow options*. In addition to the above mentioned options, the firm may have firm specific options that have to be recognized.

Based on the above, we can identify a range of different option types that are related to the future IMAS business. The mentioned options are general options, and the real options are very often firm specific and have to be considered in the scale of the firm or the industry.

The decision-making process and pondering on an innovation with the ROA start by identifying the real options of the investment, and then evaluating the investment's real opportunities and challenges instead of any numeric values or probabilities. When the tree of choices has been built, it is time to think how much money is related to each opportunity and real option. If we end up using the binomial model, we can also think about the possibilities of each step. In Figure 7 a 'Separated' Mobile Applications and Services (SMAS) industry player is considering its options concerning business in the area of IMAS.

A company that is doing business with separated and distinct mobile applications and services basically has three alternatives. It can stay in the present SMAS business, or it can switch directly to the IMAS busi-

ness. The third and most recommended alternative is to take the IMAS into the business portfolio, as a growth option. All three choices include real options, of which the most important are the option to defer, the option to stage, and the flexibility options. With these options the company is able to decrease the uncertainty related to the IMAS and avoid unnecessary losses. The timing of executing the option is important. Both internal and external developments have to be taken into account. The options are not alive for ever and their value decreases over time.

From an individual firm's point of view, for instance the interest in the possibility to collaborate depends on the rate of technological and market uncertainty and needed investments. If the technological solution for the IMAS is relatively easy to find, there is no so-called real option value concerning technological uncertainty, but there might be extremely high market uncertainty that has value. A common platform for bundling mobile applications and services is seen to be a way to collaborate and save development costs. The gain for those who are in the front line will be the-first-mover-advantage. They can take advantage of the standards faster than those who are not collaborating.

8 Conclusions

This paper has offered new ways of thinking for the development of the next generation mobile applications and services. The statements concerning the current mobile applications and services have mainly been made from the user point of view. The paper has provided ideas for the future directions of the development of mobile business, which we call Integrated Mobile Applications and Services (IMAS), from the Real Options Approach (ROA) point of view.

The market for mobile services and applications is rather young, but already there are a lot of different kinds of services and applications. As the number of different kinds of mobile applications and services has increased, there is a need for IMAS to make them less complex and more attractive to users.

The mobile business is today concentrated in 'silos', dividing users in groups based on the environments they operate in. Within these environments and groups different kinds of services and applications are offered, which have been developed for particular purposes only – these applications and services have no interfaces which would link them together.

Changing the concept of user (or customer) can crash the silos. The environments the user moves in should be handled as one area where the user regardless of role or situation maintains appropriate access to services and applications without the irritation of distinct and separated services and applications. Comprehensive understanding of ultimate user needs requires new kinds of user integration mechanisms.

In Finland, some leading companies such as Nokia, have created scenarios (Ojanperä, 2003) about future mobile applications and services, which support the vision of IMAS. However, the scenario of IMAS is risky from one firm's perspective. To integrate applications and services there should be technological solutions that would bundle the applications and services together. As the development of IMAS may require a strong collaboration at value chain level (including users), a great part of the options related to investment opportunities should be evaluated together with other value chain actors.

The ROA provides a means of structuring and managing complex decision-making situations on how to keep options open while taking steps towards future business environment. The ROA can be used as a decision-making framework or 'philosophy' to handle competing strategic investments – in our case the use of ROA was illustrated through the IMAS case, which could be one potential future track in mobile business.

The use of ROA in strategic decision-making concerning future business should be started in practice from applying the philosophy itself. Once the basic ideas are understood and applied, it is appropriate to try to apply the valuation principles of ROA.

A rich landscape of integrated mobile applications and services is upon us as soon as the underlying mechanisms have been researched and developed in terms of technological integration, converged business models, role-centered user needs and user integration mechanisms.

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Section 3 – Innovation and IPR

HAAKON THUE LIE

Haakon Thue Lie is partner in Leogriff, a consulting firm in Intellectual Property Rights development and management

Intellectual Property[1)] is abbreviated to "IP", and I have confused former telecom colleagues by saying I now work for Leogriff and specialise in IP development and management. "Whoaah, Internet Protocol, that's exciting!" would be the answer, and I would have to explain that my IP is even more interesting. Intellectual Property Rights (IPR) are almost synonymous to IP, and to avoid confusion with TCP/IP we prefer that term. IPR are the legal rights that you have or may register, and they may vary from country to country.

As IPR depend on national legislation, there are international conventions and even a UN body, the World Intellectual Property Organisation in Geneva, that coordinates the practical organisation of many an international agreement on IPR[2)]. As trade becomes more global, international rules for trade with IPR have been needed. The World Trade Organization (WTO) has three pillars – GATT, GATS and TRIPS. The two first agreements are on goods and services, whereas TRIPS' perspective is to "encourage protection and trade of ideas"[3)]. This aspect of free trade agreements is important, because it means that the various legislations must be harmonised. This is why e.g. Norway has had a long discussion on biotech patenting, nicknamed "patent on life" or why it is so hard for the EU to agree on software patenting rules similar to those in the USA. Discussing IPR and standardisation makes much sense because they meet as a result of this globalisation.

When IPR is so important that both UN and WTO bother, one may presume that top management in most companies have a clear understanding of how they should handle IPR, and how "protection and trade of ideas" relates to their innovation strategy.

"IPR strategy starts at the top of the company, or you cannot make it work," says Chris Winter, Managing Partner of NVP Brightstar – the corporate venturing and incubation enterprise resulting from the merger of the venture arms of Lucent Technologies and British Telecom. Unfortunately, according to KPMG's Intellectual Gold Report in 2002, 40 % of large European companies still have IPR entrusted to the Legal Department, and only 24 % actually have a Director of Intellectual Property.

IPR strategy should be a core brick of the overall corporate strategy typically defined by the Board. At least one board member should therefore be well versed in comprehensive IPR issues and should be the anchor point for any profound IPR-related organisational change initiative. Chris Winter of NVP-Brightstar considers the full engagement of an influential board member to be absolutely critical. Only 28 % of the above KPMG-surveyed companies however "consider IPR important enough to be handled by a board member".

Because IPR require competence, long-term ownership, and a strategic view, it makes sense to manage IPR centrally – and this is often so in practice. However, IPR departments tend to be part of the Legal Department, which is typically a cost centre. Potential profits are not visible, other issues get prioritised and the IPR budget tends to be slashed in periods of cost cutting. Paradoxically, companies such as IBM, Bell South, and the Norwegian state oil company Statoil, which have organised their IPRs as profit centres, have reaped the benefits. These lean organisations have a strong business focus, are autonomous and daring, and 'go and get' inventions in the labs. These companies tend to become profitable and are ready to invest in further inventions after a certain period of time (5 to 10 years generally when starting from scratch). Another consequence of being part of the legal department is that it will by nature focus on the legal details, and other short-term corporate business will have priority. IPR strategy needs a mix of legal, technology and business focus, assembled together in teams or in individuals with hybrid experience, and with a long-term dedication.

A well-designed IPR strategy is the necessary instrument to increase competitiveness and mitigate risks for the future. Implementing such strategy demands

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1) Intellectual Property can be patents, trademarks, domains, design, copyright and trade secrets. Good starting points for learning more are http://www.wipo.int/about-ip/en/overview.html and http://www.ipmenu.com.

2) http://www.wipo.int WIPO administers 23 treaties spanning from the Nairobi Treaty on the Protection of the Olympic Symbol (!) to the better known ones on patents, trademarks and copyright.

3) http://www.wto.org/english/tratop_e/trips_e/trips_e.htm

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an engagement across the whole organisation, affecting projects, processes, and the culture of the company. The IPR strategy should be designed and reviewed collectively by the Board and top executive management. Finally, an IPR profit centre provides the best organisations with the ability to support proactive IPR strategies.

However, working with IPR is not only about strategy. IPR focuses R&D on uniqueness, triggers creativity, invention and innovation. Snorre Kjesbu is now Vice President, Innovation at Tandberg ASA. In 2002, then at ABB, his team won the prestigious Wall Street Journal Innovation Award for its development of wireless sensor technology. He says: "During that project, we filed for numerous patents. The future effect is that ABB will own a valuable technology. But the immediate effect was even more important. The focus on finding the uniqueness in our development work and describing it clearly, boosted inventiveness, market orientation and created new and improved solutions".

Haakon Thue Lie (40) has an MSc (NTNU – Telematics – Trondheim, Norway) including a degree in pedagogy, and a Master of Management (N.S.M. – BI, Oslo, Norway). His background was from project- and line management of technology and product development, before he started working with intellectual property rights in relation to R&D management and business development. Haakon was responsible for patents, licensing and spin-offs from Telenor R&D in the late 1990s. Before starting Leogriff he also worked with an e-learning company, responsible for their line of IT training products. Haakon speaks frequently on IPR and valuation of technology.

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Innovation, uniqueness and IPR strategy

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Identifying unique ideas and turning them into income-generating products, the purpose of innovation, is part of most companies' business strategy. Uniqueness does not necessarily lie in technology; it can also be found in a way to address the market, in a new branding or in a new customer process.

Uniqueness will make the customer return. An organisation should ensure that ownership of unique assets is transferred from the employee's head to the organisation. Otherwise, the organisation may be deprived of clients the day the critical employee leaves.

An organisation needs a strategy, policies, and processes to accompany these generation and transfer processes. That strategy should interfere with other strategies, such as those for HR, R&D, Finance, Branding, Marketing. Also – the strategy needs to build awareness regarding IPR owned by others.

Innovation, uniqueness and IPR

The unique assets of a company are what sets it apart from other companies and hopefully makes it a preferred choice – for its customers, employees and shareholders. The uniqueness can be real – as a measurable set of characteristics of its products or services – or perceived – such as quality of brand, values associated with the company, shopping experience and so forth. Of course these realms are not mutually exclusive, but they do not have to be connected. Real uniqueness can be perceived by the company's customers, or it may not. Similarly, perceived uniqueness does not have to be based in any real quality of the company's products – it may simply be the result of branding, image and marketing strategies.

When it comes to innovation, uniqueness can still exist in the real or in the perceived realm. It is possible for a company to be perceived as innovative without actually contributing anything new, except maybe in the way it presents itself to the public. However, for most companies basing their public image on innovation it is important to actually be creative in the realm of product development and be able to communicate this to their customers. After all, innovative product development should not only result in a strengthening of the market potential of the improved products themselves, but also of the image of the company – innovation should strengthen the perceived uniqueness of the company.

Because of this effect of innovation on the products themselves as well as the public image of the company, protecting the results of innovation does not only protect the products or services, it is also a way of building and reinforcing uniqueness, and – as we shall see – it can also be a way of communicating uniqueness.

Innovation can take many forms. What most readily comes to mind is probably the improvement of technologically advanced products. But innovation can also involve improvement of the processes used to create the products, the design of the products, the infrastructure used to deliver them, the way they are marketed, and so on. For all these aspects of innovation, IPR gives us tools to protect, encourage and leverage on innovation.

There is a close relationship between innovation strategy and IPR strategy. An Innovation Strategy without an IPR strategy is very bad risk management – you innovate without thinking about ownership and infringement of other's rights. On the other hand, an IPR Strategy without an Innovation Strategy may make sense. A company competing on price only – and not on innovative products – may be well served by exclusively building a strong brand using fancy design and building up (or buying) strong trademarks. Similarly, a company in the entertainment industry may rely exclusively on copyright.

Market leaders have clear IPR strategies: they have identified the unique assets that make them competitive and have made decisions about how to exploit and protect those assets. Patenting may indicate an IPR strategy, but not necessarily: Some organisations have as their strategy not to patent but to publish, while others patent "at random", according to the individual project manager and ad hoc decisions. In the first case an IPR strategy exists despite the lack of patenting, while in the second case patenting may indicate an IPR strategy where in reality there is none. However, to the extent that an IPR strategy leads to increased patenting (and there is no other objective and publicly available indicator) the corre-

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lation between market success and IPR is shown in studies[1)] and statistical data is published yearly[2)].

Consequently, an IPR portfolio, and patents in particular, becomes a powerful way of communicating uniqueness. When you have uniqueness, you are also in a good position for trading and sharing those assets, and that can create even more value.

Gerard Kleisterlee, CEO of Philips, says "We use our patents more and more as a tool for sharing our technology with other companies, for example, by licensing our patent". A Philips press release complements this with, "In the past, patent applications were mainly filed to safeguard Philips' exclusive use of its innovations. Nowadays, value creation is the central strategy. Value can be created by Philips' own use of a patent, but also through the sale, licensing, exchange or pooling of patents …"

To create value from uniqueness and innovation, IPR strategies must be implemented at all levels of the organisation, not only in R&D, but also in the production, sales and marketing departments.

Understanding value creation and IPR

The Intellectual Capital Model can be used as an illustration of Value Creation Processes.

Human Capital (employees) interacting with suppliers, partners and customers, build Relational Capital (image and brand, well-functioning collaborations, general goodwill) resulting in Structural Capital, e.g. value stored as Customer Relation Management systems, effective work processes, and IPRs. In turn, this increases revenues: Financial Capital.

The Intellectual Capital model, dating from the 1980s, is still used by many companies ranging from Dow Chemical to Norsk Tipping (the Norwegian State Lottery). It helps communicate and discuss value creation dynamics within and outside the organisation. It can be measured in financial reporting, or can be associated with other management control systems, such as Balanced Score Card or Total Quality Management. The model is far too simple to explain how things happen in an organisation; it is even dangerous because it looks as if value creation is a linear process that can be easily measured and managed (so many organisations, including Telenor, have more sophisticated and non-linear models). A useful approach, however, is to think of the model as a way to discuss where the unique assets are created, how it is transferred to the company, e.g. by using IPR, and where the competitive advantages are.

In this way, it is possible to discuss the IPR strategy based on an understanding of the capacity in the organisation to

- Exploit IPR and transfer it to Financial Capital;
- Create and Acquire IPR.

In addition, when understanding uniqueness is the mindset, such models give some understanding on how Innovation and IPR are related.

Building and anchoring an IPR strategy

An IPR strategy defines the framework and objectives of optimal development and exploitation of intellectual assets essential to a company (i.e. the ones that make the company competitive). It is one of the pillars of sustained growth: you must have strong ownership and control of knowledge.

The following issues will often be part of an IPR strategy:

- Secure current technological and market position;

- Ensure freedom to operate for the future;

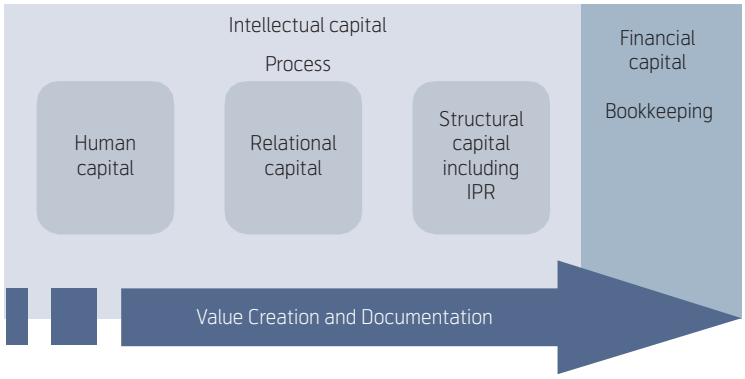

Figure 1 The focus of Intellectual Capital is on the process for creating value. The focus of Financial Capital is on bookkeeping, i.e. documenting the capital. Value is created by bringing human capital towards structure and documentation. This is of course not a linear process[3)]

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1) *Tim Jones, Innovaro: Innovation Leadership: Identifying and understanding the top performers, 2002.*

2) *MIT Technology Review Patent Scorecard – http://www.technologyreview.com/scorecards/patent_2003.asp*

3) *An interesting discussion is at Jan Taug "Intangibles and Capital Conversion" 2003, http://www.taug.no/article/articleview/92/1/4/*

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- Restrict development of competitors in identified areas;
- Conquer new markets (industry sectors, countries);
- Build up portfolio for 'swaps' with competitors;
- Increase or create revenue streams from IPRs, e.g. licensing deals;
- Communicate value to owners, funding institutions, investors, employees;
- Convert 'know-how' into formal assets: ensure critical and proprietary know-how does not leave the company.

IPR policies give guidelines on how to implement the IPR strategy, define how value is to be created or acquired by the company, and how it is to be exploited and protected. Such policies are essential in order not to waste human and financial resources and can cover:

- The organisation, processes and resources for screening and developing 'good ideas' and turning them into IPRs;
- The organisation, processes and resources to take care of the IPR portfolio;
- Exploitation and protection for 'good ideas' that are part of the core business;
- Exploitation and protection for 'good ideas' that are not part of the core business;
- Ownership and rewards of IPRs generated within the company or in collaboration with other companies.

The IPR strategy requires resources, not just talk. A strategy without an implementation plan and budget is no strategy. 'Resources' here refers to time from people that often already are critical to the Company in other areas. It means best practice processes to manage IPR issues and it means money both to formalise IPRs and to defend them.

Defining an IPR strategy

An IPR strategy is by its nature at the core of the company since IPRs are about uniqueness, i.e. about that which makes the company competitive – and should be discussed by the board[4)]. Management from all critical functions, such Marketing, Finance, R&D and Human Resources must therefore be involved in its definition, and it should

- Be initiated and driven by top executive management and/or the Board;
- Involve all critical departments and functions;
- Identify current and future assets 'unique' to the company;
- Define principles for exploitation of these assets;
- Explore possible protections for these assets;
- Decide on protection philosophy;
- Assign targets, responsibilities, resources.

IPR in research and development projects

IPRs tend to be downgraded on the priority list of Project Managers (PMs). Why should a PM, rewarded on his/her optimal use of time and resources to deliver a specified product, worry about abstract future-oriented IPRs, knowing that IPRs will probably not be granted before the end of the project anyway?

There are several factors that may help the PM:

- A well-trained and well-informed steering committee can remind the PM of his/her strategic aims with the project;
- The correct incentive policy will not distort the objectives of the PM exclusively towards the completion-budget-product specification trio;
- The correct product development process will give focus to the PM;
- A dedicated IPR budget allowance removes any financial conflict within the project;
- Finally, a well designed organisation taking over the IPR development and management from the project at its completion ensures continuity.

IPR issues in a typical product development process

This process starts with the identification of an idea and, if all steps along the way are successful, ends with commercialisation. Several IPR issues are to be considered (refer to the checkpoints in Figure 2):

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4) According to KPMG's Intellectual Gold Report in 2002, only 28 % of companies however "consider IP important enough to be handled by a board member".

1. Evaluate the idea: Is it new? Is it useful? Can it be developed in-house? Will IPR be of any use, and if so, what types of IPR?

2. Competitors: Is there a risk of infringing their IPR?

3. Contracts with employees/consultants: Who owns generated IPRs?

4. Technology partners: Sharing mode for generated IPRs, exclusion of pre-existing know-how?

5. Funding partners: Conditions attached to funding (ownership, dissemination)?

6. Sales partners: Land/sector/client attribution of rights?

7. Project management board: Will it keep the Project Manager focussed on strategy issues, such as how the product will be commercialised, and thus how it should be protected?

8. Exploitation: Patent and market landscapes for the product?

IPR in company culture

When inventive employees and other contributors are rewarded for their ideas through bonuses (Nokia), lunch with the CEO (ABB), framed IPR certificates in the canteen (Ericsson), or when L'Oréal advertises "493 patents applied in 2001 for your beauty and health", IPR awareness in the organisation grows, increasing the reservoir of employees willing to contribute to value creation.

All employees and collaboration partners (contractors, consultants, suppliers) are potential contributors, whatever their skill-base or hierarchical position, and they must therefore be encouraged and rewarded.

After having defined an IPR strategy and policies, organisations need to implement them on projects, in order to validate and communicate the new strategy. IPR should be incorporated in work and quality processes, so as to secure the position of IPRs in all activities. Finally, the culture of the company should be adressed, through rewards and incentives, recognition for the inventors, policies for spin-offs, and incorporation of IPRs in the values of the company.

Telecom companies benefit from having an IPR strategy

In the telecom industry, operators as well as equipment manufacturers invariably present themselves as innovative; what they deliver to their customers

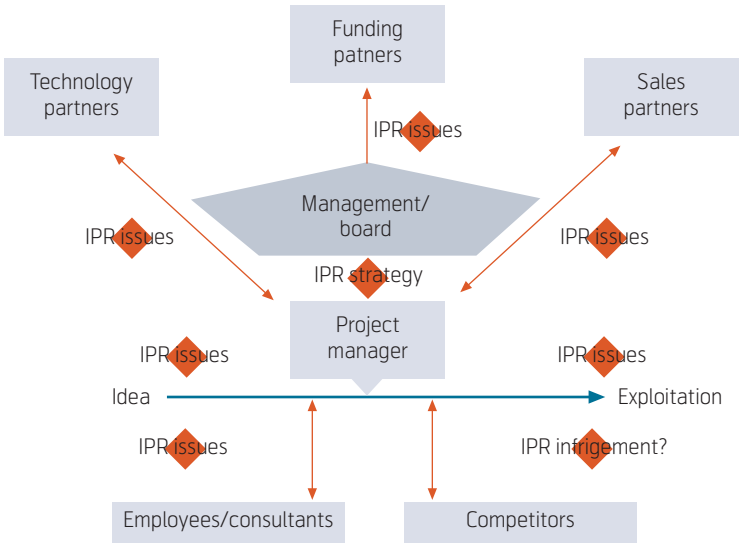

Figure 2 An R&D project with eight checkpoints relevant for the project manager and the steering group or board of that project

is new possibilities and ease of use. Their solutions facilitate communications between people; their technology does not represent hurdles customers have to overcome. Just think of slogans like Nokia's "Connecting people" and Telenor's "Ideer som forenkler" (Ideas that simplify).

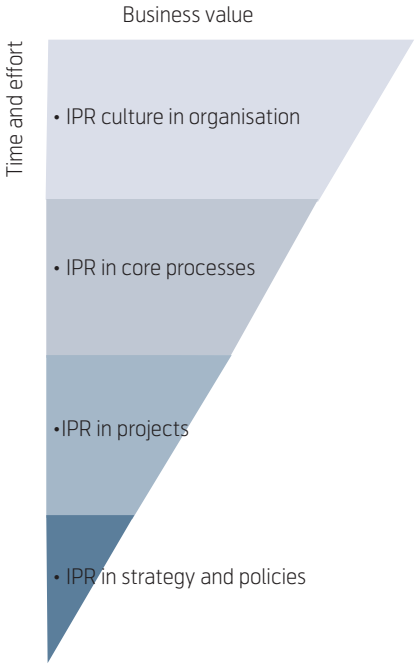

Figure 3 It takes little effort to define a strategy and policies for IPR, and it does not create much value. An organisation needs to implement the strategy in projects and in the core processes. Then the IPR strategy can be sustained by promoting a culture, e.g. by rewarding and talking about IPR

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In order for this message to come across as credible, and to be sustained over time, companies will have to deliver. Their customers' experience must be in line with the image the company is projecting. And if this is going to happen, the company must accurately identify and protect the features that are creating customer satisfaction. It could be technical features, it could be service and support, it could be customer experience associated with content or user interfaces. It could even be qualities associated purely with branding or pricing. But in any case the company must know what it is, improve on these qualities, communicate the improvements to the market and ensure that their success is not easily copied by others. IPR provide tools that can help with all of this, but only if it is addressed at a strategic level through an IPR strategy that aims at protecting, building and communicating the company's uniqueness.

For a presentation of Haakon Thue Lie, turn to page 59.

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Standardization, innovation and IPR

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Patents and other industrial IPRs have the potential to undermine the collective pursuit of a technical standard that might serve the common interests of the sector or industry. This tension between the individual and the collective, between the development of technology and its diffusion, is by no means new; it is an inherent feature of standard development as an institution of innovation. The premise for this article is that the scope for conflict has increased over time. The increasing prevalence of the conflict raises a set of challenges for policymakers, patent offices, standards development organizations, and businesses. The article contributes to increasing awareness in these environments.

1 Introduction

In an unprecedented move, a standards body recently (November 2003) petitioned the United States Patent and Trademark Office (USPTO) to re-examine a patent, which it claims should not have been granted. One of the complaints the standards body made is that the patent office was wrong to issue the ('906) patent[1)] because the extension of exclusive right to the technology in question could hamper the future development and use of HTML, the main language used on the web.[2)] The implication is that by granting exclusive rights on the particular technology, the patent office can inadvertently undermine wider innovation on the web.

The W3C's complaint is one of several current cases that illustrate that tension continues to mount between standards bodies and IPR regimes. It illustrates the scope for conflict between these two institutions and suggests that the underlying tension is intimately associated with the innovation of network technologies. This article reviews how the underlying tension between IPRs and SDOs has increasingly led to conflict. It looks to the touchstone of the conflict (in the late 1980s during the standardization of GSM), reviews some approaches to deal with conflict, and discusses how the conflict has evolved and what this might mean. The article frames this discussion in terms of the distinct roles that standards development organizations and intellectual property rights play in the "innovation infrastructure" and contends that this process is bringing what are initially complementary functions in the innovation process into increased confrontation.

2 An essential tension in the innovation process[3)]

The interrelationship between intellectual property rights regimes and standards development organizations is characterized by an inherent tension. This tension grows out of the fact that these institutions perform functions that complement one another in the innovation process. Conventional analysis of their respective roles provides an initial appreciation of how they can be construed as complementary and can thus indicate how tension might emerge between them.

2.1 An innovation perspective

Innovation is a complicated and heterogeneous process, the dynamics of which will tend to vary from case to case. In general terms the innovation process can however be understood to involve the sustainable generation, distribution and utilization of new economically-relevant knowledge which continuously accumulates and is recombined in the economy.[4)] This process boils down to an ongoing interaction between the generation of technological variety and its selection. There is a complex set of factors that induce and promote the creation of diversity and affect the selection process. It follows that there is likewise a complex interrelationship that keeps the virtuous circle of the two in swing. Intellectual property rights regimes and institutional standardization are two central institutions that play complementary roles in perpetuating such a balance. This section briefly looks at these roles, indicating the implications of the roles coming out of balance.

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1) *The patent in question is the "Eolas patent", number 5,838,906. It is already the object of contention in a case Microsoft fame, since Microsoft has appealed a patent infringement suit, entitling Eolas to $520 Million. See also Washington Post (Jonathan Krim), November 13, 2003*

2) *The standards body in question is World Wide Web Consortium (W3C)—a primary forum for internet standards-development. It is a standards forum or consortium and not a standards development organization.*

3) *This section builds on Iversen 2000a; 2000b.*

4) *E.g. David and Foray (1995).*

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2.1.1 IPRs

The economics literature tends to cast IPRs, particularly patents, as "appropriation mechanisms whose dominant function is to create an incentive for private R&D where the market does not".[5] The creation of an incentive to invent is one of at least three different ways in which patents, in particular, contribute to the promotion of technological diversity in the economy. Patents also publish details of the invention to the economy. In this way it also diffuses economically useful information to future or parallel innovative activities, thus fertilizing future inventive effort. A further function that is more and more important in a climate where inter-firm collaboration is more intensive, is that patents also help provide the basis for a desirable level of coordination of collaborative R&D activity. Patents regimes are therefore essentially a combination of an incentive-oriented "appropriability" mechanism married – in a certain state of trade-off – to a diffusion oriented disclosure mechanism (i.e. publishing patents). In other words, "patents are designed to create a market for knowledge by assigning propriety property rights to innovators which enable them to overcome the problem of non-excludability while, at the same time, encouraging the maximum diffusion of knowledge by making it public." (Geroski, 1995: 97)

2.1.2 Standards

In this "market for knowledge", IPRs are thus most often identified as a promoter of a diversity of technological ideas. An instrumental consequence is that IPRs lay the basis for proprietary technologies. In contrast, the role standardization, especially in standards development organizations (SDOs), plays in innovation[6] can be associated with a selection process to reduce variety and with the creation of non-proprietary goods; ideally, they work in the collective interest of all actors. In general the economics literature tends to associate the role of formal standardization with the idea of the 'failure' of markets. Schmidt & Werle (1998) indicate that the focus tends either to be on the reduction of transaction-costs, especially related to information, or associated with network externalities. Standards are associated with, among other things, reducing uncertainty by controlling variety; enhancing competition by clearly defining what is required to serve a market (information); constituting markets by defining the relevant aspects of products (Tirole, 1988); facilitating scale-economies for suppliers, or influencing the distribution of cost and benefits of building and operating large complex technical systems (Mansell, 1995: 217).

Standards play a particularly important role as 'selection mechanism' in the case of network technologies, where the importance of narrowing the diversity of network technologies in order that the industry can take advantage of network externalities is highlighted.[7] In short, network technologies are vulnerable to the generation of 'too much diversity'. These technologies rely on connectivity, and their worth therefore rises in proportion to their user bases. As a result, the unbounded proliferation of different, incompatible versions of an emerging radical technology may lead to a damaging Tower of Babel situation. The fight of individual alternatives to establish dominance in such a situation can be costly both for manufacturers, service providers and customers. In the end, a protracted fight for dominance might undermine the potential market for that emerging technology altogether, and remove it from the technology race. Networks will simply not be created in a sustainable way; the value of the component for the consumer will not be realised. Failing to amass a 'critical mass' of users, the technology risks missing its fabled window of opportunity. There are many examples of this situation of the type of Betamax or more recently of the CT-2/Telepoint system.

2.1.3 Division of labor

In short innovation is dependent on the dynamic interaction between variety-creation and an ongoing selection process. IPRs and formal standards development organizations play important roles in the innovation infrastructure to keep this evolutionary relationship working generation after generation of technological change. Figure 1 illustrates the stylized division of labor where IPRs, especially patents, are most closely related as incentive mechanisms to the continuous generation of technical variety while formal standards bodies, especially voluntary SDOs, are most closely related to selection from among the ripening variety of technological solutions.

In reality, the roles are not this clear cut. The way IPRs and SDOs are used mixes their roles with regard to the creation of variety and the promotion of selec-

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5) *See Arrow, Kenneth (1962). Economic Welfare and the allocation of resources for invention (in The Rate and Direction of Inventive Activity: Economic and Social Factors). For a recent empirical and theoretical contribution, see Cohen, Nelson & Walsh. Protecting their intellectual assets: appropriability conditions and why US manufacturing firms patent (or not). NBER Working PAPER No. 7552. Feb 2000.*

6) *See Iversen, 2000.*

7) *See Katz & Shapiro, 1985, Farrell & Salloner, 1985, David, 1987. For an alternate view – ie. that network-externalities are not important, see Liebowitz & Margolis, 1999.*

tion. On the one hand, the standardization process has moved further and further in front of the market, such that standards activities contribute to creating new solutions not provided for by the market; the semantic web standards are one example. On the other, the increasing strategic use of IPR to create defensive bulwarks against competing technologies for example can serve to mimic a selection mechanism; such strategies can limit the scope for competing technologies to emerge and therefore reduce the gene pool from which new combinations of emerging technologies can develop and recombine.

Indeed the interaction between variety and selection – and the roles of IPRs and SDOs in it – are much messier than the figure suggests. It does however point to an essential trade-off in the innovation process, it indicates the complementary roles of IPRs and SDOs, and it suggests the essential tension that underlies that relationship. In this setting, maintaining balance is important. Too much variety may be bad since, "variety conveys efficiencies in specialization and customization that are offset by the failure to achieve network externalities and other economies of scale" (Steinmueller, 1995). Likewise, the opposite may also be the case since, "in reducing diversity, standardization curtails the potentialities for the formation of new combinations and the regeneration of variety from which further selection will be possible" (David, 1995). Therefore, in the ongoing interaction between the generation of technological variety and its selection, "effective long-term adaptation requires that these two processes be kept in balance" (Carlson & Stankiewicz, 1991).

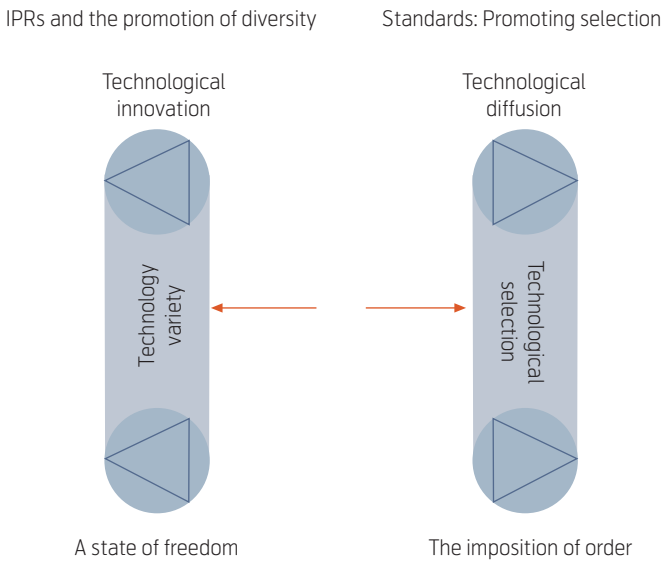

Figure 1 Stylization of the division of labor of IPRs and standardization in innovation

2.1.4 Emerging conflict

Since the mid-1990s, it has been observed (e.g. Iversen, 1996) that a set of forces has served to amplify the tension and has begun to threaten the balance. The prospect that the role of IPRs should come into conflict with the complementary role of formal standardization suggests that the way these institutions are each evolving is translating the inherent tension into conflict (Iversen, 2000b).

The potential for conflict between intellectual property rights and standardization arises when the implementation of a standard, by its essence, necessitates the application of proprietary technology. The case of 'essential intellectual property rights'[8] is implicit to the tension between the two institutions. When a standardization development organization starts work to codify a standard specifications for a telecom system it will be working in an area where private agents have already researched and perhaps developed proprietary technologies. The risk that may emerge is that the codification of the standard specs will infringe the proprietary rights described in the IPRs of one or more such agents. The IPR will be considered 'essential' if the standard, by its depth and detail, necessitates the use of the proprietary technical solutions describe in it. Should it do so, the collective interest in the standard confronts the private interests of the IPR holder.[9]

A court is ultimately needed to establish whether or not the IPR (patent or software-copyright for example) is really 'essential'. At the same time, a court case would require considerable time and resources, and could jeopardize the collective standardization enterprise. So the difference between an IPR that is in reality essential and one that is potentially essential is not that great after all: both cases threaten to tie up the standardization process. Essential intellectual property rights in this sense should be further differentiated from 'Blocking IPRs' which definitively block the process.

2.2 The business perspective

Before looking at what situations blocking IPRs present for business, this section first reviews the potential benefits of standardization in today's world.

8) *For a description of the possible outcomes, see Lea & Shurmer, 1995. See Iversen, 1999 for the way ETSI IPR Policy addressed such outcomes.*

9) *See Miselbach & Nicholson (1994) for a description of essential IPRs.*

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2.2.1 Business in a standardizing world

Business is increasingly aware of the benefits of standardization. The standardization processes taking place in the formal settings of ITU, ETSI and IETF – as well as in industrial standardizations forums is taken seriously by businesses. Yet, not all companies have the resources to follow standardization activities; to contribute and try to get preferred solutions accepted is even more time consuming. Patenting is also expensive and time consuming. As indicated above, similarities do not end there. Both patents and standards are ways of codifying technology and, thereby increasing increased use and increased innovation. This means that any company that has a strategy that encourages competitors to use their technology will benefit – in theory. If the market adopts the technology, increased volumes will lower production costs. This is the effect of making a technology public.

This is what IBM and others have done with the PC market. IBM continues to profit from that strategy in part because they continue to license out technologies related to PCs. The basic technology for the PC is free, but there are many improvements for which IBM holds patents. So they developed an innovative strategy for licensing which roughly entails that they forgo suing PC manufacturers for patent infringement where "infringers" buy IBM hardware like disks and pointing devices.

Now, the PC standard is not a formal standard produced by a standardization body. Instead it is (a set of) de facto standard(s) that have evolved continuously the last twenty years. IBM released the original AT specifications but then tried to force the Micro-Channel Architecture (a 16- and 32-bit bus standard) onto the hardware manufacturers. They objected, and the PCI standard evolved, which has now been replaced – but still most PCs have PCI-slots for add-on hardware. There are many vital parts of the PC-architecture that IBM lost control over (from processor and bus to operating system), but still IBM manages to earn money from licensing PC-related technology. This illustrates how a large industrial actor can benefit from spreading its own technology rather than using the exclusionary possibilities of IPR. Norwegian examples are how the Nordic Telecom Administrations opened their specifications for the mobile technology NMT.

2.2.2 Standardization in a business world

The link between a standards process, especially a continuous one in the software world, and business can be even closer, as the collective standards efforts take on the aspect of product in marketing. An increasingly prevalent tactic is that standards are branded and marketed as brands. This raises new considerations.

XML is a strong brand. It is however not a registered trademark, and the effect of this is that a company does not need a license from a standardization forum to state that a product is based on XML[10]. The same goes for e.g. MP3 – the digital audio format[11], which has even become a consumer brand.

For MP3 there are registered figure marks, but Thomson, who license the patents, do not require a licensee to use a particular logo, neither do MPEG-LA who do the licensing for MPEG-2 (used for your DVD-movies) and MPEG-4. MPEG-LA has a voluntary option to mark products that they are "licensed by MPEG LA®" – but that is hardly good brand building. A CD-player or most CD covers will include the "Compact Disc" logo that is a part of the licensing terms from Philips. Philips has full control over essential CD patents, so they can dictate such mark-

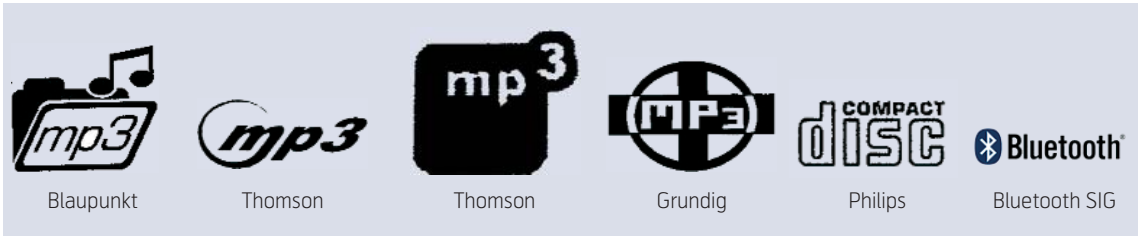

Figure 2 Some registered trademarks for standards and their owners. The Blaupunkt and Grundig MP3 versions are used proprietary. The CD logo is used on all CDs. A similar logo exists for DVDs. The users in an interest group own the Bluetooth trademark jointly

10) *XML as an industrial standard is promoted by OASIS http://www.oasis-open.org/. See also http://www.xml.org and http://www.w3.org/XML/. XML was originally developed at the World Wide Web Consortium – W3C http://www.w3.org*

11) *MP3 is the nickname for layer 3 of MPEG1 and was developed by Fraunhofer and Thomson, see http://www.iis.fraunhofer.de/amm/. It is now an ISO standard, and Fraunhofer's patents are licensed by Thomson, see http://www.mp3licensing.com/ See http://www.mpeg.org/MPEG/mp3.html#licensing for papers on MP3 and IPR.*

ing. As the CD-format now is so established nobody thinks of the branding work and how it competed with e.g. Sony's MiniDisc. Nowadays there is not much to gain for a company in promoting their products as Compact Disc compliant.[12)]

The Bluetooth Special Interest Group (SIG) has developed a very successful branding programme:[13)]

> *"The Bluetooth logo is a licensed trademark of the Bluetooth SIG, Inc. Anyone wanting to use the trademark for commercial purposes must be licensed to use it. Licensing is simple. It only requires you to become a Bluetooth SIG member. You may do this by going to the www.bluetooth.org website and follow the instructions for becoming a member. Adopter level membership is free, but requires that you sign the Bluetooth Trademark Licensing Agreement, thus allowing you to use the logo for all purposes."*

This promotes consistent use of the Bluetooth trademark and is a powerful way of promoting the standard. So any adaptor of that technology gets marketing assistance and accesses to a brand. This effect of standardization is more and more taken into consideration in standardization forums; other examples include how Apple licensed for free the FireWire brand for the IEEE 1394 standard and the logo programme from USB Implementers Forum for their competing standard.

During any standardization process the participants will be asked what IPR they have related to the standard, and whether they are willing to license their IPR using "RAND" terms, i.e. Reasonable And Non Discriminatory terms. Statements about this are usually published at the website of the standardization body.

A patent is the only way to get a legal monopoly in the private sector. When including patented technology in a standard, the owners are asked to waive the rights of refusing their fiercest competitors to use that technology – and to agree to stick to a price that is equal for all licensees. This is the trade-off for submitting a technology to a standard, and the return can be:

- A widespread use of the technology;
- Easy identification of licensees, as they will say they follow the standard when promoting their products;
- Help spot infringers, as licensees will tell on others not paying license fees;
- A patent pool[14)] that can help to establish a licensing programme.

For a company that will earn money from sales of the services or goods that are covered by the patents, it may be of little interest to earn money from a licensing programme. The main income will anyway come direct from their customers, and setting up a licensing operation, even through a pool may be a nuisance taking the focus away from core business. But for an R&D institution or for a small high-tech company, this can be a good way of recovering R&D costs. It takes a long time however to establish a pool, typically five years. This is not a good economic incentive for most organisations where the return horizon is less than three years.

For companies like IBM, Ericsson or Philips, which have large patent portfolio and culture focusing on IPR, it is common to use standardization combined with IPR for business purposes. For smaller companies, like eZ systems discussed in a case later in this article, it is difficult to participate in the standardization processes, but successful products can be developed based on standards and IPR used actively in the business model. Standards are now branded actively, and Bluetooth ® serves as a good example.

2.2.3 The balancing act

Standardization involves a trade-off between ensuring rapid deployment of a standard in the market place and maximizing profit on IPR. Time-to-market or time-to-money are two of the key decision factors for a telco when it introduces new services. International standards may be a catalyst for value creation if the actors across the value network adopt the standard. In the case of MPEG-4 (below) it is important that the chain from content provider to service provider, to network operator to end-user (terminal equipment) has adopted the standard. The sooner a standard reaches market-wide acceptance, the sooner the commercial success for the telco, as the economy of the

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12) *The DVD logo and format is licensed by DVD FLLC, see http://www.dvdfllc.co.jp/ for licensing terms.*

13) *https://www.bluetooth.org/bluetooth/landing/brand_tools.php*

14) *Patent pools are discussed many places in this article. A good overview is in "Robert P. Merges – The case for patent pools", 1999 – http://www.law.berkeley.edu/institutes/bclt/pubs/merges/pools.pdf. Many more links and information can be found at http://www.cptech.org/cm/patentpool.html.*

telco is largely based on volume of transactions (e.g. completion of a call or number of bits transferred).

One of the main forces inhibiting rapid deployment of a standard is the battle between the vendors implementing technology based on the standards, as they want to maintain their uniqueness and maximise return on investment on research and development. This behaviour is very closely linked to the business models for the technology vendors that are usually licenses based on software, and per unit based for hardware. An open question is whether business models that are more closely linked to the success of actual services from the telco, would be more beneficial for both the technology vendors and the telcos. However, one obvious disadvantage for the technology vendors would be that "time to money" increases.

2.2.4 Facing up to blocking IPR

However, the interaction between business and standards increasingly raises the situation of the essential and blocking IPR. A blocking IPR can be a result of two main situations for companies. In the first general set, the IPR holder refuses to license or refuses to on a basis that is considered fair, reasonable and non-discriminatory (see below). The threat to withhold IPRs in this situation may be used as a bargaining chip. A flat refusal would be regarded with extreme suspicion. The existence of essential intellectual property rights among individual rights-holders outside the standardization work is much less predictable. Absent the necessary search processes, such rights may appear at any time during the life of the standard. The willingness of the rights-holder to license at agreeable terms is likewise not a bygone conclusion, especially if added to already agreed upon royalty-schemes.

The second set of cases involves a plurality of rights-holders. The relevance of this case – that more than one right held by more than one rights-holder – is itself testimony to the fact that intellectual property rights and the work of standards development organizations have become much more inter-tangled. A variety of rights-holders complicates the licensing process which is supposed to be fair both for the licensee and licensor. What happens when the cumulative royalty costs, while fair to the individual rights-holder, become too high for a potential licensee? The short answer is that the standard would die. This raises the question of different ways to address cases of conflict, which are becoming more and more common. Finding solutions to new challenges in the interaction however does not happen by itself.

3 Cases of mounting tension and conflict

By late 2003, a single SDO (ETSI[15)]) reported that 95 companies had claimed 8,800 IPRs essential or potentially essential to the organization's work.[16)] Twenty years ago, things were significantly different. No record would have been available, for one thing. For another, the assumption would be that there would be few if any essential IPRs. In a relatively short period of time, essential patents have gone from being an exception to being the rule. This section will review some of the cases of conflict that have emerged over time indicating that the number of cases of conflict has proliferated in number, type, and severity.

3.1 Early cases of conflict

The first cases of conflict began to emerge in the 1980s when US courts heard several cases involving participants of standardization activities who had not disclosed their patents during standards work. The first relevant case appears to have involved a format for magnetically coding and storing information. This technology then became integrated into an ANSI's Group Coded Recording (GCR) standard, which was initiated by an existing licensee (IBM) of the patent. Mutter (2002) shows that in it, the Potter Instrument Company participated actively in the elaboration of the ANSI standard without notifying the standards committee of its patents, in a contravention of ANSI committee policy. The company then sued another company who implemented the standard for patent infringement.

The ruling indicates what can be at stake in such a case when it concluded that, "Potter … gained a monopoly on the GCR industry standard without any obligation to make its use available on reasonable terms to competitors in the industry" (207 U.S.P.Q. 763: 769 (E.D. Va. 1980) cited in Mutter (2002). The patent holder was prohibited from enforcing the patent in question in what then was an unprecedented judgement. Several years went by when a similar case again emerged at ANSI involving an ATM card validation system in Stambler v. Diebold, Inc (1988)[17)]. Under somewhat similar circumstances, the patent holder left the standardization committee for what would become the THRIFT and MINT standards without disclosing relevant patents; he waited until the standard was implemented to assert the patents. Again according to the Mutter report, the court found that this behaviour was improper and that the undue delay in asserting the patent suggested to the market that the patent had been abandoned. The patent holder

15) *ETSI (1998). IPRs; Essential, or potentially essential IPRs notified to ETSI in respect of ETSI standards. SR 000 314 v1.3.1.*

16) *Caveats about dependability: duplicates, the claim of 'essential'. However on the other side other patents may be left out.*

17) *See Mutter (2002).*

could not just "assert that his patent covered what manufacturers believed to be an open and available standard."[18)]

3.2 The GSM Case[19)]

At about the same time as Stambler v. Diebold, Inc, a case had begun to materialize in Europe that today stands as the touchstone for the increasing conflict between standardization activities and IPR. This case involves the IPR controversy generated during the extensive standardization of the now popular GSM system. The GSM case is different both in quality and in degree from the earlier US cases. The immediate areas of contention for example did not actually wind up in court. It is rather the number and degree of rights implicated, the diversity of actors involved, the timing and intensity of the controversy, and its various by-products that presage a "new situation" and the need for new approaches to deal with it.

3.2.1 Background

The GSM system is based on 10,000 pages of technical specifications, covering all aspects of the mobile system. As described elsewhere (Iversen, 1996, 2000b), this is a case of a comprehensive, deliberately over-specified and wide set of standards that entered into a veritable IPR minefield. A variety of factors including the composition of participating parties, the variety of their home markets (in technical and geographical senses), and the rather unique circumstances for involvement in the project helped what was bound to involve sensitive navigation between the collective interests of the standards processes and the private ones of individuals into a confrontation.

The question of IPRs was a central challenge that began to emerge at a critical stage in the standard's development. Thomas Haug (2002), who led the work[20)], reports that the first indications that the GSM work was "loaded with patents" emerged in 1985. Many areas of the formative standardization efforts in fact implicated patents although this was foremost the case in speech coding. This situation confronted CEPT policy which mandated that specifications should be avoided which involved technologies that were not available on non-discriminatory terms without royalties. In the event, efforts were made with the result that agreements were secured for two patents in the speech coding technologies:

Box 1 Timeline of mobile communications highlights

1946:	First civilian mobile system launched in Missouri
1979:	900 MHZ band reserved by the World Administrative Radio Conference (WARC of the International Telecommunications Union). This substantively laid the basis for the development of mobile communications.
	AMPS launched (Bell Labs)
1981:	NMT (cooperation between Scandinavian PTTS and some manufacturers)
1982:	First meeting of Groupe Spécial Mobile (GSM) in Stockholm
1985:	TACS (AMP- based)
1986:	Validations Systems tested
1987:	GSM opted for 'the broad-avenue' digital approach
	GSM Memorandum of Understanding (MOU)
1988:	ETSI instituted
	IPR conflict commences with refusal of MOU terms
1989:	GSM transferred to ETSI
1991:	GSM phase I standards
1993:	GSM phase II standards

Source: Iversen, 2000b.

beyond these, "the IPR issue was going to cause a lot of difficulties in the work of the new Pan-European system" (Haug, 2002: p 20).

Time would show that 'essential patents' were claimed at all levels of the GSM system by a number of different actors. It is reported that by the late 1990s, over 20 companies claimed to hold about 140 patents which they construed as 'essential' to the GSM standard (Bekkers, 2000).[21)] These are distributed among several types of technologies (switching, speech-coding, radio transmission, etc.). In addition, they accumulated over time. More than 60 % of these were initially applied for after the GSM system had essentially taken shape in the late 80s; that is, at a time when the equipment manufacturers had already become involved. In this context, the later patents are less important to the important first stages of adoption of the GSM system.

In the event, work was handed over from CEPT[22)] in 1988 to the new European Telecommunications Standards Institute (ETSI). The creation of this new Euro-

18) *8. 11 U.S.P.Q.2d 1715 (Fed. Cir. 1989: cited in Mutter (2002)). Contrast with the current Rambus case below.*

19) *This case is drawn on work in Iversen (2000), as well as Blind et al (2002).*

20) *In the Special Group set up by the Committee for Coordiantion of Harmonization CCH of CEPT.*

21) *This figure is based on the analysis by Bekkers et al. (2002) of first-filings of the patents reported to ETSI as being "essential".*

22) *The European PTT body: Conférence européenne des administrations des postes et télécommunications.*

pean standards organization coincided with the move to deregulate the European telecoms markets. One implication was that the standardization process grew in the transition to include a set of vendors from inside and outside Europe.[23] Another consequence of the transition was that the IPR question was moved to the purview of the administrators of the crucial GSM Memorandum of Understanding (MoU) in 1987.

3.2.2 Memorandum of Understanding: coordination and conflict

The MoU was an agreement between the Telecom Operators primarily to coordinate the launch of the system in 1991. It was an agreement in which the TOs (at the time, the PTT administrations) of 15 CEPT countries entered in 1987, directly before the handover to ETSI. This agreement supplanted an earlier four party agreement from 1985 and put into place the logistics of a coordinated launch from the TO's point of view. In it the signatories committed themselves to a common organizational line on the deployment of the GSM system. It was imperative to the success of the GSM system that the launch be synchronized, that equipment-type be proven compatible and that there was a rolling commitment to its future development of system. It also laid the basis for the first commercial contacts to take place between customers (the Telecom Operators, TOs) and vendors (equipment suppliers) for the provision of equipment based on the GSM specifications. In several prominent cases, there were traditional allegiances between the national PTTs and equipment manufacturers (Ericsson, Nokia, Siemens, Alcatel).

What provoked the confrontation were the terms governing bidders' freedom to exercise their IPRs that were employed unilaterally by the 17 participating PNOs. What was contentious for the IPR-holders was that the contracts specified that equipment suppliers were obligated to undertake to license any "essential" patents royalty-free within the CEPT area and to license to all-comers outside the CEPT area at "fair, reasonable and on-discriminatory terms." This clause was appealing since it could potentially defuse any risk that IPRs might pose to the collective launch of this "over specified system".

The controversial IPR clause has an interesting heritage. Appearances would suggest that it grew out of traditional relationships now being eroded between PPTs and national vendors, where contracts typically left the clearance of rights ("have-made rights" provisions) to the vendor (Iversen, 2000b). This may be one factor. But the real reason according to Stephen Temple, who led the MoU, had to do with the legacy of attempts during the mid-80s to lay the basis for an open mobile standard based on a Franco-German technology. In the event, the French and German governments together requested that this clause be included. The reason was that the R&D activities that had been funded by the Franco-German program in a bid to create an open standard on their own, were covered by such a clause (Temple, 2002:45).[24] Royalty free licensing provisions are not uncommon in publicly funded R&D. When Franco-German efforts were more fully integrated within the GSM work in the later 1980s, the governments were concerned that their vendors would be forced to license royalty free while other vendors could set their own terms.

3.2.3 Dissent and conflict

The terms pertaining to the equipment suppliers' exercise of IPRs that were codified in these preliminary contracts proved contentious for some of the manufacturers. The individual reactions of different suppliers must however be seen in terms of a set of factors that include: how many patents a manufacturer held that could be construed as "essential" to the GSM standard; which technical area they were in; and, relatedly, the orientation of their IPR strategies. The other factor was whether or not they had been involved in R&D funded by the Franco-German work. In this setting, the US-based Motorola Corp held a wild-card position. It became the most vocal opponent to the GSM-MoU signatories' terms. Several features of this company can be linked to the vocal position it took, including the fact that its home-market was outside the EU, the structure of its markets was different (technically and geographically) from the other actors, and that it needed to strengthen its position in Europe while limiting the potential for competition with its other markets (for example the US).

The number of essential patents claimed by Motorola was three times as high as its rival (in the range of 24–30, according to interviews.) This fact alone effectively raised Motorola's 'ante' and implied that it would want a larger part of the pot. Further, the technical area in which these patents were concentrated was important. The reason for this has to do with the different types of pay-off structures con-

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23) *The ETSI was established in line with the recommendations from the Green paper on the development of the common market for telecommunications services and equipment (COM (87) 290), which signalled the deregulation of the telecoms market in Europe. The ETSI included multinationals including companies with their headquarters outside Europe, for example Motorola.*

24) *Stephen Temple led the administration of the MoU.*

nected to different sorts of technologies. Because of the orientation of its technology, Motorola was dissatisfied with market prospects and was therefore unwilling to forfeit the additional returns afforded by licensing royalties. This raises a third characteristic, namely about Motorola's aggressive in-house IPR policy coupled with its lack of market shares in Europe.

It became increasingly apparent that the emerging GSM system was extraordinarily exposed to the risk that either "cumulative" licensing costs would price GSM out of the market or that IPRs would not be licensed. The system was indeed perceived to be extremely vulnerable. Against this background, the North American company decided to utilize its patents to gain access to market shares in the dawning European market. Therefore when Motorola refused the terms of the MoU and demanded separate undertakings for individual contracts, a serious controversy was ignited with MoU signatories. Motorola's strategy of a selected number of cross-license agreements helped reduce the number of equipment suppliers effectively to five: Siemens, Alcatel, Nokia, Ericsson and Motorola.

The conflict mounted with accusations and recriminations. Concerns peaked when consensus around the IPR clause in the MoU began to break down, and procurement contracts were issued without it. Some telecom operators are reported to have launched something of a campaign at this point, claiming that Motorola was refusing to license its IPR: their concern was that Motorola's strategy would make GSM too expensive (which during the recession of 1991–2, when this occurred, was a general concern). The well publicized conflict began to involve talk of legal actions and Motorola, who said its reputation suffered as a result of the accusation, at one point considered a liable case. In the end, prices of network equipment and handsets did not undermine the adoption strategy behind the standardization of the GSM system. But controversy went on to breed more controversy in ETSI.

3.2.4 SDOs begin to readdress the IPR conflict

The adoption of the GSM standards represents something of a watershed in the relationship between formal standardization and intellectual property rights. This case presaged a proliferation of conflict since, involving different national and technological settings, and different types of rights (including copyrights) under different circumstances. It also set the stage for a somewhat different case in the related area of Terrestrial Trunked Radio standards[25)], an interesting conflict involving software copyrights and irregularities in the SDO's procedures related to IPRs.

The legacy of the GSM conflict that is perhaps most important is that it directly led to the reappraisal of rules and guidelines not only in ETSI but in other SDOS, for addressing the increasing probability for conflict. ETSI's controversial search for procedures that departed from normal practice of other international SDOs tested the question of what sort of new provisions a modern SDO needed to address the IPR question in the emerging environment was hotly contested. It became a lightning-rod for conflict and led ETSI into a protracted controversy both at the institutional, the legal and the political levels. ETSI's search for new procedures involved a total of five identifiable phases, and generated an unprecedented level and degree of controversy (see Iversen, 1999 for details), ultimately leading to a lawsuit before the European Commission. ETSI's search for an approach to IPRs that differed from normal practice subsequently sparked a revision in the ways other international SDOs address IPR policies. In parallel, the ANSI revamped its IPR policy in light of its experiences with the GCR, and the THRIFT and MINT standards. Although ETSI's attempts fell away from their initial trajectory and gravitated back towards normal practice, the minimal procedures of SDOs like ITU-T were subsequently updated in the wake of the ETSI work. The search entailed a difficult balance between more or less detailed procedures designed to address the increasingly complicated problem facing ICT standardization.

4 The emerging need to readdress the question

In addition to TETRA, a set of cases followed in the wake of GSM and ETSI's controversial search for new procedures is currently forcing the industry to re-examine the balance between IPRs and standardization. Standards bodies from the traditional ITU to the less traditional (and more idealistic) W3C have since introduced new guidelines to varying levels of controversy; IETF's attempts have consistently met with controversy. The overall tendency is that conflicts and concerns have grown as a series of new types of conflicts have evolved, and the question of what to do with 'essential IPRs' is a day-to-day concern. At the same time, there is an emerging need for new ways to deal with the increasingly common conflict, such as patent-pooling arrangements accompanied by some form for regulatory clearance. Other

25) *See Bekkers (2000), Blind et al (2002).*

initiatives may involve reforming the way patents are granted, for instance as indicated in the W3C case involving Eolas.

4.1 Current signals from the Courts

A current case in the US has reopened the question of how individual IPR holders is to be balanced against the interests of collective standardization activities. Taking place on the heels of a landmark case which related non-dislosure to anticompetitive practices[26], the Rambus case is now drawing into question this obligation in certain respects.

4.1.1 Rambus v. Infineon and FTC v. Rambus, Inc., FTC (No. 9302)

The balance between the rights of right-holders and the collective interests of the standards is however in the process of being reopened by a current case. The original case, Rambus v. Infineon Technologies AG, pertains to patents on synchronous DRAM[27] held by Rambus, a company that manages IPRs. Four companies including Infineon were charged with infringing these patents when they produced what was intended to be an open, royalty-free standard for SDRAM elaborated by the JEDEC Solid State Technology Association[28].

Rambus, the patent-holder, participated in the JEDEC committee work from 1992 until 1996 when it left prematurely. Rambus' departure reportedly coincided with the Consent Decree of Dell Computer Corp; and allegations are (Mutter, 2002) that a patent application that was pending while Rambus was on the committee was subsequently altered through a series of divisionals or continuations.

In October 2003, the Court of Appeals for the Federal Circuit (CAFC) however found in favour of the patent-holder (Rambus) in a remarkable 2-1 split decision which overturned a lower court that had found it guilty of fraud for failure to disclose patents[29] that it later tried to enforce. The two judge majority held that Rambus was not obligated under JEDEC's patent policy manual[30] to disclose pending patent applications.

Rambus is today in a position to assert patent rights pertaining to the relevant JEDEC standards, that would entitle it to an estimated[31] billion dollars in royalties from memory manufacturers producing in compliance with those standards. In addition, its patent position is expected to knock-on to several other markets. This has laid the basis for a Complaint lodged by the Federal Trade Commission against Rambus on antitrust charges, alleging the "deception of Standard-Setting Organization and violation of Federal Law." The assertion is that,

> Had Rambus properly complied with JEDEC's rules and abstained from any misleading conduct, the FTC contends that this likely would have impacted the content of the organization's SDRAM standards, the terms on which Rambus could license any pertinent patent rights, or both. That is, according to the FTC, the royalties that Rambus has been able to charge SDRAM manufacturers would not likely have been sustainable without the pattern of misleading and deceptive conduct outlined in the complaint. (FTC, 2002)[32]

The complaint concurs with the lower court ruling, and is under consideration before the FTC Administrative Law Judge (ALJ). One key question is whether patent applications, which have not been published in the US until recently, should have to be disclosed. The interpretation of the ALJ is expected to have a set of important implications. In general, the line taken in the CAFC ruling seems to take balance between IPR holders and SDOs in a significantly different direction to that established in the Consent Decree re Dell. It will have significant implications for how JEDEC and indeed all US SDOs approach IPR disclosure rules. A clarification is awaited with considerable expectation by JEDEC, who is currently reconsidering its IPR policy in light of the CAFC ruling, and by the industry.

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26) *Federal Trade Commission v. DELL Computer Corporation – 1996.*

27) *According to Nuts & Volts Magazine: http://www.nutsvolts.com/Encyclopedia.htm: "(Synchronous DRAM) A type of dynamic RAM memory chip that has been widely used starting in the latter part of the 1990s. SDRAMs are based on standard dynamic RAM chips, but have sophisticated features that make them considerably faster"*

28) *Once known as the Joint Electron Device Engineering Council.*

29) *According to The Inquirer (http://www.theinquirer.net/?article=9224), the original patent application was filed in 1990 before Rambus became involved with JEDEC. This application subsequently led to numerous divisionals and continuations, such that the case currently involves 31 unique U.S. patents.*

30) *No 21i. 1993.*

31) *See FTC Complaint. http://www.ftc.gov/opa/2002/06/rambus.htm*

32) *FTC Issues Complaint Against Rambus, Inc. Deception of Standard-Setting Organization Violated Federal Law http://anon.user.anonymizer.com/http://www.ftc.gov/opa/2002/06/rambus.htm*

4.2 Patenting pooling: MPEG 4

The pooling of patents is an increasingly utilized method for standards to deal with the situation of multiple patents in the hands of various actors. It has been used recently for DVD technologies, but perhaps most notably in terms of different MPEG standards, one pool that has been hailed as a success is the pool established for the MPEG-2[33)] standard in 1997. It is managed by the Denver-based company MPEG LA, and was set up to provide an easy, reasonable, fair and non-discriminatory way for users to access the necessary patent rights to develop digital video. The licensees receive at one set price access to all rights needed in order to meet the MPEG-2 standard.

4.2.1 Background

The MPEG2 patent pool proved to be a tremendous success for the licensors, and the standard achieved widespread acceptance in the market place. The critical success factors in this licensing scheme was:

- A royalty scheme that was perceived to be fair and reasonable in the market place;
- A professional licensing administrator with the ability to deal with a large number of licensees and closing contracts;
- A critical mass of licensors with credibility in the market place, and the financial ability to enforce the rights if necessary.

With this success in mind, the MPEG-4 Visual patent pool was set up in 2000 to serve the commercial interests of the essential patent holders in the standard. In 2002, patent holders and the licensing administrator agreed on licensing terms for the pool. The patent holders are approximately the same as those participating in the MPEG-2 patent pool, with some new entrants including Telenor. A total of 22 companies hold essential patents in the pool. At present 103 companies have signed up for licenses. Equipment manufacturers and software companies dominates this list of companies, even though the license is also targeted at telecommunication service providers. The reason for this is mainly that there is currently a very limited number of operators that facilitate streaming MPEG-4 over their networks.

For the telecommunication operators, this is a new set of circumstances. Traditionally telecommunication operators bought equipment from vendors through contracts that had patent indemnity clauses. These clauses protected the operator patent from getting entangled in litigation with third parties (see have-made rights). With the Internet the distinction between platforms and services has become more blurred. In the case of the MPEG-4 Visual license, the telecommunication operator now provides a service that is streaming MPEG-4 video, becomes a licensee. This is a completely new business model, where the patent holders in the MPEG-4 Visual patent pool are actually claiming a royalty for every MPEG-4 video streamed by the telecommunication operator.

One main difference between MPEG-2 and the competitive environment surrounding MPEG-4, is the availability of competing proprietary technologies. Major competing technologies include Microsoft Windows Media Player, Apple Quicktime and Real Networks. One implication of this arrangement is that a licensor in the MPEG-4 Visual patent pool like Microsoft has had access to all information regarding the formation of the patent pool and the license terms. In launching a version of its proprietary *Windows Media 9 series platform* in 2003, Microsoft created its own licensing terms explicitly to compete with the pools, claiming "Microsoft's new licensing agreements give greater flexibility to developers and cost significantly less than MPEG-4, MPEG-2 and other mainstream technologies" (Gartner Research, 2003).

This is the beginning of the battle for rich media content distribution on the Internet. In contrast to the more software driven vendors like Microsoft, the equipment vendors are more in favour of MPEG-4 and want to promote the open standard. At the moment, competing solutions coexist, and there are no signs of who is winning the war.

4.3 Combining copyleft in licensing arrangements: the example

The collective efforts of software developers has taken on qualities of a standardization process. Such efforts have faced the challenge of combining proprietary contributions into collective frameworks in novel ways. The case of *eZ systems* illustrates one strategy that combines copyright with copyleft.

eZ systems[34)] develops an open source framework for Content Management Systems. eZ produces software and publishes all their code. It is based on a voluntary community that contributes to testing, improvements and bug fixing – and they earn their

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33) *MPEG-2 is the technology that underlies the effective transmission, storage and display of digital video, which feeds over media including satellite and personal computers.*

34) *see http://www.ez.no*

money from selling services and from their licensing model, where you have two choices. You can either buy a professional license by which you have the sole rights to whatever software you build based on their framework, or you can have a free license based on the GNU General Public License.[35] The GPL licensing terms mean no licensing fees for the user on the one hand but commits him to a set of dos and don'ts on the other. The user commits for example to disclose source code on his contributions publicly and freely and to assure the code to be free open source software (no rebranding nor bundling with proprietary systems). By committing to these terms, the user avoids paying licensing fees while being able to use the software, to distribute modifications, as well as to sell services based on the software.

These limitations are typical for "copyleft" licensing. Note that eZ systems insists that all copies must have a proper copyright notice and that any added code must be public and cannot be licensed. If you buy a "professional licence" even if you have the rights to the additional source code you have written, if another programmer wishes to make changes to that she will also need a professional license.

The code eZ systems publishes is based on international standards including XML and PHP programming libraries. So in order to actually use the framework, a developer will depend on standardized technology. The nice touch in eZ's business model is that they will benefit independently of what licensing option a programmer chooses. If she goes for the free copyleft license, she will share her results with eZ. If she pays and goes for the professional license, she will pay eZ and if she shares the results, the new programmers will also pay. eZ benefits from the standards that are an integrated part of their framework; they could have developed it all by themselves – but the rapid adaptation of their framework is of course due to the confidence that standards promotes. Many standards are good brands, and XML is one that eZ benefits from.

The arrangement also benefits from the work that the standardization bodies do to ensure that the technology does not infringe the IPR of others. So, the XML-standardization bodies like W3C have a patent policy[36] that ensures that XML can be used without paying royalties or taking a license[37]. This is also connected to the discussions on patenting and software in general, an area which is still open in Europe after the EU parliament did not manage to pass the directive on software patents.[38] In brief, eZ uses copyright and copyleft and a licensing scheme to promote their technology. It is based on standards, and benefits from both their branding and the patent policies of the standardization bodies.

4.4 The Eolas patent and the W3C Complaint

The balancing act between IPR holders and standardization activities not only involves the procedures of standards development organizations in dealing with essential IPR; it also involves the quality of the corpus of intellectual property currently building up in the ICT area. The World Wide Web Consortium (W3C) complaint mentioned in the introduction implies that the way patents are granted unnecessarily exacerbates the potential for conflict in promoting new standards ultimately facilitating innovation. The complaint contributes to a gathering critique of patent quality in the US.[39] One instrumental element is the recommendations of the Federal Trade Commission for ways to reform the patent system in the US.

The complaint draws into question in particular two aspects of patent granting procedures at the United States Patent and Trademark Office; patent novelty and patent scope. The "Eolas" patent[40] was originally granted to the University of California for a technology that provides web browsers to access interactive features on a web page. The patent was subsequently licensed to Eolas Technologies Inc.

Eolas is not a vendor, but rather an IPR management company that lives by creating and, more to the point, enforcing IPRs. It recently won a patent infringement suit against Microsoft on the same '906 patent, rewarding Eolas $520 Million. Companies like Eolas play a non-traditional role in the market since they do not vie for market share. They live by 'leveraging'

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35) *http://www.gnu.org/copyleft/gpl.html The notion "copyleft" is used in favour of Copyright. The legal framework and IPR however are that of Copyright. Read more about GNU and the Free Software Foundation at http://www.gnu.org/.*

36) *http://www.w3.org/Consortium/Patent-Policy-20040205/*

37) *There are hundreds of patent applications on XML-based technology. Microsoft was awarded a US patent in February 2004. More details and references are at http://news.com.com/2100-7345_3-5158432.html*

38) *Håkon Wium Lie, chief technology officer of Opera Software, said to ECT News Network August 26, 2003 indicated that software patents are not helpful to software development.*

39) *See Updegrove, Andrew (2003). Do IT Patents work? And: Patents: Too Easy to get, too hard to challenge. (httm//www.consortiuminfo.org/bulletins/nov03.php.*

40) *Patent number 5,838,906, covering technology that allows Web browsers to access interactive features on a Web page.*

IPR. Accordingly their market considerations are much different from traditional IPR holders, who create and maintain IPR portfolios as a means to support their manufacturing activities. This means, among other things, that their behaviour will not necessarily comply with the market logic that brings together the different interests into the standardization process to begin with. In this setting the IPR portfolios of IPR management companies have the potential to become loose cannons in the standards setting environment. This type of player poises a challenge to standards development organizations and consortia. It is interesting to note that the W3C activities had not yet led to litigation by the Eolas patent, only to the Microsoft case which has caused something of an IPR outcry. The fact that W3C and Microsoft are active advocates against the Eolas patents indicates how widespread the outcry has been.

Two issues are raised in the W3C which have deeper implications for the way the USPTO grants patents. The first is that the USPTO granted a patent that does not fulfil the novelty criterion required by the patent system. The second is more fundamental and involves the changing role of the patent regime: the standards body complained that by granting exclusive rights on the technology in question, the USPTO can inadvertently help undermine the future development of HTML, the main language used on the web.

5 Conclusion

The scope for conflict between IPRs and standardization continues to increase, generating considerable uncertainty. The increasing prevalence of the conflict has brought into question how standardization efforts can better deal with the potential conflict, and it even has actualized calls to improve patent quality. The potential for conflict raises a set of challenges for policymakers, patent offices, standards development organizations, and business.

The article contributes to increasing awareness in these environments. It briefly surveyed the genesis of this conflict by first looking at the conceptual basis for conflict in terms of the innovation process. The article went on to review cases that illustrate the potential for imbalance between IPR and standardization and that indicate ways to deal with this increasingly likely situation. The cases survey different conflicts in different settings, including those related to the non-disclosure of granted patents (e.g. the GCR standard), US patent applications (Rambus), as well as copyright questions (DVSI in TETRA). Emphasis was however placed on the GSM case. This case, and ETSI's subsequent search for a new IPR policy, stands as a lightning rod for the increasingly delicate balancing act between IPR and standardization. This European case further raised issues related to multiple patents spread among diverse interests, including concerns of cumulative royalties. In the US, the recent cases involving the Federal Trade Commission have more recently served to reopen the question of the balance especially in light of factors that are unique to the US environment.

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For a presentation of Haakon Thue Lie, turn to page 59.

Section 4 – Innovation and product development – methods and tools

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Innovation is a broad issue. It is about national economies and politics, publicly funded research and links between industry and research. It is the importance of facilitating early-stage investment and introducing support measures for small and medium-sized companies. And it is about the way one goes about to commercialise an idea, the methods and tools best suited for doing practical development work. Also what one does innovate may differ:

1. Commercialising new products through product development projects within a company;

2. Commercialising product improvements through product development projects within a company;

3. Commercialising new ideas in a company through spin-offs;

4. Inventing awesome new products like the light bulb or the telephone, and commercialising them through a long term effort from inventors, entrepreneurs and investors.

One thing remains constant, though. Invention is about solving perceived or non-perceived problems. The greatest inventors are not those best at *solving* a problem, it is more often those best at *seeing* a problem. And in order to really innovate, in any company, it is important to identify and understand problems that customers may struggle with, included those that have to do with the company's existing products, platforms or policies.

When this is said, a product may not always be "new to the world". More often it is new to the national market or to the company. New inventions usually require that the inventor, an entrepreneur and investors work together to commercialise and capitalize on it. Other times innovation happens inside of a business, to improve existing products or processes, or to create new products on existing platforms. Even then there is a great need for creativity, champions and capital to develop ideas into successful products in the market. Regardless of whether an innovation happens inside or outside of a company, it provides more value to have effective ways to commercialise the ideas. And the management of such an "innovation process" is what produces "premium value" for customers, employees, partners and shareholders.

The quality and efficiency of the methods and tools a company uses to commercialise products and create innovations, will lead to value for the involved. To

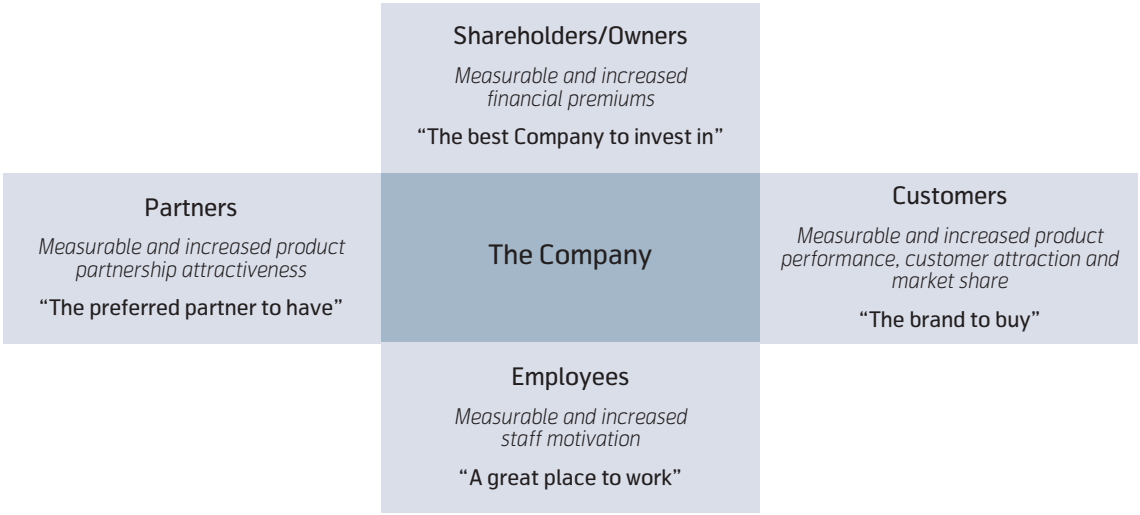

Figure 1 The four dimensions of the innovation premium[1)]

1) *Jonash, R S and Sommerlatte, T.* The Innovation Premium – How Next-Generation Companies Are Achieving Peak Performance and Profitability. *Arthur D. Little, 1999.*

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measure a company's innovation potential it is important to look at several factors:

- The success rate of previous products/innovations;
- The tools and methods utilised in the innovation efforts;
- The present product and IT platforms in the company;
- How customers/owners/employees/partners perceive the company's innovation ability.

When we study the art of managing innovation, we need to look at how – and what – companies do, compared to others. Hence we evaluate benchmarking efforts as well as methods and tools for innovation from both a qualitative and quantifiable perspective. As many of the studies that have been done in this area are about North American companies, it is important to look at whether there are any differences compared to European practice, here exemplified by a comparison between Norway and North America.

To understand more about tools for innovation management, we also take some time to look at and evaluate specific tools that are commercially available. To avoid possible misunderstandings, it should be said that *Telektronikk* does not endorse the specific tools mentioned here any more than other tools in the market.

Innovation is a significant driver for business. To drive innovation in a company, it is mandatory to understand the different tools and methods available. To understand how my company may improve its innovation efforts, it is also helpful to participate in benchmarking. External factors such as funding and national policies are important to a company's innovation ability. Companies who succeed also realise the importance of the methods and tools that are being used to see and solve problems for customers.

For a presentation of the author, turn to page 2.

On the path to a new product process
– Introducing an integrated product process in Telenor

BJØRN ARE DAVIDSEN

Bjørn Are Davidsen works in Business Development at the Fixed Lines Residential Market, Telenor Norge

To achieve operational excellence one must understand the challenges involved in designing, implementing and streamlining a best in class process. This case story about the introduction of a highly successful integrated product process in Telenor may provide important learning in this area. It will hopefully inspire to a more determined effort at long time improvement of such processes, in order to really satisfy customers and meet revenue goals.

1 Abstract

A New Product Development (NPD) process has become mandatory for leading companies the last years, as a prerequisite for efficient commercialisation of innovation opportunities[1)]. The Telenor NPD was developed in an effort to integrate and implement a full set of product processes across the company, Life Cycle **P**roduct Management, **P**ortfolio Management and **P**roduct Development. This emphasis on the interdependency of the "three Ps" led to the overall process being named **P^3**. The target was to achieve a state of the art process, and the result came close. At its launch in 1996, the integrated process was among "Best In Class", though some questionable choices may have been made regarding the decision process. Prior to 1996, time-to-market in Telenor was 29 months. A better process led to a reduction in the number of projects by 42 % the first year, and to a remarkable reduction in time-to-market of 70 % in less than two years. It was also one of the reasons that made Telenor achieve the world's highest ISDN penetration in the late 90s in the residential market.

The process was improved several times in the next years, supported by a cross company team (P3OP). It was even commercialised and sold to other telecom companies[2)]. However, due to less top executive focus on formal business processes in the late 1990s[3)], it was for a period difficult to get support for having common processes across the company. This led to P3OP losing its funding in 1999. In 2004, variants of the P^3 process are still used by major business units (BUs) in Telenor, though in different ways and at various levels of executional quality. Several major development projects since the late 90s had been undertaken in new business units without formal or phase oriented processes, leading to a less than optimal performance.

The last years several BUs have recognised the need for a major update of their NDP, and there has also been a new corporate understanding of, and effort at, "Operational Excellence" through cross company processes. In early 2004 process improvement efforts were going on in several BUs, though with little coordination between units. However, the Operational Excellence initiative should change this.

> *"There is no lack of stand-alone NPD processes, and most are adequate as long as they are really being followed. However, such an integrated process as P^3 is unique in its interrelation between the different processes and the overall strategy. It is the interfaces that are difficult, not the processes. And there must be a totality to really ensure a sufficient basis for cultural change".*
>
> Eivind Bakke, Director of Product Development, Norway Post, Communication Division[4)]

2 "Best in Class" processes to prepare for a high competition telecom market

To prepare for the next step in the liberalisation of the Norwegian Telecom market in 1998, Telenor started early 1994 an analysis of which business processes in the company that most needed to be improved and streamlined. Based on a survey from executives throughout the company, product development was chosen as the second most important area.

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1) *A study on 105 North-American businesses from a broad range of industries (50 % in service industries and 50 % in goods), and 1500 employees on average, showed that 73 % had a formal New Product Development process (Product Development Institute, 2003).*

2) *As reflected in Cyprus Telecommunications' Annual report: "During 1999, the implementation of the PROMITHEAS business reengineering project continued with the aim of modernising the Organisation. The areas in which it has led to the greatest improvements are customer service, access network management and product development." Nicos M. Timotheou, CYTA General Manager, June 16, 2000 – from Annual Report 99, see http://www.cyta.com.cy/pr/annualreport/*

3) *The priority at the time was a major internationalisation strategy, with great success.*

4) *In Norway there is no integrated "Post and Telecom" company, however, the NPD process in Norway Post was developed in 2002 in a joint project by NPD professionals in Norway Post and Telenor, based on P^3.*

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The main goals were also the design criteria for the process:

- Increased profitability
- Reduced time to market
- Opportunity and customer driven product development

It was early a clear decision not to do a Michael Hammer type of Business Process Reengineering, or any other of the other BPR variants available at the time. Another strategic choice was to avoid doing an official "benchmarking". The reason behind these decisions was a recognition that BPR-processes seemed a bit of a hype at the time, and that there were few documented results. Doing a benchmarking was also thought to imply a risk of looking at too minor change opportunities, as the Telecom business in 1994 was characterised by either rather slow moving incumbents or smaller, specialised companies not directly comparable to Telenor. Instead it was decided to do a study of the best product and product development work in Telenor[5)], as well as to do literature studies and visit several companies in the U.S. and France. The object was to get an understanding of what constituted "best in class" in this area, as well as provide stimulation for ideas even surpassing this.

To achieve this goal of "best in class" processes by 1998, Telenor initiated in October 1994 a large project embracing all major business and process areas, from Sales to Delivery processes, utilising an international consulting company as well as selected Telenor experts. This "P98 project" got high attention from top executives, and a sufficient budget.

In the "Product stream" of this major project, The New **P**roduct Development Process (NDP) was seen in context with the whole product area. It was early understood that no well functioning NDP was possible without also having a Life Cycle **P**roduct Management process (LCPM) and – even more important – a **P**ortfolio Management process (PM) both for products and projects. This emphasis on the interdependency of the "three Ps" led to the project and overall process being given the rather potent name **P^3**.

In the product area, about 15 people from Telenor worked full time in collaboration with seven consultants to study "AS-IS", develop "TO-BE" and plan for implementation to start in March 1996. The project was divided into three subprojects, one for each "P", later a fourth was added on the Fuzzy Front End.

It was understood that effective, creative product development was decisive in this age of dramatic changes in the telecom- and IT-market, with new actors and alternative mindsets, and new marketing and technological possibilities.

Despite some cultural challenges[6)], the project was a success, launching new overall company processes on time, with a solid support from a common company operational process team (P3OP).

Findings for product development in Telenor, 1994	Remedies for this in the P^3-process
• Different product processes, principles and methods make cooperation and resource prioritisation difficult across business units	• Common framework and process descriptions, clear principles, handbooks and templates to enable efficient product development
• Projects often lack management support • All projects are prioritised • Difficult to find resources on time	• Management takes time to clear away barriers to progress for valuable projects
• Too little focus on development pace • Culture gap and poor communication	• Cross functional teams coordinate parallel activities to reduce commercialisation time
• Unclear requirements for decision making and decision makers	• Phase driven project evaluation and an efficient decision process to ensure focus and progress
• No focus on sharing knowledge and experience. Big gap between actual and desired performance	• Continuous learning contributes to better products and skills

5) The Product Division in Telenor Networks had implemented a Stage Gate System in 1992, based on a standard Robert Cooper model.

6) It soon became rather obvious that there were quite a few cultural differences between an international consultant company and a telecom incumbent. It didn't always help matters that Americans and Norwegians did not view politics or processes in quite the same way. This became a learning experience as well as leading to some serious fun in the production of projects T-shirts and team building activities.

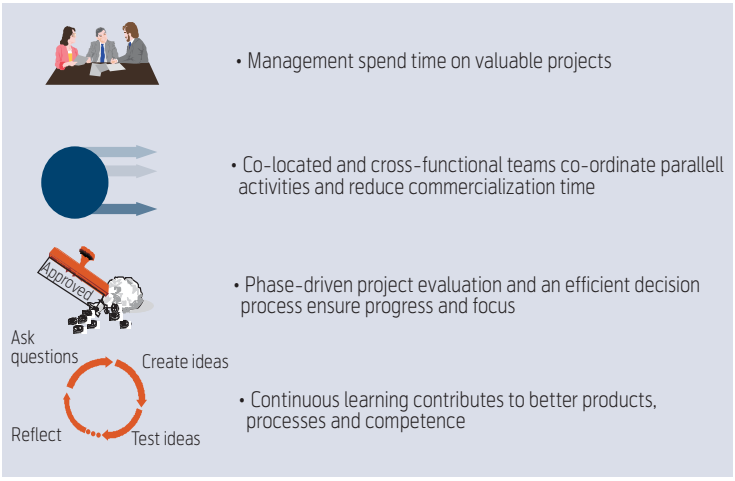

Figure 1 The four main principles of P³

3 Designing the process

The AS-IS study involved analysing major product development projects from the previous years, through a thorough mapping of goals, activities, tools, resources, delays and organisational interfaces. This pre-work focused on a range of challenges and barriers that got in the way of effective product development, both in the organisation and in the industry as a whole.

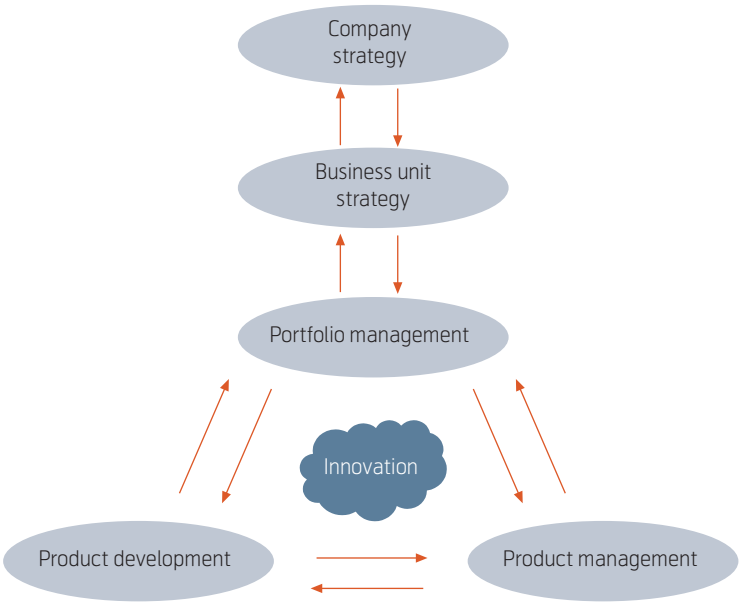

Figure 2 There is a need for formal interplay between the product processes

'Products' are goods, services or solutions which customers are willing to pay for, (in) directly. Products embrace related production and delivery processes that must be designed and developed at the same time.

The diagnosis came as no surprise, and the P³ process was created to combat this.

It was understood that practical focus on development work comes by following these four guiding principles. Basically the P³-process was designed to create a supporting environment for these. The principles matched professor R.G. Cooper's sensible ways and were thoroughly tested and adapted to suit the needs of the Telenor organization. To help with the understanding and later implementation of the process, there was a large gallery exhibition of the process for invited executives, middle managers and people working in the product areas across Telenor. This was also done for various vendors, all to receive feedback on the initial spec. The principle of management spending their time wisely on valuable projects was suggested at this event from development people at Ericsson.

To support the principles the project wrote handbooks, including both detailed courses of action for the different stages in the process and advice from earlier projects and a pilot done to test and improve the new process. The following is an example of the kind of received advice from practitioners included in the NPD process handbook, on the four basic principles.

Another issue that had to be solved early was the need for a common definition of products. The ruling definition became:

The reason behind this was an understanding of a product as an integration of technological solutions a customer needs, as well as of "behind-the-lines" processes to ensure efficient delivery and production.

P³ was also designed for a necessary interplay between the organisation's product processes:

Experience has given clear signals:

- 'It is these principles that create the 'outline conditions' for everything else in the process!'
- 'Flow charts and project management quickly lose value if these principles are not followed!'
- 'Division of responsibility and risk means that resource owners and decision makers in the evaluation team are more involved. The result is clearly shorter commercialisation timescale, because of faster decisions and door-opening, which again leads to a highly motivated core team'.

But it doesn't happen by itself!

- *The line organisation should be measured for its ability to follow the principles – use an evaluation form to indicate the degree of "process loyalty" for the project, with 'green', 'amber' and 'red' P³ status!*
- *Managers cannot support or evaluate projects unless they set off time to them!*
- *Managers should be measured also for ability to ensure a future portfolio!*

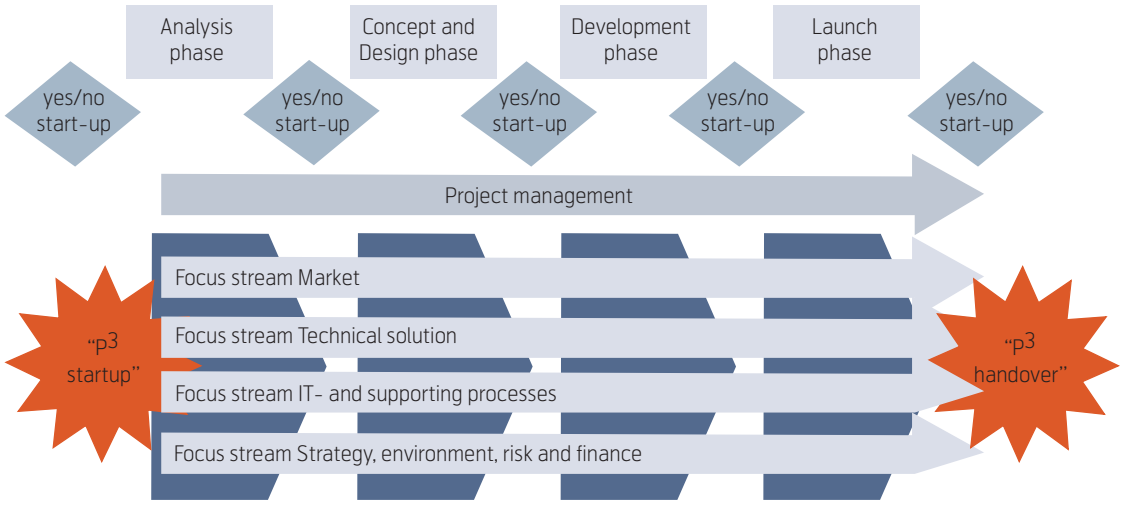

Figure 3 High level view of the NPD process in P³

- *Portfolio management, of ideas, projects and products*. There was a strong need to make this the focal point of P³, as it provided a holistic approach that integrated the product work with BU-strategy. The PM process was designed to help executives identify gaps in the product and project portfolio, as well as to decide and support start-up of development projects after a formal project proposal made through the idea process.

- *Life Cycle Product Management*, the responsibility and authority to manage the product's lifecycle after launch – managing the "4 Ps" (Product, Price, Promotion and Place).

- *New Product Development* – commercialisation of value proposals, products and product platforms, as well as bundles and price plans.

This NPD-process was designed with *four phases* along *four focus streams*, a clearly defined enabling process for project teams at *start-up* and an equally well defined *handover* process at an appropriate and accepted point in time after launch.

A high level description of the phases is given in the following.

*"P³-**start-up**" begins when the project is approved. The objective is to staff the project properly and enable a competent cross functional core team through an "acceleration lane" that ensures focus and speed from the beginning.*

In **the analysis phase** the objective is primarily to understand the users' needs, who and what they are. Technical possibilities are preliminarily evaluated. Is the project in line with our strategy, including security and environmental control? Is the risk acceptable? What is most important for this development project – time, cost, or quality? The team make a selection from a large set of product and process questions that are to be answered for this development project in this phase, related to market and technical issues, IT, strategy and finance.

In **the concept and design phase** the concept is tested. A new set of questions is selected for the phase. Customers' needs and willingness to pay are studied, and a market potential is estimated. Needs are translated to a product design and then to more definite technical specifications. A decision is made whether to do the development in-house or to buy ready-made. The delivery and production processes, and IT support are defined as well. Cost, investment and income estimates are set up in accordance with the company practices.

In **the development phase** the product and support systems are developed and tested. A program for environment control is established. Launch and product plans are made, and the production/sales staff are trained. A selected set of questions are to be answered. The phase ends with a mandatory deliverables test.

In **the launch phase** the product is sanctioned for release in the market, depending on the answers to a selected set of questions chosen for this project. Customer response and sales figures are measured and evaluated. Development experiences and learning are documented according to rules for how these are to be systematized. Everything is made ready for the official handover of product responsibility to the line organisation.

*"P³-**hand-over**" is decisive at the end of the launch phase. As with the "start-up" this is a set of enabling activities to support and formalize proper handover from the project in such a way so that the involved units formally – by signing check lists – take full responsibility for commercial product management, operations, sale and delivery of the product. No project is to be finished until this is done.*

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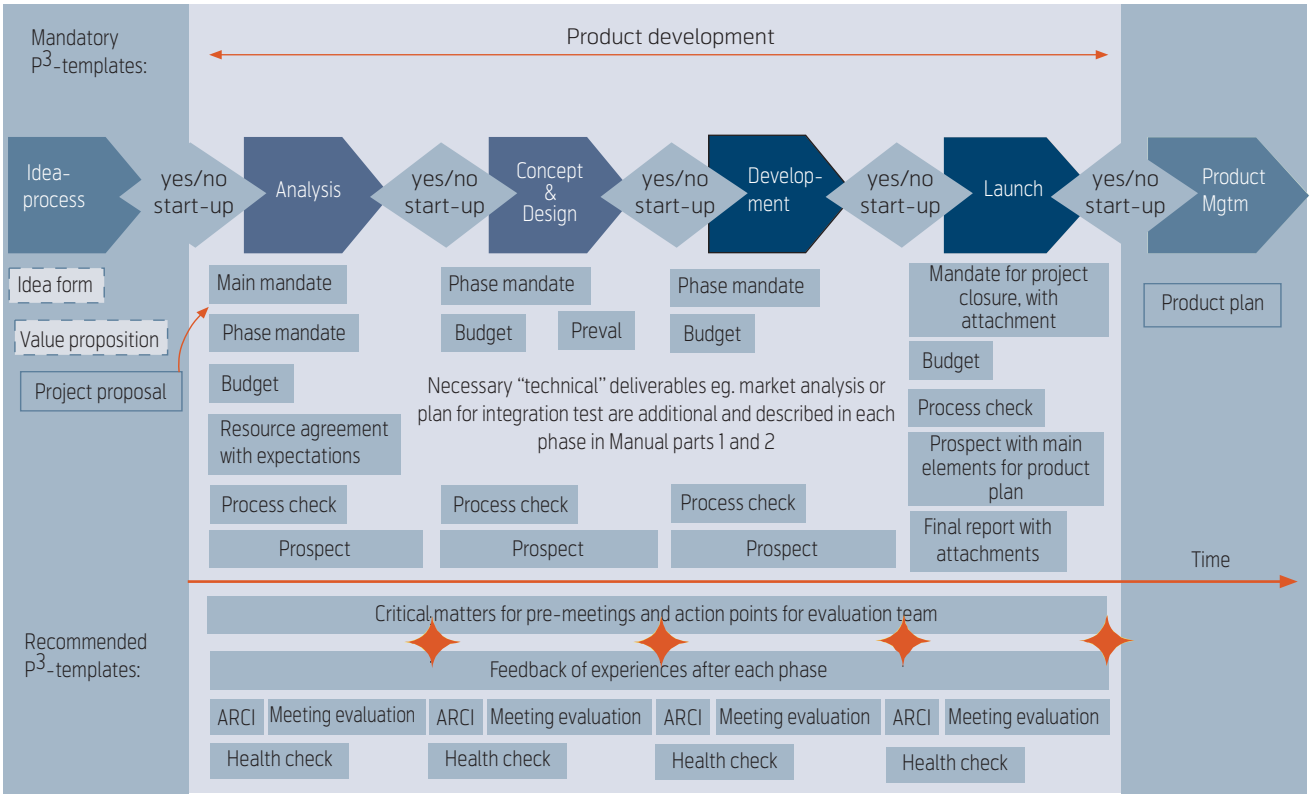

Figure 4 Overview of deliverables related to process and project management

The NPD was also set up with mandatory and recommended process elements.

While the process in most areas was designed according to the perceived "state of the art" at the time, with a thorough set of supporting tools and templates, some questionable choices may have been made regarding the decision process and gate criteria. For reasons that probably mostly had to do with a "democracy" attitude, the original intent of having a defined gatekeeping group for each decision point, was changed despite warnings from experienced product developers. As a study by Robert Cooper comments:

"A final issue is the need for the same gatekeeping groups across all projects. Two companies I have worked with both implemented their Stage-Gate™ processes with different gatekeeping groups for different projects. At Kodak, each project had its own gatekeeping team, but no one gatekeeper group had an overview picture of all the projects; the result was that resource allocation across projects became impossible. At Telenor, the Norwegian telephone system, the situation was similar, with each project having its own gatekeeper group; these evaluation teams quickly turned into steering committees and "cheerleaders" so that no projects were ever killed! Both companies have revised their gatekeeping methods, and have moved toward "standing gatekeeper groups" that review all Gate 3, 4, and 5 projects"[7)].

"P³ ensured a common language within the product area in Telenor. However, introduction of such a comprehensive framework as P³ in the late 90s put too much demand on a corporation not sufficiently mature in the area of process work. At the time Telenor consisted of a series of highly independent units, something that made it difficult to establish a common implementation and process practice. To everyone involved this was a great learning process and variants of the NPD process are still followed in Telenor."

Bjørn Møllerbråten, Market Controller,
Business Consulting, Telenor Operational Services

4 Implementation and support

The process was launched in March 1996, through a thorough implementation effort including a common cross company support team (P3OP) as well as each business unit having process owners responsible for implementation. This involved a major training plan that ensured that 1600 individuals were trained in P³ practice within three years, as well as making a broad set of practical templates and tools available.

A study on the status for 1998 showed that 74 % of projects in Telenor used P³, as shown in Table 1.

7) *Cooper, 1998, pp. 177–78.*

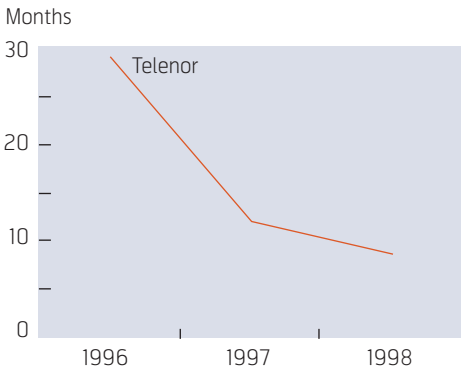

Figure 5 Decrease in time-to-market for NPD projects in Telenor Residential

Prior to 1996 the average time-to-market for NPD projects in Telenor was 29 months[8]. Following the implementation of P^3 in 1996 there was a dramatic reduction in Telenor Privat, to 12 months. Next year there was another reduction, to 8.6 months. This was due to a better process and to a reduction in the number of NPD projects by 42 % within the first year[9]. All in all, this meant that the P^3 process led to a remarkable reduction in time-to-market of about 70 % in less than two years. It was also one of the reasons that made Telenor achieve the world's highest ISDN penetration in the late 90s, in the residential market.

During the first years several formal evaluations were made of the process and the practice of it. Even if, as shown above, there had been a dramatic improvement in performance in some BUs, one study in 1998 revealed that the P^3-process was felt to be too bureaucratic, this was a particularly strong attitude at management levels and in parts of the organisation that used the process rather infrequently or not at all.

An analysis indicated that this could have one or more of the following causes:

"P^3 is a tool and not a detailed book of answers. Still, it contributes to a holistic approach in project management as well as in portfolio management of projects. We know from experience that the NPD part of P^3 works, and it has been changed and adapted to match present concern in a way which makes it suitable for both small and big projects."

Bjørn Skogland, manager of NPD in Telenor Business Solution 2001–2003

Employees trained in P^3	NPD-projects using P^3	LCPM plans using P^3	Portfolio plans using P^3
40 %	74 %	32 %	36 %

Table 1 The degree of P^3 implementation in Telenor in 1997

- P^3 was in fact bureaucratic as such;
- The process was followed in a wrong way in some BUs;
- Parts of the line organisation felt uncomfortable due to previously having had too little experience in doing work as laid down in definite guiding principles and processes;
- The corporate structure worked against common processes across the Business Units.

After a thorough analysis and improvement of the process and the templates in a new project over several months, it became clear that the reason behind the perception of P^3 as "bureaucratic" was mostly due to major players in management finding a process oriented organisation too new a thing. Some executives had also come to have other priorities. While there of course were other more important issues to be solved, this lack of executive support for common processes unfortunately led to a rapid decline also in the status for P^3. The attitude with some went so far as to say in public that "processes are for chickens". The reason for this change seems to have been the perception that the liberalised telecom market and the many business opportunities in

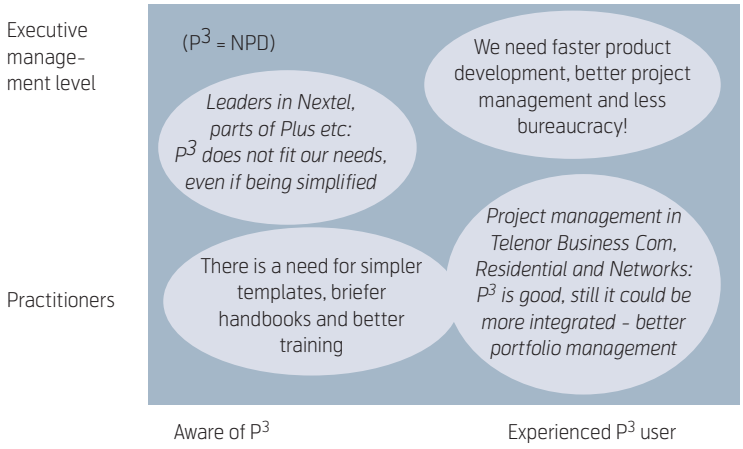

Figure 6 How P^3 was perceived depended on the respondent's role in the organisation and experience with the process

[8] *Part of this was also due to the customary integration of platform and product development at the time.*

[9] *K.R.127/6100/97.2 and P3OP/Rådgivning Systemintegrasjon, July 1999.*

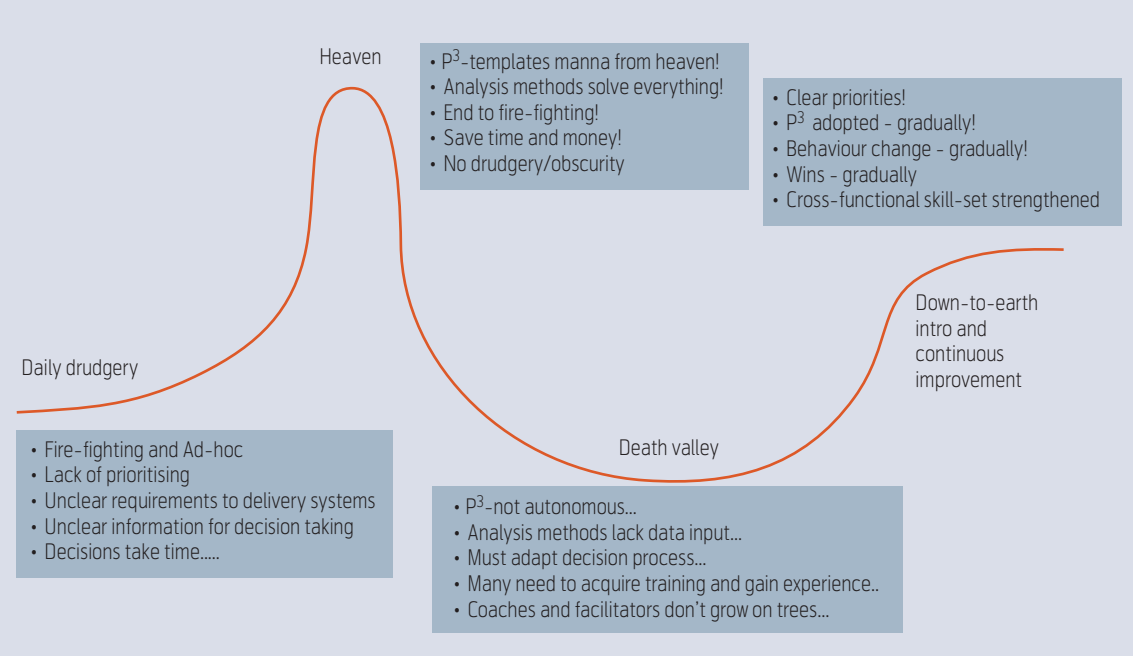

Figure 7 The turbulent life of a process implementation, from great expectations to wuthering heights

the late 90s, especially in the area of Internet and foreign markets, called for bold action, rather than what was perceived to be "inflexible" processes.

Fortunately this attitude does not prevail four years after the experience of the dotcom frenzy. Today there is a great interest in processes that support operational excellence.

While Telenor in the late 90s had not quite become a mature process oriented organisation, it became clear that the P^3 framework was considered as "best in class" by other telecom players. CYTA (Cyprus Telecommunications Authority) did in 1998 a global search for high quality product processes, and Telenor was chosen to provide CYTA with an integrated process for the product area[10].

"The P^3 process was under consideration by the German company VIAG Interkom in 1998. However, their rather hierarchical management system was a great challenge. The conclusion was that the P^3 framework seemed to be best suited to companies with a "flat" structure, like Telenor. I trained hundreds of people in P^3, and there was a great enthusiasm among those experienced in typical NPD pitfalls. The framework provided a solution for most of these. The P^3 network became one of the largest knowledge networks in Telenor. The exchange and sharing of experience was some of the best I've ever seen in my 35 years of professional work."

Åse Haugan, IT-consultant, Telenor Operations.

6 The Importance of a Supporting Environment – to create an "ecology of innovation"

Creating an NPD-process is really not that difficult. There exists today a wide range of practical and proven processes in small and large companies. However, *using* the process, *improving* it, as well as adding and updating IT-tools, demand focus, energy and budgets.

As shown in Figure 7, used as part of the training in the NPD, it is easy to become disappointed when a new way of working is perceived as a "fix-it-all". If at the same time there is also too little understanding of the need for patience and a supporting environment in the implementation and continuous improve-

10) *When implemented in Cyprus Telecommunications the process was called "DEUCALION" (from Greek Mythology): "During 1998 we completed the development of the DEUCALION methodology, which covers the complete life cycle of a product from the original conception to its final removal from the market at the end of its life. The new methodology places on a systematic and complete basis the development and management of all our products and is a significant milestone in the efforts of the PROMITHEAS project for the promotion of our new customer-oriented strategy.*

The DEUCALION methodology consists of four basic activities: innovation management, product development, product management and product portfolio management. The methodology has gradually been implemented with the introduction of electronic support systems for innovation management, with the establishment of working groups for the development of new products, such as those for the intelligent network and broadband services, and with the distribution of user manuals for the new methodology", from CYTA's Annual Report, 1998, see http://www.cyta.com.cy/pr/annualreport/

ment of the process, it may lead people not to use it, or use it in unconstructive ways.

The story is usually not that an NDP is tried and found wanting. The risk is more often that it is perceived as difficult and then abandoned or reduced to a set of templates or tools, without an active adherence to its "spirit" or guiding principles (Figure 8).

Professional product development and portfolio management need to take a long term view, as well as keeping abreast or ahead in finding and commercialising new business opportunities. A sound "Ecology of Innovation" is about both creating and maintaining relevant technological and platform oriented roots, as well as having a helpful and healthy way of watering, feeding and pruning the trees and plants of products.

The P3OP implementation team initially focused on road shows and training programs, and eventually on coaching and process revision projects. One followed a strategy of "continuous development" of the P^3 process through active networking of the product environment cells. The effect of the networking emphasis can still be accounted for, several years after the funding ended. P3OP took the role of operational coordination, through common scorecards and an annual range of "top 10" projects in Telenor. And this was done in a company at a time when fierce competition among the business units was the strategy. Although a healthy initiative, P3OP may in retrospect be perceived as having been "fighting the windmills" of changing company priorities.

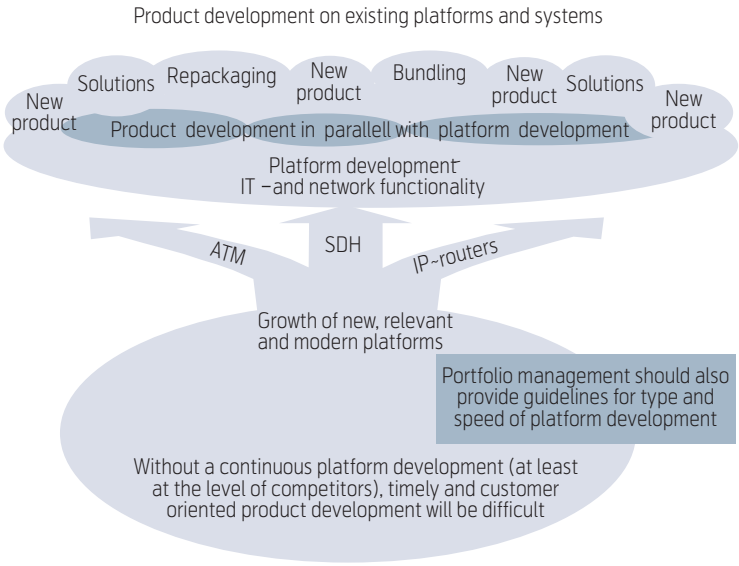

Figure 8 An ecology of innovation

7 Conclusion – if we should do it all over again ...

In 2004, variants of the P^3 process are still used by major business units in Telenor, though in different ways and formats, and at various levels of executional quality. Several major development projects since the late 90s have been undertaken in new business units without formal or phase oriented processes, leading to a less that optimal performance.

The last years several business units have recognised the need for a major update of their NDP and there has also been a new corporate understanding of, and effort at, "Operational Excellence" through cross company processes. In early 2004 process improvement efforts were going on in several BUs, though with little coordination between units. However, the new Operational Excellence initiative that is being planned also for the product processes should change this.

In order to design and implement a best-in-class NPD process it is mandatory to learn from experience – both within Telenor and from other efforts. At a high level view there are several pitfalls one should avoid:

- Underestimating what it takes to create and implement an NPD process – management believes this is easy or that they have achieved it;
- Treating NPD redesign as a hype;
- Not ensuring a sufficient alignment with portfolio management;
- Undermining the process by launching products before they are ready for launch, e.g. before delivery processes are designed, tested and implemented for the product;
- Not understanding how to involve employees, or change the culture;
- Not having sufficient management leadership or follow-up;

"My most valuable experience with P^3 was the exceptional results we reached in NPD in Telenor Residential. About a year and a half after implementation, we had managed to cut development time by 50 %, while increasing customer satisfaction with new products from 86 to 93 %. These results led to international recognition. During a five year period in the late 90s, we managed to launch more than 20 products in the Norwegian consumer market."

Per Velde, former Manager of the NPD department in Telenor Residential, now consultant in NPD

- Lacking time or investment in continuous training and improvement of guidelines;
- Not realigning company policies and reward systems to support NPD.

Table 2 is a more specific list of some of the learnings that have been made in Telenor.

If we should do it all over again, it seems that at least the following changes should be made:

Area	Pro	Con
Idea generation	• Emphasize on a broad range of idea sources • A common database for gathering ideas	• Lack of formality • Lack of resources to maintain and improve the database • The idea of a structured innovation and idea process must be carefully balanced to the responsibility for innovation placed on the individual business units. The shared idea process in Telenor was early abandoned so as not to "act as a pillow for the management to sleep on" as one director put it.
CFT – Cross functional teams	• Very important that e.g. both market and IT-people participate from the start • In the mid 90s several Telenor executives realised that an emphasis on CFT is "the glue" that keeps a large company together	• May create some cultural challenges • Some of the more technical minded participants may feel a bit "out of it" in the beginning of an NPD project, as the main theme then is understanding the customer
Phases	• A "four phase"-process as well as a four "focus stream"-process in each phase is easy to understand	• May be perceived as "repeating" some of the work from earlier phases, or postponing important issues to later
Decision process	• Based on a "team spirit" and "joint venture" with the executive level considered as "part of the project team"[11] • The goal was a "new paradigm" of helping the projects do it right the first time, not telling afterwards what needed to be redone	• Lack of formal gate passing criteria led to too many projects passing • The new paradigm seemed difficult to understand or follow by gatekeepers and steering committees • The effort needed to follow/understand a defined decision process led to some bypassing of the process • Delayed decisions and lack of common understanding of deliverables in gate meeting led to projects feeling "trapped in bureaucracy"
Launch	• Emphasis of good planning, and formal agreements with the line organisation in order to launch ("check-out contract")	• Too little emphasis on formalising and measuring the launch practice led to second level goals often being paramount (e.g. launch date, rather than product or delivery process quality)
Flexibility	• High – basically the only inflexible requirements process was four principles • A possibility for "tailor making" the process for each business unit and project	• This kind of "formal flexibility" was ahead of its time and little understood or used by the business units and projects • Difficulty communicating the paradigm of flexibility led to projects following templates too vigorously and feeling bogged down in bureaucracy
Tools	• Annually updated Handbooks with advice from new hands-on experience • A collection of good working methods • An Idea Database • Electronic templates, regularly improved in a learning organisation • Set of examples from previous projects	• Some of the tools were a bit inflexible in the beginning, and not well suited to different kinds of projects
Measurements	• A set of measuring tools were provided	• Few were used, some due to difficulties in getting solid data, others because of measuring tools not being relevant to all units
Interface with other processes	• The P^3 process was designed to provide solid interfaces with other processes like IT, customer service and delivery	• Too few other processes defined in 1996 • As other processes have become implemented in the BUs, NPD has been modified to ensure a proper exchange of data and competencies
Interface with the project management system	• The project management system was developed by people familiar with P^3 • P^3 was designed as a complementary process to any formal project management systems	• No formal and common Telenor system in place in 1996 • Some projects used P^3 as a project management model, which led to some challenges in the area of "project control"

Table 2 Pros and cons of the process

11) *The "team spirit" approach was chosen despite clear warnings in the literature, and by key P^3 project members, see also Cooper, 1998*

Even if there are opportunities for improvements, the P^3 process is an excellent reference point for future work on even better customer oriented product processes in Telenor.

Literature

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Supporting environment
Committed top executive level support for a longer implementation period
Incentives for middle managers to support the process
More follow up of – and supporting tools for – the learning organisation
Maintaining a supporting environment and coaching culture • Professional Process Owners and Project Facilitators – fully dedicated
Company wide targets and measures on innovation
Having an even more formal "follow up" by a corporate unit responsible for overall innovation

The NPD as such
More formal gate passing criteria • Specific minimum requirements rigorously followed • Score Card approach – more than "Business Case"
A formal set of gate keepers for all projects in the BU • Supplementing Project Steering Groups (which have a different role)
More "automatic" guidelines • Web based
Better IT-tools for portfolio management • Facilitating an overall value analysis and graphical views, as well as a follow-up of NPD results

"Excellent to focus on phases – a stage-gate process – working from one decision point to the next.
Good training in Telenor Networks among management, project managers as well as project participants.
Everyone speaks the same project-process language.
It is crucial that IT is involved early.
The management in newer Business Units like Nextra, International etc., did not use the process, which created several challenges in cross company projects."

Jørgen Grinnes and Eskil Dahlen: Project Managers, Telenor Privat, formerly in Telenor Networks

"P^3 provides a good framework for running NPD projects, however it is not often that the projects really are "allowed" to use it from beginning to end. P^3 is an enabler for good NPD work. Still, the most important success factor in my view is how much and how active the executives and the steering committee adhere to the guidelines for the decision points."

Birgit Bjørnsen, Manager of Business Development, Telenor Privat, formerly Manager of Project Management Department, Telenor Mobil

For a presentation of the author, turn to page 2.

Managing innovation – An overview of the last decades' experience with tools and methods

TOR-ARNE BELLIKA AND BJØRN ARE DAVIDSEN

Tor-Arne Belllika is co-founder and major owner of Convergent Innovation Management AS

Bjørn Are Davidsen works in Business Development at the Fixed Lines Residential Market, Telenor Norge

Innovation should be managed at all levels in a company. However, to ensure that this is not done through either killing creativity or launching products in the market too early, it is important to have facilitating tools and methods. Experience from the last decades indicates possible ways ahead for individual companies, depending on size, process maturity, business context and product area.

1 Abstract

Rapidly decreasing product lifecycles and growing global competition have increased the importance of formal Product Development methods and processes. The competitive nature of global markets leads companies to accelerate their NPD (New Product Development) activities. The goal is to commercialise more products, faster, better and more efficiently. There have been several distinct changes in the attitudes and development concepts in the last decades, from the stepwise methods of NASA in the 60s to today's Remote Collaborative Product Development now being implemented by innovation leaders. This evolution has left companies at different innovation maturity levels, spread all the way from no formal innovation system to advanced IT and web based collaborative innovation systems. The article will look at important learnings for companies wanting better NPD methods and tools, including what "not to do", as well as providing a perspective of product development in the last decades.

To move ahead it is important to learn from the past. In NPD it is just as true as elsewhere that those who do not learn from history tend to repeat it, something that may become costly in today's competitive markets. And at the same time we may mention that the last years of experience in NPD has made it possible also in this area to say that we stand on the shoulders of giants[1]. While we cannot here provide more than an overview of important factors, it may hopefully lead executives, R&D units and companies to a more systematic approach to innovation. Hence, this article is more about adding advice than an advanced academic analysis.

2 Understanding NPD – recent phases, failures and financial successes

New Product Development (NPD) is a process by which a new product (or service, or a combination of both) is developed. The economy of today is becoming more and more knowledge oriented. We experience this by shorter product lifecycles[2], an emphasis on innovation, and a quickening pace of technological development and market regulation to increase global competition.

To cope with this, there has been a growing recognition of the importance of formal innovation management in the last decades. New research evidence supports that innovation system maturity and company profitability are closely connected (Cesati et al. 2002).

However, this knowledge has still not been adapted and acted upon by most company boards and top management groups. In a market study published in December 2003 by the Boston Consulting Group, 52 % of top executive representatives stated that there was no person in the company responsible for the "Innovation to Cash" process.

It has not made the management role easier that the term "innovation" seems to be understood in different ways. Some prefer to focus on spin-offs and new businesses, some on major platform development projects and others on improving or growing business in existing business units. It leads to a difference in one's approach to innovation if one perceives it more as radical, technological breakthroughs, than as systematically improving or introducing products on existing technological platforms. The same Boston Consulting study showed just how different executives defined innovation. Even more important, the study revealed *"Excecutives at all levels showed little*

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1) *"Bernard of Chartres [1130] used to say that we are like dwarfs on the shoulders of giants, so that we can see more than they, and things at a greater distance, not by virtue of any sharpness of sight on our part, or any physical distinction, but because we are carried high and raised up by their giant size." John of Salisbury, 1159, from Metalogicon.*

2) *The 2003 PDMA CPAS study indicates up to 40 % shorter cycle time in 2003 compared to the last study in 1995.*

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agreement on how to measure the success of innovation". A number of respondents said they had no way to measure innovation effectively. Without the ability to measure innovation, they have a difficult time managing it."

Considering the broad range of issues related to managing innovation, one needs to focus on the most important. A good overview of main challenges is given in (Jonash & Sommerlatte, 1999):

1 *Intellectual property is becoming increasingly difficult to protect and preserve, measure and manage.*

2 *Business – even entire industries – is no longer insulated from the competition, and innovation leadership is difficult to sustain.*

3 *The nature of competition itself has shifted to cost leadership in many industries, and reengineering-driven cost reductions have overwhelmed many innovation initiatives.*

4 *Technological advances have radically altered the old view of research-and-development techniques, leaving many traditional R&D departments mired in yesterday's key competencies and technologies.*

5 *Traditional research-and-development managers focus primarily on internal operations, while the extended enterprise, which includes suppliers, partners, and customers, often remains unmanaged.*

Factors such as these – not to mention the heavy loss from the dotcom bubble – have reduced the level of NPD investment in many companies[3]. And in the "post-reengineering world" it seems difficult not for managers to act as if R&D – and the whole area of product development – is just another overhead cost. This is manifested in a reluctance to increase or maintain R&D budgets, and an insufficient focus among top executives in taking responsibility for innovation as a cross-functional and multidisciplinary effort (Jonash & Sommerlatte) (BCG, 2003). The challenge is that a lack of funding, of formal methods and IT-support tend to create suboptimal work along the broad range of NPD activities. Instead of becoming faster, more agile and versatile, companies tend to treat product development more like a cost factor to be cut than as an investment opportunity to be managed.

How did we get where we are, and how may we find the way forward?

3 "Methods in the madness?"

Product development is nothing new. It has been done more or less intuitively for centuries, if not for millennia, by traders, inventors[4] and companies, creating a stream of new goods and services. However, with a change of focus from supply optimisation to increasingly competitive market in the second half of the 20th century, formal methods have evolved or – more precisely – been developed.

In the 1960s NASA developed a staged program management process to meet the challenge of landing a man on the moon in that decade[5]. The process utilised state-of-the-art project management tools and

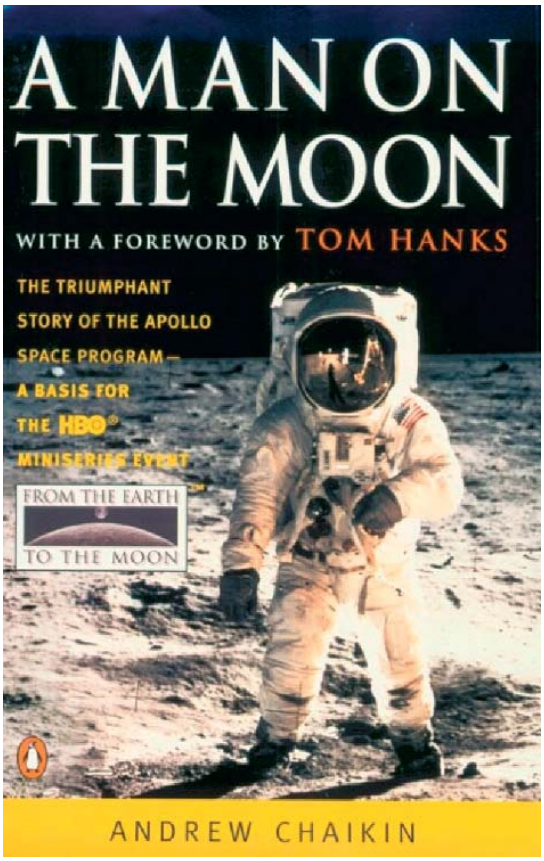

Figure 3.1 NASA was a pioneer in formal New Product Development methods, with their staged management process in the 1960s, being able to put people on the Moon and safely returning them to Earth, well documented in this book by Andrew Chaikin

[3] *The PDMA 2003 CPAS study clearly demonstrates a change towards more low risk low return projects and lower R&D spending.*

[4] *Inventors like Roger Bacon (1214–1292) and Leonardo da Vinci (1452–1519) represent just the "tip of the iceberg" of creative people the last thousand years, and even in their own time.*

[5] "I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth." *President John F. Kennedy, May 25, 1961.*

was a decisive factor for the 1969 moon landing success. The process was basically about having experts in each area working in successive stages, with a hand-over to the next department or set of experts for each phase. This kind of highly structured method came to be widely used, as it seemed to ensure quality and control.

And for high-tech companies in a monopoly situation – or a perceived such situation due to e.g. IPR or dominating position – the result often seems to have been a process designed for product quality, rather than development speed or customer satisfaction. For Xerox, who had near monopoly of the plain copier market until the mid-1970s, the decision-making process as it had developed over the years, was so slow and unwieldy that the company was unable to prevent the incursion by Kodak and the Japanese into its markets. Not only were there problems of geographic coordination; the process of getting a product from design to implementation was painfully complex. In the first place, product planning, engineering and manufacturing did not converge until decision-making met at the executive level in Stamford. Second, each of these three organizations had its own functional units and hierarchy, lengthening the process of the decisions. A product would first go to drafting, then to detailing and to service engineering. If the drawing was approved, it would be passed on to the manufacturing engineering organization. Throughout, it would be subjected to their product development system adopted from NASA's staged program management, which entailed constant review and critiquing of products.

Furthermore, the total Xerox system was built around matrix management where, as Jim Kearney, an engineer and manager at Xerox says, *"No one takes the blame for anything. Everyone opens their kimono for everyone else to see. Everyone shares. No one really cares about actually completing projects. In fact, people think it's their job to not complete projects. You're promoted for not taking risks because the company never is exposed."* (Bled and Aaker).

As companies in the following decades utilised or looked for faster decision processes and better product development methods, this area attracted academic studies. One groundbreaking study was done by Robert Cooper (1987) who analysed NPD processes at more than 200 different companies in different businesses. He found thirteen value adding steps in a product development process:

1 Initial screening
2 Preliminary market assessment
3 Preliminary technical assessment
4 Detailed market study / market research
5 Business/financial analyses
6 Product development
7 In-house product testing
8 Customer tests of product
9 Test market / trail sell
10 Trail production
11 Pre-commercialization business analyses
12 Production start-up
13 Market launch

This became the basis for Coopers Stage-Gate® process which in many ways set the existing NPD paradigm as a suited way of viewing and managing product development at a high level. To the degree that companies need to move to other forms of doing NPD, experience has shown that this rarely succeeds without a thorough training in – and some years use of – a Stage-Gate®-model.

Cooper (1993) also found – to little surprise – that the probability of new product success increased if all thirteen steps are conducted well. In Cooper's work different phases and components of the NPD process are analyzed. However, his studies show that most of the companies do not always conduct all thirteen steps.

The rather strict structure of Cooper's thirteen phases may not be optimal for software companies, where time to market often is more crucial in product development than quality of the earliest delivered versions. Still it is important to bear Cooper's model in mind as

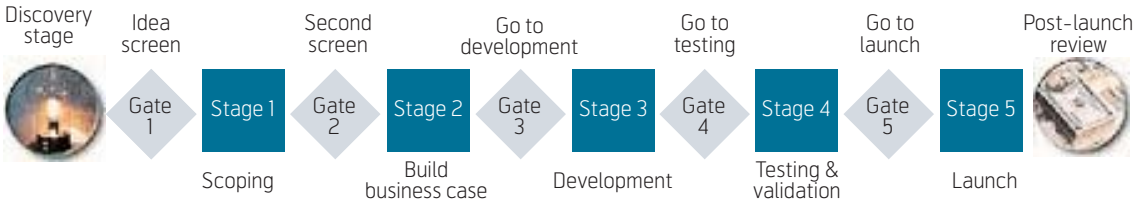

Figure 3.2 A generic Stage Gate model for product development

it provides the best general way of looking at NPD, as well as being suitable for analysing in what area of their NPD work companies succeed or fail. His more recent studies show, for example, that in 74 % of projects the detailed market study was scored as deficient – either done poorly or not done at all (Cooper, 2001). Initial screening was rated as the weakest overall activity, scoring lowest on proficiency scale (Cooper, 2001).

Responding to customers' needs is often cited as an important part of successful NPD. In a survey by Industry Week and Price Waterhouse Coopers Consulting (2002), 70 % of the respondents listed customer needs as the primary focus of NPD strategies. After that, the next-closest factor cited, low product cost (only 13 %), then innovative features (11 %), and first to market (5 %).

Factors such as these, emphasise the need for a markedly better NPD process. Davenport et al. (1996) have shown, however, that a company's NPD process cannot easily be reengineered. It is often a challenge that the process is misunderstood by stakeholders or different parts of an organization. In addition, the NPD process may not be sufficiently documented, if documented at all. Finally, because of the strategic importance of NPD for a company, changing a process is risky, especially if at the moment it is producing acceptable outcomes. Many studies and practices have shown that an ideal NPD process that works for all industries, organizational structures and companies at all times – does not exist.

Table 3.1 provides an overview of different methods. Note that an effective Stage-Gate®-model seems to be the key for innovation management, as well as a baseline when considering other or related ways of performing NPD. The broad acceptance of a staged process as the foundation is confirmed by the latest PDMA[6)] performance benchmarking study (2004). 72 % of more than 400 participating companies had a non-sequential, cross functional development process.

Although there are characteristics of NPD processes that are common for different industries, there are also significant differences. While the Stage-Gate® model still is highly important for many companies, what is called "agile methods" encompass other methods that began to emerge from the mid-90s. Emphasis of these methodologies is on creativity, change, speed and quality, something that is needed in businesses with a strong competition and rapid deployment of new technologies and products.

McCormack's study (2001) has tried to identify the key success practices for an NPD process using agile methods:

- An early release of the evolving product design to customers;
- Daily incorporation of new software code and rapid feedback on design changes;
- A team with broad-based experience of shipping multiple projects;
- Major investments in the design of the product architecture.

The influence of these methods is growing. The Giga Group (2002) estimates that 10 % of corporate IT organizations now use agile methods, while 25 % are exploring them. The Giga Group also estimates that in the next year and half, more than 2/3 of IT organizations will be using some form of agile process (2002).

An agile approach is characterized by close work with the customers, quick response to every change in requirements, less documentation, and close interaction within the product team.

Some of the main characteristics of the agile approach are that:

- "Development is broken down into a number of 'sub-cycles', each of which is geared to producing a subset of the functionality to be provided in the final product;
- A prototype is released to selected customers at a very early stage of development;
- The development process encompasses mechanisms to ensure rapid feedback on the impact of ongoing design changes." (MacCormack, A, Kemerer, C, Cusumano, M & Crandall, B, 2002)

Successful NPD seems to require a pragmatic approach. Using the Stage-Gate®-model as a managerial basis, different tools, techniques and methods may be used to increase speed and quality according to market and customer needs – and related to the

6) *Product Development Management Association*

Prosess type	Characteristics	Benefits/Concerns	Conclusion
"Phased Review" (NASA in the 1960s)	• Fixed phases/activities • Reporting to the department in charge of the specific phase	+ Extremely structured – Different department taking responsibility with each new phase – No one unit in charge of the development from start to finish	• Not relevant – old fashioned! • Important to avoid that other development processes in practise turn out functioning like this
Stage-Gate® (SG) (from the 1980s) A "Waterfall Development Model"	• Phase oriented with defined activities and questions to be answered in each phase • Parallell activities • Clear criteria at each gate • Consistent core team throughout the project • In general the product requirements - are knowable before launch - have no unresolved, high-risk implications • will not change very much during development	+ Structured and flexible (phases, gates and activities may be dropped or developed in more detail) + The gates provide a managerial link to a Portfolio Management Process + May hinder bureaucracy by emphasising focus areas and principles + One unit or person responsible for all phases + The phase oriented approach is important to reduce risk and provide formal milestones also for spin-offs and new businesses – May be perceived as bureaucratic until one knows and follows it – May be difficult to find good criteria to support also radical innovations	• Easy to adjust to the challenges of specific business units • May be combined with other types of processes (for some activities or sub-contractors) • 68 % of leading U.S. product developers now use some type of Stage-Gate process (Cooper, 2001) • An SG-process suits to a high degree both large and small companies, as well as new and old businesses
Overlapping "Stage-Gate™" (from the 1990s)	• Parallel processing (over-lapping phases at the beginning and end to save time) • Otherwise as SG	+ May save time and resources when "stage-gate" implemented and well known! – Complex project management – Requires discipline and rigorous follow-up	• The model is not contrary to an SG model • Supplementing an SG model, though may be too ambitious as a general model
"Agile methods" which may support the SG model or change the way it is used			
"Prototyping", – Stepwise delivery, iterative process (from the 1990s) A "Spiral Development Model"	• A series of partial releases of the product • Prototypes are delivered at planned intervals and tested by customers prior to a final delivery • May require special contracts on cooperation • Useful when the risks are significant, when there is a need/opportunity to launch a partial product in a short time, and when the requirements are not fully understood or can change • Appropriate when - A "prototype" is sufficient so that customers will continue to participate in its evolution - The architecture is scalable to a full set of product life cycle requirements - Users/customers are sufficiently flexible to adapt to the pace of product evolution	+ Frequent response from customers! + May ensure income before "final delivery" of the product + Reduces risk! – Not all kinds of products are suited for early prototypes – Usually requires highly motivated customers	Especially suited for software and high speed development on flexible platforms (e.g. Web, Mobile CPA and Intelligent Networks) May also be part of a concept phase in an SG project, or for sub deliveries related to the IT-part of a product (e.g. for an order and billing system)

Time boxing (from the 1990s)	• Stepwise deliveries at regular intervals (e.g. quarterly, annual or bi-annual), sometimes based on long term plans and development projects, as in upgrading of telephone switching systems • Customers may or may not buy every next "upgrade"	+ Facilitates upgrading of existing products or systems, based on customer needs + Regular releases of upgrades – May not function as well when developing brand new products or systems – Not optimal in periods of quick shifts in market, technology or customer requirements	Especially suited for improvements and adjustments of existing platforms and systems. Much used for sub deliveries related to the IT-part of a product (e.g. for an order and billing system).
Different order of stages (from the 1990s)	• Start by selling the product, and develop it if anyone buys • Or deliver an early prototype and then develop/adjust the product based on customer feedback	+ Saves time and resources + Lowers time to market dramatically + Suitable for some product niches in new industries – May create a paradigm which leads to underestimating the complexities in creating a valid product – May make managers focus on too short term goals	• May be too much of a deviation to really be an SG process • Must also be managed as a formal process to avoid "anarchy" and a too chaotic product portfolio with "unfinished" products
Strategic partnering (from the 1990s)	• Outsourcing of whole or parts of the development efforts, often limited to specific technologies, interfaces or markets • Reduces the need for a new tender process every time there's a need for a product change	+ Development may begin earlier + High degree of influence on supplier + May create product families based on common technology – Risk of losing competitive incitements of suppliers – Need to be very cautious not to break formal or regulatory rules	Good supplement to SG for some technologies and markets, however rarely suited as a general model
Remote Collaborative Product Development (RCPD) (from the 2000s)	• Integrates widely distributed engineers for virtual collaboration through creating a common working environment. Web solutions constitute a backbone of this collaborative environment, • New tools for electronic system design that transform electronic engineering into a global, distributed activity in a virtual RCPD environment	+ Allows engineering and production cost reductions (e.g. less travel time), improved product quality and reduced time-to-market through a sharing of high expert development resources for a broader range of companies or business units + Suppliers can join collaboration sessions to discuss parts or tooling directly with their customer from their location – May put higher demands on management skill – Need for appropriate standards in tools and processes for global engineering collaboration to work	Much used in the goods industry, e.g. automotive industry Allows people, or groups of people, to work together from remote sites. Design sessions, product reviews, supplier meetings, and customer reviews no longer require travel and time away from daily work. Documents are modified in an interactive session by computer May improve the SG process through easier involvement of suppliers, customers, experts and scarce resources

Table 3.1 Overview and comparison of some management methods used for new product development

specific challenges in the area of business the company is in (see Table 3.1 for a general overview).

> *"NPD using the Agile methodologies is becoming a more popular way to produce quality software product in a timely way. However, efficiency for this method and how to enhance this process has not been studied sufficiently."* (Lazarevic, 2003)

4 Innovation maturity, tools and support

Firms with mature, company-wide innovation systems cannot defend the cost of their innovation systems without a focus on effectiveness and thus company-wide automation and standardisation supported by IT tools. This is confirmed through the 2003 PDMA CPAS[7)] study (PDMA, 2004). IT support

7) *PDMA sponsored studies of New Product Development Comparative Performance.*

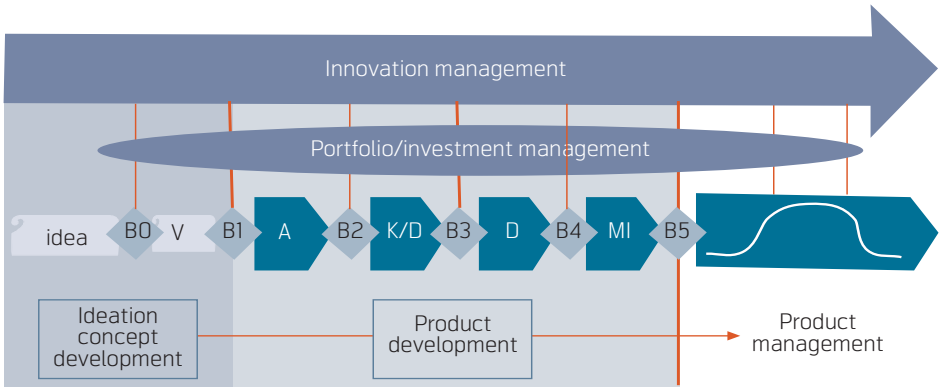

Figure 4.1 The four basic innovation processes in an innovation system

tools are now in extensive use, something that is one of two major practices differentiating the most innovative companies from the rest.

What is an innovation system? Figure 4.1 illustrates the Innovation Management processes. They are Portfolio management, Ideation/concept development, Product development and Product management. These processes, the tools, the work practices, and the competence of the involved personnel constitute the innovation system.

According to the 2003 PDMA CPAS study 80 % of participating companies now have formalised development processes (PDMA, 2004). 56 % of respondents have a formal portfolio management process.

How well companies have implemented these formal processes of the innovation system has been used to define the innovation maturity of a company. The same research shows a direct link between innovation maturity level and company performance measured in net profit (Cesati et al., 2002).

The best innovation performers today are stage 3 companies. They are now improving the portfolio management process having the following three elements:

- Monthly, quarterly or bi-annual portfolio reviews where top management rank ALL development projects and allocate resources to the preferred project mix.

Stages of Overall Product Development & Innovation Capability	
Stage 0 Informal Management	Product development is unstructured and dependent on individual experience. Performance may be good for a very small company, but the informal approach is not sustainable and is a liability to a larger, growing enterprise.
Stage 1 Functional Excellence	Companies at this stage have defined processes within individual functions, but these processes are not integrated across the business. Time to market is slowed by serial, "over-the-wall" interactions.
Stage 2 Project Excellence	The concept to-market process is integrated across functions and is supported by focused, cross-functional teams and business-driven decision making. Intimate understanding of customer needs allows teams to develop targeted, winning products.
Stage 3 Portfolio Excellence	Explicit processes facilitate translation of business strategy into robust market, product, and technology strategies. Planning techniques enable platform leverage. Senior management regularly assess and refine portfolio balance. New opportunities are rapidly identified and selected and projects are staffed and executed, based on strategic merit.
Stage 4 Collaborative Development Excellence	The development chain is configured to fully utilize core competencies and maximize R&D throughput by leveraging capabilities of development partners. Processes are in place to enable effective partner management and efficient interactions.

Table 4.1 Stages of innovation maturity and performance excellence. Innovation Performance studies have documented a direct link between maturity level and net profit [Cesati et al. 2002]

- The gate meetings ending a phase in an individual project.

- A strategy process describing the framework for how the development resources are to be used to secure that business strategy is implemented.

The key goal of this process is to maximize the value of the portfolio of ideas/concepts, development projects and current products, balance the portfolio and align projects to actually implement current business and development strategy.

4.1 Evolution of IT support

The way IT tools are used in Innovation Management can be divided into two groups:

1 Separate tools to support specific work processes or tasks at project team level. Examples are engineering & design, market research and analysis, project management, document management, configuration management, knowledge management, etc.

2 Process support and management systems used predominantly by top management, middle management, project managers and process owners. Examples are idea management, portfolio management, product data management and resource management.

There are other ways to segment these types of tools and we would recommend a series of three articles by Stewart McKie (MacKie, 2004).

As innovation is cross-functional in its nature, IT support has evolved gradually from the first point solutions to solve specific problems up through a number of more such "quick fix" systems that have not been integrated. Today we see the first integrated systems designed from ground up to supporting the entire innovation system and the first ERP[8)] systems (Oracle/ SAP) adding cross-functional support and idea to end-of-product-life support have entered the market (MacKie, 2004).

Today, the typical toolset for the most innovation mature companies consists of a number of cheap off-the-shelf general purpose software tools and internally developed systems. The latter is predicted gradually to be phased out as integrated Innovation Management, Product Lifecycle tools and ERP systems with cross functional Innovation Management add-on's are becoming more mature.

Table 4.2 lists the complete set of relevant NPD tools and their frequency of use (PDMA, 2004).

IT support in innovation makes little sense if there is no formal innovation system and processes it is supposed to add to and support. We should still consider the new integrated Innovation Management solutions somewhat immature.

Very few companies in the Nordic economy have implemented integrated IT-systems for innovation support. A key reason is that the Nordic economy is dominated by small and medium sized businesses and the new integrated cross functional IT-solutions hold a price tag representing an economic barrier to all but the largest companies. The top tier solutions providers target the enterprise market, and both system complexity and pricing reflect this.

Tool type	% of time used
CAD/CAE	**56.3 %**
Project Management System	55.3 %
Document Management System	51.2 %
Design for manufacturing, assembly, testing DFX	40.8 %
Simultaneous/Concurrent Engineering	40.1 %
Rapid Prototyping Systems	38.7%
Failure Mode / Effect Analysis (FMEA)	38.7 %
Product Data Management System	32.7 %
Performance Modelling & Simulation System	31.6 %
Resource Management Systems	25.8 %
Value Analysis / Value Engineering (VA/VE)	25.7 %
Configuration Management System	23.9 %
Knowledge Management System	21.7 %
Six Sigma Analysis	21.1 %
Product Portfolio Management Software	16.1 %
Customer Needs / Requirements Analysis Software	13.3 %
Remote Collaborative Design Systems	12.9%
WEB-based Sourcing Management Software	11.6 %

Table 4.2 Penetration of new IT tools in NPD Usage by average % of time used in a set of more than 400 US companies (PDMA, 2004)

8) *ERP: Enterprise Resource Planning*

5 Remote Collaborative Product Development – the way ahead?

Remote Collaborative Product Development (RCPD) is done by companies expanding their NPD capabilities by sharing core competencies internally, among partners and customers through a strategic use of IT-solutions. These tools are predominantly used by those companies moving into stage 4 of the innovation maturity level model shown in Table 4.1 above.

The most important driver is the ability to harness specialised resources and reduce *time-to-profit*. This TTP is achieved through leveraging *"every means available to shorten every aspect of the product development cycle"* (Lasser, 2003). The Stage-Gate® process has led to good results in shortening TTP, and in reaching cost and quality targets. However, the Stage-Gate® model may need adaptations for a highly dynamic and uncertain environment. It might be too structured and may limit system flexibility, speed and adaptability under turbulent conditions. RCPD tools can support a dynamic environment with an integrated view of all ideas, projects and all product information and a range of interfaces, relationships and collaborative resources.

Tapping the potential of integrated RCPE tools will be a real challenge if the partners have different methods and systems for project management, resource allocation and management involvement. In order to meet such typical challenges, an RCPE should be designed around a common set of work practices and tools or be based on the solutions of the partner with the most advanced innovation system. This will slow the implementation pace of such systems until integration between heterogeneous systems is made much easier or a "de facto" solution standard in RCPE tools emerges in the marketplace.

Still, tools cannot completely replace face-to-face methods. *"Discovery of the nature of working together apart, via a telecommunication network, will link the next generation RCPD participants more intimately in their daily work increasing productivity"* (Lasser, 2003). This is a highly relevant area to explore for telecom companies, both in regard to providing services to support remote collaboration for others, and for use in their own innovation efforts.

6 Conclusions

There is a broad range of NPD methods and tools. In order to select the most suitable it is important to understand the kind of business one wants to do, how the competitors aim in this area, and the degree of process and IT tool maturity in one's organization. As a general rule a Stage-Gate® process is the best to use and there exists a range of IT tools to support this. However, for various reasons, it may be more optimal to combine an SG® with other approaches.

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For a presentation of Bjørn Are Davidsen, turn to page 2.

Profitable innovation management practices
— Benchmarking tools reveal large profit potential in innovation

TOR-ARNE BELLIKA, JENS ARLETH AND CLAUS J. VARNES

Tor-Arne Belllika is co-founder and major owner of Convergent Innovation Management AS

"Innovate or die" and "Innovation warfare" are commonplace statements these days. The ever increasing technological pace and the global competition relentlessly cut product lifecycles and put pressure on every firm's ability to renew and innovate. It is difficult to survive in the long run without making innovation performance and the quality of the most important innovation work practices more manageable. Our studies of innovation performance and practices in eleven Nordic companies in 1993 and 2003 reveal a potential to increase the net result of these companies each year with the size of their total development budget by closing only some of the gap between this group's average innovation performance and the best performers. Our research data also indicate that there have been only small performance and practice improvements in Denmark and Norway during the last ten years and that none of the companies had a metrics program in place to make this area more manageable. We present tools that enable the key management practices; continuous performance measurement and benchmarking, and discuss how industry level institutions and stakeholders can play a role in spreading such management practices.

Jens Arleth is a leading European innovation consultant and the creator of ProBE™ Innovation Benchmarker

Claus J. Varnes is a doctoral candidate with Copenhagen Business School

Abstract

Innovation performance metrics is a weak practice area in companies[1)]. Lack of standardised metrics makes Innovation Management more of an "art" reserved for the most experienced managers than an empirically based management practice. Lack of metrics programs and practices hamper effective knowledge diffusion and learning at project, company and industry level. Our studies of two groups of Nordic companies in 1993 and 2003 show almost no innovation performance improvements and indicate that the diffusion rate for best innovation practices seems to be very slow.

The results we present are based on the use of a set of innovation measurement & benchmarking tools developed through a major international research effort [1]. This article presents for the first time how these tools are taken to the industry level and produce important value to company stakeholders and member organisations. It is evident that industry level stakeholders have a key role to play to make innovation more manageable in their "member" companies. The organisations involved in our study (macro level) are now bundling innovation measurement and benchmarking into their member service. We believe this will be a strong motivator for member companies to introduce fact-based innovation management practices.

The benchmarking services make performance data from organisation members available on an ongoing basis. This will be used by the industry level stakeholders to identify common weaknesses and motivate joint improvement efforts to identify best performers, best local practices and to measure the effects of joint efforts over time. The benchmarking data also enable these organisations/stakeholders to work politically to improve the external conditions for innovation in member firms.

Standardisation of key innovation performance metrics and frequent measurement and benchmarking at the project, at the company and at the industry level, hold the potential to produce a learning system capable of increasing innovation performance at multiple levels and diffuse best innovation practices much faster than what seems to have been the case during the last ten years.

The findings from our studies of Nordic companies in 1993 and 2003

We have been performing innovation performance and practice benchmarking in Scandinavia for more than ten years. The results from one of our first studies in 1993 involved one Swedish and ten Danish companies and introduced the first version of the measurement and benchmarking tool ProBE® [2] for data collection and benchmarking. The study revealed that only half of the completed development projects were successes and that 85 % of the projects were delayed.

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1) *4th weakest practice area out of 18 practices in our sample of eleven Norwegian and Danish companies. Key conclusion in the latest benchmarking study by Cooper and Edgett [1].*

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Performance area	Average result in 1993	Average result in 2003	Industry norm[2)]	The 20 % best	Comments
Success rate for development projects conducted during last 3 years	55 %	52 %	58 %	79.5 %[3)]–75.3 %[4)]	Success is defined as whether the project was considered a success compared to original goals
Kill rate	9 %	25 %	18 %	4.3 %[3)]	% of projects entering development phase stopped before launch
Unsuccessful projects, fiascos	36 %	23 %	24 %	8.1 %[3)]	% of projects that did not meet goals and were considered fiascos
% of development projects on time	15 %	49 %	No data	79.4 %[3)]	
Average delay for delayed projects	>50 %	39 %	No data	No data	

Table 1 Only little improvement in innovation performance over the last ten years
The table compares innovation performance results for eleven Nordic companies in 1993 with another group of eleven companies in 2003. The results are also compared to our entire sample of 300+ companies from two other international studies published in 2003 and 2004 [1], [4]

Since 1993 the benchmarking tools have been further developed and the benchmarking database now hold practices and performance data from more than 300 companies in Europe and North America [3].

Ten years after the first Nordic study we conducted a similar study of eleven Danish and Norwegian companies, this time in close co-operation with the industry level institutions where these eleven companies are members. The industry level institutions involved were the Danish and Norwegian employer's organisation; *Dansk Industri* (DI) and *Næringslivets hovedorganisasjon* (NHO). In both countries their sector organisations for the IT & Communications industry, ITEK and Abelia ran a pilot. The collaboration to develop a common member service in innovation measurement and benchmarking will make national benchmarking possible both at the company level and the sector level.

Table 1 shows the key performance results from the eleven Nordic companies in 1993 and 2003 respectively compared to an international sample of over 300 companies. We have also added the performance results for the 20 % best in recent studies by R.G. Cooper and the association PDMA. So far, our own sample is too small to separate the 20 % best in the Nordic group from the rest.

In our 2003 investigation we collected financial data about the total development efforts of each company and used Net Present Value (NPV) calculations to make rough estimations of the financial impact of reducing project delays and increasing the success rate.

Table 2 shows the total economic value of closing approximately 50 % of the performance gaps between the group average and the best performers. The assumptions behind these calculations are detailed by J. Arleth in an article published in 1994 [2].

Table 2 suggests that the average company may increase its annual bottom line result by the size of their development budget, if increasing its success rate by 10 % by completing the majority of their projects on time just as the best performers[6)] do. This level of economic potential for improvement has also been confirmed by research studies by the Performance Measurement Group (PMG) during the last 10–15 years. PMG have monitored innovation performance and innovation maturity and found that companies with inadequate and immature innovation practices had a net profit margin of 12 % on average. The most mature companies in their study had on average a net profit margin close to 25 % [5].

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2) *An Average of the companies in the benchmarking database. This database is built up during the last ten years and contains the performance and practice results from more than 300 companies.*

3) *Performance results for the 20 % best firms in studies in 2003 by R.G. Cooper [1].*

4) *Performance results for the 20 % best firms in studies in 2003 by PDMA [4].*

Performance area	Average result in 2003	The 20 % best[5)]	"What if" goals for the group	Bottom line economic value of reaching the "What if " goal in the average company
Success rate for development projects conducted during last 3 years	52 %	79.5 %	If the success rate were increased by 10 % to 62 %	NOK 19 mill or circa 50 % of the average development budget of NOK 38 mill
Average delay for delayed projects	39 %	No data	If all projects were on time	23.2 mill NOK or 63 % of development budget by doing all project on time

Table 2 Great potential for improved profits from new products
The table shows the average project performance in our sample of eleven companies compared to the results of the best 20 % in the international studies. The last columns indicate the potential for improved profit in the average company in our sample

Our study revealed that none of the companies in our group of eleven companies had metrics in place to monitor innovation performance at the project and company level. The existence of performance metrics was rated as the 4th weakest out of the 18 practices we tested. Some companies have a few metrics. But none are near to setting measurable and balanced improvement goals, to keep track of all the metrics and to report improvements and learnings. The recent studies by Cooper & Edgett confirm that a metrics program is a key requirement for companies with the ambition to close the performance gap related to the best innovation performers [1].

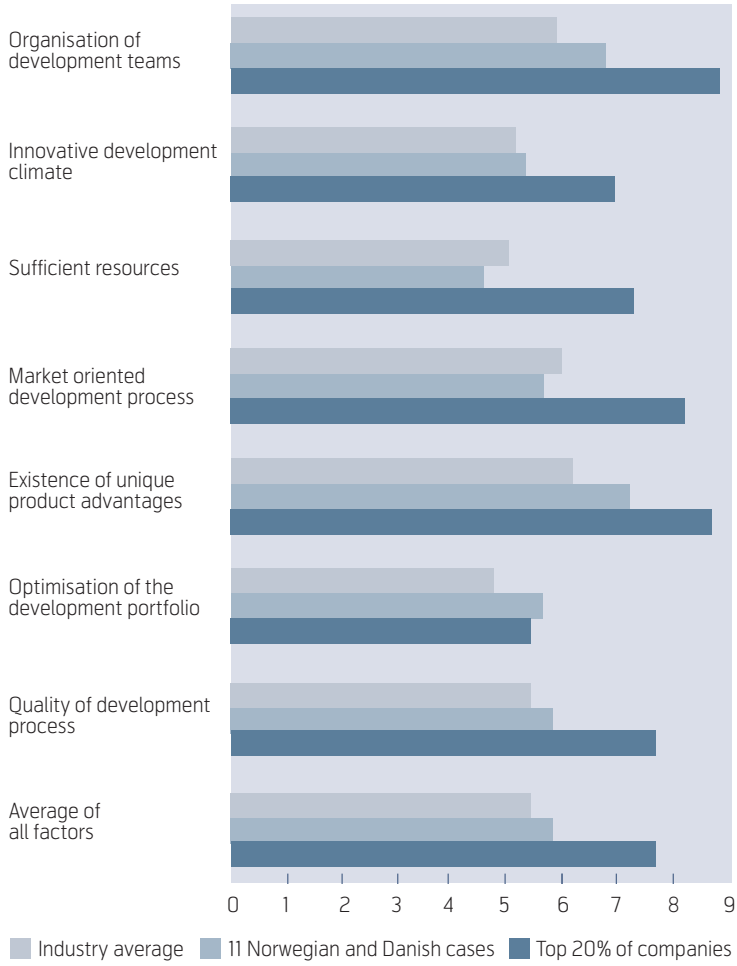

Figure 1 The innovation practices in the 11 Nordic firms in 2003 are quite average

Quality of implemented innovation best practices

The tools we used to collect data in 2003 also monitor the perceived implementation quality of key best innovation practices. The quick version of the tool that we used in this study measures 18 specific best practices in seven areas. The data from each company is collected from 3–7 respondents at management level. The respondents are the ones responsible for both performance and work practices in the company. Each company then receives a benchmarking report and the results are discussed in a meeting with the management team. In some cases the inputs from the respondents were updated after this discussion.

The eleven Nordic firms (middle bars) are compared to the average and the 20 % best performers from our international benchmarking database.

Figure 1 shows the summary of practices of the aggregated industry level benchmarking report for the sample of eleven companies studied in 2003. These companies are also benchmarked against the 20 % best and the average companies in our international database.

A number of studies have proved that a strong link exists between the quality of certain innovation practices and the innovation performance [5]. Our small

5) Performance results for the 20 % best firms in studies by R.G. Cooper and PDMA [1], [4].

6) The best in both of the recent international studies indicate that the 20 % best are on schedule with 80 – 90 % of their projects.

preliminary investigations suggest a big potential for improving bottom line results by improving the quality of the innovation practices in Scandinavian companies.

As what is perceived as best innovation work practices has changed somewhat since 1993 and the tools have changed with them, the 2003 study is not directly comparable to the 1993 study. We cannot directly compare the quality of all the work practices monitored, but the results indicate that there has been some improvement on the ability to adhere to time schedules and the ability to stop "bad" projects before wasting too many resources on them. The success rate has not improved and we consider these improvements small compared to what the economic effect of the improvements could be.

Many factors contribute to the low diffusion rate for Innovation Management practice. We think the cross-functional nature of Innovation Management is a key factor. The management cultures in marketing, R&D/ Technology and general management are very different and many management teams lack a shared vocabulary and view on innovation and innovation management.

Conclusions, findings and further research

None of the companies in our study use metrics to monitor the overall innovation performance. Some do have metrics; however these metrics are far from complete and the lack of standardisation makes benchmarking and continuous performance benchmarking and monitoring impossible.

Our study also reveals that the diffusion rate of best practices is surprisingly slow considering the large economic improvement potential. To speed up the implementation of best practices, it is critical to standardise the key performance metrics at industry level and spread the knowledge of the profit potential, the metrics and the best practices to as many companies as possible.

Another result of our study is that it reveals a large untapped economic potential for companies with average or substandard innovation practices and innovation maturity. Moving the average company up to the performance levels of the 20 % best performing group can double the net profit of the company and increase bottom line with more than the size of the annual development budget.

The first and most important performance area to focus on is to improve the success rate of the company's development projects. The second key area to focus on is the ability to keep development projects on schedule.

We feel that the industry level institutions, such as industry federations, can play a key role in the diffusion of best practices knowledge. We are very enthusiastic about the initiatives of the Danish and Norwegian employer's organisations. We would even propose that both the employer's organisations and the national authorities should work to encourage innovation performance reporting. Innovation performance data is as important at the national level as other performance data reported each year. There is a growing consensus on how to measure innovation performances at project and company level and the tools to do so are now available.

Our conclusions so far are based on a rather small sample and we will continue our research based on a considerably larger sample as more industry federation members test the member benchmarking service. The innovation best practice knowledge that our tools build on come from a sample of companies dominated by large North American and international firms. However, practices in Scandinavian firms may have significant differences compared to North American best practices. Cultural elements, firm size and other factors might influence what is a best practice in our region. As a consequence we are currently working to initiate a Nordic Best Innovation Practices research project.

Appendix 1 The data collection methods and management tools

The tools used to collect data in this study are based on more than 20 years of research into innovation best practices. The work was initiated by a team of Canadian researchers at the School of Business at McMaster University in Hamilton, Ontario, Canada with Professor R.G. Cooper as the most widely known name. Through the years more the 2000 individual projects and over 300 companies were studied in order to identify the characteristics of the winning new products and the practices used by the companies that generated these winners [3]. These studies have been widely published in leading journals and several books by Robert G. Cooper and others[7)].

Ten years ago, in January 1994, one of the authors, Jens Arleth of Innovation Management U3, presented

7) *See Bibliography.*

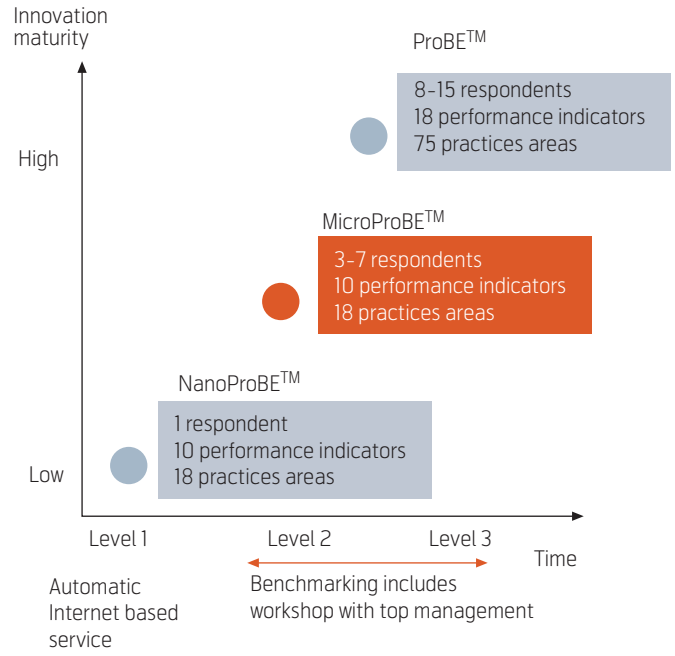

Figure 2 Overview of the toolkit used to benchmark individual companies
The tools are adapted to suit company size and innovation maturity level. The main differences are the number of respondents and the number of performance and practice indicators used.
NanoProBE® and MicroProBE® are internet-based services enabling rapid collection of data from a large number of firms and semi-automated delivery of reports to customers.

results from the first investigation of eleven Danish companies to test the Mini-ProBE®[8] tool developed jointly by Jens Arleth and Dr. Robert G. Cooper.

In 2003 and 2004 we conducted pilot studies using the ProBE® tool for the Danish and Norwegian employer's organisation, *Dansk Industri* (DI) and *Næringslivets Hovedorganisasjon* (NHO) and their sector organisation ITEK and Abelia. This contact resulted in the development of two scaled down versions of the ProBE® toolkit and a new industry level benchmarking tool using results from individual member companies to report innovation performance and practice quality at member organisation level.

How research data are collected

The toolkit we use to collect data from individual companies consist of three family members as shown in Figure 2. A key functionality of the tool is that the level of detail of the data we collect is adapted to the size and the innovation maturity of the company.

In order to collect data, a group of individuals are handpicked by the company that is to be benchmarked. Each person then responds to a set of performance questions. The Nano- & MicroProBE® versions used in this study have 10 performance questions.

The respondents also evaluate the quality of the innovation practice in the company using a 0 – 10 scale. MicroProBE® and NanoProBE® have 18 specific practices that fall into seven practice areas as shown in Figure 1. Based on the responses a six-page benchmarking report is produced.

In addition MicroProBE® includes a workshop where a group of key individuals in the company (usually the respondents) interpret the results and draw conclusions on how innovation practices and performance can be significantly improved. At the end of the workshop an action plan is determined complete with action items assigned to specific individuals.

The benchmarking report is the key for planning and implementing improvements

The benchmarking report is a key component and a motivator for companies and industry level institutions to participate.

Participating companies receive their own performance metrics as shown in the example in Table 3. The industry level institutions receive a similar report based on the average performance and practice quality for all the members participating. As the number of respondents increases we will be able to give figures both for the average company and for 20 % best performing companies.

For most of these metrics each company is benchmarked against the average and the 20 % best in the total database. As already mentioned we will start producing local and sector specific data for averages as well as the 20 % best in order to make the benchmarking results even more relevant.

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2 Arleth, J. Innovation Management U3. *Temahefte*, 3, January 1994. The Danish Association for Product Development.

3 Cooper, R G. *Winning at New Products, Accelerating the process from idea to launch*, 3rd edition. Perseus Publishing, 2002.

[8] *ProBE® is a Danish registered trademark owned by Jens Arleth, Innovation Management U3.*

Performance metric (average last 3 years)	Result from combined sample of 11 companies
Success rate	52 %
Failure rate	23 %
Kill rate	25 %
% of projects delayed	51 %
Average delay for the delayed projects	39 %
Average development budget/project	4.91 mill NOK
Average annual sales after launch/project	15.36 mill NOK
Average annual development (NPD) budget/company	37.1 mill NOK
Average profit margin	57 %
Average scheduled development time	16 months
Average actual duration of project	22 months
Net Present Value of average project	16.22 mill NOK
Average number of months on market	60 months
Perceived time efficiency on scale 0 – 10	5.5
Average number of person years in NPD/company	31
Average bottom line, net value of 10 % increase in success rate/company	18.55 mill NOK
Bottom line, net value of having all development projects on time/company	23.17 mill NOK

Table 3 Example of the key performance data in the benchmarking report
All participants and the member organisation will receive a report comparing their own results to industry numbers in the performance areas listed below. The numbers listed are average numbers for our sample.

4 PDMA Foundation & Adams, M. 2003. Comparative Assessment Study Results. *Conference Proceedings*, March 17, 2004.

5 Cesati, J et al. Pipeline/Portfolio best Practises Yield higher profits. *Signals of Performance*, 3 (1), 2002.

Bibliography, recommended reading

Cooper, Edgett, Kleinschmidt: **Best Practices in Product Innovation: What Distinguishes Top Performers**
This book documents a breakthrough study that reveals the impact of performance drivers at business unit level. It reports in detail on the work practices and the NPD performance in more than 100 companies. It is authored by the foremost world experts in new-product development. Also included are five in-depth case studies of top performers in new product development. Published in March 2003.

R.G. Cooper: **Winning at New Products (3rd Edition)**
For over a decade Robert G. Cooper's book has served as a bible for product developers everywhere. In this fully updated and expanded edition Dr. Cooper demonstrates with compelling evidence why consistent product development is so vital to corporate growth and how to maximise your chances of success.

R.G. Cooper, S. Edgett: **Product Development for the Service Sector**
In Product Development for the Service Sector is presented a comprehensive approach to product development tailored specifically for the dynamics of service industries, leveraging the authors extensive research and consulting experience as well as the experiences of companies such as Sprint, Pennsylvania Energy Company, Marriott, VISA and the Royal Bank of Canada.

R.G. Cooper: **Product Leadership**
Product innovation is a high-risk war, the battles are fought both behind a company's doors and against the competition. But with all the effort companies exert to become product leaders, over a third of their new products still fail at launch and many more never gain a profitable return. So what is it that product leaders like 3M, Merck, and Proctor & Gamble know that allows them to continually lead the way with exceptional new products?

Cooper, Edgett, Kleinschmidt: **Portfolio Management for New Products (2nd Edition)**
Portfolio Management is the result of years of research by Cooper, Edgett and Kleinschmidt. This groundbreaking book is full of true examples of companies' portfolio management strategies, combined with the authors' analysis of the methods.

The PDMA ToolBook for New Product Development
An essential book for new product development professionals, including Project Leaders, Process Owners, and Program or Portfolio Managers in a broad range of industries from heavy manufacturing to services. In this book, the Product Development & Management Association brings together practical, authoritative approaches to every aspect of the product development process, from idea generation to delivery of the final product and commercialisation. The ToolBook provides cross-functional coverage of the most important topics. With effective methods, tools, and techniques in every chapter, and a complete glossary of all related terms. Edited by Paul Belliveau, Abbie Griffin and Stephen M. Somermeyer.

Preston G. Smith and Donald G. Reinertsen: **Developing Products in Half the Time : New Rules, New Tools, (2nd Edition)**
The book is written for practitioners. It will be most useful for readers who already have some experience and can appreciate the significance of key points, which can be extracted quickly by skimming.

This popular book retains the clear message that a time-based new product development process is usually (but not always) more fruitful than the historical cost-based approach. Published 1998.

Simons, Robert: **Accounting control systems and business strategy**
Accounting, Organizations and Society, 12 (4), 357–374, 1987.

For a presentation of Tor-Arne Bellika, turn to page 101.

Jens Arleth (63) is the founder and owner of the Innovation Management U3 consulting firm. He is the leading European expert in implementing Stage-Gate™ new-product development processes, portfolio management of product development and benchmarking best practices. During the last 25 years, Jens has advised many leading European organisations including Alfa Laval, Akzo Nobel, Carlsberg, Confederation of Danish Industries, Danfoss, Enraf B.V., Ferrosan, Hempel's Marine Paints, Icopal, LEGO, Linak, Maersk Medical, Sonofon, Tele Danmark, Telenor and Uddeholm Tooling AB. He is also the partner of Dr. Robert G. Cooper, with whom he has collaborated closely for over 20 years.

Jens Arleth is, in co-operation with Cooper, the creator of ProBE™ Innovation Benchmarker, which is our tool for benchmarking new product development practices and performance. ProBE™ allows you to benchmark against several hundred companies and over 2000 projects. As a result you can develop ways to significantly improve your company's profits from new products.

Jens is the co-founder and former president of Danish Association for Product Innovation Management. He is also a board member and the former president of ISPIM.
Jens Arleth holds a Master's degree in industrial engineering, and a Bachelor's degree in marketing.

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Innovation management methods and tools and their relevance in meeting the determinants of innovation

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In perseverance to establish the grounds for systematic innovations, this paper presents a synopsis of obstacles in front of innovation in general that have been identified through basic research. These obstacles are then used for further "reverse analysis" in an attempt to provide a comprehensive picture about what might be the outcome/s, or consequence/s, if one or more of these obstacles are present. The other goal that is targeted from this reverse analysis is to help build criteria for identifying the characteristics of the innovation management (IM) methods and tools, such characteristics are seen to open new venues for further development of the existing and new methods and tools.

Abstract

There is no dispute on the relevance and usefulness of the innovation management (IM) methods and tools to the innovation process. This paper presents a synopsis of basic research conducted on innovation obstacles as well as the relevant results of some accessible surveys in conjunction with the INNOPSE[1)] survey results. The identified results from the conducted research are summarized in general categories describing the general main obstacles in front of IM. Then, in an attempt to further cover issues that have not been captured during the original research and surveys, a reverse analysis is conducted in order to provide a comprehensive picture about what might be affected or what could be the outcome from each identified "general" obstacle, that are considered to be surmountable, in what is called "symptoms of the IM obstacles". This approach would further delve and bring to light other issues that could be missed when conducting surveys about IM with questions like "what are the difficulties you are facing when you want to innovate?" The other goal that is targeted from using this backward research, besides identifying the general possible symptoms, is to help in identifying the possible characteristics IM methods and tools must have in order to optimally answer the IM obstacles and produce innovations systematically. At this point, the work is envisioned to have the ground basis for introducing an algorithm that lists the criteria that successful methods and tools must possess in order to successfully serve innovation.

Introduction

In order to produce a scientifically sound study about what a method or tool that addresses innovation must be like, it is imperative to have a peek into the realm of innovation by looking at the problems that stand in its way; and the type of prerequisites a person, a company, an institution or a government shall have in order to proceed successfully.

Innovation has attracted the interest of many scholars, professionals, businessmen and statesmen. To avoid repetition of work, innovation is here shortly introduced and briefly defined leaving the details of different versions of definition to other available literature see (Rogers, 1998 p. 6; OECD, 1997 p. 28; Grupp and Maital, 2001; Cebon P. et al, 1999; Urabe et al, 1988 p.3).

Innovation in this work is considered from a general perspective meaning that it is not restricting the definition of innovation to the product or the process levels, but rather it considers as well the applicability of innovation to services. This approach has been included in the Oslo Manual in its 1997 revision and was adopted by EUROSTAT and DG-XIII (European Innovations Monitoring Systems).

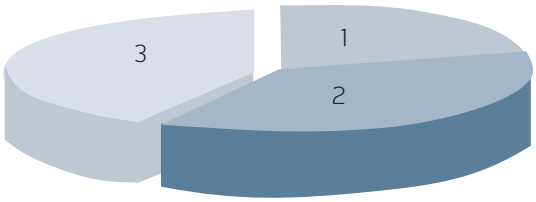
Aligning to the theme of this paper, section 1 presents a brief summary of what is relative to the IM methods and tools from the INNOPSE survey findings. Section 2 provides a synopsis of the research conducted on the innovation obstacles together wit the results of the reverse analysis "the symptoms of the IM obstacles".

Section 3 lists the characteristics that methods and tools shall have if they are to help overcome the identified innovation obstacles and identifies where each characteristic can contribute in answering the IM obstacles. This section is followed by a conclusion.

1 The INNOPSE survey in brief

Over 2000 Small and Medium Size companies (SMEs) Europe wide were surveyed under the context of the EU project INNOPSE on the topic of Inno-

1) *INNOPSE: "Innovation studio and exemplary developments for product service engineering", an EU project from the fifth framework programme.*



1 Small size companies (<100 employees)
2 Medium size companies (>100 <1000 employees)
3 Large size companies (>1000 employees)

Figure 1 Classification of surveyed companies according to their size

vation Management. The results of 216 companies were considered. The aim of the survey was to lay the grounds for a scientific work in finding ways to overcome the obstacles in front of innovation. The survey questionnaire was reviewed and accepted by the European Commission (EC) and was carried out by the whole project consortium who are located in six EU countries. The 216 companies that have been considered are organizationally categorized as follows: 42 % small companies (less than 100 employees), 37 % medium sized companies (between 100 and 1000 employees), and 21 % large companies (over 1000 employees).

1.1 Why do companies implement IM methods and tools?

The survey covered a wide array of topics that relate to IM, i.e. expectations and motivations, structure and organization, human resources, methods and tools, and finally the deficits and needs companies face in pursuit of innovation.

A particular interest in the findings of the survey in general is that there is greater awareness, and consequently implementation, in large companies for the value and importance of IM methods and tools with diverse expectations and motivation for the application of such methods and tools. Figure 2 summarizes these findings showing the drivers that companies consider key factors behind implementing IM methods and tools, these are:

- *"External Factors":* Market position and competition status. This category of drivers gained the largest share of 55 % from the total surveyed companies. It includes factors like the application of IM for new business fields and technologies, establish networks and synergies, provide a steady flow of new products, hedge a leading position or reduce risk.

- *Internal Factors:* 49 % of the companies consider themselves to be motivated to use methods and tools for the purpose of improving their products and/or processes. That includes factors like cost savings, idea generation, intra-firm networking, information gathering, problem solving and knowledge building.

- *Better "Customer Relations":* 21 % of the respondents considered better customer relations as a driving force for the application of IM methods and tools with 46 % of the respondents being from the small size category. This implies that the smaller the company in size the more it is concerned with, and dependent on, the approval of its markets and customers regarding its products and/or services, in other words they are more risk averse. In large companies it is found that only 19 % have considered customer relations as a driving force for implementing IM methods and tools, while the ratio is at 35 % for the medium size companies.

- *Improving the human capital:* 17 % of surveyed companies consider "Human Resources" as the driving force behind implementing IM methods and tools. In this respect companies were interested in providing training, spreading a culture of innovation, increasing the individual motivation, extracting the expert's tacit knowledge and sharing it with other employees and establishing formal and informal networks.

- *Flexibility:* Only 13 % of the companies considered flexibility to be a motivation for implementing IM methods and tools. This percentage of the companies stressed the need to use IM methods and tools to help them decide faster and shorten the time to market in the very fast developing and dynamic technologies and markets and to be able to detect market trends and respond quickly and accordingly.

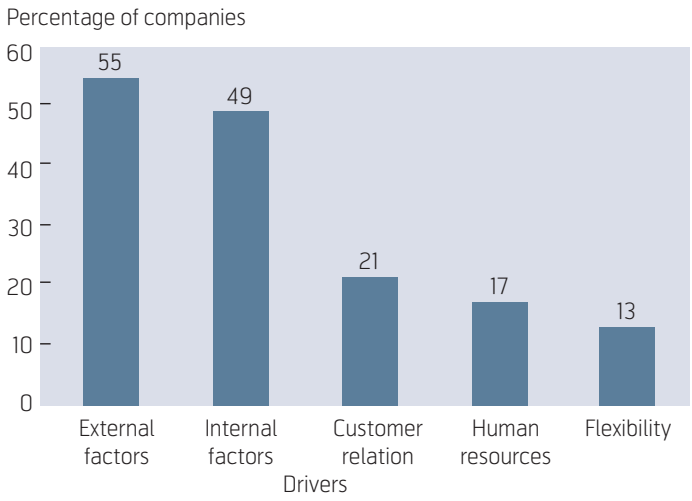


Figure 2 Drivers for using IM methods and tools

The survey finds clear differences between SMEs and other large companies, especially when it comes to implementation of IM methods and tools. SMEs are not implementing certain powerful types of innovation methods and tools, as is the situation with larger companies. It has been found that companies in general are more aware of the generic methods and tools (i.e. brainstorming is known and successfully used by 85 % of the surveyed companies), while only larger companies are more aware of the methods and tools that are complex and/or technical (i.e. the TRIZ is known to 37.84 % of the surveyed companies, mostly large companies, and 66.1 % of this percentage have used the TRIZ successfully).

2 Synopsis of the innovation obstacles

The value of determining the problems facing innovation becomes very clear when one is to structure, organize, or use an algorithm of methods and tools that are intended to make innovation and problem solving easier tasks. The first milestone of this work is to identify the state of the art factors regarding the obstacles that hinder the innovation process. It is rarely recorded that enterprises that peruse innovation projects can do so without facing problems. The conducted research has led to the identification of the obstacles in front of innovation pursuant firms. For reasons of brevity, only the synopsis of the conducted research is presented in this paper. Table 1 presents a summary of these obstacles. The factors that are presented in the second column "Factors (From Basic Research)" are those that were revealed through basic research. These obstacles are grouped in an affinity relationship to form five categories as found in the first column. The third column presents the factors that were revealed through reverse analysis "symptoms of the IM obstacles".

Generally, the five major classifications of factors listed in the first column fall under two domains: The first are those factors that can be overcome by enhancement initiatives (and can be aided through the use of IM methods and tools), i.e. the "Human resources factors". The second are those that need "uprooting" like the organisational factors or the government regulations and policies. According to this classification, factors can be divided into:

A Obstacles that can be overcome by some techniques and enhancement initiatives (from the point of view of using methods and tools), they are:
   1 Economic factors
   2 Human resources factors
   3 Supporting factors
   4 Other factors

Category	Factor (From Basic Research and surveys)	Factors (From "Reverse Analysis") "Symptoms of the IM obstacles"
Economic Factors	High costs [36] High risk [36] Lack of funds [2], [20], [36]	Risk averse [9], [38] Lack of R&D activities Loss of Experts Lack of knowledge [8] Lack of resources [14]
Human resources Factors	Lack of top management skills [2], [20], [32], [36]. Lack of skilled labour [2], [5], [20], [21], [32], Lack of knowledge [1], [25], [35], [16].	Lack of knowledge [8], [11] Lack of innovation culture [14] Lack of strategies [14] Inability to catch up with technology [5] Lack of networks (social and technical) [6], [8].
Supporting Factors	Lack of information [4], [23], [43], [44]. Lack of networks [2], [13], [45], [27], [22], [10], [7], [24], [29]. Lack of technology [2], [20]. Not using IM methods and tools. [2]	Lack of knowledge [11], [6], [30], [19] Lack of opportunities [17] Low competitiveness [11] Lack of methods and tools [8]
Organizational factors	Centralized rigid structure [12], [36] Risk averse [12] Lack of "human based" management principles [40]	
Other factors	Government regulations and policies [36] Increasing competition and globalisation [20], [29]	

Table 1 Summary of the obstacles hindering the innovation process

B Obstacles that are immune to enhancement initiatives (from the methods and tools point of view), they are:
   1 Organizational factors (i.e. structural and cultural)
   2 Other factors

Notice that "other factors" lie under the two categories, that is because some factors in this category need "uprooting", like the government policies that hinder innovation while other factors can be enhanced, like automatically winning the competition by producing innovation through enhancing other factors in the other categories. For that reason the "reverse analysis" has been focussed on the first domain of factors that are enhancement viable.

The result of the reverse analysis and research is presented in the third column "Factors (From "Reverse Analysis")", these are the factors that were identified when analysing and researching on the symptoms of the factors that are seen to be enhanced using IM methods and tools. Here it has been looked at from the reverse point of view, i.e. the questions here are "what will the firm suffer (in terms of innovation) if it is facing financial restraints? If it is suffering from Human Factors? Or if it is suffering lack of Supporting Factors?" Whenever it is difficult to directly identify the symptom then supporting arguments (from literature and other resources) were looked for. The numbers in the table are the supporting references, which can be found in the bibliography.

3 Relevance of the IM methods and tools to the identified factors

This section presents the second major milestone, which is to identify the elements of a benchmarking algorithm that is envisioned to scrutinize existing methods and tools for innovation and problem solving. That is in order to be able to judge their capability of mitigating or overcoming the obstacles of innovation and consequently judge their implementation and use.

Figure 3 shows the concept behind the importance of the IM methods and tools this work is assuming. The IM methods and tools are considered the means by which the company experts overcome, mitigate or solve the diverse difficulties and obstacles in their way to innovation.

Plenty of methods and tools have been devised and developed for the purpose of helping companies innovate. These methods and tools address diverse fields of activities including creativity techniques (i.e. brainstorming, mind mapping); quality management (i.e. QFD, Taguchi); problem solving (i.e. TRIZ); and other business processes. It is assumed given that the use of the designated methods and tools will produce significant advantages and benefits for the firm that is using them.

In order to mitigate the obstacles in front of innovation, the characteristics of a given method or tool must be mapped to the identified IM obstacles. In other words, a given method or tool must be able to provide solutions, aid in overriding or eliminating the obstacles. Thus, this section is presenting the key characteristics or elements of indispensable success factors, these characteristics referred to as the "benchmarking algorithm", that are envisaged to benchmark or scrutinize the validity of the major methods and tools that are intended to serve innovation in firms. The elements of this benchmarking algorithm shall be capable of determining the strengths and weaknesses of each method or tool, when benchmarked, and to bring a surface where it is good at for implementation.

A method or tool that is designed to serve innovation, at its best, should give answers to the previously identified economic, human resources, and supporting factors. Figure 4 shows a general outline of the determined characteristics a method or tool shall posses if it is to help overcome IM obstacles. These characteristics are:

1 Be simple in structure, terminology and does not require much time or effort to implement and consequently costs less money through the course of implementation. Such features, besides contributing to the economic factors, provide judgemental criteria for deciding whether to use the method or tool, especially in SMEs who suffer various restraints. This criterion is considered to be minor because if the method/tool is proven good, then it is worth investing time and effort in training.

2 Be mature and developed (and able to develop) so that it can be deployed systematically with proven results. This implies that the method/tool can provide dependable results and can be re-applied to various cases. But at the same time it has a venue to catch up with the technological developments thus it must be able to develop concurrently with the technology and requirements of the given field of application.

3 Require the availability of information (or identify the lack of information) "know-what": this means that it should act as an interrogator, i.e. in the form of blocks that need to be filled with data

pertinent to the problem at hand and at the same time these blocks constitute a prerequisite for the succeeding blocks so that the user cannot proceed to the next stage without finishing the current requirements and provide the required information. For example, it can have a field to describe the situation, another to list the causes, a third to list the involved parts or systems, a fourth to describe the symptoms … etc.

4 Be a prodder for networking "know-who": by determining answers to questions like know–who which emphasize the importance of networking and identifying the experts in the field under question. This infers that the given method/tool is in software form and capable of providing secure access, i.e. restricted to licensed users while at the same time provide the possibility of communicating through the network (in electronic form). As work and usage progress and time passes by, the method/tool will have a repository of experts' contacts that have been previously contacted.

5 Be capable of building knowledge "know-how": this factor is a must that contributes in answering all factors affecting innovation, be it economic, human resources or supporting factors. It is believed that no organisation embarks on acquiring knowledge without the purpose of applying it or else the organization will be only collecting information and thinking that it is building knowledge. Keeping in mind that information is mere "meaningful" data, while knowledge is the process of applying this "meaningful" data to produce products, services, processes, solutions, learning, experience or understanding. "Carrying out knowledge management effectively in an industrial environment requires support from a repertoire of methods, techniques and tools." (Speel et al, 1999). The method/tool must have venues that care for all aspects of knowledge management and activities (acquisition, creation,

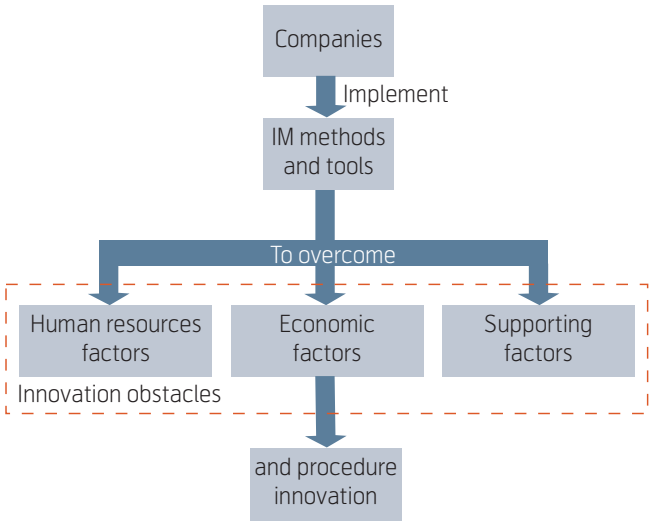


Figure 3 The concept of IM methods and tools mitigating the innovation obstacles.

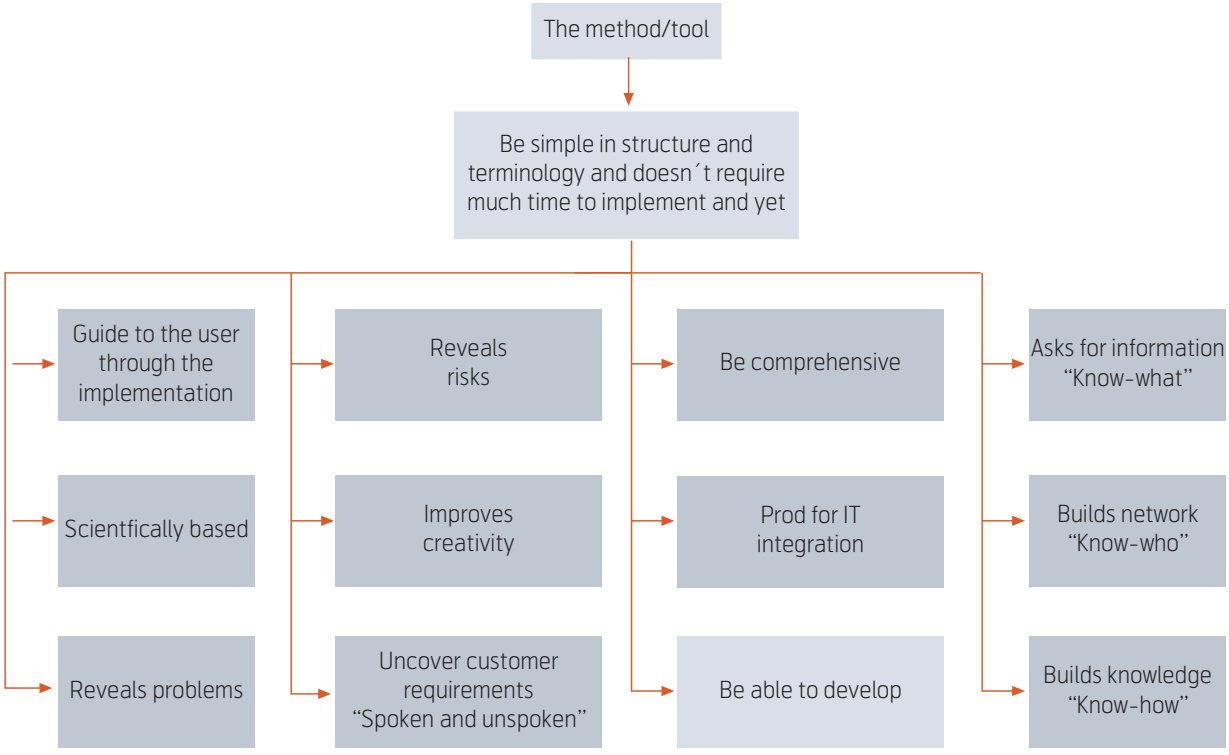


Figure 4 An outline of the elements of the IM methods and tools benchmarking algorithm

storing, sharing and utilization) in order to better enhance existing knowledge by adding new blocks of knowledge from multi-disciplinary fields. In this sense a method/tool can help in knowledge management and creation through:

a Integrating the expert's knowledge into the firm's knowledge. This helps in transferring (and consequently sharing) knowledge and avoids harm if the expert leaves the firm. Explicit knowledge is easily codified but the expert's tacit knowledge is more difficult to codify and consequently harder to transfer. An excellent method/tool is the one that can provide the means to release and transfer the expert's knowledge into the knowledge base of the company. This is strengthened by the view of Nonaka & Takeuchi (1995) who state that the key to acquiring new knowledge is to make tacit knowledge into explicit knowledge. This is further supported by the research conducted by Soo et al (2002) who provide lessons learned regarding knowledge creation and state that in order to enhance knowledge creation there is a need for the implementation of databases as strategic tools and stress the importance for informal networking to realize knowledge exchange. The emergence of communities of practice is another example of transferring tacit knowledge in an intra-firm environment (Davenpoert and Probst, 2000).

b Providing a learning venue in order to add to the available knowledge: that can be achieved by providing venues for problem solving possibilities. According to the FSB/SFEDI small businesses learning survey "93 % of small business managers thought more effective learning occurs if it is directed at solving problems" (SFEDI, 2002, p. 5). To solve a problem it is required to identify the problem, identify the fields of knowledge relevant to the problem, apply this knowledge and learn from the results (Sumner et al, 1999). Or through providing a retrievable and tabulated repository of documented situations (both successful and unsuccessful) that are similar or related to the field of the problem. Learning can also be achieved through debriefing. Gilbert Probst, for example, refers to case writing as an excellent tool for knowledge management (both explicit and tacit) (Davenport & Probst, 2000 pp. 248–260). Realising that explicit knowledge can be transferred by communication and codifying it through documents or any other printed form, while tacit knowledge can be transferred through application (Grant R., 1996). Thus in order to learn from tacit knowledge, the method/tool can help through documenting a complete case study of an expert's knowledge in certain applications and providing this knowledge back when needed. The method or tool is seen, in this context, as a learning process that is part of the wider organizational learning routine. It provides the possibilities of on the job acquisition of tacit knowledge and the means to accumulate the necessary technical and organizational knowledge through codification and archiving in databases, which will help the organization gain competitive knowledge assets. "… for the firm, learning about, dealing with and transferring tacit knowledge represent valuable tools for enhancing their competitive and technical profile, requiring little in terms of new resources or funding but having the potential to make substantial improvements to industrial performance." (Howells, 1996)

c Being the market place for knowledge management (creation, documentation, storage, transfer, retrieval and sharing): it shall provide compartments for documenting existing cases into a library of cases and archiving it into blocks of knowledge that are easily accessible. At the same time it should be able to transfer and share the available knowledge in an easy to understand way. "The level of sharing within an organization impacts the efficiency with which it can create, transmit, store, and share knowledge assets" (Hall, 2002 p. 2). Achieving these activities is realizable if the method/tool is capable of interfacing many users in an intranet with input/output capabilities. Requiring inputs from different departments or experts from within (or outside) the firm produces a process of continuous interaction between those input providers and open the possibilities for face-to-face meetings or networking and trust building between the participants which involves information exchange and consequently tacit knowledge transfer.

6 Be comprehensive: an ideal method/tool shall provide diverse interest in the different aspects concerning a certain problem or situation. It might be that certain solution initiatives require the presence of prerequisites while the development of certain tasks makes it possible to embark on several other developmental tasks. The comprehensivity issue tackles diverse factors from the

previously identified IM obstacles. Comprehensivity can be achieved when:

a The method/tool presents a complete picture on the overall fabric concerning the task at hand and how it affects or is affected by the other strands in the institution, i.e. organizational, financial, cultural, skills … etc. This can be more concrete if the method/tool is capable of providing performance measures or indicators.

b Another issue in the comprehensivity requirement is the attendance of certain factors within the method/tool, i.e. the inclusion of customers' requirements, employees' skills, the addressing of costs and time issues, high quality and environmental awareness or other safety issues. Such comprehensivity implies the simultaneous satisfaction of the diverse criteria of a given issue (i.e. problem solution) and will bring afloat the critical aspects and define the required needs.

c Comprehensivity can be tracked by verifying that the method/tool can be applied to products, processes and services alike.

d Comprehensivity also means that the method/tool must be capable of managing a given situation at all phases from concept to recycling, passing through design, development, implementation and marketing (i.e. in the case of products).

7 Integrate IT in the process of implementation: a method/tool shall be incorporated within the existing IT system of the firm, i.e. on the intranet, and if the firm is missing such an infrastructure the method/tool must require such integration. Such integration, together with the full utilization of it, allows the rapid acquisition and analysis of data, and if the experts who are working on or discussing a certain problem are separated by time and/or space, then a method/tool that is IT implemented will enable the participants to share their work and ideas. The IT has a potential to affect all businesses, i.e. through e-business and access to resources; further the advent of e-business has improved business transactions in terms of quality, speed and quantity which will lead to mitigating not only supporting factors but will extend to the economic human resources factors. Keeping in mind that the Internet provides a worldwide network that encompasses paramount amounts of information it would be very helpful in providing access for problem solving and knowledge building. A method or tool must contribute to the development of the IT skills of the respective users and enhance their appreciation for the potential of computers and communication technologies. Development of IT skills for the users can be further enhanced if the given method/tool is capable of interfacing with word processing, spreadsheet, and database programs.

8 Reveal risk: a method or tool would be very valuable if it guides the user to reveal possible risks beforehand. There is an increasing importance for the need to overcome risks and mitigate uncertainties in an environment of change, as the one we live in, which requires the inevitable association of decisions in dynamic environments. Thus, if the method or tool provides a venue for uncovering the uncertainties it will contribute to the success of the project at hand. Such risks and uncertainties might be predictable if the method/tool has a database about similar previous projects the firm, or competitor firms, have concluded or if the method/tool identifies possible options to a given situation/problem. Other risks could be unveiled if the method/tool identifies the success factors or suggests possible scenarios, i.e. best case (predicting excellent conditions), normal case (predicting the current conditions to be everlasting) and worst case (predicting severe conditions).

9 Provide a room for creativity: one reason for using methods and tools is to be a helping hand in improving the creativity of the users. Methods/tools that open the universe for diverse thinking and stimulate the latent potentials of the minds and souls would produce better options and possibilities for problem solving and idea generation. "… creativity is the main driver in new knowledge creation and the generation of innovative outputs" (Soo et al, 2002 p. 143).

10 Cater for customer spoken and latent requirements (economic answer) "know-why". Realising "… that customers, no matter where they are located, who find themselves in similar market phase, request similar solutions" (Davenport & Probst, 2000 p. 204) implies that if a method or tool can help identify and answer certain customers' requirements then this will help in bringing tremendous benefits in predicting customers' requirements globally. Answering customers' requirements enhances the competitive advantage of the firm and results in stronger economic returns for the firm. A good method/tool provides the means to anticipate customer and market expectations and unmask new opportunities.

11 Provide a possibility of guiding the user, especially if the user is a novice or if the problem is complex: this requires that the method or tool access a database of case studies and solved problems in order to provide such self-guided application environment or "provide context specific help on what to do next". Further, there is a need to always add to the existing databases from case studies and new experiences. Concurrently a successful method/tool provides a facilitating structure that leads the user to what to do next. It works in this context as a teacher who accompanies the user through the complex problem-solving domain.

12 Be scientifically based through its approach and implementation. The choice of its components to the needed information and other activities to be initiated in the input and development phases must be scientifically based so that they can be replicated for further training or application to other situations. A scientifically based approach is of paramount relevance especially when it comes to problem solving and the need to understand the critical parameters of the existing situation to be able to move on for analysis, application and evaluation. It is also important to have a scientific root for determining the possible options a solution might have and at the same time giving a scientifically based approach on the evaluation criteria leading to an accurate result. In general, a scientifically based method/tool means:

   a It can provide empirical knowledge that is drawn from successful previous implementations on different case studies;

   b It can provide measurements or observational differences (advantages) that can be identified when implementing the method/tool (compared to other options before implementation). Valid and reliable results are the arguments for implementation.

   c It ensures that the method/tool provides sufficient details and clarity to allow for replication and, at minimum, offer the opportunity to build systematically in its footsteps.

13 Be capable of providing a room for identifying and assimilating new problems, whether such problems are related to customer satisfaction, employees' skills or pure technical problems. The identification of problems is very critical for adding new knowledge through learning and paves the way for possible solutions. Company individuals need to continually learn and relearn how to (1) identify potential problems, (2) identify knowledge relevant to the problem, and (3) build the required knowledge to solve the problem (Sumner et al, 1999). This implies that the used method/tool is able to provide ample information, or spurs for new information, that may help the user be aware of possible problems or conflicts.

It is worth realizing that some of the previous factors are indispensable success factors, i.e. knowledge related factors and problem definition and solving factors while other factors are considered to be enhancements factors, i.e. ease of use (considering the point of view that training might overcome such factors).

3.1 Mapping the benchmarking algorithm features to the IM obstacles

Table 2 shows the features of the benchmarking algorithm in the left column and the IM obstacle that it overcomes (or helps overcome) in the right column. In many cases it is difficult to set a clear-cut boundary between the effects of the different factors that shape the process of innovation. For example Siemens' motivation for cooperation and network formation are the sharing of risk and development costs and the reduction in product "time to market" (Davenport and Probst, 2000 p.108). This means that the economic factors are intertwined with the supporting factors as well as the human resources ones. Table 2 further stresses this intertwining.

Algorithm feature	Obstacle (to overcome)
Be simple and easy to implement	Economic
Be developed	Economic
Require information	Supporting
Build networks	Economic, Human, Supporting
Build knowledge	Human, Supporting
Be comprehensive	Economic, Human, Supporting
Prod for IT	Economic, Human, Supporting
Reveal risks	Economic
Improve creativity	Human
Uncover customer requirements	Economic
Guides the user	Human
Be scientifically based	Economic, Human
Identifies new problems	Economic, Human

Table 2 Mapping the algorithm features to the IM obstacles

4 Conclusion

Precisely identifying the problem is more than 50 % of its solution. Methods and tools are not "usually" used for fun, but rather to solve problems, open new opportunities and, consequently, gain a competitive advantage. How wonderful it would be, one day, to have an algorithm of methods and tools where if you input information it will output innovation! Such "wishful thinking" would not come close to reality without scientific steps and measures that guarantee the effectiveness and adequacy of such an algorithm. This work is directed towards that scientific approach of establishing the criteria by which methods and tools can be judged against what they can offer in terms of overcoming the obstacles in front of IM. This work presented the imperative features of successful innovative companies so that methods and tools must cater for if they are to be successful. In order to reach and identify these indispensable success features or characteristics came the need for conducting the INNOPSE survey and the extensive literature research regarding the obstacles in front of innovation "having the assumption that those who overcome the obstacles of IM are successfully innovative".

The pursuit to facilitate the process of innovation and make it easier, as well as the interest of researchers and professionals in systematizing innovation has caused the appearance of many methods and tools. Mapping the features of the benchmarking algorithm to the identified IM obstacles pinpoints how important these characteristics are. Mapping the features of the benchmarking algorithm to the available methods and tools sets the stage for the next phase of work in order to determine how best to measure the success (or failure) of the given method or tool when weighed against each and every feature from the determined algorithm. One shall not forget that no matter how powerful a given method or tool is, it is the human being that is implementing it that matters. A great emphasis shall be given to the human values of the firm's organizational attitudes "which has to be innovation proponent".

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A comparison of new product development practices in North America and Norway

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The ability to create successful new products is more important than ever today, particularly in high technology product markets. While empirical research has established that factors such as customer orientation, well designed resource deployment, and careful attention to screening out bad ideas early can improve new product success rates, the basis for many of these conclusions are based on research on large firms based in North America. This paper compares the scores of a North American sample with a sample of Norwegian high technology firms on important new product success drivers, and finds a surprisingly high degree of similarity.

Abstract

Much of the published research on new product development is based on samples of larger multinational firms, most often based in North America. In addition, there are few studies that compare the new product development practices of firms in different parts of the world. This paper addresses these gaps in the knowledge by comparing a sample of large North American firms with a sample of much smaller high technology firms based in Norway. While the new product and corporate environments are quite different between the samples, the major finding of the comparison is that the new product practices are more similar than different. In particular, both samples show their greatest weaknesses in allocating human and other resources to new product projects. The other major area of weakness for both samples is in the use of customer information and market planning and testing.

1 Introduction

The long-term survival of business firms hinges upon its ability to successfully introduce new products into the marketplace. Previous research in North America has found that 25 % or more of sales can typically come from products introduced in the past three years for firms with successful new product development (NPD) processes and strategies. In part this is because rapid technology change, tougher competition, and dynamic customer needs and wants are making products obsolete faster than ever. The failure rate of new products has remained high (35 to 45 %) for the last 25 years, but research indicates that the chances for success are increased when the new product offers something novel AND is perceived as useful to the customer. The needs for new products are higher than ever, but many of the tools and methods of NPD have not changed much over recent decades.

Previous research has found that factors most related to success are managerially controllable through better utilization of marketing and technical resources and skills to understand the marketplace and develop desirable products for it. Improving the NPD process can also be the result of developing a successful strategy that ties product development to corporate strategy and goals, identifies areas of focus for product development, has long-term orientation, and is well communicated to the entire firm. Resources in terms of allocating the necessary people, giving them time to work on new products, and providing the necessary R&D spending for technology development and testing are also well linked to success.

Most of these finding, however, are based on the study of NPD practice of large North American firms. Whether the importance of these factors is different in other parts of the world where firm size, competitive intensity, and regulatory environments are also very different is a very under-researched topic. The goal of this paper is to compare the NPD practices of Norwegian firms with those that were found to be important in North America (NA). Norway is interesting because its small size in geography and population has meant that its firms have also tended to be much smaller than in larger countries such as those featured in many studies of NPD practice. Other differences in Norway include government as a much larger part of the economy, and among the world's highest levels of consumer acceptance for high technology products such as the Internet, mobile phones, and home PCs.

2 Methodology

This paper reports the results of an on-going survey of new product development practice among Norwegian firms. The questionnaire is largely a Norwegian translation of Cooper et al. (2003) survey instrument designed to measure "drivers of new product development performance" of 105 large North American based business units. The work of Robert Cooper and his colleagues was used as the base for this comparison study because he is perhaps the best known researcher and consultant in the new product develop-

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ment area. His empirical work on factors that influence new product development such as organizational structure, customer orientation, allocation of resources, and use of various development methodologies has appeared in numerous books and prominent journals for many years. While his and his colleagues' work is well known world-wide, almost all of their published empirical studies have used samples from large North American based firms.

In their latest empirical study from 2003, Cooper et al. used three measures to rank the importance of their hypothesized drivers of new product development performance: 1) comparing the significance of differences between those in the top 20 % and lowest 20 % of the sample on the perceptual driver measures and ranking them from biggest to smallest, 2) comparing the correlations between the drivers and three measures of new product success and ranking the correlations from highest to lowest, and 3) the predominance of the driver among the top performing firms. Due to the length of that questionnaire (over 150 questions), dimensions and items that were not found to be significant predictors of new product success were deleted for the Norwegian survey.

Perceptual measures for the Norwegian survey also used the same 0 to 10 scale of Cooper et al. with 0 indicating "none" or "never" and 10 indicating "excellent" or "always". Descriptors used to interpret the results were also borrowed from Cooper et al. (2003) and consisted of the following: rating less than 5 = "very weak", 5.0 to 5.9 = "weak", 6.0 to 6.5 = "mediocre", 6.6 to 7.0 = "moderate", and greater than 7.0 = "strong".

The sample reported here is comprised of 14 high technology firms in Norway including the two largest telecommunication providers, five of the leading IT firms, two leading firms in the offshore technology industry, and three leading firms in medical technology. In comparison, the major parts of Cooper's sample were comprised of 51 % manufacturing business units, 12.8 % services, 7.8 % telecommunications, and 5.9 % health care, although no separate analysis by industry were provided in the published results.

3 Results

Table 1 presents the behavioral and demographic measures of the survey. On average, the sample firms had introduced 11.2 products during the previous three years whose sales represented an average

		Norway high-tech. sample	Cooper* industry sample	
			avg.	best
1. New products launched in past 3 years:		11.2	na	na
2. % of new products from:	R&D:	34.2	na	na
	Marketing:	24.7	na	na
	Customers:	27.5	na	na
	Competitors:	8.4	na	na
	Suppliers:	.4	na	na
	Others:	5.0	na	na
3. Turnover % from new products (lt. 3 years):		34.6	27.5	38.0
4. % new product launches that achieved goals:		62.6	60.2	79.5
5. Avg. time from idea to launch (months):		15.8	18.4	na
6. % of the products launched	within budget:	65.8	57.1	79.0
	within time:	50.8	51.1	79.4
7. % development budget in homework stage:		13.7	12.1	13.4
8. % of ideas killed before launch:		21.8	19.0	4.3
Sample demographics:				
1. Turnover (NOK)		1,800,000,000	17,479,000,000	
2. Number of employees		841.1	4,711	
3. Turnover % spent on R&D		25.1	5.1	

Table 1 New product development behavior over past three years

* *from: Cooper, Robert G, Scott J. Edgett, and Elko J. Kleinschmidt. 2003*. Best Practices in Product Innovation, What Distinguishes Top Performers. *Ontario, Canada, Stage-Gate, Inc.*

na = not available

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34.6 % of the firm's current turnover. In comparison, Cooper et al. 2003 survey of North American business units average percent of turnover from products introduced during the previous three years was 27.5 % for the entire sample, and 38 % for those in the top 20 %. While the Norwegian sample falls between the two figures from North America, it should be noted that high technology firms typically rely on new products for sales and profits to a much higher degree than the manufacturing sector that is predominant in the NA sample.

The original idea for these new products originated from R&D 34.2 % of the time, while market factors accounted for 60.6 % (marketing 24.7, customers 27.5, competitors 8.4). While Cooper et al. do not report the source of new product ideas, they do note that ideas originating from market sources tend to have a 100 % higher success rate and 70 % higher market share than those originating from the laboratory or other non-market sources. These results indicate a higher than typical market orientation from the Norwegian high technology sample than is usually the case for high-technology firms.

Nearly 63 % of the new products that were launched by the Norwegian high technology firms were said to achieve the goals that were set out for them, compared to 60.2 % for the average NA business unit and 79.5 % for the top performing 20 %. Figures were also quite similar for average time to launch (15.8 months in Norway to 18.4 months in NA), % of products launched within budget (65.8 % in Norway, 57.1 % average for NA, 79.0 % for best in NA), and within the planned time schedule (50.8 % in Norway, 51.1 % average for NA, and 79.4 % for best in NA).

While the new product behavior of the Norwegian sample corresponds fairly close to the NA sample, the demographic characteristics reflect the very different business environment of the two samples. Average annual turnover for the Norwegian sample is 10 % of the size of the NA sample, while number of employees in Norway is about 20 %. Turnover % spent on R&D, however, is five times higher for the Norwegian sample, most likely due to the higher amount of R&D spending that is typical in high technology businesses.

Table 2 presents the construct index results from the perceptual measures portion of the questionnaire, listed in order of importance as drivers of new product development success in the Cooper et al. study (2003). According to their study, the most important driver of NPD performance was "new project team accountability" which was defined by the degree to which the firm's NPD structure had: 1) dedicated team leaders assigned to each projects, 2) leaders assigned to project from start to finish, 3) cross-functional teams for each project, 4) team members assigned from project start to finish, 5) leader and team having responsibility for the project outcome, 6) team rewards for successful performances, 7) quick responses to team requests for resources, etc., and 8) team information availability on centralized information systems. The NA sample index mean of the 8 individual measures was 6.7, which Cooper et al. labelled as moderate, while the Norwegian sample mean was a "strong" 7.3.

	Norway high-tech. sample	Cooper* industry sample
NPD Project Team Accountability	7.3	6.7
Climate for Innovation (tied with 3)	4.4	4.1
Adequate Resources	5.1	5.2
Voice of Customer	5.5	5.6
Quality of Execution Pre-development Homework: (tied w 6)	6.0	5.8
Product Advantage	7.3	6.9
NPD Portfolio Management: (tied with 8)	6.2	5.3
Quality of Execution of Marketing Steps:	5.6	5.8
Quality of Execution of Business Assessment:	6.4	5.9
New Product Process:	6.9	8.0

Table 2 Top ten drivers of new product development success

* *from: Cooper, Robert G, Scott J. Edgett, and Elko J. Kleinschmidt. 2003.* Best Practices in Product Innovation, What Distinguishes Top Performers. *Ontario, Canada, Stage-Gate, Inc.*

** *measures were on 0 to 10 point scale with 0 = not at all, 10 = very much.*

According to the Cooper et al. study, the second and third most important drivers were equally important. The second was listed as the firm's "climate for innovation" which was defined by the degree that the firm: 1) encourages employees to submit new product ideas, 2) gives rewards for submitted ideas, 3) give employees time to develop their new product ideas, 4) encourages skunk work activities, 5) is willing to invest in more adventurous projects, 5) educates employees about the firm's NPD process, and 6) does not punish employees for new product failures. Here the two samples were virtually identical with "very weak" average scores of 4.4 for the Norwegian firms and 4.1 for the NA sample. The third driver was listed as the degree to which new product projects received "adequate resources" from marketing, technical, manufacturing, and sales force functional areas. Once again, the average scores were virtually identical with 5.1 for the Norwegian sample, and 5.2 for the NA sample.

The fourth most important driver was the degree to which the firm built the "voice of the customer" into the NPD process as defined by: 1) NPD teams working closely with customers/users, 2) use of the lead user method, 3) use of ideas generated from market research, 4) use of market research to define the product, and 5) use of customer input throughout the NPD process. Both samples had "weak" scores of 5.5 for the Norwegian high-tech firms and 5.6 for the NA firms.

The fifth and sixth most important drivers were also tied in importance. Number five was labelled the "quality of execution of pre-development homework" and consisted of the perceived quality of early stage 1) market research, 2) idea generation, 3) preliminary market assessment, 4) preliminary technical assessment, and 5) early idea screening. The Norwegian mean was a "mediocre" 6.0, while the NA mean was a "weak" 5.8. The sixth driver was labelled "product advantage", which was the degree to which the NPD process created products that: 1) offered customers new and unique advantages, 2) advantages that were important to customers, 3) clear technical superiority over competitors, 4) clear quality superiority over competitors, and 5) superior value for money. The Norwegian mean was a "strong" 7.3, while the NA mean was a "moderate" 6.9.

The seventh and eighth most important drivers were again tied in importance according to Cooper et al. (2003). Number seven was labelled "new product development portfolio management" which consisted of: 1) having a formal portfolio management system, 2) balance between the number of projects and available development resources, 3) systemized ranking for prioritising projects, 4) systemized creation of a portfolio of high value projects, 5) balancing between short- and long-term projects, and 6) support for projects that best fit firm strategies. This construct had the second largest difference between the samples, with the Norwegian mean a "mediocre" 6.2 and the NA mean a "weak" 5.3. Driver number eight was labelled "quality of execution of marketing steps" and included the quality of 1) concept testing, 2) customer testing, 3) test marketing or trial selling, and 4) market launch. Both samples were "weak" at 5.6 in Norway and 5.8 for NA.

Driver number 9 was the "quality of the execution of business assessment" which consisted of 1) value assessment, 2) financial assessment, 3) product design and development, 4) in-house product testing, and 5) post-launch review. This resulted in the third biggest difference between samples with the Norwegian mean a "mediocre" 6.4 and the NA mean a "weak" 5.9.

Driver number 10 was labelled "new product process" and was edited down from the original Cooper et al. version consisting of many items to the single most important measure: "use of the stage-gate process". This resulted in the largest difference between samples, as the NA mean was a "strong" 8.0, while the Norwegian sample was a "moderate" 6.9.

4 Discussion and conclusion

Despite major differences in business size, industry type, and geographic location, there was remarkable consistency between the large North American sample of Cooper et al. and the Norwegian sample of much smaller high-tech firms on the new product development drivers.

Relatively strong performances were measured in such areas as team accountability and product advantage, but there were also several areas where both groups can improve their performances greatly; with the biggest weaknesses for both groups in the personnel management and marketing areas.

"Climate for innovation" was the weakest area for both samples, and includes such issues as encouraging employees to imagine, research, and develop new products as well as educating them on the firm's new product strategies. This weakness may well be linked to the next weak area consisting of a lack of adequate resources. Firms that do not supply their new product development efforts with enough resources, may not just slow down their new product development efforts, but may also be signalling a lack of desire for employees to take new product initiatives. It is also

interesting to note that while the Norwegian sample spends five times as much on R&D (as a percentage of turnover) than the NA sample, it is not reflected with a higher rating on the adequate resources dimension. This may partly be due to the higher level of resources needed in high technology fields, but may also reflect other factors such as less than optimal resource allocation, or perceptual differences due to culture, etc. Exploring the reason for this is an area for future research.

Voice of the customer was also a weak area for both samples. The lack of customer orientation from the Norwegian sample is in keeping with other research that has found that high-tech firms often neglect customers in their new product development efforts due to their emphasis on technology and engineering. This technology focus may also be reflected in the low score on the quality of marketing steps execution. Although the Norwegian sample may have the "excuse" of being from a high-tech area for their lack of focus on customers and marketing, the NA sample's different industry makeup, but similar scores do not offer a convenient explanation. It is clear from other research, however, that not making customers a part of the NPD process from idea generation to market launch results in much higher rates of new product failures in the market.

Another area of weakness is found in the portfolio management scores. Research has found that a well planned process for screening out weaker ideas is an extremely important factor in improving new product development performance because it frees resources to be used on the more worthy projects in the portfolio. To assist managers, sophisticated management science tools (software) have been developed by researchers to improve the quality and timeliness of new product screening decisions, but although they have been around since the 1980s, they have not been widely adopted by North American firms. Because Cooper did not inquire about the use of portfolio management software, our results are not shown in the comparison tables, but we can report that these types of software have also not been adopted by Norwegian firms.

Although some caution needs to be taken in drawing conclusions due to the differences in sample characteristics, the results of this study suggest that the relatively small high technology firms in Norway are not at a competitive disadvantage relative to the North American sample when it comes to their new product development processes. Moreover, the similarities in weaknesses and strengths suggest that a potential exists to create competitive advantages by focusing efforts on improving the weak areas.

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Creating breakthrough innovations by implementing the Lead User methodology

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Getting the customer involved in the generation of new product ideas has been both suggested and criticized as a method to increase the success of new products. One of the major criticisms of customer input is that the typical customer is not creative enough to come up with breakthrough product ideas that can create new markets and lead to superior profits. The Lead User method can solve this dilemma by using the input of the most advanced product users to come up with product concepts that will lead the market. This paper uses four high-technology applications to describe and illustrate the LU method. Suggestions to better utilize the method are also presented.

Abstract

The Lead User method evolved out of research on the sources of product innovations. The research found that customers with advanced needs often develop solutions because no currently available product is able to do the job. In many cases these customer-generated solutions have been adopted by industry and achieved widespread marketplace acceptance. The Lead User method formalizes this previously ad-hoc process into a mechanism that has proven to be a great source of breakthrough product concepts in a wide variety of industries. This paper describes and illustrates the method and offers suggestions on optimizing its use.

1 Introduction

A breakthrough product is one that has a major impact on customer habits and marketplace competitors. Recent breakthrough examples include the personal computer, Internet, and mobile phone. While 90 % or more of new products are only incremental advances of existing products, a disproportionate share of profits and sales growth frequently comes to firms who successfully introduce breakthrough products. While research has found that new product development (NPD) processes that include the "voice of the customer" increase the success rates of new products, some critics suggest that customer driven NPD processes reduce the likelihood of breakthrough product concepts because the typical customer does not have enough imagination to envision anything radically different from today's product offerings. The purpose of this article is to describe the Lead User (LU) method that has been found to increase the likelihood of breakthrough product concepts while also bringing the voice of the customer into the NPD process from the very first stages.

The LU method was popularized and refined by MIT's Eric Von Hippel, and over the past few years many well-known firms such as Nortel Networks, Verizon, Nestle, Kellogg, Pitney Bowes and Phillips have successfully adopted the LU method into their NPD processes. Perhaps the one firm that has most publicly embraced the LU method is 3M, which like many firms desired a method that would help their managers and engineers create more and better breakthrough product concepts. Before making the LU method a central tool in their NPD efforts, 3M conducted an internal study which compared the outcome of traditional ways of doing new product development (brainstorming, focus groups, regular customer visits, conjoint analysis etc.) with the LU method. They found that the ideas generated by the LU method were 41 % more novel and original (i.e. more breakthrough like), had 21 % higher success rate, 106 % higher market share, as well as 17 % better fit with the firm's strategic plans and functional capabilities. Another benefit of the LU method is that its implementation requires the use of cross-functional product development teams which have been shown in significantly lower product development costs and time.

Why does the LU method give such good results compared with traditional methods when searching for breakthroughs and innovations? One key factor is that instead of collecting information from the "average" consumer, the LU method seeks out product users facing challenges and opportunities involving the product months or years ahead of the general marketplace.

2 Background and descriptions of Lead Users and the LU method

By dealing with advanced issues well before they are on the radar screen of ordinary customers, Lead Users have a strong desire for innovations that will solve their problems in ways that currently available products cannot. Empirical research in product markets ranging from high technology computers to more mundane items such as bicycles and pipe hangers has found that Lead Users not only have advanced ideas,

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but in many cases have already developed the new product themselves for their own use. Examples of Lead Users include the aerospace industry for anti-lock brakes on cars and veterinary medicine for low cost methods of dealing with infection prevention during surgery on humans.

The LU method evolved from empirical studies of the sources of breakthrough product ideas by MIT professor Erik von Hippel. Refinements over the years have led to the five step methodology or process for concept development and testing listed below:

Step 1 – Planning the project: The major goal of this step is the identification of product and market areas to focus product development efforts on. In addition, the identification and recruiting of the key stakeholders from various functional areas within the firm for the LU working team is done. The step is completed with a detailed project plan that includes goals for the innovation and a project kick-off.

Step 2 – Determine key trend(s): The goal of step 2 is to identify and thoroughly research the market and technological trends effecting development in the chosen product and market area. This process involves the identification and interviewing of experts inside and outside the firm that have expertise in the area of interest. Once the trends have been identified and researched, the LU team must prioritise them based on their likely new product development impact and choose the one or more trends that will be the focus of Lead User recruiting.

Step 3 – Identify Lead Users: Step 3 uses a networking process to identify likely sources of Lead Users inside and outside the market under study. The contacting and qualifying of Lead Users and preliminary interviews follow this.

Step 4 – Development of innovative ideas and product concepts: Workshops involving the recruited Lead Users and the LU team further develop, refine, and test Lead User developed ideas and concepts. Finished concepts are then prioritised based on technical feasibility and management priorities.

Step 5 – Concept testing: Testing of approved Lead User generated new product concepts on typical customers to determine "current" market acceptance.

3 LU method implementations in high technology companies

To more fully illustrate the LU method we will review four cases involving high technology firms, two of which had positive experiences with the method (3M and Nortel Networks) and two who had less positive experiences (Cinet and Telenor). 3M was an early adopter of the LU method as a means to increase the frequency in breakthrough of new product concepts. Their first full-scale LU project started in 1996, when a team was created and charged with finding a breakthrough idea in the area of surgical drapes – the material that prevent infections from spreading during surgery. Cinet, a large IT integrator in Norway used the LU method in their PC hardware and Symfoni software product categories during the late 1990s. Nortel Networks was the first company in the Internet industry to implement an LU method project in 2000, when they applied it to discover new voice, data, and location-based services for the wireless Internet, and to help identify disruptive technologies to their industry. Disruptive technologies typically enable new markets to emerge by allowing a large population of customers to do something that historically had been available and affordable only to a small group of specialists. Telenor, the biggest telecom company in Norway, implemented the LU method in one of their divisions in 2001–2002 to identify opportunities in the Telecom, Internet, Media, and Entertainment segments.

Step 1 – Planning the project

The 3M case provides an example of good LU planning. During the earliest stage of their LU project, the 3M team identified the kind of markets they want to target, as well as the type and level of innovations desired by the stakeholders within the company. 3M's initial goal was to; "Find a better type of disposable surgical draping". The development group spent the first month and a half of the project learning more about cause and prevention of infections by researching the literature and by interviewing experts in the field. They then held a workshop with management in which they discussed all that they had learned and set parameters for acceptable types of breakthrough products.

One of Cinet's major goals in planning its first LU project was to get non-engineers involved in their new product development process. Previously, personnel from other functional areas had typically not been involved in new product development until the later stages when many of the design parameters had already been fixed. Previous research had established that one of the major benefits of the LU method was its cross-functionality where members of the LU team are purposely chosen to represent the various key

functional areas within the firm. Another major goal for the Cinet LU project was to make the firm more customer-focused, as their previous new products had almost exclusively evolved out of the engineering labs of Cinet or their supplier firms such as Intel and Lotus. In contrast with the 3M case, however, the innovation related goal for the Cinet LU project was more vaguely defined as "generating new product concepts for the major hardware and software units of the firm."

Step 2 – Determine key trend(s)

Once the planning phase was completed, 3M moved to the trend identification stage by interviewing experts who had a broad view of emerging technologies and leading-edge applications in the area of important trends in infection control. While the experts they talked to were very knowledgeable about the latest technology advances, they did not prove to have much understanding of the needs of medical professionals in developing countries where infectious diseases are major killers due in part to the lack of available funding for western style technology. To remedy this problem, the LU team travelled to hospitals in Malaysia, Indonesia, Korea and India to learn how surgeons combat infections where disposable drapes and other more expensive asepsis measures are not widely available. The team realized that even if 3M could radically cut the costs of surgical drapes, most hospitals in developing countries simply would not be able to afford them. These insights led the team to redefine their goal as finding a much cheaper, much more effective way to prevent infections from starting or spreading that did not depend on antibiotics or surgical drapes.

The Telenor LU process was largely implemented by outside consultants with the help of Telenor managers who selected the area of focus as the consumer market. To identify the trends within the consumer markets, the consultants conducted in-depth interviews and workshops with Telenor employees identified as experts in technology and markets. The 22 trends that emerged from these interviews and internal workshops were thought to be complete enough to not require any additional workshops with external experts.

Step 3 – Identify lead users

After completing the first two steps of the LU process, the identity of Lead Users for the *Nortel Networks* LU team was defined as having one or more extreme communication/data mobility needs or contexts such as: 1) life or death outcomes, 2) wireless Internet access, 3) real-time data needs, 4) extreme context sensitive data. The LU team also wished to find lead users with not only the need, but also the resources to have developed solutions to their communication/data mobility issues. This led the LU team to such areas as military battle management, remote diagnostic field technicians, mobile telemedicine, law enforcement, aviation specialists, oil field operations, and remote news broadcast operations. Later in the search for Lead Users, other potential domains became apparent such as animal trackers and storm chasers. Once an initial contact was made, the Nortel LU team member assessed the level of knowledge and the level of innovation of the potential Lead User, with only those scoring high in both areas being recruited for further contact. In cases where the contact did not meet the Lead User criteria, they asked for referrals of colleagues who better fit the Lead User definitions. Through this networking process, the LU method project team was able to identify more than twenty lead users.

For the 3M LU team, seeing the needs of medical professionals in developing countries caused the networking process to change its focus from the high-tech arenas to those with extreme needs in both fighting infection and cutting costs. As is often the case, some of the most valuable Lead Users turned up in surprising places. For example, the team learned that specialists in some leading veterinary hospitals were able to keep infection rates very low despite facing difficult conditions and cost constraints. As one of the interviewed veterinary surgeons explained to them; "our patients are covered with hair, they don't bathe, and they don't have medical insurance, so the infection control that we use can't cost much". Another surprising source of ideas was Hollywood. One of the team members learned that make-up artists are experts in applying materials to skin that are non-irritating and easy to remove when no longer needed. These attributes were very important in the design of infection control materials applied to the skin.

By contrast, Cinet's more limited financial and personnel resources also limited the search for Lead Users to their own customers identified by local IT experts as likely to have high technological needs and interests. A list of contact names was obtained from the LU stakeholders and other Cinet employees such as sales representatives and a Lead User networking and qualifying process was initiated by asking contacts: who do you regard as the most expert user in desktop PC/Symfoni type applications in your company?, and who in your company do group members turn to when they face difficult desktop PC/Symfoni type applications problems? Using this process led to the recruiting of 16 Lead Users for further discussion.

Step 4 – Development of innovative ideas and product concepts

Once lead users were recruited, the Nortel Networks LU team used workshops to uncover and refine two concepts: 1) the dynamic tether, and 2) store-and-forward caching. By bringing Lead Users together from such diverse fields as animal tracking and broadcast engineering, connections were made between the individuals that helped in the uncovering of innovative solutions. For instance, one of the storm chasers recognized that the broadcast engineer had ways to solve problems that were critical to weather warning and disaster prevention. The common element among the Lead User group was their critical need for mobile solutions to transmit data collected in their field of study. The LU team also put the Lead Users into scenario teams that enabled them to work together on tangible problems outside their domains of expertise. Each scenario team was asked to design the network and devices given the requirements of the expedition scenario. As the workshop progressed, more constraints were placed on the designs, and as a result, innovations started to emerge. The creative portion of the workshop ended with a list of key innovations. Several application domains were identified by the Lead Users for the innovations that were developing, including emergency medicine, aviation management, virtual experience in education, fleet management, and statistical modelling.

After getting a list of new product concepts from the recruited Lead Users, the 3M LU team chose three product line concepts that they felt were the strongest to present to senior management. One key factor in choosing the three concepts was that they could all utilize existing 3M technology. Although only one of the three would actually be considered a breakthrough concept, all three ideas also had significant advantages over existing products on important product attributes such as lower costs, increased convenience, and improved infection prevention. The breakthrough product concept was for an "armour" anti-bacterial coating that could be used on medical instruments allowing 3M to enter the $2 billion market aimed at controlling blood-borne, urinary tract and respiratory infections.

Telenor also implemented a series of workshops for their recruited Lead Users. In addition, on-line workshops were also used to keep in touch with the Lead Users over a period of several months. Just one of the workshops revolving around the broadband services area resulted in a total of 72 new product ideas and/or concepts. A subsequent evaluation and ranking of the ideas by the Telenor LU team led to the choosing of the top four for further development. Focus group sessions for the Lead Users recruited by Cinet contributed 30 new product concepts in the software and hardware sides of the business.

Step 5 – Concept testing and further work towards launch and commercialization

After compiling the next generation product concepts from the LU focus groups in Cinet, the ideas were tested for acceptance on a sample of 15 "routine users" in each product category. These user-evaluators were asked to review the proposed desktop PC and Symfoni software concepts in detail, noting particular strengths and weaknesses. Their responses were very positive overall, with over 90 % expressing a willingness to buy an LU generated next generation product concept when it became available. Among those willing to try the new product concepts, all indicated that they would be willing to pay 5 to 10 % more relative to existing products. Subsequently, over 75 % of these ideas were adopted into Cinet's next generation products.

After further testing with the potential customer demand, the 3M LU team prepared a report on all three concepts with details on their likely acceptance by customers and projected financial returns. The report was presented to top management and an approval was given to develop the concepts into a physical product. At this point the LU team was disbanded, although one member remained behind to guide the development process through to market launch so that the rich body of knowledge that was collected during the LU process could have a direct impact on the remaining steps of product development and marketing.

In the end, the ideas that emerged from LU workshops at Telenor were largely seen as a confirmation of new product ideas that had previously been researched and discussed by Telenor engineers. Of the few LU generated ideas that did become future products at Telenor, none were considered new to the Telenor LU team, while the majority that were not adopted were judged to be not very interesting or not specific enough to pursue further.

4 Lead User case conclusions

All four examples of the LU method resulted in the generation of product concepts. The number of concepts that were ultimately released into the marketplace ranged from none for Telenor, three for 3M, four for Nortel Networks, and over twenty for Cinet. While many of the commercialized concepts were not breakthroughs, several were, including the 3M's armour coating which allowed them to pioneer a new $2 billion market. Nortel Networks and 3M continue to use the Lead User method in their various business

units, but neither Telenor nor Cinet followed up with additional LU studies after their first attempts.

3M experimented with the Lead User process in order to break free from incrementalism. They were concerned that too many of their recently introduced new products had not offered the opportunity to pioneer new markets and/or shake up mature markets that breakthrough products are able to do. The LU process offered 3M a systematic way to generate new products and strategies based on a deep understanding of the leading edge of rapidly moving markets. Another important driver in 3M's decision to continue with the LU method was its strength in building cross-functional teams.

In Telenor's case, the failure to find the resources to dedicate internal personnel to the Lead User project was a major deterrent to further use of the LU method. While the consulting firm did much of the "leg work" in implementing and carrying out the LU method, the Telenor manager assigned to the LU method was also responsible for many other tasks which prevented her from devoting her full attention to the LU method. This made it difficult to maintain momentum and internalize the LU method processes, even though some innovation attempts were made in creating lead user panels to follow over time. At this point in time Telenor's management consider the LU method as a process that is currently on "hold" as a future tool for generating product concepts.

Cinet's experience with the LU method resulted in the generation of numerous ideas that were added to the product line, and initial management opinion of the method after it had been tried was very positive. Those involved in the project had been particularly happy with the way the method had increased the cross-functionality of the new product development efforts as they had hoped it would. Despite the positive experience and attitudes that they had with the LU method, Cinet did not continue with the method or any other form of customer research for several reasons. First, they experienced high personnel turnover so that nearly all of the original LU team were no longer at Cinet within a few months of the first LU study's completion. This problem was magnified because the knowledge of the method was not passed on to the people promoted to replace them. Second, the engineering based culture at Cinet was never provided any motivation by top management to become and stay customer focused. The Cinet engineers preferred to talk with other engineers rather than Lead User customers, and were given no rewards to continue with the extra efforts required to continue with the LU method. Third, while many Lead User generated ideas were adopted, no effort was actually made to measure any incremental gains in sales, profits, or other measures of company performance, so no direct measure of LU related gains were available for motivation.

5 Seven critical success factors in using the LU method

The lead cases reviewed here, together with other research on the LU method, offer some guidelines for optimizing its implementation.

1 Be sure to have top management support from the start of the project to the end – both financially and internal resource allocations! Telenor's reliance on outside consultants and Cinet's lack of provision for customer-focused rewards may have reduced the LU method's effectiveness. While outside consultants can provide valuable guidance in designing an optimal LU study program, it is important that the internal LU team members are given the time and resources to be heavily involved in the method so that the knowledge gained can be spread and used throughout the firm to increase the effectiveness of the NPD process.

2 Use the first weeks of the project for in-depth investigation of the chosen product and market for understanding the case in detail. Also do not forget to specify the goals for innovations! While Cinet had detailed goals for using the LU process to improve its new product development process, their process could have been improved by developing a specific set of innovation goals they hoped to achieve.

3 Do not use shortcuts in finding and analyzing trends. 3M's extensive trend analysis led them to change the major focus of their entire LU process and the result was a new breakthrough product and two major product improvements. 3M's initial focus on leading edge medical practice in the highly developed economies changed to medical doctors in developing nations, veterinarians, and Hollywood makeup artists. Limiting the trend analysis process to internal people and/or one geographic area as Telenor and Cinet did, may hamper efforts to recruit the most relevant leading edge customers of the most important trends.

4 The quality of the Lead Users is dependent on the quality of your networking process. Nortel Networks' extensive and flexible networking process took them to several unexpected areas for Lead User recruiting such as animal trackers. Similarly, 3M started in high technology fields and ended up in developing nations and animal clinics.

5 Start out with small groups in the LU workshop and let them roll. Later on in the workshop you can put all the groups together and make conclusions based on their former discussions. It is important to start the discussions very broadly with few restrictions and narrow it down during the workshop discussions to get product innovations that are more useable for the company! Nortel Networks' funnel approach to their LU workshops led to product concepts that were very well defined and useable. In contrast, Telenor's less structured approach led to the generation of many concepts, but few that were deemed marketable and/or doable by management.

6 Measure the final outcome of the Lead User generated ideas and solutions in such areas as tangible product improvements to existing products, financial outcome changes, and/or creation of new product categories and lines! One of the weaknesses of the Cinet LU effort was the failure to track the results of their LU generated product concepts, which might have provided some motivation to continue with the method. 3M, by contrast, did a careful comparison of LU projects with non-LU projects to document the higher proportion of breakthroughs and higher levels of profits and sales for LU generated new product concepts.

7 Never forget to test the new and innovative product concepts that have evolved from Lead Users on "average users" in your market. Remember that Lead Users can be months and even years in front of the rest of the market!

6 When is it appropriate to use the LU method?

We have described and explained how the LU method can be used in high-technology companies and the most critical success factors when implementing this innovation process. The next question to ask is what type of firms will most benefit from the LU method?

One common problem with high-technology firms is that their new product efforts are often focused on using or developing the technology to the exclusion of understanding and satisfying customer needs. By putting leading edge customers into the NPD process from the very beginning, the LU method can direct development efforts where they will be most appreciated. In the Cinet case cited above, an examination of the Lead User generated product concepts was compared to a list of concepts gathered from NPD engineers. Table 1 shows the findings broken down into four main categories and shows major differences in next generation PC product concepts in the technical and service areas. The engineers described about 50 % of their next generation product concepts in very technology specific terms, while the LU group only had 13.3 %. In contrast, 63 % of the LU group's ideas were focused on service issues, while the engineers had less than 17 %. A similar pattern was established for the Symfoni software side, where the engineers described their next generation products in technical terms 35 % of the time, while it was 0 % for the Lead Users. These findings correspond well with earlier research which has found that managers in high technology areas often have difficulty translating technical characteristics into product features and benefits, and that high technology customers often have difficulty translating their desired benefits into technological solutions. If your firm too often develops products that customers do not appreciate, the LU method can make sure your NPD efforts are put into the areas that customers want!

High technology firms can also suffer from compartmentalization of their NPD efforts as engineers fre-

	Technical characteristics	Benefits provided	Style issues	Service issues
PC Engineers	49.5 %	22.7 %	8.9 %	16.9 %
PC Lead Users	13.3	23.3	3.3	63.3
Software Engineers	35.0 %	55.0 %	0.0 %	22.0 %
Software Lead Users	0.0	55.5	11.1	33.4

*Table 1 Next generation product concept characteristics comparisons: Engineer versus Lead User descriptions**

Table key:

- *Technical characteristics category is: product features using concrete technical terms such as 800 MHz Pentium processor, 20 Gb hard-drives, etc.*
- *Benefits provided category is: product features which list tangible benefits such as faster processing, fewer crashes, etc., but without specific technological solutions.*
- *Style issues category is: product features dealing with visual effect on the eye such as better computer case styles, more pleasing screen layout, etc., but without specific technological solutions.*
- *Service issues category is: product features which involve service issues prior to or after the sale such as pre-loading software or helplines, but without specific technological solutions.*

* *taken from: Olson, Erik L. and Geir Bakke. 2001. Implementing the Lead User Method in a High Technology Firm: A Longitudinal Study of Intentions versus Actions*. Journal of Product Innovation Management, *18 (Nov), 388–95*

quently dominate the process, particularly in the early steps. Failure to consider issues of manufacturability, financial costs, and customer needs that might be brought to the development effort by including personnel from production, accounting, and marketing often mean that resources are wasted in developing products that will not be as successful or profitable as they could be, and/or the need to do expensive rework on the design to fix problems that emerge late in the process, and/or development delays that push back the launch. Many of these problems can be reduced or eliminated through the use of cross-functional development teams, which is part of the first step in the LU method. If your firm's NPD efforts do not use cross-functional teams, the LU method can be a way to implement them!

Finally, and perhaps most importantly, the LU method will be of major value to all firms that need an increase in product ideas and concepts that go beyond small incremental improvements to existing products. Leading edge customers may already be using your industry's next breakthrough product because they developed it themselves to solve a problem that no current product can. The ability to bring customers into the NPD process while increasing the possibility of breakthrough product concepts is a major advantage of the LU method over any other idea generation method. Whether your firm's NPD process currently does no customer research or relies on the viewpoints of "average" customers, its ability to generate breakthroughs that can create new market opportunities will be improved by the adoption of the LU method!

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InnovationEnterprizer – System for evaluating and managing corporate innovation

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As traditional product and service lifecycles shrink in their turbulent markets, managers are placing greater emphasis on the timely and efficient development of new products, processes and services. This paper relays the development, methodology and application of a systematic method for assessing and promoting innovation best practice in corporations: innovationEnterprizer. This method provides the framework for a software-based knowledge system, which also contains comprehensive support materials for manager and business consultant training.

Subsequent to the short introduction, an overview of the concepts and issues relating to the field of corporate innovation is given. Thereafter, the innovationEnterprizer methodology and algorithm are relayed as are the software functionalities. Finally, a short conclusion highlights the benefits of innovationEnterprizer.

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Introduction

It has been widely observed that business growth and long-term profitability are related to, and probably largely dependent on successful corporate innovation. This is because traditional product and service lifecycles are shrinking in their turbulent markets. Thus greater emphasis is placed on the timely and efficient development of new products, processes and services (cf. Cooper, 2000) to meet this capricious demand and to compete against evolving competition.

Due to the perceived importance of innovation, academics and practitioners have devoted significant energy to understanding the benefits, impediments, catalysts and conditions that might promote innovation both amongst individual employees and organisations as a whole. This paper contributes to this end by relaying the development, methodology and application of a specific approach to assessing and promoting innovation best practice in corporations: innovationEnterprizer.

Fundamentally, innovationEnterprizer is positioned as an action-oriented, method-driven managerial support system with a scientific basis. Its two main modules facilitate the assessment of an organisation's product or service development process and its management thereof. It provides a common, categorical framework, which allows the explication and measurement of both tangible and intangible factors, which best practice research suggests are critical for successful, repeatable innovation. In short, the system measures and benchmarks an organisation's innovation competency and provides prescriptions for procedural and managerial improvement. Accompanying the managerial support system is extensive learning and support materials for managers and business consultants alike.

The analytical core of innovationEnterprizer is defined by three inter-related parameters: stakeholders, best practice success factors, and performance measurement inputs. The definition of successful innovation depends on the viewpoint that is taken. As such, innovationEnterprizer employs the multi-perspective approach of organisation-specific stakeholders, each with weighted importance. The best practice success factors are the core of the system and are organised into three parsimonious, coherent dimensions. These success factors, and the way in which they combine have been developed from primary and secondary best practice research.

Finally the performance measurement inputs are provided in a facilitated environment within the organisation in question. These make explicit the organisation's current performance levels, benchmarked against best practice. They allow for group discussion and the development of feasible plans for improvement. As such, algorithms can be used to generate what-if scenarios that represent potential future improvement strategies. These key functionalities are supported by embedded innovation expert help. This scientifically-based online advice provides context-specific assistance and suggestions for further reading and learning for facilitators and managers alike.

Following a short introduction, this paper provides an overview of the concepts and issues pertinent to stimulating and managing corporate innovation. Next, the structure of the individual modules is described within the context of the innovationEnterprizer methodology and algorithm. Subsequently, the functionalities of the innovationEnterprizer software are briefly relayed. Finally, a short conclusion draws out the essence of the paper and the benefits of innovationEnterprizer are detailed.

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Innovation

Innovation is a new idea, method, or device. Innovation can be defined as the act of creating a new product, service or process. The act includes invention as well as the work required to bring an idea or concept into final form (Rosenau et al., 1996).

Innovation and product development are now even more critical to the success of organisations and companies than before. Information technology has played an important role in facilitating innovation. In this changing environment, networking, co-operation, and effective group work are of growing importance for innovation. Human capital and knowledge management appear to be key factors in today's effective innovation processes (Nonaka and Takeuchi, 1995). Also from the global perspective, innovation and technological progressiveness are commonly considered as being among the most important drivers of economic growth.

As innovation and product development have become more important to business, and competition has increased (Hayes et al., 1988), organisations seek to obtain more results from their R&D expenditure (Hatfield, 2002), and pressures to develop products more rapidly have increased. In this complex arena, where companies cannot afford to be wrong, the importance of decision-making concerning innovation has increased (Carneiro, 2001).

Success factors

In order to identify the success factors for corporate innovation, a number of criteria must be defined by which a project's success can be measured and which can be used to make an objective distinction between successful and less successful or failed innovations.

In the literature of innovation management, some major trends have prevailed during the last ten years. Competition is harder when more companies are competing for the same markets (Hayes et al., 1988). Market conditions are changing rapidly while product/technology life cycles are becoming shorter (Bayus, 1994). Many studies on (new) product development practices and principles give ideas for and confirm the need for effective innovation management. Customer involvement in product development activities is increasingly important for market success (Cooper and Kleinschmidt, 1995; von Hippel, 1978, 1988). Spivey et al. (1997, p. 206) have proposed that "At the crux of any successful system for new product development is an effective communications network." In order to stay competitive in the competitive environment, organisations must pay attention to innovation management practices and utilisation of appropriate IT-tools, e.g. innovationEnterprizer.

Cooper (1993) has identified four main approaches to project evaluation. He emphasises that the problem is usually about resource allocation among a number of projects or technologies and there is no one best way to solve the problem. Cooper's four approaches include benefit measurement, economic, portfolio selection and market research models.

The need for innovationEnterprizer can be conducted from the perspectives of innovation, conditions affecting innovation, challenges and fundamentals, success factors, measures, benchmarks, and criteria. The main argument here is that corporate innovation is a very challenging area that has to be supported from the whole organisation point of view. The organisation has to take the changes in the dynamic, competitive environment into account and attempt to, proactively, innovate a new product or service that matches the market need.

The criteria involved in innovation management decisions can vary greatly, depending on the characteristics of the product and the organisation. Regardless of the criteria used, the selection process itself must meet some basic requirements. Platts (1994) has proposed some common characteristics of successful selection methodologies (see Table 1). These success factors should be carefully considered when developing and carrying out innovation management.

Acs and Audretsch (1987) tested the Schumpeterian Hypothesis (large firms are more innovative, imperfect competition promotes innovation) in their study. They explored when large firms are more innovative, and found that the answer was when those firms are in markets characterised by imperfect competition. Significant variables in explaining the difference in innovation rates between large (500+ employees) and small firms are: capital output ratio, advertising intensity, concentration, unionisation, and percentage of industry accounted for by large firms.

Procedure	Project Managing
Well defined stages Easy-to-use tools and techniques Producing written records	Adequate resourcing Agreed timescales
Participation	**Point Of Entry**
Individual and group Workshop style meetings Decision making leading to action	Clearly defined expectations Ways to establish understanding, agreement and commitment

Table 1 Characteristics of successful methodologies (Platts, 1994)

Bachman (1972) discussed how to measure the return on research. He proposed the measure of the profit from projects in the last five years divided by the cost of all projects in the last five years. He suggested the idea that one should compare profit from older operations to profit from more recent operations. Profit results from:

1 the selection of research problems;
2 the solution of the problem; and
3 subsequent commercialisation of the research results.

According to Cohen and Levinthal (1989) firms' spending on R&D makes them more able to absorb technological knowledge.

$$\sum_{i=1}^{i=I}\left[\frac{\left[\sum_{j=1}^{j=J}\left[\frac{a_j\cdot b_i\cdot c_{ij}\cdot d_{ij}}{\sum_{i=1}^{i=I} c_{ij}}\right]_{ij}\right]_i}{\left[\sum_{i=1}^{i=I}\left[\sum_{j=1}^{j=J}\left[\frac{a_j\cdot b_i\cdot c_{ij}\cdot d_{ij}}{\sum_{i=1}^{i=I} c_{ij}}\right]_{ij}\right]_i\right]_i}\right]_i\cdot\frac{1}{\sum_{j=1}^{j=J} a_j}$$

Where:

a_j = importance of stakeholder
b_i = importance of success factor
c_{ij} = importance attached by stakeholder$_j$ to success factor
d_{ij} = utility function of stakeholder$_j$ per success factor

Figure 1 Generation of success scores

Cooper and Kleinschmidt (1995) focused their empirical study on companies' performance rather than project performance. They began with ten performance measures, which were factor-analysed into two factors: program profitability and program impact (sales, success rate, technical success, etc). They categorised four groups of companies: 1) solid performers, 2) low impact performers, 3) high impact technical winners, and 4) dogs. Finally, they determined what distinguishes the solid performers from the dogs. According to Cooper and Kleinschmidt (1995) drivers of performance were:

- high quality new product process
- clear and well-communicated new product strategy
- adequate resources (senior management attention, R&D, necessary people)
- senior management commitment
- entrepreneurial climate
- senior management accountability
- strategic focus and synergy
- high-quality development teams
- cross functional teams

Next, the structure of the system is described within the context of the innovationEnterprizer methodology and algorithm.

The innovationEnterprizer methodology

innovationEnterprizer is essentially an intelligent tool that is driven by S3i's Enterprizer software platform. The innovationEnterprizer tool contains an "expert-shell", a software front end and an "assessment engine". An expert shell represents an enterprise's business and operational environment, and includes a baseline of all the relevant success factors, stakeholders, relationships and weightings. The expert shell is divided into three distinct dimensions each with a unique set of critical success factors. These three dimensions are: 1) Organisational environment, 2) Operational procedures, 3) Human processes. Respectively, they deal with enterprise-wide strategic issues related to innovation, the day-to-day processes and decision-making regarding innovation and thirdly, the micro inter-personal and cultural level. This baseline of success factors is the result of scientific research and serves as a starting point for best practice.

Throughout innovationEnterprizer, stakeholders are given an important role. Using a stakeholder approach to make decisions is becoming increasingly effective as networks of enterprises become the norm, and collective agreement is necessary to successfully execute business decisions. Therefore, innovationEnterprizer requires the views of relevant stakeholders to be inputted against all success factors on the three dimensions.

Having been guided through this structured reflective process, the assessment engine calculates the overall innovation scores for the enterprise on the three dimensions (see Figure 1). It does so by transforming each stakeholder's rating of each factor into a utility score, and then calculating a weighted average, based on the relative importance of each stakeholder. The system then offers prescriptions for improvement or adjustment of the enterprise's management of and potential for innovation, by identifying the success factors that have the greatest impact on the final innovation score.

Online materials support the user in every entry made to the system. This is available through an html advisor (innovationExpert) that offers contextually pertinent best practice and conceptual tools. The methodology and components described in this section are clarified in the following section, where the usage scenario is relayed.

innovationEnterprizer usage scenario

It is important to understand that innovationEnterprizer can only be used by trained experts acting as facilitators. This is due to the nature and complexity of the subject matter. These "experts" must be trained not only in the technical aspects of how to use innovationEnterprizer but also in the underlying methodology. For this purpose, innovationEnterprizer includes both technical training and learning and support materials (innovationExpert) that gives context specific methodological advice and examples.

A facilitator could either be internal, in the case of larger companies, or external (consultants and business advisors) in the case of smaller companies. In both cases this person must be able to effectively administer innovationEnterprizer, drive the development process, guide the assessment and optimisation process and interpret the results generated by the optimisation process. The facilitator must also be able to generate meaningful output. It should be noted that the target client-users of innovationEnterprizer include both large enterprises and small and medium sized businesses.

Usage process

The facilitator will work with innovationEnterprizer in workshops and small-group sessions interacting with the target beneficiaries and any innovation-specific stakeholders. The first step is for the facilitator to help the client group define the deliverables that they wish to assess. These deliverables are typically products, services, projects or occasionally policies. In each case, the level of innovation will be assessed and then optimised. For each deliverable, the user must enter assumptions, research findings and data, based on collective knowledge and experiences.

More precisely, inputs to innovationEnterprizer will be provided before, during and after the workshops, for each specific deliverable. This is done through a series of in-built questions and required inputs for multiple innovation-specific parameters. These inputs include:

- relative importance of stakeholders;
- stakeholder preferences for success factor performance (utility functions);
- relative importance of success factors per stakeholder (relationships);
- performance measurements against standard success factors (from expert shell);
- innovation management objectives, strategies, plans and actions.

Review of these inputs during the workshops ensure that they are relevant and acceptable to the participants. Indeed, numerous sources may be consulted to give the optimal picture. These include research findings, assumptions, and other inputs provided by any subject matter experts and stakeholders whose knowledge can be solicited and used. Indeed, any form of input is possible with findings from innovation-specific research, such as competitive studies, represented in innovationEnterprizer as textual inputs, and can be captured via the hypertext link facility.

Following the entry of these data, the facilitator or nominated system administrator will be able to use innovationEnterprizer's inbuilt assessment and optimisation functionalities to drive multi-parameter "what-if" and impact analyses to set new goals and generate optimised prescriptions for reaching these goals (see Figure 2).

Links to Gantt charts and budgets (see Figure 3) will enable implementation of the analyses via defined tasks and actions.

The results can also be used for subsequent review, refinement and enhancement. Indeed, these plans as well as the assumptions, and data upon which they are based, will be reported by the facilitator using the fully-configurable reporting facility in HTML with graphics that allow users to generate any type of report required. Users can decide whether to include all data relating to a specific deliverable or simply modify a report to include specific data. Users can also choose whether or not to include detailed graphics or simply to have textual output.

With the fully populated innovationEnterprizer model in place, the facilitator may choose to continue the dialogue with stakeholders though the *e*Notes facility that allows users to communicate in context. Each *e*Note includes the user's identification details and the facilitator retains administrator privileges over the communication. At this point, innovationEnterprizer can be made available either as a stand-alone version or a networked multi-user version and can be accessed via various user access privileges. Typically there will be three user access privileges; Administrator (allowing changes to both the embedded expert shell and user environment), Author (allowing user input), and Reviewer (restricted to review and comment only). It should be noted that access is restricted to licensed users only, with other user access combinations configurable as required.

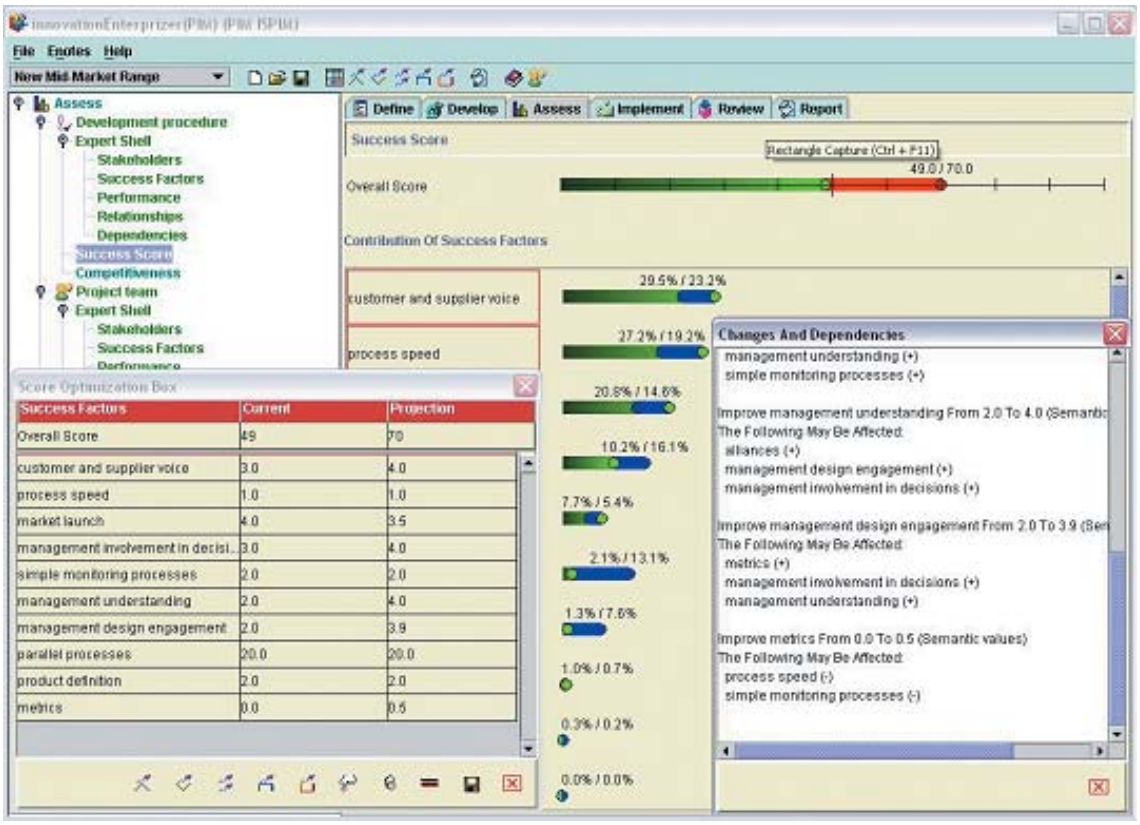

Figure 2 innovationEnterprizer optimisation screen shot

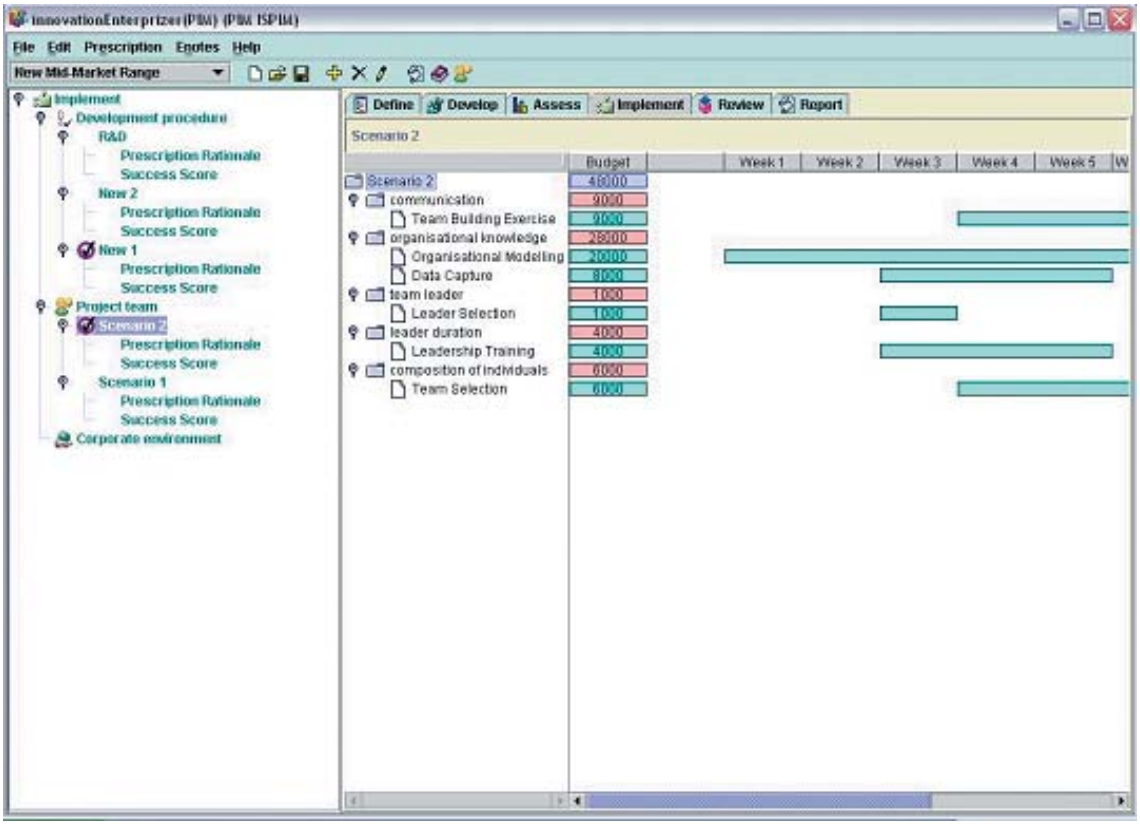

Figure 3 innovationEnterprizer Gantt chart screen shot

As a dynamic model, innovationEnterprizer should be regularly updated in review meetings whenever new information and research findings are available or whenever changes in the business and operational environment occur. Depending on the nature of the update some updates may be done collectively, in workshops facilitated by experts and/or the trained system administrator, while others may be entered directly by trained innovation managers. Whenever an update has occurred, the person responsible must save the updated data under an agreed version control regime, and make it available to all authorised users.

Implementation of innovationEnterprizer

The following describes a typical scenario-specific process for training and licensing the target users and for integrating or interfacing innovationEnterprizer with existing business processes:

Step 1: Facilitator Training : Train-the-facilitator program (training of in-house trainers in methodology and usability aspects)

Step 2: Adaptation : Adapt the innovationEnterprizer intelligent tool (more industry-specific; stakeholders, success factors, relationships, dependencies; terminology & language)

Step 3: Testing : Testing in a simulated or actual project by fully populating innovationEnterprizer to ensure correct use

Step 4: Licensing & Report Generation : Define the licensing arrangement including number of Enterprizer Licenses, any potential networking requirements and user privilege assignment.

Step 5: Installation : Install innovationEnterprizer on the enterprise's network and on any designated laptop computers ensuring multi-user accessibility.

Step 6: Integration with Existing Business Processes : Develop procedures and software interfaces or links to existing business processes to ensure that innovationEnterprizer is integrated with existing company practices.

Conclusion

The importance of speedy, effective, repeatable innovation has generated the need for innovationEnterprizer. The configuration of innovationEnterprizer, which is a knowledge-based software support system is based on the unique scientifically-researched best practice methodology. The methodology contains three distinct dimensions that represent organisational, operational and human critical success factors. These factors, and the way in which they combine have been developed from primary and secondary best practice research conducted during the development of innovationEnterprizer.

By way of a trained facilitator, stakeholders give contextual background to the situation, evaluate pertinent parameters in each dimension. The facilitated process allows the various stakeholders in the innovation process to be taken into account, and can calculate success scores, based upon the three aforementioned dimensions. Ultimately, innovationEnterprizer offers prescriptions for "innovation score improvement" and managerial action, with associated budgets and Gantt charts.

Benefits

Throughout the development and validation of the system, feedback from managers and domain experts has highlighted the following major benefits of using innovationEnterprizer.

- Crisp visualisation of factors that impact success : "makes the invisible visible"
- Clear insight into complex scenarios : "unexpected results that otherwise would have been missed"
- Optimal and financially grounded paths to improvement and implementation
- Rapid, in-context decisions : "uses collective wisdom to inform sophisticated decision-making"
- Consensus development and stakeholder buy-in : "I walked in with individuals and walked out with a team"
- Easy interaction with knowledge and expertise : "the best I've seen for shared understanding"

In addition, the following benefits, which are specific to consulting firms, have been received:

- Unique value proposition for "report-weary" market
- Own innovation-specific consulting tool
- Increased opportunities for integrated strategy and implementation-support projects
- Higher productivity & profitability due to more efficient consulting performance
- Improved client participation and acceptance
- New sources of revenue from client adaptation and software.

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Intranet based system for a product innovation management process

YVES BOISSELIER

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Several factors in our society develop the need for collaborative solutions to be implemented between all types and all sizes of actors (from big to small, from very specialised to general) and accessible at any time, anywhere on any type of equipment. Development of innovative products and services to faster satisfy clients (even on a 1:1 approach) requires shortening the time to production and the time to market with greater distance between teams and increased number of technologies/fields of expertise. All that supply chain is more and more obliged to work in a project mode approach and even to marry competitors for the time of the project. Intranet based groupware or collaborative solutions to support the innovation phase of a product and even its production become more and more natural.

What is hiding behind these solutions? The most integrated or sophisticated collaborative system is not always the most appropriate one for your project. It is often better to start small and with common sense, to make sure your intranet collaborative solution will grow with your project and successfully support your product/service innovation process. Don't forget, the human factor remains the most important part when we talk about collaboration!

Think global Act local ... ... Think local Act global

No question that:

- Present acceleration of pace in developing products and services to final client is still increasing and will not slow down.

- More and more developments are becoming global:
  - Distances between actors is increasing,
  - Teams work with/on different time zones,
  - Different cultures and ways of thinking, procedures or processes have to find common areas of understanding and exchanges keeping in mind the satisfaction of the local needs of their end-clients,
  - Regulations also quickly change in content/procedure at national, federal, European or international levels or in spirit (e.g. precautionary principle). Products and companies have to adapt as well as to innovate. I have already been able to support an SME for whom new regulation is a catalyst for innovation they developed and implemented remotely with the support of simple intranet tools.

- Competences, skills and know-how are not any more within one single company. There is a necessity to regroup forces even between competitors with an acceptance of a kind of DMZ (demilitarised zone) where people can share info in a secured way (compared to the world outside the project, but also to the other partners).

- The whole supply chain is involved in the development process. Clients no more want a product; they are asking for an integrated service or a function (the product has to provide a function/service). This approach is spreading out along the whole chain from the end-users' request to the various sub-contractors on the way who are no more simple suppliers but have become technology partners. This approach has been strongly developed in a project mode where collaborative tools present high added-value.

- A job market with economic and time pressures comes back to smaller units (huge companies, even if they are still big, have had a tremendous decrease in number of employees). Small becomes more and more beautiful but is implemented in a networked and project approach. In parallel with the project mode, the explosion of independent actors or small units reveals the necessity for efficient collaborative ways. Another trend of the present job economy market is to look more and more for "off-shore" work forces. "Off-shore" also means remote teams, sliced projects, enhanced management systems for logistics, quality, engineering, marketing … and all the supply chain aspects.

The question is not whether or not to introduce an intranet/collaborative Internet (or telecom) based system, but how to do it in an efficient way to really support the innovation process and to fulfil expectations of the various target groups (actors from the whole chain: up- and down-stream, but also shareholders, end-users, employees, …). It is no longer a game of

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managing new product development; it is about managing cross-organizational innovation!

This presentation will focus on intranet based systems for product development involving multi types of actors' cooperation at various levels. I will not deal with intranet based systems for a purely technical solution in a product innovation process such as CAD (Computer Aided Design) systems for remote teams, which can "simply" be implemented in an intranet environment provided that you look carefully at the different procedures and "house-style" aspects.

Since 1995, I have been involved in implementing web and intranet based solutions for project management and innovative product development with remote teams and multi types of actors across Europe. The main product development activities I have been involved in, deal with innovative training materials and systems development, and indirectly with products linked to the agro-food sector.

To indicate the level of complexity in terms of innovation development in the training and life long learning services, we have been obliged to define a global context to all our training developments: the MAC approach, i.e. the Multi-Actor-Cooperation approach. Indeed, to be efficient in terms of Target groups identification, Needs analysis, Training expertise, Pedagogy innovation, Technology innovations, Training of trainers, but also for the involvement of actors such as Trade unions, Local authorities, Regional developers, Research centres, Professional bodies, …, you need to make all these actors able to contribute and to collaborate to the product development as a whole and in sub-groups despite remote locations and time zones.

Common sense …

Behind these two words, two key ideas are hiding:

- "Common sense" as being pragmatic;
- "Common sense" as being able to speak the same language, i.e. the same idea behind the same words.

When you set up a new environment, usually with people not used to working together and drift paradigms, you have to keep things concrete and much focused. Often very common or simple ways of doing things, defining procedures, implementing workflow and monitoring systems have the best impact when you base them on self-evident behaviour. This approach is even more important when you work in a group on an innovation product project where you have to concentrate innovation power to the content itself and not to disturb it with complex behaviour environment or rules.

As you are gathering people in a relatively long term project (over a few months, because when you add all people-months together you start having an important investment to valorize), you have to make sure that the same words mean the same to everyone in their own environment and language, and that the mission, aims, objectives and milestones are clearly and commonly understood and shared right from the beginning.

Keep it simple at first …

When you implement for the first time an intranet based system to support your collaborative innovation process, you must keep it simple. No need to go for a fully integrated system right from the beginning nor for over embedded functionality. If you try to embrace or integrate too many dimensions in the first place you may very quickly face a heavy and unmanageable system, ignored by the users. You certainly have to keep it open but not Intricate/Complex.

Please resist the temptation for over detailed input systems. You only have to ask for the needed data to know how to exploit these data and for which purpose. It is easier to identify a few simple tools at the beginning which are not integrated, but which are easy to understand and get used to for users. This approach may facilitate the definition of a better specification for a more integrated system once you have really identified the key components of your innovation product team. Even if part of your team has some advanced software tools enabling integration with other systems, it is better to start working in a simpler environment to make sure that all participants are in, rather than blocking the innovation and collaborative process. Waiting a little to observe the real needs will provide you with high level impact and quicker return of investment.

Do it the right way …

Can be summarised in one word: Quality. Whatever you name it, the easiest way to describe it is the TQM approach (Total Quality Management).

If anything is unclear or looks wrong, press the alarm button and discuss it! Don't wait until problems get worse! You have to set up an interactive alert collaborative sphere within the project. This quality approach works as well on the working group environment/rules as on the intranet based system. Your intranet based system should also support the TQM approach, with a clear support and a hotline system

and clear objectives of the collaborative system in line with the objectives of the project. If you don't define things, you don't get the expected results! and you cannot learn and progress from experience.

Doing it the right way also means defining rules, tasks, responsibilities and milestones as in a usual project. The technology based system does not replace management, it can only empower it. To reinforce the TQM approach, implementing or participating for the first time in a collaborative platform requires commitment from the organisation in the support of the paradigm shift it represents.

Prefer animation and facilitator to heavy administration ...

The implementation and management of a collaborative intranet system is not to add an extra layer of administration or driving goggled users. When we talk about users we gather in a virtual place, we are also talking about people and individuals. Therefore, the intranet based system has to be seen more as a participative and animating system rather than a simple administration tool.

I have always been astonished at the start of such kinds of group/project that we are in fact regrouping a lot of senior persons, used to managing people or having very good results in their own usual group. But when they arrive in a new group (even with very clear and specific objectives), they are lost and need to be accompanied to build an effective and efficient collaborative group. In that aspect, the collaborative intranet tool together with its animator has a strong cohesion role to play.

You don't need a technologically minded administrator of the collaborative platform; you really need an animator and a facilitator. This facilitator has to encourage participation and make sure that everybody in the group is involved and participates. Empowerment is a key word. You have to make sure that users of the collaborative platform will not see the technological tool but the collaborative result. This facilitator has to make sure that clear milestones and objectives are defined; that the steps and triggers are monitored for the partners; that users are re-active but also become pro-active.

As we have been talking about users and individuals, don't forget that the collaborative intranet platform remains only a virtual place. People also need to meet physically, in person. You can only make a virtual tool efficient if people know each other. It is therefore important to ensure that people meet at the beginning (for instance in a kick-off meeting defining all the common bases and training users together in using these collaborative tools) and regularly during the innovation project's life.

Win-win ...

In the MAC approach, we have to keep in mind that each project is a multi-actor project. You have individuals, groups and also different companies/organisations. The collaborative intranet tool is not only to administer the project. To be accepted and fruitful, each actor must find a positive and motivating result in using the tool. You have to get the users informed and aware of the benefits of sharing and updating information.

Using a third party intranet platform is also often a security for actors to share only the information that is needed. Information can then circulate more easily between partners and really become power. Knowledge and information mean power, but only when they are circulating, not when they are being hoarded.

Ubiquity and flexibility ...

"Anywhere, any time, any device". The first two dimensions are mandatory; the third one can come in a second phase depending on real user needs.

Key advantages of an intranet collaborative platform are to provide a central repository for the whole group which is accessible at any time, from any where depending on users' access rights. This enables asynchronous work in a coherent way. It also ensures always up-to-date and organised information which can be structured or proposed in different ways (files, calendars, vote, mailing lists, databases, templates, procedures, guides, etc.).

Because it is on the Web, every valuable actor in the project – internal and external – can work with you, connecting easily to the rest of your business infrastructure if authorized. You can also include some workflow patterns in your system which make sure that information is immediately and automatically dispatched to the right group of people depending on results or events.

You can also choose to push information rather than work only on a pull system waiting for people to fetch info. Then, messages can be sent directly to people when data is posted to the collaborative platform.

Depending on collaborative system, you can also create sub-groups of users with working places using different level access rights. Then you are sure that

users can access only the information they are entitle to (but don't structure the system in a too complex way!).

Empower users

Empowering users is not only avoiding heavy control systems, or making users pro-active or re-active and aware. Empowering users also means to suppress technology bottle-necks by allowing users to produce content and workflow directly.

When you can, eliminate as much as possible barriers of technology requests or green lights. You have to facilitate and ease the access to the collaborative tools and sharing of information. Don't transform users into techno-users or computing engineers. Users need to be able to naturally access the tools with their basic knowledge of office tools. Suppress also administrative barriers such as being obliged to request permission to use some collaborative tools. Users should be able and allowed to use the collaborative tools as they make a phone call.

Make users feel secure and confident

Several levels of trust, confidence, safety, security, etc. can be looked at.

Organisations and companies first want to make sure that sensitive information is not accessed by unwanted partners/competitors. Therefore, the solution to go for an external platform secures internal information provided that internet accesses are properly firewalled. In this type of solution, only deliberately shared information on the collaborative platform can be seen by authorised partners.

The choice of the external collaborative platform is also important in terms of security: level of encryption, number of access levels which can be defined, trustworthiness of third party provider, etc.

You also have to check the on-line availability delivered by the platform provider (clear and efficient SLA – Service Level Agreement). It is no use having a collaborative platform if your teams cannot access it.

From the users' point of view, they will feel secure and confident when:

- they are convinced that the collaborative system is not used to trace their working time;
- they can get cooperative support in an open and almost immediate way;
- they are not afraid of mis-using it (deleting things by errors, sending the information to the wrong recipients, store information at the wrong place, being lost in the sub-levels of the storage place, …).

All these aspects can easily be dealt with when you keep it simple, progressive and open with a quality approach.

Evolve with needs and people

Starting simple to reduce the learning curve and simplify it in immediately valuable and simple steps does not mean that the system you collaboratively use will end as a very sophisticated and efficient tool for all users. Once technological steps or paradigm shifts have been integrated by users, it is important to build upon it and to provide users with more power when needed.

The other key aspect of evolution is to build upon past experience and capitalise it. Some collaborative platforms enable you to separately manage several projects at the same time and also to create some template structure to simplify the management of new emerging projects. It is the role of the facilitator and the support team to improve the templates based on previous or current projects results.

A third party provider, why?

You can always decide to have your own collaborative platform managed internally to your organisation.

One big advantage of managing it internally is that you feel more secure because you own it and you can monitor everything and control access to it. But it may be the wrong approach, to do so you have to keep in mind that:

- You have to be sure of your own security system (firewall, procedures, DMZ, encryption systems, etc.). Maintaining such a system with a lot of external access requires a high level computing team and strict implementation of procedures.
- You don't always know at first which collaborative solution is the best for your organisation. You may want to test a few market solutions live beforehand.
- You will have a lot of things to learn at first use: technical/technological aspects if you want to implement a solution internally; and functional and organisational aspects with the users and the project teams. It is easier to learn the functional and

organisational aspects first by using a third party platform.

- You have different types of projects requiring various types of collaborative platforms. Third party solutions may be cost-effective and simpler to manage.

- Information technologies (hardware and software) change rapidly. Your first solution can become obsolete quickly. Then you have to cope with it for several years or make new investments. The same goes for maintenance costs; they can rise rapidly. Using a third party provider suppresses that risk.

- You may not want competitors to have access to your computing system with a certain level of rights. And reciprocally, competitors may not like to be hosted and depending on your systems. An external platform is often considered neutral.

- You may need to combine several collaborative tools, the collaborative and central repository platform, and also some phone conferencing, video conferencing or web conferencing tools. You can highly simplify your infrastructure by using a third party provider for a web conferencing tool that you can rent per hour/minute in the same way you make a phone call.

Cost effective ...

Apart from maintenance and obsolescence costs, you have to keep in mind that any system should be cost effective as well in quantitative and qualitative terms as in time, budget, comfort, security, development, knowledge and experience capitalisation.

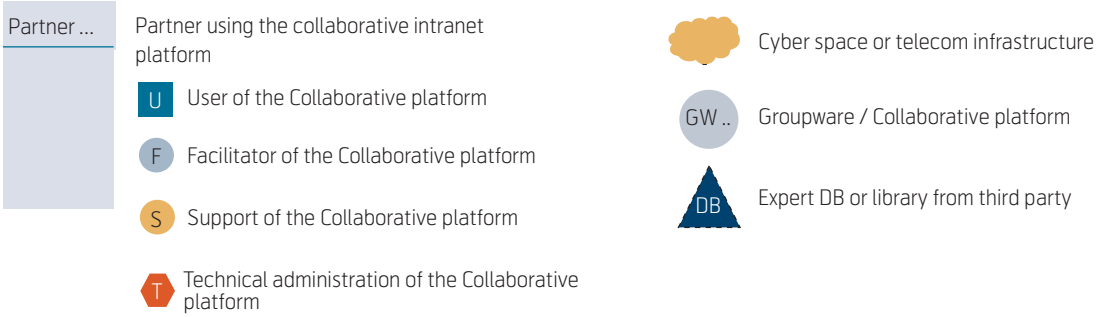
For instance, depending on your main working pattern, it will not be interesting to use collaborative tools to manage a small project of a few weeks' duration with collaborative tools if you only have that project or if it is only a low-budget, low- impact project. But, if the working model of your organisation if based on the project mode, if this small project is one amongst several others, if you have a quality approach to learn from past experience and if you already have access to (or want to go for) a collaborative platform, then it is really worth while using a collaborative tool even for the small sized projects.

Depending on the size of the project you manage, keep in mind the level of monitoring you want to implement. Administration or management time by user directly accountable to the collaborative tool should not exceed 10 % of the total project. It should normally amount to about 5 % once the learning step has been assimilated. If it goes close to 10 % or more, then you had better look to your procedures or infrastructure to simplify and improve them. These 10 % are largely covered by the positive input of the collaborative tools.

In the same spirit as you will go for a third party provider, the more you use the tool and the more you mutualise it on several projects, the higher profit and benefit your get. Therefore, in the first place or first trial for a collaborative tool, the time spent on facilitator and support jobs has to be considered as an investment and not benchmarked to the 10 % rule on the first project as mentioned above.

Depending on the size of the projects managed by the group or on its confidentiality/security, return on investment can be covered during the life of the project. Only in case you have very sensitive projects to manage, you may be obliged to invest in a high security platform of which security cost may be covered separately. But don't be paranoid, only very few projects require a top security level on a collaborative platform.

The digital work place you will use for the development of your innovative products can also very rapidly be extended to the rest of your teams or activities once users have had a first taste of it.



Symbols used in the figures

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In the same approach as encouraging the use of a third party provider, other services can also be used to help your organisation focus on its core business. There is no need to reinvent the wheel or to maintain systems or data-warehouses which can be better produced by external suppliers when it isn't internal know-how. More and more you can find expert databases or sectoral/professional databanks which are too expensive to develop internally. These databases are accessible in a B2B way on-demand and can be connected to collaborative tools or mutualised. Here again, the collaborative platform/project represents a good opportunity to test and learn these systems before buying them internally or before contracting them on the collaborative platform in a dedicated environment. Measurement of cost effectiveness should also take into consideration gain in terms of workflow.

Figure 1 represents a simple configuration to start with. One key collaborative platform is used as central repository system (GW1). You don't need to administer it; the technical administration is done centrally by the provider and shared across all the projects. You don't know the other projects managed on the provider's infrastructure, nor do the other projects/clients see you if you don't wish them to.

Depending on the level of security or services you want, you can find collaborative platforms starting from 0 euro per month to several hundreds euro per month per user.

For normal projects, I have been happily using some free collaborative platforms such as www.smartgroups.com. You can also use others provided by yahoo, hotmail, etc., but I prefer to use free tools which are more dedicated to the direct topic of collaborative work. In other cases, I have been using more sophisticated tools such as e-Room (www.documentum.com), not direct but through third party providers; or also tools which are becoming more and more common due to mass distribution such as Sharepoint by Microsoft (www.bcentral.com/products/sp/). In the latter case, here again you are not obliged to buy the software and implement the hardware platform, you can rent it from Microsoft itself or from third party suppliers.

The second collaborative tool (GW2) is not required or it can be used from time to time only. It includes tools such as phone-, video- or web-conferencing tools. This second set of groupware represents a very convenient complementary tool which can also be used independently to any collaborative platform. Getting actors used to remote collaboration by using this type of tools can be seen as a good way to identify preparatory work to support a paradigm change for collaborative context.

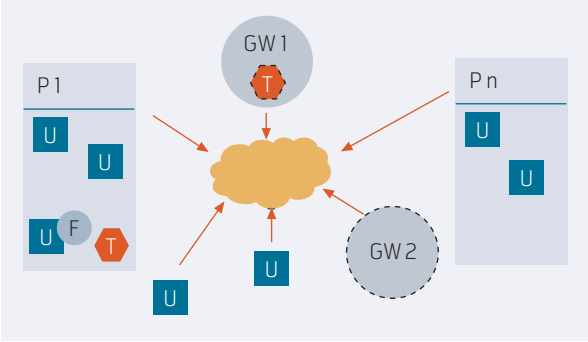

Figure 1 Discovery or simple project level

What is interesting with the second type of groupware tools, especially the web conferencing tools, is the possibility to support brainstorming activities and to share documents live.

In this first case, you can also keep the resources to a simple level. You can designate a kind of super-user which plays the roles of facilitator and support to other users at the same time. Once you get more used to this type of tool, or if the size of your project justifies it, you can separate the roles with dedicated Facilitator and Support resources.

Figure 2a is a more advanced configuration in which the main collaborative platform is still managed by a third party but with strong involvement from one of the partners. This situation can occur when a partner is already used to collaborative tools and is using third party services to simplify its computing infrastructure. The ASP mode (Application Service Providing) offered by third parties is developing and you can more and more easily find partners who rent dedicated space and applications to ASP providers. Then in a case of a collaborative innovation project with

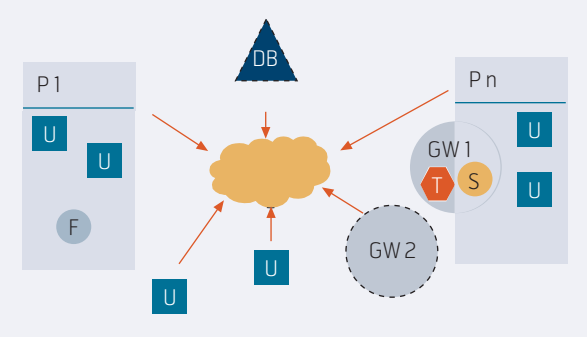

Figure 2a Enhanced collaborative level, still outsourced

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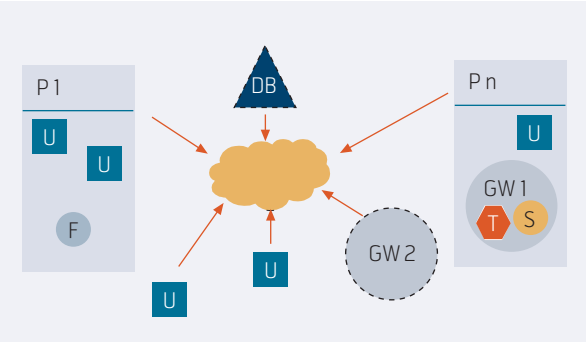

Figure 2b Enhancd collaborative level, privately hosted

external partners, that "Pn" actor can ask the ASP provider for a specific collaborative space for the project and keep consistency with the rest of its projects in a secure way.

The technological administration and infrastructure is still managed by the third party provider (in a cost effective way due to mutualisation of resources between several clients). The support resources are provided to all the partners by the "Pn" actor which is used to it and which makes the other partners benefit from its experience in collaborative work.

The facilitator can be anywhere (not especially in "Pn") provided that he/she feels confident in animating and monitoring a virtual collaborative place for product innovation development. It could also be recommended to implement a core group of facilitators when projects are big or when you need to face critical time response to users.

Collaborative environments can also include common access to databanks, libraries or services from providers of software used as a common basis by the partners. Biotech databanks, picture databases, structure and material definition libraries, catalogues, …

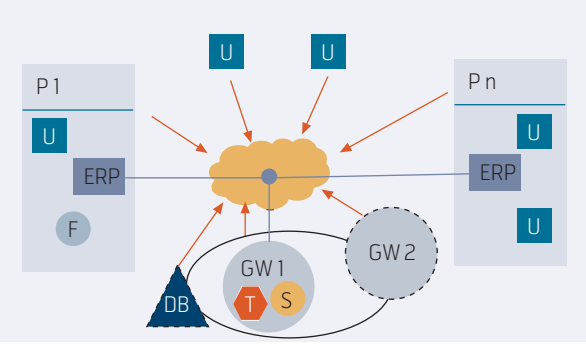

Figure 3 Advanced integrated collaborative level

can be accessed by all the partners with competitive conditions on the one hand and, on the other hand with improved quality results being sure that everyone is using the same references and definitions. The cost benefits of subscribing to these databanks are evident when you don't have specific technical data to your activity: you can focus on your core business and be sure that professional data are up-to-date without being obliged to maintain them.

Not every innovation project needs to access this type of database on a regular basis; it is the reason why it is represented with a dashed line.

Figure 2b represents nearly the same case as Figure 2a except that the main collaborative tool is completely technology managed by a partner. In this case, investment costs can rise very quickly in case you need a highly secure system for both the hosting and the other partners.

This system can remain affordable for small projects if you don't have to ensure a high level of security of access and services or when you are only working with teams belonging to the same organisation or group of organisations. In this case, the hosting partner owns the system and is independent of external resources.

In the case of simple collaborative projects where you don't need sophisticated tools, you can have the same configuration. Indeed, you can easily deploy it using basic functionalities such as FTP spaces (File Transfer Protocol) where your share files, email functionalities (mailing lists, shared calendar). In case you have resources to develop simple web pages, you can also implement a kind of voting and decision systems using forms in web pages. These three types of tools can easily be implemented in an intranet environment using login and passwords in a restricted area of your web server. So don't think that a collaborative tool is complex or expensive, it only depends on the size/ type of your project.

Figure 3 considers a group of partners using a common type of application such as an ERP system (Enterprise Requirement Planning). More and more groups use this type of applications in collaboration with other sub-contractors (technology partners) represented by the isolated "Us".

For partners already using an ERP system, it could be very efficient to enable access to the ERP database for the innovation product development team through the collaborative platform. In this case, the platform can be complex to implement. The group of partners can decide to use services of the ERP software editor/

supplier. Editors are developing more and more collaborative solutions because they want to get their business model migrating from selling their software to indefinitely renting it with a recurring income profile. Editors are migrating with various approaches and strategies. The proposed solutions can vary considerably in terms of successful impact depending on your own business profile.

Another difficult situation which is developing is that isolated users such as sub-contractors are faced with a complex environment. They work for different main contractors and they may be obliged to use various collaborative systems. If you are in the position to choose such a collaborative system or software application to be used in a collaborative environment, consider portability, compatibility and openness in line with what your collaborative partners are familiar with. It is not because the software editors/suppliers belong to the biggest ones that their solution will fit your needs.

In the same way as Figures 2a and 2b, you could derivate Figure 3 into Figures 4a and 4b.

Conclusion

To summarise: a few key points on using or implementing a collaborative platform for innovation product development. I would like to regroup them into four areas:

Dangers ...

- To want to run before knowing how to walk
- To go too complex when it is not needed
- To forget TQM approach
- To forget what is the object of the work
- To make a project for the sake of doing a project (A project is a set of people working together toward a shared goal, using shared tools and shared assumptions)
- To use collaborative tools only for project administrative project management (unless it includes a broader capitalisation schema)
- To only base group relations on virtual tools
- To forget fundamentals and get driven by automated procedures and measurements
- To underestimate the power and value of user support
- To absolutely want to own a system (renting or using a partner's solution may make you develop faster, cheaper, safer and better)
- To neglect security or to "bunkerise" it

Barriers to overcome ...

- Resistance to change and to paradigm shift
- Lack of support and clear commitment from the management level
- Information and knowledge retention. (In fact, the more collaborative the project is, the more likely that knowledge will emerge. Information increases its value only when it circulates)
- Technological gap between users, or users scared by technology environment
- Cross-enterprise collaboration paradigm (it was already hard in the past to collaborate between internal functions or teams, now we have to share and work closely with competitors)

Advantages ...

- The web makes managing collaborative projects more challenging than ever
- Accelerates deliverable development
- Increases the quality and value of the deliverables
- Reduces non-value added time
- Speeds Time to Market
- Provides a Single Place for Project-Specific Communications
- Manages and Controls Project Life Cycles
- It automatically compiles, records and traces all activity, charge, versions without requiring extra time
- Connects Virtual Team Members via the Web
- Facilitates Learning from Similar Projects
- If well implemented, a collaborative sphere will enable you to develop/enhance:
  - Rich feature selection and trade-offs – instead of ending up with a product people don't really want

- High value decision making and issue resolution – speeding up time to market (ensuring and increasing profits!)

- Product manufacturability across the supply chain – to build it in time and within budget (instead of wiping out all your profits for your fall line of products!)

A few selection criteria ...

- Before going on the market to look for a solution, check what you really need for the step you want to undertake. You may already have the necessary tools or environment to start with within your organisation or group of partners. The solution you will go for should be:

- Scalable

- Consistent with enterprise directions and standards

- Easy to deploy and administer

- Secure

- Appropriate SLA (internally or from your providers)

- Customizable

- Advanced set of functionalities you can deploy when needed (at the same pace as users learn):
  - Common work area
  - Version control (of any document)
  - Routing and workflow management
  - Discussions and forums
  - Tracking lists (progress monitoring)
  - Notification system
  - Decision tools and polls/questionnaires
  - Search tool
  - Admin tools: group, members, area
  - Customizable home page (for the group, sub-group, …)
  - Meta tags (to classify and search info)
  - People and resource profiling
  - Accessibility (any browser, any time, anywhere)

But above all recommendation don't forget that behind technology and a project (especially a collaborative one), in fact you have people and individuals.

Yves Boisselier (43) presents a multi-cultural and multi-sector advanced experience from his initial background (agro-food and agronomy engineer specialised in automation), his top executive MBA delivered by CPA-HEC in 2000 (Centre de Perfectionnement aux Affaires – HEC France) and his strong experience both on European Commission – international projects management and ICT. He is the director of ACTIF-Europe and member of the ISPIM – the International Society for Professional Innovation Management (www.ispim.org).

Yves Boisselier has for more than 15 years been managing projects at high level from inside and outside of the European Commission (to evaluate projects, monitor EU programmes, to transform ideas into EU supported projects and to assist transnational networks in their development and management). He also developed a 20+ years experience in ICT projects (Head of IT departments for some EU programmes, collaborative tools and ASP systems on Internet, audit and consultancy on IT services), and in company organisation services (including strategic alliances support and decision making processes based on Enterprizer tool by S3i, www.S3inter.net).

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Assessment and prioritization of IT infrastructure and systems development initiatives/projects in banking and financial services

ITZHAK MALACH AND JOSEPH BITRAN

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Assessment and prioritization of competing strategic and operational projects are daunting tasks, particularly in view to their impact on the availability and performance of the critical information systems (IS) and information technology (IT) infrastructure in banking and financial services enterprises.

Demand and expectations by customers and bank executives for innovative, instantly available services pose challenges for senior IS and IT executives to manage systems development and infrastructure upgrades while ensuring continuous operations and enhancements with no disruption. They must introduce the innovation and cost-savings expected by the top management team and the enterprise's strategic business units to ensure on-going business competitiveness and growth, and the achievement of their strategic goals.

Continuous upgrades and on-going enhancements of both the infrastructure and the information systems that support financial products and services are undertaken via a large number of development and enhancement projects. Given limited resources, the determination of which projects to fund in any given year can present daunting and potentially contentious sets of challenges, since not all projects could be or deserved to be funded and implemented.

Following a brief introduction, this paper provides an overview of the process leading to an innovative assessment and prioritization software solution, recently implemented at Bank Leumi and representing the critical success factors that applied to all projects and the performance standards and assessment rules expected by the stakeholders. Subsequently, the outcome is discussed and samples from the actual outputs are presented.

1 Introduction

In a world of information overload and rapidly changing competitive environment, enterprises regularly face an array of complex business, technology and policy issues. To be successful, enterprise executives have "to collaborate for competitive advantage; to promote a long term vision in a world of short term pressures; to benchmark their performance against the best; and to forge alliances with other businesses and with employees" [1]. Assessment and prioritization of competing strategic and operational technology projects are daunting tasks, particularly in view to their impact on the availability and performance of the critical information systems (IS) and information technology (IT) infrastructure.

However, the current state of IT projects across all industries is fraught with pitfalls. The following are some of the findings in the broad IT markets:

- "42 % of IT projects were abandoned before completion and roughly 50 % of all technology projects failed to meet chief executives' expectations" [2]
- "Only 34 % of application projects will come in on time and on budget. 51 % of the projects are challenged projects (projects that are either over time, over budget and/or lacking critical features)" [3]
- "10 % of IT projects were abandoned before completion. More than 15 % of IT projects were deemed failures after completion" [4]
- "Industry statistics indicate a 75 % project failure rate due to disappointing results or abandoned projects" [5]
- "90 % of project managers often underestimate project size and complexity. Nearly half (44 %) have cost overruns of 10 % to 40 %, and only 16 % consistently meet scheduled due dates" [6]

The near total dependence of banking and financial services enterprises on IT, for the delivery of products and services to customers, mandates efficient IT infrastructure and timely completion of IS projects. Demand and expectations by customers and enterprise executives for innovative, instantly available services, pose challenges for senior IT and IS executives to manage infrastructure upgrades and systems development while ensuring continuous operations and enhancements with no disruption.

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Clearly, "to drive success, executives must move away from ad-hoc setting of priorities and allocation of resources and towards a strategy that:

- Intelligently compares initiatives across a set of strategic imperatives and dimensions
- Prioritizes initiatives across the organization on an informed basis
- Effectively allocates resources to drive successful execution
- Provides information to better understand the on-going costs and progress of the efforts
- Gains better visibility into the value (financial and strategic) that investments deliver to the company". [7]

Thus, executives and managers must introduce the innovation and cost-savings expected by the top management team and the enterprise's strategic business units to ensure on-going business competitiveness and growth, and the achievement of their strategic goals. In the process, they have to assess the projects' contribution to the achievement of the enterprise's strategic goals and operational continuity, and select the projects that contribute most to the achievement of these goals, while adhering to strict budgetary guidelines and remaining impartial to pressures from stakeholders. Moreover, IS and IT executives must reach these decisions with speed and confidence, and with the full organizational support necessary for timely implementation.

2 The challenges

Bank Leumi, one of the largest banks and financial services group in Israel and the Middle East and the 126th largest bank in the world, has a significant state-of-the-art information technology infrastructure and a wide range of innovative banking and financial services products serving customers worldwide through some 300 branches and offices in 19 countries [8].

Continuous upgrades and on-going enhancements of both the infrastructure and the information systems that support the bank's products and services are undertaken via a large number of development and enhancement projects and a limited annual budget. Given such limited resources, determining which projects to fund in any given year has proven a daunting and potentially contentious set of challenges, since not all projects could be or deserved to be funded and implemented.

The 2003–2004 Assessment and Prioritization Project addressed the challenges facing the Bank's senior management and its IT and IS executives, by developing an expert solution that consisted of an objective assessment and prioritization system. Driven by Enterprizer [9], an innovative assessment and optimization software, this solution represented the critical success factors that applied to all projects and the performance standards and assessment rules expected by the stakeholders.

Success assessment and prioritization of existing projects and any new initiatives were heavily dependent upon multiple factors, such as:

- Demonstrable contribution to the achievement of strategic goals
- Demonstrable "level playing field" for assessment and prioritization
- Agreement on critical success factors with measurable and actionable attributes
- Systematic evaluation of risks and benefits – qualitative and quantitative
- Understanding and managing stakeholders' expectations
- "Depoliticising" the process and the assessment outcomes
- Providing optimal guidelines for funding and implementation.

3 The approach

Utilizing the solutions development suite of an advanced assessment and optimization software [10], a bank-specific solution was interactively developed in a workshop environment and in small group work sessions. The solution included a high-level representation of the various projects and initiatives that serve the bank's strategic business units. Each project/initiative was represented in three dimensions – Strategic, Economic/Business, and Realization.

Bank-specific "assessment rules" were then developed in a process that was prompted by the software, with all findings entered into a bank-specific "enterprise model". The key steps in the process included the following, for each dimension: (a) Definition of the critical success factors that serve the achievement of the bank's strategic goals and technology objectives; and (b) Definition of expectations of the involved parties and the various performance standards.

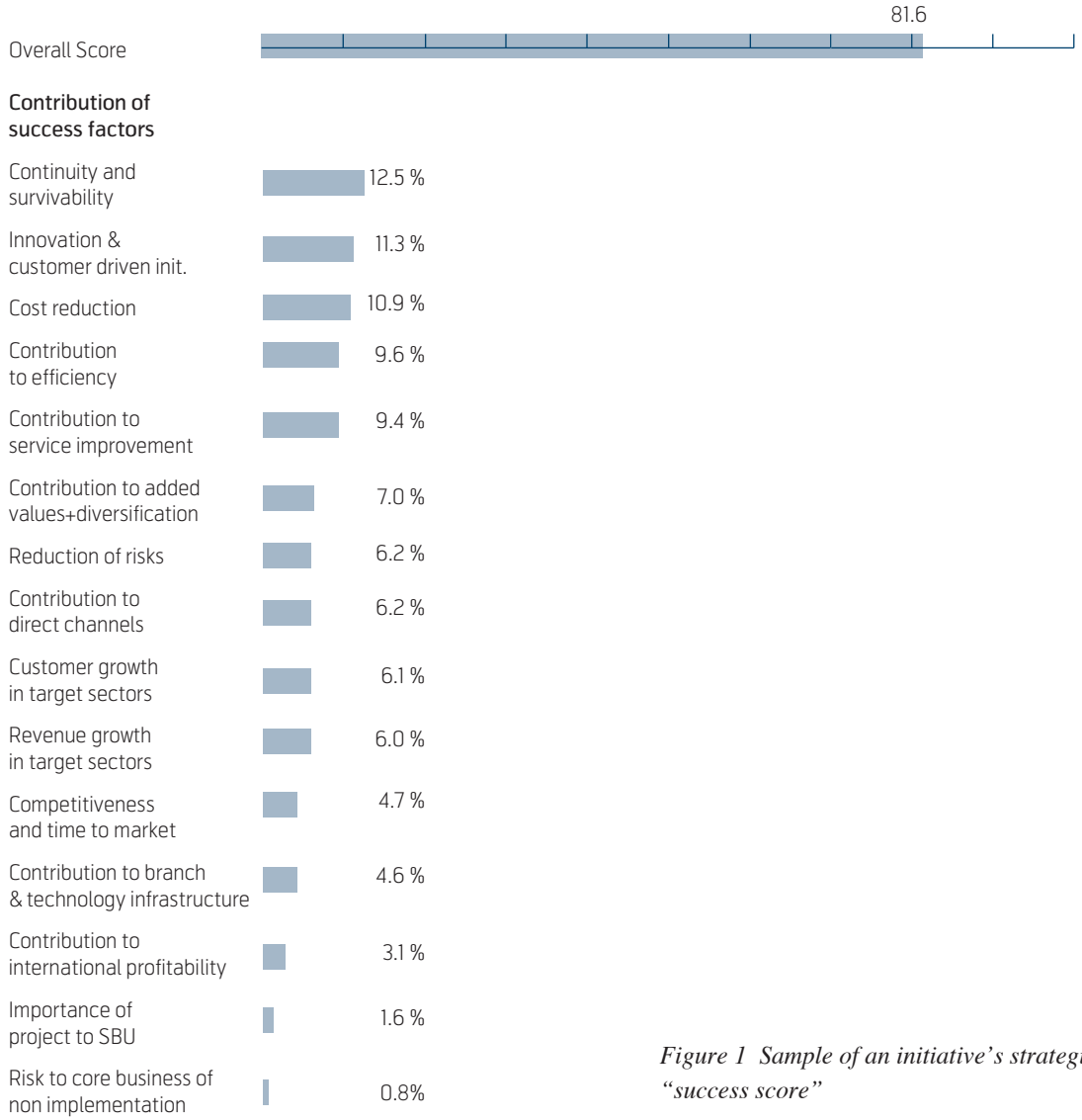

Figure 1 Sample of an initiative's strategic "success score"

Applying these bank-specific "assessment rules" for each dimension and utilizing the software's built-in generic computational and algorithmic capabilities, this solution then generated "success scores" (Figure 1) showing the contribution of the various success factors to the overall score. Success scores were generated by the software for individual projects/initiatives as well as comparative scores for all project portfolios (Figure 2), which were used for approval and funding decisions.

For low scoring projects and initiatives, the software provided optimized improvement "prescriptions" – recommendations that could be followed later to improve the ranking of the project in the overall list of comparative scores (Strategic, Economic/Business, and Realization). This approach ensured in-context, multi-parameter assessment that enabled systematic prioritization, and supported on-going improvements and implementation.

Central to this approach have been full participation in the project of a designated project coordinator and access to existing information on the projects/initiatives (under a strict confidentiality agreement) as well as solicitation of inputs from the key stakeholders via a combination of questionnaires and interviews.

4 The outcomes

The project has resulted in a software solution that consisted of a populated model representing the bank's various projects/initiatives (organized by strategic business units). The solution's software platform was configured for interactive presentations of individual and comparative "success scores", enabling goal setting and generation of optimized prescriptions for improvement and implementation. This solution has also provided the following:

- Understanding of the strategic, business/economic and realization success factors that impact each project and initiative

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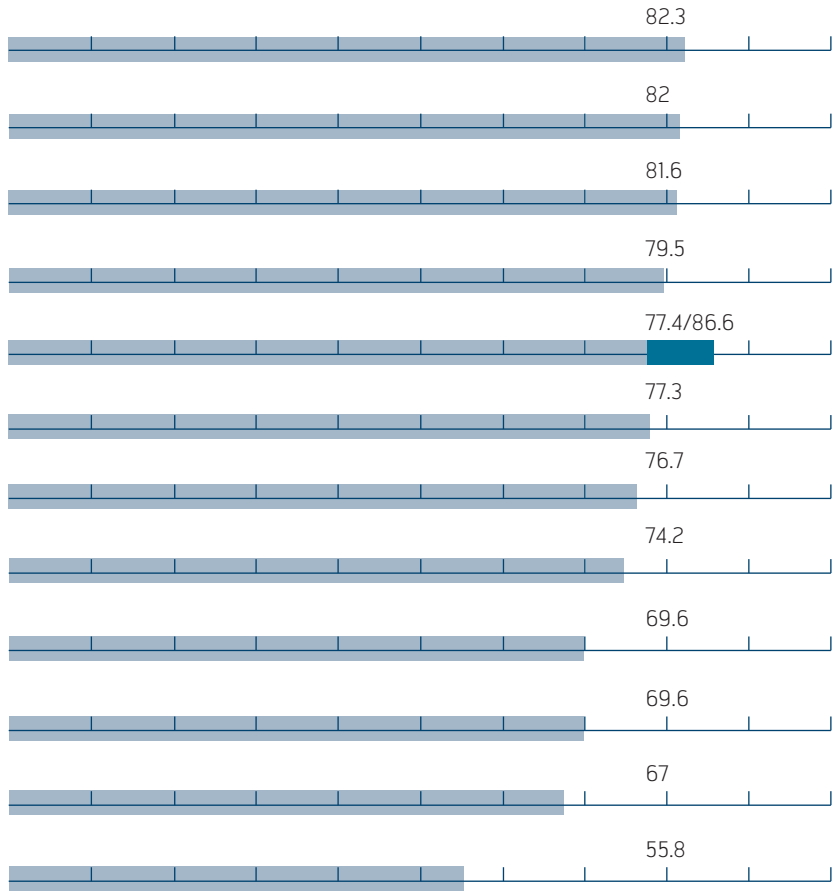

Figure 2 Comparative "success scores" (project names omitted)

- Individual and comparative "success scores" for projects and initiatives that supported prioritization and decisions for funding and implementation
- "What-if" analyses and generation of strategies for improvement and implementation, under various scenarios
- Built-in, user-selected optimization algorithms
- Multi-parameter assessment and comprehensive reporting (roll-up and drill-down) by project/initiative, business unit, and the overall enterprise
- Optimized prescriptions for performance improvement.

5 Conclusions

The growing complexity of IT and IS projects and the relating potential conflicts between stakeholders created the need for objective assessment and prioritization of strategic projects and initiatives. This need has been filled by an Enterprizer-driven software model that enables objective evaluation of all projects and initiatives and supports executive presentations to and effective funding and implementation decisions by senior management teams.

The populated model functions as a "strategic management system" for the portfolios of projects and initiatives included in it. It takes into account the various stakeholders that have interests in a project or initiative, and calculates "success scores", based upon enterprise-specific "assessment rules". Finally, the system offers optimized prescriptions for improvement and implementation planning.

This approach and the resulting software solution enable a truly multi-dimensional and multi-parameter assessment, thus simplifying complex problems and reducing them to manageable and easily understood "success scores". All valid stakeholders and success factors and the respective performance rules and standards are represented in the model, which must be at all times inclusive of all parameters that affect the enterprise.

The development and validation of this and any other Enterprizer solution is cumulative, evolutionary and

on-going, and has served the bank in both the 2003 and 2004 budget cycles. On-going updates and feedback from executives and managers enable the system to represent at any given time existing and potential assessment and prioritization challenges, while cumulatively representing the enterprise's collective knowledge and wisdom.

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Joseph Bitran has more than thirty years of international experience in executive management, marketing, training and simulation systems, including systems design, enterprise modeling concepts and applications, computer-based training, strategic planning and management systems, scenario planning, and facilitation consulting. He worked with a variety of financial, information, industrial, and governmental enterprises – in many cultures and countries, having lived and worked in the USA, Europe, southern Africa, and Israel. His passion is conceptual design and marketing of "expert solutions" that harness collective knowledge, intellligence and research, and that empower enterprise managers and consultants to assess, optimize, prioritize, and implement strategic initiatives with speed and confidence.

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Section 5 – At the Edge of Innovation

BJØRN ARE DAVIDSEN

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"The human race, to which so many of my readers belong, has been playing at children's games from the beginning, and will probably do it till the end, which is a nuisance for the few people who grow up. And one of the games to which it is most attached is called, 'keep tomorrow dark', and which is also named (by the rustics in Shropshire, I have no doubt) 'Cheat the Prophet'. The players listen very carefully and respectfully to all that the clever men have to say about what is to happen in the next generation. The players then wait until all the clever men are dead, and bury them nicely. Then they go and do something else. That is all. For a race of simple tastes, however, it is great fun."[1)]

It has long been notoriously difficult to tell the future. It has gone so far that some insist we should expect the unexpected. The only thing that is certain about the future is that there will be big surprises. The great science fiction writer Arthur C. Clarke, who also was an important figure in the development of the communication satellite, has made an interesting list of expected (some ideas have been around for thousands of years) and unexpected inventions[2)].

Expected (some achieved, some not)	Unexpected
Automobiles	X-rays
Flying machines	Nuclear Energy
Steam engines	Radio, TV
Submarines	Electronics
Spaceships	Photography
Telephones	Sound-recording
Robots	Quantum Mechanics
Death-rays	Relativity
Transmutation	Transistors
Artificial life	Masers; Lasers
Immortality	Superconductors; superfluids
Invisibility	Atomic clocks; Mössbauer Effect
Levitation	Determining composition of celestial bodies
Teleportation	Dating the past (Carbon 14, etc.)
Communication with the dead	Detecting invisible planets
Observing the past and the future	The Ionosphere; van Allen Belts

Let's for good measure add some for the IT and telecom business:

Expected successes (some achieved, some not)	Unexpected successes
ISDN[3)]	Personal computers
GSM/Mobile phones	Internet
ADSL	SMS
Video on demand	Antispam programs
Videophone[4)]	Integrating television shows and SMS
WAP	Integrating mobile and digital camera
MMS	IM and presence
UMTS	3D chatting
VoIP	eBay

1) *From the introduction to the novel The Napoleon of Notting Hill, 1904, by G.K. Chesterton.*

2) *Hazards of Prophecy – failures of imagination, from Profiles of the future, A.C. Clarke (pages 38–39), Pan books 1973.*

3) *Norway was one of the few countries that succeeded in making ISDN an innovation in the 1990s.*

4) *The videophone as a two-way television communication device was invented in Germany in the 1930s, by a system utilising 1000 telephone lines. Even if one can point at historical circumstances that hindered commercial deployment at the time, also later efforts to turn videophones into a mass consumer product have so far been futile.*

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Due to the predictability of surprises arriving, it is mandatory for any business to be prepared to meet the unexpected. This has again to do with a company's ways of working and perceiving the situation, as well as having a creative culture that may turn quickly around when needed. Sometimes it may mean changing the business, sometimes leaving it, sometimes combining the new and the old. The steam engine did not replace sailing ships in one year. In the 1800s many of the ships crossing the Atlantic utilised both sail and steam. However, those prepared eventually to leave sails altogether were better at meeting the future than those attempting to survive by improving sailing ships. Still, take care. The nuclear driven passenger ship never really took off. There is a message here, though it may be unexpected.

The paddle steamer 'Sirius' is shown in central port profile under steam and sail arriving off New York around 1840. From the Merseyside Marine Museum, Liverpool

For a presentation of the author, turn to page 2.

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Strategies for innovative project management – Improving enterprise performance

LARRY PULEO

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One of the largest issues facing executives in most organizations today is improving enterprise performance to move the company forward. This challenge exists due to the lack of a disciplined process for selecting strategic priorities and allocating resources to execute those priorities. This paper discusses two innovative approaches using project management to help leaders achieve project alignment and improve project performance across the enterprise. One approach is to employ portfolio project management to enable leaders to select and prioritize projects that align with an organization's strategic plan. The second approach discusses a new method of employing an integrated project management process within an organization that incorporates the strategic, developmental and tactical levels and describes the ownership and accountability of each level to ensure that projects are completed much more quickly, so that benefits to the organization are realized much sooner.

The paper is intended to help business leaders recognize the need to change their approach to the way change initiatives are selected and implemented within their organizations to achieve a major improvement in return on their business investments. Focusing on a select few top priorities that are aligned with the strategic plan and allocating the limited supply of key resources to implement those priorities is the way the company will move forward. Organizational leaders must face the truth and realize that their companies cannot survive with management and management systems that do not have a bias towards action. Utilizing an integrated project management process as an accountability system and execution model to make things happen and get required results positions executives to execute their strategic initiatives instead of just thinking and talking about them.

Project management is a learned discipline used to implement organizational initiatives efficiently and effectively. To do so, trained and experienced project managers employ specific methodologies, tools and techniques to lead teams toward a common goal. Significant portions of organizational activity are driven by projects, however in most organizations project management is not a core competency. Our years of experience working with corporations reveal that projects are not aligned with strategic plan initiatives, they are sanctioned in silos, there is no repeatable process in place, decision makers receive limited information regarding project status and therefore can not monitor whether projects should proceed or be terminated and project management training is non existent!

Most organizations have hundreds of projects underway and ad-hoc manners in which projects are started and resources are assigned to these initiatives. These projects are an organization's portfolio of business investments needed to move the company forward. The problem is most leaders don't realize they have a portfolio and worse, they don't do a good job of managing the portfolio. With so many possible business opportunities, picking the right projects for profitability can mean the difference in the success or failure of a business. To address these problems more organizations are pointing to project management methods and training to get better returns on business investments.

Portfolio project management, an integrated accountability model that focuses on alignment and execution to achieve results, is the method and strategy that business leaders must employ to break through performance walls. Portfolio project management is not a "techie" thing, but rather a business discipline needed to ensure successful execution of strategic business investments.

Dr. Eliyahu Goldratt, an Israeli physicist, is the person most credited with advancing the knowledge of the improvement methodology called Theory of Constraints (TOC). Dr. Goldratt states that there is a need for a new method of project management. Simply stated Dr. Goldratt indicates that 'if a project is initiated to have a positive effect on the organization, the sooner the project is completed; the sooner the organization receives the benefits. Therefore the constraint of any single project must be its cycle time, the time it takes for the project to complete. The constraint of the entire collection of projects of an organization, its portfolio, must be the combined cycle time of all of the projects." [1]

Described by Fortune Magazine as a "guru to industry", and by Business Week as a "genius", Goldratt

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suggests that organizations answer the following questions to develop better project management methods:

- What causes project cycle times to be longer than necessary?
- What can an organization do to drastically cut the cycle times of all projects?
- What role must the executive play in order to have an impact on these cycle times? [2]

"Projects are essential to the growth and survival of enterprises and organizations because they help deal with the changes in the business environment, competition and market needs," says David I. Cleland, a member of the Project Management Institute's Research Advisory Group and professor emeritus of the University of Pittsburgh's Department of Industrial Engineering, Pittsburgh, PA, USA. "Executives are responsible for managing change, and the best way to manage change is to have an organizational portfolio of projects." [3]

A two year study conducted from 1999 to 2001 by researchers, Dr. Janice Thomas, Dr. Connie Delisle and Kam Jugdev from Athabasca University (AU) revealed the need for project management training is critical and that project failure dominates all sectors and more than half of project managers have little or no formal training to deal with the complexities of today's projects leading to the "accidental project manager" phenomenon. Dr. Peter Carr, Acting Director for AU's Centre for Innovative Management, stated, "This study on project management constitutes another component in a growing research program line developed by AU to address the emerging knowledge requirements of managers in today's new economy." [4]

Seventy-five percent of target group respondents reported that projects consistently come in late and over budget across all sectors. Almost half of the respondents noted a lack of application of appropriate project management tools, techniques and methodologies. The survey also indicates that many company executives around the world continually underfund project management and view the role of project manager as an add-on to an employee's job description without appropriate training or compensation further supporting the "accidental project manager" phenomenon.

Organizations and their people are set up to fail

Most organizations have numerous projects underway with no formal project management process in place to effectively manage successful outcomes.

- "We strategize beautifully, we implement pathetically," say U.S. automobile executives. [5]
- "42 % of IT projects were abandoned before completion and roughly 50 % of all technology projects failed to meet chief executives' expectations," says the Wall Street Journal. [6]
- "Industry statistics indicate a 75 % project failure rate due to disappointing results or abandoned projects," says Standish Group International. [7]
- Robbins-Gioia Inc found that "90 % of project managers often underestimate project size and complexity. Nearly half (44 %) have cost overruns of 10 % to 40 %, and only 16 % consistently meet scheduled due dates." [8]

Years later and we still have not embraced project management as the discipline to hold people accountable and execute the implementation of strategic change initiatives. For many organizations, projects are the building blocks that provide the foundation for the organization's future viability. Projects emanate from the strategic plan, therefore to increase project success at the strategic level a process must be established to select and monitor projects and ensure projects and resources are in alignment with the strategic plan. This process is portfolio project management. At the developmental level the focus is on project throughput, repeatable processes and mentoring to improve the organization's and individual's project management capability and at this level the process is the project management office. At the tactical level it is all about individual project management leadership and execution and how the project team interacts with the complexities of the project, copes with the changes that inevitably occur and deals with the unexpected problems inherent in all change initiatives. For success to occur, synergy is required from all project participants at all levels. To drive success, executives must move away from ad-hoc setting of priorities and allocation of resources and towards a strategy that:

- Intelligently compares initiatives across a set of strategic imperatives and dimensions;
- Prioritizes initiatives across the organization on an informed basis;

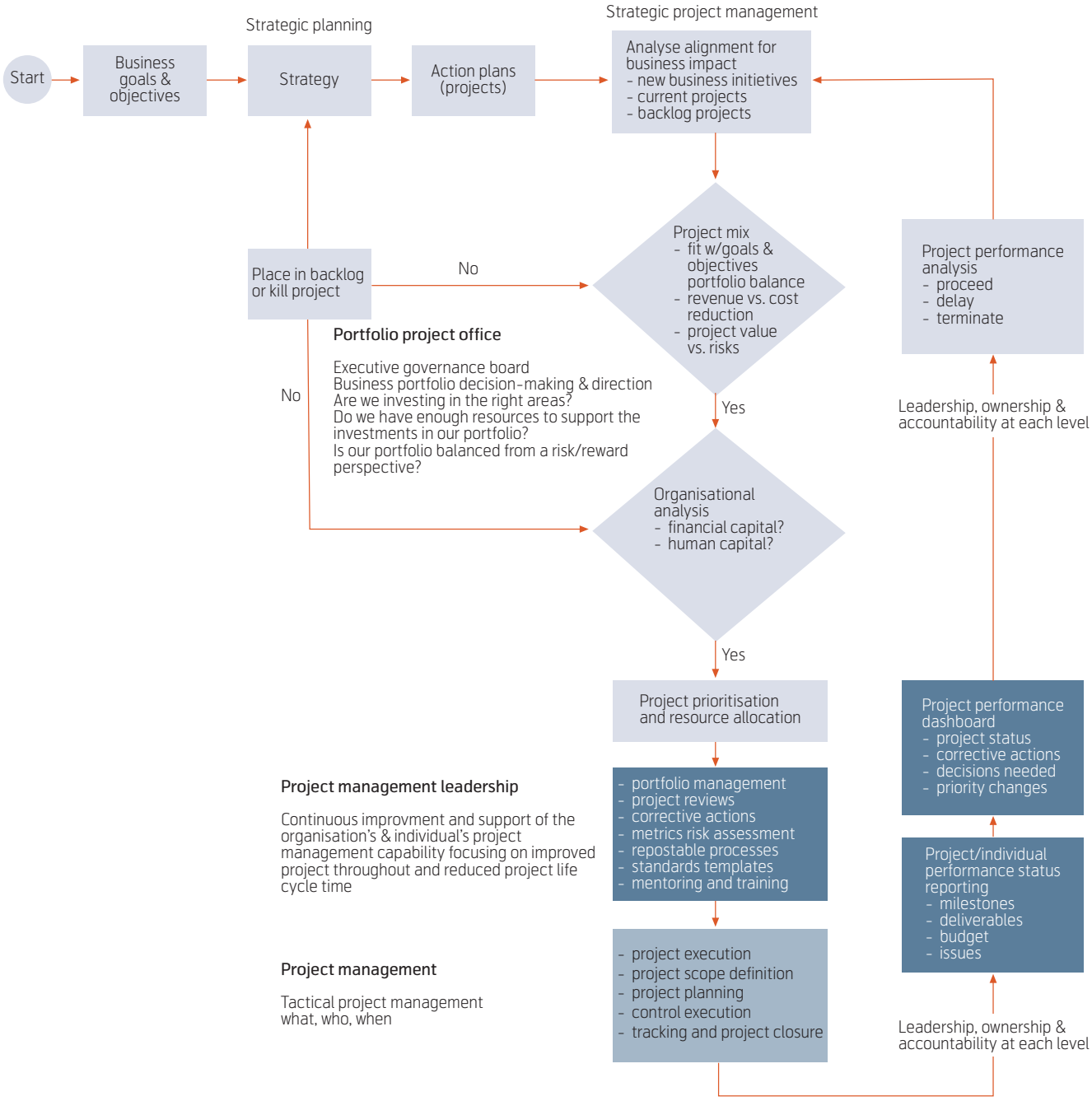

Figure 1 Integrated portfolio project management accountability model

- Effectively allocates resources to drive successful execution;
- Provides information to better understand the ongoing costs and progress of the efforts;
- Gains better visibility into the value (financial and strategic) that investments deliver to the company. [9]

Figure 1 illustrates an integrated portfolio project management accountability model.

Strategic level – Portfolio Project Management

Portfolio Project Management is the component of the accountability system that links strategic planning with execution processes to improve an organization's capability to implement change initiatives by enabling executive management to view existing and proposed projects as a portfolio of business investments to properly assess the allocation of limited resources, time and money by asking:

- Are we doing the right projects?
- Are we investing in the right business areas?
- Do we have enough resources to support the business investments in our portfolio?
- Is our portfolio balanced?

Benefits of Portfolio Project Management

Portfolio Project Management provides the following benefits

- It improves project planning and management processes.
- It positions the organization to make good financial decisions and meet their defined strategic and financial objectives.
- It limits risk.
- It establishes metrics for managing the portfolio and provides information on how investments are performing relative to strategic objectives.
- It focuses limited resources on projects that further the organization's most important goals.
- It keeps close tabs on a project's effectiveness and value throughout its life cycle.
- It discovers and eliminates duplicate projects.
- It recognizes earlier in the process those projects destined to come in over budget or schedule.

Developmental level – the Project Management Office

Organizations have departments for all operational functions such as accounting, human resources, information technology, and marketing, but few organizations have a centralized office to manage projects, yet all organizations have many projects underway. The project management office should be established for maintaining and supporting best practices for the project manager and providing the organization consistency in project performance. A project management office provides project delivery improvement by:

- Focusing on driving down project life cycle time;
- Flowing more projects through the organization;
- Choosing a better project mix to meet organizational goals.

At this level we ask:

- Are we capturing the right metrics and reporting the right information to ensure successful executive execution?
- Are we providing organizational and individual development and consistency for project management to accelerate project delivery?
- Do we have the right people and tools in place to ensure project success?
- Are we eliminating the 'accidental' project manager?

Functions of a PMO

A Project Management Office typically performs any or all of the following project management functions:

- Manage and monitor projects and portfolios;
- Establish and enforce project management processes, standards, metrics, templates and methodologies;
- Manage and develop project managers;
- Organize and manage the resource pool;
- Conduct project reviews;
- Provide project management training, consulting and mentoring.

Benefits of a Project Management Office

- Develops project management expertise as a core competency to execute projects more efficiently;
- Centralizes management and coordination of projects and resources;
- Formalizes project proposal and prioritization process eliminating wasted money/effort on cancelled projects;
- Formalizes and standardizes project management methods and tools;
- Reduces/mitigates risk of cost and schedule overruns.

Figure 2 identifies the project management functions typically performed by a project management office.

Figure 2 Project management functions typically performed by a project management office

Tactical – Project Management Leadership

A repeatable project management process provides a consistent framework to coordinate and communicate all project activities and at the tactical level provides an execution methodology to ensure projects are:

- Done well
- Delivering the desired results
- Within budget and on time

At this level we ask:

- Who is the project sponsor?
- Why are we doing this project?
- What are the project scope and stakeholder expectations?
- How will we know we are successful?

Benefits of Project Management Leadership

Employing a project management methodology introduces the following benefits at the individual project level:

- Creates ownership and accountability;
- Improves the organization's ability to deliver project requirements;
- Ensures appropriate review and coordination;
- Establishes a focal point for problem resolution and communication;
- Introduces consistency – a repeatable process.

In addition, at the tactical level, project management standards are followed to avoid common project problems such as:

- Poorly defined scope, objectives and/or customer expectations;
- Scope 'creep':
- Absence of project planning and control;
- Poor overall coordination of project activities;
- Lack of communication amongst all stakeholders;
- Lack of project sponsorship;
- Insufficient allocation of project resources;
- Poor estimation and/or unrealistic timeframes.

Figure 3 summarizes the phases and major activities that a project manager is accountable for in this leadership role.

Leading researchers and scholars view the twenty-first century as the age of project management, which is the means to ensure organizational effectiveness and competitiveness.

> *"In traditional organizations, project management processes are fragmented, invisible, unnamed, and unmanaged and inevitably exhibit poor performance."* [10]
>
> Michael Hammer

> *"Successful organizations are 'projectized' organizations, that is they run the business by project management."* [11]
>
> Tom Peters

Executive Management needs to engage people in project execution to obtain information, evaluate progress and learn from failures regarding strategic change initiatives. If they don't, they, like most projects, will fail.

The Gartner Group proposes, as a "Strategic Planning Assumption" for companies that through 2004, organizations that establish enterprise standards for project management, including a Project Office, with suitable governance, will experience half as many major project cost overruns, delays and cancellations as those that fail to do so. [12]

Figure 3 Phases and major activities for a project manager

Summary

Stop thinking and talking about change and focus on making change happen to improve your organization's performance! Project management is your ticket to that success. It will enable you to get on the road to quicker implementation of strategic initiatives and keep your company moving forward. Organizations that want to be successful need to establish an integrated project management process in order to execute strategic initiatives and enhance the organization's and individual's project management capability. This is not easy stuff, but if you are not spending your time reviewing and reevaluating your strategic initiatives and capabilities to deliver those initiatives, what are you spending your time on?

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- *Strategic plan alignment (portfolio project management)*
- *Establishing project management offices (PMO's)*
- *Providing project management leadership for corporate strategic initiatives*
- *Conducting project audits and assessments of organizations' project management capabilities*

Recent accomplishments include:

- *Project management leadership for a business process analysis initiative for a major city government resulting in recommended savings of $39.9 million ($35 million scheduled for implementation according to a press release from the Office of the Mayor).*
- *Providing executive leadership for a performance turnaround initiative for a regional insurance company that contributed to reversing a $40 million loss to an $8 million profit in one year.*

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In search of corporate renewal — Focus on corporate venturing

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This study defines a framework which can help established corporations use corporate venturing as an engine of corporate renewal by focusing on strategic management of the corporate context and innovation and corporate venturing within it. It identifies the layers of management processes needed to sustain continuous corporate renewal (strategy, innovation, corporate venturing) and the linking processes (learning, leveraging, nesting) needed to intermediate between the different contexts and management processes. By doing so it constructs a framework which can help established companies avoid the "innovator's dilemma".

Abstract

In today's rapidly changing business environment established companies venture to sustain growth and corporate renewal. But developing new business from scratch takes time. Thus companies find it hard to justify investments in venturing: when measured by financial terms only, the track record of corporate venturing is poor.

This study drafts a theoretical framework which may help companies have a clear-eyed view of their venturing activities as a part of the corporate context. By doing so it may help them focus on elements essential for improving the odds for achieving corporate renewal through venturing.

The framework is verified by using data from three companies that are/have been involved in venturing. This study concludes that the commitment in venturing needs to be strategic. It notes that ventures can generate corporate renewal even when they are not commercial successes. It identifies learning by doing, knowledge transfer, relocating personnel, context transfer, generating new business and generating new ideas as the mechanisms through which the ventures helped sustain corporate renewal.

Scope of this study

The ability for corporate renewal has become an important determinant of success as many successful companies have failed to respond to change and therefore lost their position in the marketplace (Brown & Eisenhardt, 1998; Christensen, 1997; D'Aveni, 1994; Hamel, 2000; Tidd et al., 2001; Tushman & O'Reilly, 1997).

Large enterprises engage in corporate venturing for various reasons, corporate renewal being one of them (Backholm, 1999; Burgelman, 1988; Chesbrough, 2002; Chesbrough & Socolof, 2000; Dickman et al., 2002; Tidd & Taurins, 1999). Yet a research gap exists in identifying the mechanisms through which corporate venturing can help sustain corporate renewal.

This study constructs a framework of strategic corporate venturing which seeks to provide an answer to the following question:

> *What is the role of corporate venturing in sustaining corporate renewal?*

Its aim is to help established companies to better justify investments in corporate venturing in the short, medium and long terms.

Methodology

This study follows the constructive research process (Kasanen et al., 1991). Due to the scope of this study, corporate venturing in the corporate context, which is a holistic, complex, real-life phenomenon which cannot be separated from its context (Yin, 1994, p. 3), the case study method was chosen as a method for verifying the framework. The three case companies were large established corporations that were or had been engaged in venturing. The structure of this study is illustrated in Figure 1.

Key concepts

This study builds on the following key concepts:

- *Strategy* is an attempt to take into account both deliberate and emergent strategies (Mintzberg, 1987) for guiding the course of action.
- *Corporate renewal* is defined as a *series of actions* leading to a change in the strategic direction of a company (Meschi & Cremer, 1999).
- *Innovation* is seen as a source of corporate renewal.

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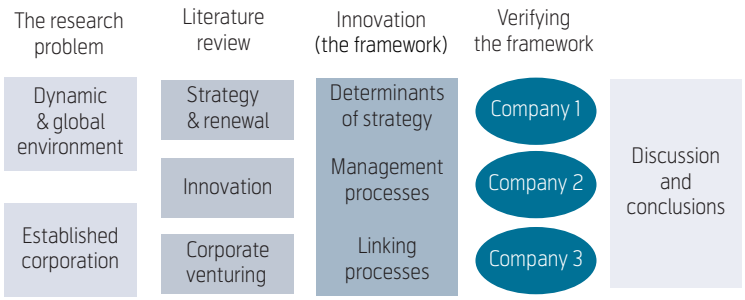

Figure 1 This study proceeds through a thorough literature review based on which a framework of strategic corporate venturing is constructed. That framework is then verified by using data from three established companies that are/have been engaged in venturing

- *Corporate venturing* is seen as a strategic new business development function focusing on corporate renewal.

Figure 2 illustrates the relation between these key concepts. Corporate strategy guides the management of innovation and corporate venturing. Renewal in turn originates in innovation, which corporate venturing can help to sustain.

Components of the framework

Instead of viewing corporate renewal as a top-down effort (Baden-Fuller & Stopford, 1994) this study recognizes the need for corporate renewal as a continuous action taking place in the strategic context of a corporation (Bartlett & Ghoshal, 1995; Beer & Eisenstat, 1990; Eisenhardt & Brown, 2000; Mezias & Glynn, 1993). It concludes that the following factors influence a company's ability to sustain corporate renewal through corporate venturing:

- *Determinants of strategy* define an established company's current competitive position.
- *Dimensions of innovation* are essential for determining the renewal challenge and the business potential related to a given innovation.
- *Management processes* are needed to align the management of different contexts and to ensure continuous corporate renewal.
- *Linking processes* are needed to intermediate between the management processes and different contexts.

Determinants of strategy

Determinants of strategy include the issues influencing corporate context and components of innovation.

Corporate context is the foundation on which a company's innovative capability rests. It is defined by the following factors:

- *Industry:* Industries differ in their rate of development. This has an effect on the sources of competitive advantage and profitability (Christiansen, 2000; McGahan & Porter, 1999; Meschi & Cremer, 1999; Tapscott et al., 2000; Tidd, 1997).
- *Location:* Today most large companies operate in global markets. Even though new technologies have enabled rapid diffusion of information location still matters (Furman et al., 2000; Porter & Stern, 2001; Tidd et al., 2001).
- *Resources:* Instead of physical resources, competition is today about people (Barney & Arikan, 2001; Bartlett & Ghoshal, 2002; Hamel & Prahalad, 1993; Tidd et al., 2001).

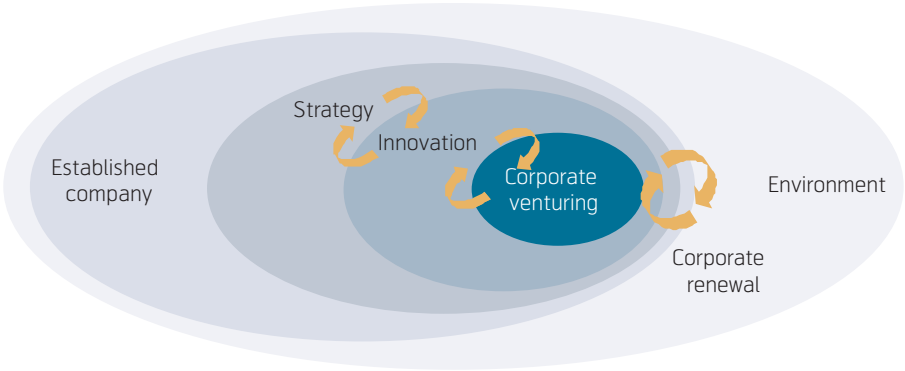

Figure 2 This study observes an established company operating in a dynamic and global environment. Strategic context relates to innovation – in achieving which corporate venturing may help

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- *Knowledge* is more fugitive than physical assets, it can be applied in different product categories and it is organizationally embedded (Drucker, 1985; Martin & Eisenhardt, 2001; Nahapiet & Ghoshal, 1999; Nonaka & Takeuchi, 1995).

- *Structure and culture* are history dependent. They influence how a company perceives its environment and may limit its view of new opportunities (Abernathy & Utterback, 1978; Bartlett & Ghoshal, 1994; Calish, 1984; Ghoshal, 2000; Goleman et al., 2001; Johnson & Scholes, 1999).

The importance of corporate context roots in tacitness of knowledge (Nonaka & Takeuchi, 1995) and the fact that it is organizationally embedded (Martin & Eisenhardt, 2001). This study suggests differentiating between a company's *innovation contexts* and positioning *venturing context* as a home for projects that involve greater risk.

Components of innovation: This study suggests that by dividing innovation into its components a company can better identify the needed changes in the corporate context.

- *Market* orientation is found to be an important factor underlying the success of a company (Christensen, 1997; Dougherty et al., 2001; Ghoshal, 2000; Narver & Slater, 1990; Slater & Narver, 1995; Tidd et al., 2001; Tushman & O'Reilly, 1997; Von Hippel, 1988).

- *Technologies* relate to products or the processes through which they are created and are important sources of competitive advantages (Bower & Christensen, 1995; Christensen et al., 2002; Tidd et al., 2001).

- *Business model* describes the process through which technologies are brought to markets and can have a fundamental effect on the success of a company (Hamel, 2000; Magretta, 2002; Sandberg, 2002; Von Hippel, 1988).

The dimensions of innovation

In addition to components of innovation, this study defines novelty and complexity as dimensions that influence a company's ability to benefit from an innovation.

- *Novelty* has been recognized as an important dimension of innovation (Christensen, 1997; Damanpour, 1991; Henderson & Clark, 1990; Norling & Statz, 1998; Tidd et al., 2001). It has been conceptualized as incremental (continuous, evolutionary, linear) innovation or as discontinuous (radical, disruptive, non-linear, revolutionary).

- *Complexity* of innovation has been analyzed by dividing innovations into autonomous and systemic (Chesbrough & Teece, 2002) or into architectural and modular (component) innovation (Christensen 1992a, 1992b; Galunic & Eisenhardt, 2001; Henderson & Clark, 1990; Tidd, 1997). Competitive advantages that involve more complex systems are likely to be more sustainable and have greater business potential.

This study suggests assessing the novelty of each component of innovation to determine the renewal challenge related to it and assessing the complexity to determine the business potential related to it (Kola-Nyström, 2003). It notes that novelty is always relative to the corporate context, that is a company's existing position and competencies.

Management processes

The management processes of interest in this study relate to managing the corporate context and the innovation and corporate venturing contexts within it.

Strategy processes as seen in this study are the *processes through which corporate renewal takes place*. In the end, a company's ability to sustain corporate renewal is dependent on its ability to manage the corporate context through these processes:

- *Strategy formulation* comprises of *purposeful* attempts to ensure company success in the long term (Andrews, 1980; Brown & Eisenhardt, 1998; Burgelman, 1994; Burgelman & Doz, 2001; Dranikoff et al., 2002; Eisenhardt, 1999; Eisenhardt & Brown, 1998; Grove & Burgelman, 1996; Johnson & Scholes, 1999; Martin & Eisenhardt, 2001; Rumelt, 1980; Slywotzky & Morrison, 2000).

- *Strategy formation* is concerned with *autonomous* actions taking place as a response to changing conditions (Burgelman, 1983a; Burgelman, 1994; Grove & Burgelman, 1996; Mintzberg, 1987; Quinn & Voyer, 1994).

- *Strategy implementation* is concerned with building organizational structures, systems and culture to achieve desired results (Andrews, 1980; Bessant & Francis, 1999; Ghoshal & Bartlett, 1996; Hrebiniak & Joyce, 2001; Johnson & Scholes, 1999; Martin & Eisenhardt, 2001; Quinn & Voyer, 1994).

The process of innovation is essentially about managing the innovation context of a company, about

choosing strategies for innovation and selecting the context in which different ideas are developed further.

The process of corporate venturing involves managing the portfolio of ventures and managing the individual ventures (both external and internal). It involves *portfolio management* (Block & MacMillan, 1993; Coveney et al., 2002; MacMillan & George, 1985; Mason & Rohner, 2002; Simon & Houghton, 1999), *management of internal ventures* (Block, 1982; Block & MacMillan, 1993; Burgelman, 1983a, 1983b, 1984; Day et al., 2001; MacMillan & George, 1985; Simon & Houghton, 1999; Zajac et al., 1991) and *management of external ventures* (Chesbrough, 2002; Chesbrough & Socolof, 2000; Markman et al., 2001; Keil, 2002).

Linking processes

Linking processes are needed to intermediate between the management processes and different contexts.

- *Learning:* In the context of corporate venturing the process of learning aims at systematic learning about and exploration of changing markets, technologies, business models or about venturing itself (Block, 1982; Burgelman, 1983a, 1983b, 1984; Garud & Van de Ven, 1992; Hamel, 2000; Keil, 2002; Sinkula, 1994; Tidd, 1997; Tidd & Taurins, 1999).

- *Leveraging* is about exploitation, making most of the resources and capabilities a company already has (Keil, 2002; Sinkula, 1994; Tidd & Taurins, 1999).

- *Nesting* essentially means building the ability to manage timing and resource allocation within the processes of innovation and corporate venturing (McGrath & MacMillan, 2000).

The framework

The framework of strategic corporate venturing (Figure 3) involves an established corporation and the dynamic and global environment in which it operates. It suggests that the role of corporate venturing in sustaining corporate renewal relates to the following issues:

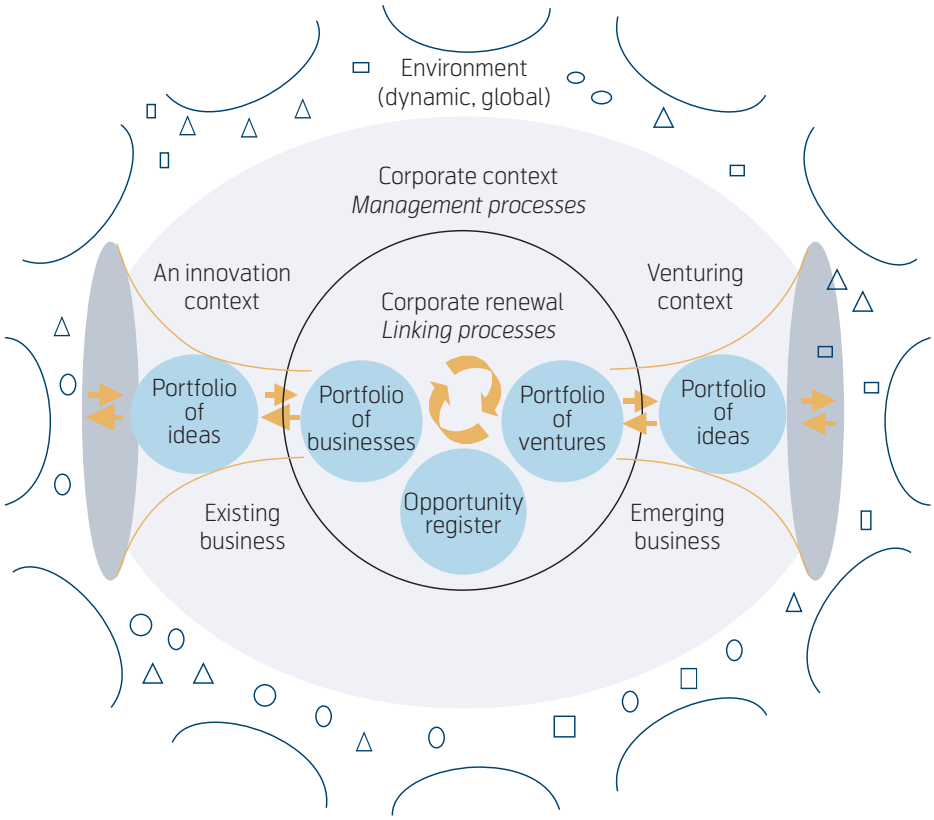

Figure 3 The framework of corporate venturing describes an established company operating in a dynamic and global environment. In order to generate corporate renewal through corporate venturing companies need to focus on corporate context, management processes *taking place within it and the* linking processes *that intermediate between different contexts and management processes*

- Venturing needs to be rooted in corporate strategy and managed as a part of the corporate context, not separately from it. An ability to benefit from venturing as a source of corporate renewal relates to the *corporate context* and the *management processes* that take place within it.

- By balancing freedom and support companies can enhance their view of opportunities (*portfolios of ideas* are different in existing and emerging businesses). The systematic management of opportunities (*opportunity register*) is an important part of venturing.

- In order to respond to the changing environment companies need to keep assessing the *portfolio of ventures* and *portfolio of businesses*, to be able to choose the right timing for a venture start or exit.

- In addition to management processes companies need to form efficient *linking processes* that intermediate between different contexts and management processes.

This study suggests that when rooted in corporate strategy and actively managed as a part of the corporate context, corporate venturing can act as a source of continuous corporate renewal and help companies respond to the challenges posed by today's business environment.

Verifying the framework

The companies included in this study were large companies involved in venturing. They represented two industries: machinery (1 company) and telecommunications (2 companies). To describe the role of sustaining corporate renewal through corporate venturing, the interviews were not limited to the venturing organization but also involved people from the existing business. Table 1 summarizes the interviewees by the company and organizational position.

In order to verify the framework this study focused on the following issues:

- *Company characteristics* and the change related to each characteristic provide background information of the companies.

- *The role of venturing* in the company describes the primary reasons for engaging in venturing.

- *The ventures:* This study observed eight ventures aiming at corporate renewal in order to find the renewal potential of a venture (*how did the ventures differ from the existing business in terms of market, technology and business model?*) and the renewal effect and mechanism (*if the ventures generated corporate renewal, how did they do it?*).

Company characteristics

All the companies involved in this study were large established companies which have a strong position in their respective industries. Table 2 and Table 3 summarize the characteristics of the corporate context and the components of innovation in each case company.

Table 4 and Table 5 summarize the challenge of corporate renewal related to the components of innovation and the resulting need for change in the corporate context.

The role of venturing in each company

The companies were venturing for very different reasons which are summarized in Table 6.

The ventures

Company 1 has a distributed venturing organization. Since the ventures organized as a part of the corporate venturing division were not aiming at corporate renewal, this study observed two ventures organized as a part of different business units (ventures 1 and 2). The rest of the ventures (ventures 3–8) were from

Position / Company	Company 1	Company 2	Company 3
SVP/VP corporate management		2	1
Project engineer corporate management		1	
SVP/VP/director existing business	5	2	2
SVP/VP/director venturing (portfolio)	3	1	1
Director/manager (venturing)	6		
Program manager (existing business)	1	1	
All	15	7	4

Table 1 Interviewees by company and function

Characteristics	Company 1	Company 2	Company 3
Industry	Machinery (paper production & mining, emerging environmental industries)	Telecommunications	Telecommunications
Location • R&D • Operations	 Majority in Finland Global	 International Global	 Finland & Sweden International
Resources & knowledge	Strong competencies in managing complex technologies and large volumes	Strong competencies in managing complex technologies in large scale	Strong competencies in integrating complex systems
Structure and culture	Technology lead 2 global divisions with different focus	Technology lead 2 two global divisions with shared focus	Technology lead Strong country organizations

Table 2 The characteristics of the corporate context in the case companies

Characteristics	Company 1	Company 2	Company 3
Market	Paper and pulp producers Mines	Mobile operators Enterprises	Consumers SME Large companies
Technology	Paper and pulp production Minerals processing	Mobile communications IT	Telecommunications IT
Business model	Product	Product	Service

Table 3 The characteristics of the components of innovation in the case companies

company 2 and were/had been organized as a part of the venturing division.

Ventures were born as a response to an opportunity related to the existing business or as a result of a purposeful attempt to explore entirely new opportunities. Table 7 summarizes the novelty of the components of innovation related to each venture.

Technology: All ventures involved new technology development and related complexity but technology itself was not seen as a great challenge.

> *"The process involves new characteristics, but the principles are the same."* Project Manager (venture 1), Company 1

Characteristics	Company 1	Company 2	Company 3
Market	Focus on true understanding of customer needs	Focus increasingly on end-user acceptance	Focus on "decoding" market complexity
Technology	From large scale, long term projects to small and rapid	From standardization driven to de-facto standardization	Outsourcing as much as possible
Business model	Finding a profitable service business model	Creating new business models around new technologies	Finding business models that enable profitable cooperation

Table 4 Renewal challenge related to the components of innovation

Characteristics	Company 1	Company 2	Company 3
Industry	Capitalizing on customer's willingness to outsource their service and maintenance	Capitalizing on convergence of mobile communications and internet	Capitalizing on convergence of mobile communications and internet
Location	Moving from global product development to local services development	Benefiting from global sources of information	Capitalizing on global technology development in local markets
Resources & knowledge	Leveraging the existing process understanding and using IT to build services around it	Leveraging existing knowledge and developing new capabilities in IT	Focus only on activities that add value for the end user
Structure and culture	Transferring itself from a machinery company to a service provider	Moving beyond the existing market (mobile operators)	Moving from technology orientation to market orientation

Table 5 Needed change in the corporate context

Characteristics	Company 1	Company 2	Company 3
History of venturing	Venturing division home of heterogenic businesses that do not fit the mainstream	At the end of 1990s "all flowers were allowed to bloom"	Involved in venturing at the end of 1990s, venturing ended when economy worsened
Venturing today	The scope of venturing is being defined	Rooted in corporate strategy and managed systematically	Networking
Primary motive for venturing today	Increasing value of the ventures	Renewal	Monitoring
Venturing modes	Venturing division Venturing in business units Investments in VC funds	Internal venturing Internal fund (External fund)	Maintaining the network

Table 6 The role of corporate venturing in each company

"HW, SW and architecture were challenging, but that kind of complexity was nothing new." Venture manager (venture 3), Company 2

"The technology was new, but it was not a great risk." Venture manager (venture 4), Company 2

Market: In the case of Company 1 (ventures 1 & 2) the market challenges related to the non-existing industry structure: complex legislation and the lack of "natural" customer. For Company 2 ventures the difficulties related to measuring a market that did not exist with poor tools (ventures 3, 6, 8), the difficulty of moving into a new market in general (ventures 4, 5, 6, 7) and resistance from the part of the existing business (ventures 4, 5).

"Environmental business is not a normal business. The regulations and subsidies make it a difficult area." VP, (venture 2), Company 1

"The decision to exit the venture to the existing business closed everything but the operator market." Venture Manager (venture 5), Company 2

"We could bring even more radical solutions to this market if we were established in it." Venture Manager (venture 6), Company 2

	Related to existing business			New/undefined		
	Technology	Market	Business model	Technology	Market	Business model
Venture 1	X				X	?
Venture 2	X				X	?
Venture 3				X	X	X
Venture 4				X	X*	X
Venture 5			X	X	X*	
Venture 6			?	X	X	
Venture 7		X**	X**	X		
Venture 8				X	X	X

Table 7 Novelty of the venture's technology, market and business model in relation to the existing business (indicates changes in the original idea during venturing, ** indicates that the ventures are still ongoing)*

Business model was found to be the most difficult dimension. For company 1 (ventures 1 & 2) the business model difficulties relate to market complexity. As the rules of the market are undefined it is hard to determine who will make money. As company 2's business model has proven to be extremely efficient the ventures found it hard to make changes in it. That was partly because of the resistance from the existing business (ventures 4 & 5) and partly because of resource limitations (ventures 6 & 7).

> *"When we talk about environmental issues they need to be translated to monetary terms. Otherwise the message does not get through."* VP, Company 1 (venture 2)

> *"The business model caused problems because management perceived that it would lead to a conflict with existing customers (mobile operators)."* Venture Manager (venture 4), Company 2

> *"The business model is chosen based on our limited possibilities to differ from the mainstream."* Venture Manager (venture 6), Company 2

Renewal effect

The ventures studied as a part of this study were all aiming at corporate renewal. The ventures were purposefully different (both successful and "failed"). Some of the ventures were still ongoing. Table 8 summarizes the venture exit (actual or planned) which is later used to analyze the renewal effect.

In terms of corporate renewal venture outcome was not limiting a venture's ability to generate corporate renewal. In fact the terminated ventures seemed to have a renewal effect or the potential to generate renewal if attention was/will be paid to relocating people and leveraging knowledge gained in the course of the venture. This study identified six potential renewal mechanisms that are summarized in Table 9.

Learning by doing took place in all eight ventures. Venturing was seen as an efficient method to "exit from PowerPoint".

> *"We would not have learned the true mechanisms of the market and technology if we hadn't actually developed the solution."* Venture manager (Venture 3), Company 2

Knowledge transfer from existing business to ventures and from ventures to existing business was intense in most cases. The ventures sought feedback from the existing business which in turn was interested in the development that took place in the ventures.

Venture 3 was terminated before commercialization. Attention was paid to relocating the people in the

Project	Exit (actual or planned*)
Venture 1	To be defined
Venture 2	To be defined
Venture 3	Terminated before commercialization
Venture 4	Influenced creation of a new division
Venture 5	Transferred to the existing business
Venture 6*	To be transferred to the existing business
Venture 7*	To be transferred to the existing business
Venture 8	Early termination

*Table 8 Venture exits in the data (*ventures 6 & 7 are still ongoing, but they will most likely be transferred to the existing business)*

Project	Learning by doing	Knowledge transfer	Relocating personnel	Context transfer	New business	New ideas
Venture 1*	A	A				
Venture 2*	A	A				
Venture 3	A	A	A			
Venture 4	A			A	A	
Venture 5	A	A		A		
Venture 6*	A	A			P	
Venture 7*	A	A			P	
Venture 8	A	A				A

*Table 9 The renewal mechanisms for different ventures (A = Actual, P = Planned, * = ventures still ongoing)*

existing business, thus the knowledge gained during venturing was not lost and the venture did generate corporate renewal through relocating the personnel.

Context transfer: The entire venture 4 was transferred from the venturing organization to the mainstream business where it continued in a "venturing mode", as a small team. It helped to renew the existing business by bringing a new way of thinking, new competencies and an efficient way of operating.

> *"The decision to keep the venture team together was a good one. Had the team been spread around the competencies would have been lost immediately."* Venture manager (Venture 5), Company 2

Venture 5 resulted in a change in corporate strategy by influencing the creation of *a new division*. As such its renewal effect was one of a "successful" venture, if the measurement of success is the ability to create a commercial solution.

Ventures 6 and 7 aim to create new business. In the short term they will however be linked to existing business, and their ability to generate renewal is yet to be seen.

Venture 8 was terminated at an early stage. It did involve learning by doing, and knowledge transfer to the existing business. Its effect was however not very significant, as best it could have stimulated thinking and the discovery of *new ideas*.

Conclusions and discussion

This study introduced a framework of strategic corporate venturing which described venturing as a strategic tool to help companies respond to the changing environment. In the light of the 26 interviews involving people from three companies and eight ventures within them this study aimed to answer the research question:

> *What is the role of corporate venturing in sustaining corporate renewal?*

In answering the question and verifying the framework attention was paid to the following issues:

Was venturing strategic? In Company 2 venturing was a strategic tool. Its commitment to venturing lasted even when economic conditions worsened. In Company 1 the position of venturing was ambiguous: the venturing organization did not drive renewal, but instead the "venture like" development in the existing business units did. Company 3 made a hasty retreat from venturing when economy worsened. Thus it appears that it was not linked to corporate strategy.

Conclusion 1: A company's commitment to venturing needs to be strategic. This study found two types of strategic corporate venturing: within corporate venturing division in Company 2, and the "distributed mode" in Company 1.

Did the ventures have the potential for corporate renewal? By looking at the differences between the existing business and the eight ventures analyzed in this study the answer is yes: the venture's characteristics of innovation (market, technology and business model) were different from the existing business.

Conclusion 2: Novelty of innovation appears to be important. As far as the complexity is concerned, the ventures did involve technological complexity which however was not seen as a great risk. Market (Company 3) and business model (Company 1) complexity were identified as drivers of renewal. Determining

the importance of each component is however a subject for another study.

Did the ventures generate corporate renewal and how did they do it? The ventures included in this study had different outcomes. If analyzed by their ability to generate new business only one venture was successful (venture 4). However when analyzed by their ability to generate corporate renewal, all of the ventures did have an effect.

Conclusion 3: This study identified learning by doing, knowledge transfer, relocating personnel, context transfer, generating new business and generating new ideas as mechanisms through which the ventures helped sustain corporate renewal.

This study achieved its purpose by constructing the framework of strategic corporate venturing and by identifying the mechanisms through which ventures generated corporate renewal. As far as verifying the framework of strategic corporate venturing, this study was able to scratch the surface. It involves a clear challenge for future research: thorough verification of the elements of the framework and their respective importance is needed.

Summary

Today, competitive advantages are increasingly based on knowledge. Contextuality of knowledge implies that the value of the framework of strategic corporate venturing is in its ability to identify the essential elements of the corporate context, relate them to the components of innovation and guide attention to the management processes and linking processes needed in order to benefit from venturing.

The three case companies confirm that venturing needs to be managed strategically to generate value for the company and that the strategic management of venturing needs to involve other criteria than the financial one. If analyzed by their ability to commercialize only one venture succeeded. However all did have/have potential to generate corporate renewal. By identifying the mechanisms through which the ventures helped sustain corporate renewal, this study may help justify investment in venturing in the short and medium terms.

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Innovation in the years to come

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Customers will be the main focus in the years to come. They will demand services and products that are easy to use, reliable, and personal. Here is where the business opportunities are. By integrating services and making them more intelligent, interactive, and tailor-made, companies may delight their customers. But it is impossible for single companies to do all this by themselves, and integration along the value chain becomes a must. Therefore, open innovation and information brokerage are on the agenda. It will also be important for companies to be associated with positive values among the public, and non-commercial indicators will come to the forefront along with financial indices.

Abstract

Innovation practice changes with time. In the 1980s and early 90s we were talking about new products, core competences, total quality management, matrix organization, and technology transfer. Then came the extreme market focus of our times, as well as continuous innovation processes, globalization, and virtual collaboration. Future trends may include value chain integration, exploitation of customers' attitudes, tougher fight for values, and an intense search for new ideas. Networking and information brokerage will be highlighted.

Our modern society needs innovation to survive. Businesses must serve society and its people. Those companies that understand their role in the global culture will also be those that can meet the future with great expectations.

Companies within the IT and telecommunications sector will find new opportunities in the space between established technologies and systems. By integrating the numerous services and helping technologies to converge, they may delight their customers and in turn satisfy their shareholders.

1 Introduction

"Innovate or die!" That slogan has been with us for some time. Still we see that many companies today reduce their budgets of innovation and concentrate instead on minimizing capex/sales or improving other financial indicators. So we have to ask the question: Will we be more and more innovative in the years ahead – or will we enter an era of effectiveness and action instead of freedom and creativity?

There once was a time, some forty years ago, when innovation was regarded by industry as "brooding by oddbodies in their closet". In 1963 Theodore Levitt wrote in Harvard Business Review that creativity – the capacity to bring forth brilliant ideas – could be disastrous for businesses. Because they lack practical insight needed to run companies, thinkers and theoreticians may lead the company into talk and nonsense instead of fruitful action [1].

Will we return to such a time in the years to come?

Hopefully this article will shed a little light on that problem. Let me first indicate what I mean by innovation. It includes small everyday improvements proposed by operations people, by marketers, or through cooperation between customers and technical personnel, as well as more radical discoveries and inventions and the implementation of them to the benefit of customers. My definition of the term "innovation" stays wide open because I want it to include all of these and areas not yet imagined by any of us, neither awake nor in our dreams.

2 "Innovation moves"

As outlined by Tim Jones of Innovaro in London [2], innovation emphasis and practice change with time. One might say that innovation moves. Innovation practice in recent years has been outlined in previous articles of this magazine. Here we consider trends that I believe will extend into the future. Let us start with a short survey of business innovation objectives.

Innovation contributes to the development of a business in several ways. It relates to the strategic impetus of the company, and the way innovations are presented to customers by a company has to do with its market focus. These two factors may be more important than the products themselves, although many people think of innovation as merely product enhancements. Differentiation is key to product development. At least as important as the products is the effectiveness of innovation delivery. The development process itself can be organized innovatively. Finally, organization matters, both internal structure and how companies work together in the value chain.

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Jones has described five waves of innovation during the last two decades. To each of the key areas mentioned above he has described main trends as far as innovation practice is concerned. Among important factors today he draws attention to intense marketing creation efforts, personalization of products, recognition of customer values, virtual collaboration, and brand exploitation.

In this article we are most concerned with his fifth innovation wave; that is possible trends after 2005. Jones suggests that these years will be characterized by, among other things, reconfiguration of the value chain, attitude exploitation, permanent networking, and information brokerage.

3 Why innovate?

This may seem to be an odd question. We are told over and over again that companies need to innovate to survive. One of the main arguments is that since competition is tough and many companies offer similar products, you need to improve offerings or lower prices to gain a competive advantage. This point is discussed further in later sections.

But let us consider for a moment society's needs for innovation on a general basis. Is innovation important for our culture, or maybe for survival of life on earth itself in the 21st century and beyond? More and more people today seem to mean exactly that. According to a thought-provoking book by Martin Rees [3] scientists warn that terror, error, and environmental disaster threaten the future of humankind in this century. It seems that only innovative approaches and extreme skills at managing them may save us.

On a smaller scale, the trends in society in the first decennium of this century point to the needs people see as most urgent just now. Even financial managers would be interested in that since undiscovered needs and market opportunities are obvious sources of new revenue.

4 Trends

Many people have considered Year 2000 a crossroads in history. Our grandchildren may pass judgement on this statement a couple of decades ahead. But we feel that things are changing. I was wondering in the late nineties if we were entering a new romantic period, like the 'belle epoque' of the 1890s. Presently it seems that September 11 and its aftermath has changed the agenda somewhat.

But let us first consider the impact of technology. At the core of the recent trends there are very significant developments in science and technology that contribute to our futures. The Computer Science Corporation [4] has described trends that follow from recent technological development:

We are becoming *'cyborgs'* (cybernetic organisms) as advances in computing, biotechnology and robotics create a world in which a purely biological human may one day be a rare breed. Computers have become cheap, plentiful and wearable – or even embeddable – and they will provide the knowledge, reasoning and sensing to form a "sixth sense". Advances in drug design and medical technology will transform medicine, making it more precise and more patient-administered. And even our environments will become intelligent and serve our needs, from smart objects and homes to smart cars and smart stores.

We will take charge of our information, the clock and the map thanks to the Semantic Web, teleimmersion, location-based services and wireless. The zero-latency enterprise will make timelier, better-informed decisions based on real-time data. CSC believes that digital copyrights will be managed, allowing the Internet to become a primary distribution medium for content while rewarding artists fairly, and the industrial nations will reach out to emerging nations to help close the gap between the technology 'haves' and 'have-nots'.

According to the Copenhagen Institute for Futures basic megatrends of our times are IT/digitisation, individualization, immaterialism, globalization, health, time squeeze, and economic growth [5]. Some years ago the Institute told us that we are entering a 'Dream Society' [6] with emphasis on adventures and storytelling, togetherness, identity, care, and convictions – as well as security aspects.

Today the Institute have changed their mind a little. In a recent publication [5] they point to tendencies toward 2010: individualism, everyone trying to be perfect, sensual, but alas also exposed to stress. Sensuality means that we want to see, taste, smell, hear, and feel – maybe by means of more and more "nature-like" technologies. However, some people choose to escape the modern rush of mobiles, computers, and the time squeeze. Instead they live *offline* – cut off from customer society and the constant presence of business life – and concentrating on living a simple life and being themselves.

We will see a growing fight for values. This struggle will be fought between companies and nations for attention and profitable deals. But it will also take place within our own minds. The Copenhagen Institute for Futures claims that ours is a time of tremendous upheaval of value systems. Nobody knows the outcome of it.

5 Individual needs – and customer control

Future communication technologies will be individualized, intelligent, interactive, and integrating [5]. This is a significant change as compared to the last century when technology supported the state, the system, the super power, and big business.

Many people consider modern information and communication technology not any more to be in opposition to nature and the natural. On the contrary, technology can be used to enhance our experiences and lives in general. This opens for vast opportunities – technology can find its way into almost any aspect of life. Look to your own needs and those of your family, friends, and neighbours, and you will see vast opportunities!

But the new technology also allows market researchers to learn to know their customers more intimately than ever before. It is possible to trace the customers almost step-by-step. In addition, newly discovered techniques such as MRI therapy make it possible to get visual images of the brain's reaction to various stimuli [7]. By comparing and analysing this information service providers can draw pictures of customers' preferred behaviour and their attitudes and beliefs. This gives them unprecedented opportunities for product tailoring and marketing.

The mapping of attitudes opens frightening perspectives in conjunction with the future fight for values, but that's another story!

6 Business model innovation

Innovation does not only mean to bring forward new products. Improvement of business models is perhaps even more profitable. Donald Mitchell and Carol Coles [8] claim that the one thing that can most improve a company's growth and profitability is having the best process for continuous business model innovation.

How is such business model innovation carried out? Peter Drucker has said, "The purpose of a business is to create a customer". Mitchell and Coles rephrase him, saying, "The purpose of a business is to create and serve customers, while fairly rewarding stakeholders". With that balance in mind, a new and better business model should help companies get customers for themselves (faster than their competitors), provide more benefits and fewer drawbacks than present models, reprice offerings to encourage more use of your products, reduce resources needed, etc.

An important point in Mitchell and Coles' arguments is that business model innovation is a continuous process. You should first understand and follow your existing business model properly. Then a new model should be specified and installed, including transition procedures. New models should follow a clear vision, and they must be tested to ensure shareholder value.

It should be noted that Mitchell and Coles do not see a contradiction between innovation and cost cutting. On the contrary, saving on harmful costs is part of business model innovation along with price adjustments to increase sales and product improvements to serve and delight customers.

Recently, the focus on customer value has forced companies to collaborate in order to deliver complete products that *delight* their customers. This integration along the value chain is perhaps the most obvious trait of business model thinking presently. I discovered this very clearly last fall during the ITU Telecom event in Geneva. Sessions on business modelling were focused on exactly this trend of integration along the value chain.

There are numerous examples of such cooperative efforts. Recently it was announced that France Télécom and Ericsson have formed a partnership to develop IP multimedia services for the consumer market. Vodafone is working with Sharp to influence the design of the Vodafone Live service. Well-known and new companies are all there to gain influence beyond their traditional position in the value chain.

This value chain integration may reach beyond traditional business borders. An example is Hitachi's collaboration with car manufacturers and clothing companies to introduce their Radio Frequency Identity Device, a wee chip that can be attached to items in shops and elsewhere.

As the Internet emerged, several companies chose to exploit it to gain competitive advantage. Even if there still is room for innovation to improve net-based business, the fact that most successful companies use it implies that it is not enough to excel. That said; please note that Bill Gates believes that Web Services will lead to a more advanced Internet that promotes on-line inter-company business [9].

7 Needed: More and better ideas

During the last two years the need to generate more and better ideas has come to the front of many companies' agenda [10]. Communication and competition has reduced the difference between companies in most businesses and in telecommunications and computing in particular. Innovation exploitation and delivery processes are being streamlined and companies across the world are able to achieve similar levels of performance.

What counts now is to find really new ideas. Products and services have become more and more alike among competitors. Many companies have similar procedures and ambitions to improve their offerings, and they work from similar if not equal knowledge bases. There are also a number of consulting companies serving many competing businesses. Through adoption of new and more advanced techniques or cooperating with external sources, organizations all over try to increase their focus on creativity [2].

What sort of techniques are we talking about? A focal point is to rely on customers as a resource. There are several methods available [11]. Focus groups can define actual problems and get people excited. Interaction groups with key customers can help a company brainstorm solutions. A technique called "total involvement" requires more lasting contacts between your company and customers through "camping out" for shorter or longer periods of time at the customer's premises. Other methods involve setting up expert panels to see into the future, or carrying out depth interviews with customers. It should be noted that the latter technique is rather demanding on the interviewer side.

Not all ideas come from customers. The employees of a company are an excellent source of new product ideas! The difficulty consists in unleashing the hidden power of their minds. This may require some extra efforts and thereby increased costs, but the award is plenty-fold in return!

All this may seem obvious, but to really profit from employee creativity you need to do some hard work. "*How* you do it makes the difference", says Robert Cooper [11], who has been involved in such activities for decades.

There are numerous idea generation options. Suggestion schemes must be promoted and actively followed up. Contests or targeted initiatives may work. Ideas must be handled promptly. All ideas must be handled. Guidance must be provided through websites or otherwise. Lots of minor tasks have to be done. – My experience is that Norwegians are not very clever at such efforts compared to the British, but it may be that we beat the Swedes! However, I think we can improve if we can transfer the excitement of sport events into the businesses.

American companies report that MFAs (Master Fine Arts) are now getting more popular on the employment market than MBAs (Master of Business Administration) [7]. This obviously has to do with the need to create "artistic" products that customers really value.

According to Telenor Networks' new innovation process ideas will be sorted into three groups: [1] long-term technology or products that can be realised in 3–5 years from now and require a new platform, [2] new products that can be realised on existing platforms, and [3] improvements in production methods, delivery procedures, or product enhancements. Ideas from each of these groups are analysed according to specific procedures.

Special attention should be given to disruptive technologies, which are dealt with in a previous article. The mere fact that more people than ever are involved in product development worldwide implies that surprises will pop up. Disruptive innovations may be inconvenient for established communities, but they spur growth [11]. Disruptive businesses either create new markets or take the low end of an established market. The process for identifying and shaping disruptive businesses relies more on pattern recognition than on market-driven analysis.

Disruptive opportunities require a separate business planning process. Instead of designing products and services that dictate customers' behaviour, one should try to let the tasks people are trying to perform be built into the new products. Don't try to change your customers – help them. If you meet obstacles or 'missing links' – build bridges and integrate. And a final advice from Clayton Christensen and his allies is this, "Be patient for growth but not for profitability!"

8 Are there new spaces of opportunity?

Many companies exploit the "well-known" roads of innovation practice, which in part have been covered in previous paragraphs: surveying sociological trends, studying technology development, and redefining business models – especially related to the Internet. Unfortunately, this road of innovation becomes less fruitful as more companies master it. According to Innovaro [10] new spaces of innovation may be found "at the confluence of multiple societal, political and economic needs, technology evolution and new business configurations, or in the gaps in between them".

We live in an era of images – both still pictures and video. Another megatrend is the strong contributions from biology and medicine. In the space between those trends one can glimpse numerous opportunities.

9 Networking to innovate

Remember John Steinbeck's words, "The group never invents anything; the precious gift lies in the lonely human spirit. The free, seeking spirit of the individual is the most precious thing in the world."

Figure 1 This photo may illustrate the future of innovation. It is an example of the pictures that will soon fill up the Internet. It also illustrates the individualism of customers and the loneliness of real innovators in our profit-hungry era. But innovators should also draw on networks and other resources. Copyright: DRØMSMIA [13]

Still we know that cooperation and networking is necessary – and its importance increases as our systems and problems get more and more complex. Networking may take numerous forms. We have already discussed the need to integrate along the value chain. Many companies, notably in the service arena, are beginning to operate as networks from the start. In other cases partnerships are built to deliver complex services that would otherwise not be possible. Such permanent links may be enduring and be perceived by customers as companies.

Other cooperative schemes may be more ad hoc. The Internet opens opportunities to build communities on a worldwide basis, and you will always find complementary competence or services to your own somewhere on the globe. Such virtual collaboration has already become commonplace in some contexts, but I mention it here because I think there is much to be gained by increasing such efforts by employees and groups in our businesses.

Innovation initiatives at larger companies have obvious benefits through cooperation with professional innovation consultants. This article has for instance been realized through comments and support from Innovaro in London, the Copenhagen Institute for Futures, and Abelia Innovation in Oslo.

10 Open innovation

We have been used to a funnel-like process for innovation: proposals are sorted and selected, some of them are analysed further, resulting in a small number of accepted proposals; again leading to a modest number of products launched to the market. Henry Chesbrough [14] confronts this procedure, which he thinks is unproductive and misses out a lot of opportunities. Instead he proposes a method that he calls "open innovation" as opposed to the old "closed" innovation.

Open innovation is keeping and developing further many proposals that do not fit into the system. In open innovation it is also possible to enter the idea process at undefined times and in surprising manners.

Open innovation acknowledges that there are many smart people *outside* the company. We may profit from working with them. External R&D creates significant value to our company. We don't have to originate all research to profit from it. If we make the best use of internal *and* external ideas, we will prevail. We should also profit from external use of our intellectual property, and we should buy external knowledge whenever it advances our own business.

Chesbrough argues that open innovation is far more effective than the traditional closed approach – a

statement that is supported through many definite examples from American business life. He is convinced that innovation in the years ahead should be open.

11 Information brokerage

Even if networking and open innovation seem like obvious steps, the increasing complexity of networks makes the task demanding. One needs catalysts for the interaction between parties – or information brokers. These information brokers are facilitating the introduction and defining the operation principles between external partners. Positioned as centres of expert information input in an ever-expanding web of companies operating throughout and across industry value chains, these intermediaries are quickly becoming the hub of new innovation creation and exploitation activities [2].

12 What do customers think of us?

The importance of brands has been with us at least for a decade. What is new is the increasing importance attached to the perception by customers of the company. Not only financial numbers contribute to stock exchange indices but the general public opinion of the company's societal role and benevolence is important as well. This is why Coca Cola tries to be associated with sports and Shell with environmental protection. In Norway Tine Dairies have succeeded in convincing the public of the connection between health and consuming its products.

13 Quo vadis, Telenor?

Telenor has an enviable position as an integrated telecommunications provider in one of the world's most technological countries. The company has still to realize its potential, as I see it. Telenor will need to gain the reputation at home and abroad as an integrator – supplying customers with the "hands-free" convergence between fixed networking, the mobile regime, Internet services, television and radio, and home leisure and pleasure. In my mind, people's perception of this convergence and Telenor's ability to make it happen may be far more critical for the company's success than financial numbers from the stock exchange.

It may be possible also for Telenor to develop the role as an information broker. Storage of data is part of that business, both for commercial customers and private individuals.

Telenor's innovative efforts these days are not enormous. Maybe no revolution is needed in terms of funding for that kind of activity. What is needed, however – and again I express my own opinion – is a revolution in *attitude*. We need to become believers in a future in which we serve customers, delight them, and don't irritate them unduly. They should become as proud of their number one national telecommunication provider as they are of our Olympic gold winners!

Benchmarking has shown that Telenor is rather clever at identifying possibilities, taking action, and organizing projects. What is needed however is maybe a more realistic evaluation of trends and needs in society and a follow-through to meet those needs and delight customers. Telenor could also act as a locomotive of the telecommunications industry in the Nordic countries and take responsibility for birth and growth of new firms, new solutions, and new products. Remember that innovation is more than idea generation and piloting – only those projects that lead to commercial successes can be named true innovation.

14 Conclusions

Why should we innovate? Society needs it – to survive. Businesses must serve society and its people. Those companies that understand their role in the global culture will also be those that can meet the future with expectancy, as I see it.

In the next five years prevailing trends will be individualism, sensuality, strong advances in biology and medicine, and cross-cultural understanding – but also stress and fight for values.

Technology will help build bridges, assist us in organizing our lives, and in amending our weaknesses. Exactly in this space you also find opportunities for companies within the IT and telecommunications sector: by integrating the numerous services and helping technologies to converge, they will be able to delight their customers.

It will not be easy to satisfy the customer of tomorrow. No single company can do it all. Therefore modern businesses are forced to cooperate and maybe merge. The companies will be under stress from customers in at least two ways: they will need to deliver seamlessly to satisfy customer demands very quickly and they must perform to keep their position at the stock exchanges.

In this reality the innovator must operate. Do we need him or her? In my opinion we do – because our complex world must be kept on track. The times ahead are challenging but vastly exciting for those who are committed.

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Terms and acronyms

A more general NPD glossary is available at www.pdma.org.

4P Product, Price, Place, Promotion	• **P**roduct – Product characteristics, functionality, shaping etc. • **P**rice – Price profile, discounts etc. • **P**lace - Distribution, sales channels, delivery mechanism etc. • **P**romotion: market communications. The 4 Ps are also referred to as the marketing mix.
API Application Programming Interface	The specific method prescribed by a computer operating system or by an application program by which a programmer writing an application program can make requests of the operating system or another application.
ASP Application Service Providers	A company offering software to business users over the Internet. For the business users it is a kind of outsourcer. The users are not required to buy, own or take care of their own software.
Bench-marking	An improvement process in which a company measures the performance of its products or processes against that of best-in-class products or companies, determines how the product or company achieved their performance level, and uses the information to improve its own performance.
BIC "Best-in-class" or " best practice"	The method or innovative practice that contributes most to the performance of an organization, usually recognized as "best" by other peer organizations. Though no one tool or technique assures success, a number of them are associated with higher probabilities of achieving success. Best practice is often somewhat context specific.
BPR Business Process Re-engineering	An analysis and redesign of workflow within and between enterprises
BU Business unit	
CAD Computer Aided Design	In industry, construction, calculations and drawings made by a computer. It is used as a tool for everything from design of small parts for machines and electronics components, up to large enterprise constructions as bridges, oil rigs and buildings
Commer-cialization	The process to take an idea from development to full volume sales. It includes testing and market validation, production launch and ramp-up, development of marketing programs and materials, supply chain development, sales channel development, training development, training, and service and support development.
Concept	A high level description of an intended solution for one or several customers. A representation of a new product in the form of a written description, a sketch, a diagram or a simple model. An early representation of a new product or of alternative approaches to designing a new product.
CPAS Comparative Performance Assessment Study	PDMA sponsored studies of New Product Development Comparative Performance
CR Cost reduction	A formal activity employed to reduce the cost of an existing process, product or design. A CR effort has a quantified objective and may affect NPD schedule, performance or support to achieve this objective.
CRM Customer Relationship Management	An integrated information system that is used to plan, schedule and control the presales and postsales activities in an organization. The objective is to enable a customer to interact with a company through various means including the web, telephone, fax, e-mail, mail and receive a consistent level of quality service.
Customer need	A fundamental need to be satisfied independent of a particular technology or product solution (e.g. to access the internet.)

DB Data base	A collection of data structured and organized in a disciplined fashion so that access is possible quickly to information of interest.
DCF Discounted Cash Flow	See also NPV – Net Present Value
DFX Design for Excellence	DFX is a general term for "Design for" initiatives such as Design for Assembly, Design for Cost, Design for Manufacturing, Design for Test, Design for Logistics and Design for Performance.
DMZ DeMilitary Zone	Used in technical computing terms to indicate an area in your network which is located in between your system you have to protect (generally your own internal system and production area) and the danger (generally the outside world, including Internet cyberspace or any telecommunication access possibility to your network). Generally, DMZ contains your outside Internet website and your external gateway to email system
CFT Cross-Functional Team	A team consisting of representatives from marketing, customer service, engineering, purchasing, test, quality, finance and any other required disciplines for developing a product. This team is empowered to represent the disciplines and develop a product by addressing its life cycle requirements including its product and support.
ERP Enterprise Resource Planning	It is a way to manage a (production) activity integrating needs and resources of the company taking into account information up- and downstream (from suppliers and clients). This ERP approach is mainly implemented using information systems.
FMEA Failure Mode/Effect Analysis	A pro-active engineering quality method that provides help to identify and counter weak points in the early conception phase of products and processes.
FTP File Transfer Protocol	A communication protocol mainly used on Internet to transfer files and make repositories dedicated to file exchange (instead of displaying it directly to the screen).
GK Gatekeeper	A member of management that participates in conducting the stage-gate or phase-gate reviews as part of a Stage-Gate™ process in new product development. A gatekeeper is usually a member of a formal group that is responsible for portfolio management
IMAS	Integrated Mobile Applications and Services
Innovation	Commercially successful implementation of new product ideas and inventions in the market
Innovation System (extra company)	The sum of innovation structures, resources, competencies and tools, processes and culture available to a firm in any value configuration (see also **VC** – Value Chain, **VN** – ValueNetwork and **VW** – Value Workshop)
Innovation System (intra company)	The sum of individual innovation competencies and the firms tools, processes and culture
Innovation Performance	A company's ability to succeed with inventions measured as a mix of metrics at both project and company level
Invention	A creation (a new idea, device or process) resulting from study and experimentation
IPR Intellectual Property Rights	Intellectual Property is produced by effort of the mind, as distinct from real or personal property. Intellectual property generally takes one of four forms: inventions, ideas, trade secrets, and goodwill. Intellectual Property Rights is a legal term concerning the ownership of intellectual properties
ISPIM The International Society for Professional Innovation Management	A worldwide network of academics, business leaders, consultants (A, B, C) and other professionals involved in Innovation Management. ISPIM's goals are to create a worldwide network of excellence in the field of innovation management.

LCPM
Lifecycle Product Management

The responsibility and authority to manage the product's lifecycle after launch – managing the "4 Ps". This may embrace innovation and (sub) portfolio management, project and program management, collaborative design, product data management, manufacturing process planning, and delivery, service and support process management.

MAC
Multi-Actor Cooperation

Expression defined by ACTIF-Europe in the framework of European project development (e.g. www.food-MAC.com) where you get higher and faster results when you can get all types of actors concerned by a theme working together in a TQM and collaborative approach involved right from the beginning

New product

Goods, services or solutions perceived by customers as new. This implies that an existing product in a new marked is a new product and that changes in pricing, delivery processes etc. also may be perceived as new products

NPD
New Product Development

The business process for commercialising value proposals, products, product portfolios and product platforms such as IT/IS-systems, as well as bundles and price plans. It includes all activities from development of the idea or concept, through the development of the product and its processes, and to the launch of the product into production and the market place. NPD has a clear customer perspective. It also embraces cost reduction activities and projects as well as business and market development, with the aim of creating new business opportunities.

NPV
Net Present Value

Term used when evaluating a business case about the present net value of future investments

OSA
Open Service Architecture

Part of the 3rd generation mobile network or UMTS. OSA describes how services are architected in a UMTS network. The standards for OSA are being developed as part of the 3rd Generation Partnership Project (3GPP). The standards for OSA are published by ETSI and 3GPP

PDMA
Product Development Management Association

Founded in 1976, PDMA is a volunteer-driven, not-for-profit organization. About 80 % of its members are corporate practitioners of new product development, with the remaining 20 % split evenly between academics and service providers.
PDMA's mission is to improve the effectiveness of people engaged in developing and managing new products - both new manufactured goods and new services. This mission includes facilitating the generation of new information, helping convert this information into knowledge which is in a usable format, and making this new knowledge broadly available to those who might benefit from it. A basic tenet of the Association is that enhanced product innovation represents a desirable and necessary economic goal for firms that wish to achieve and retain a profitable competitive advantage in the long term.
http://www.pdma.org/

PM
Portfolio Management

High level business evaluation of products, product ideas and product development projects with stress on resource prioritizing. The process of managing new product ideas, proposed projects and current projects under development as a portfolio to maximize the value of the portfolio, keep it in balance, and align it with company strategy. By reviewing the projects in a company's portfolio as a whole, through a set of high level representations, it is possible to prioritize and select projects

PMG
Performance Measurement Group

P^3

The Telenor process integrating the three product processes **P**ortfolio management, Life Cycle **P**roduct management and New **P**roduct Development

Process

Defined activities that hang together in a recommended way

Process owner

A person responsible for the results from – and quality of – a process. It entails maintaining and improving the process as well as training people in using it

Product	Products are goods, services or solutions that customers are willing to pay for, directly or indirectly. Products embrace related IS/IT production and delivery processes that must be designed and developed at the same time.
RCPD Remote Collaborative Product Development	A way of working together across company or BU boundaries, to develop new products. It is an strongly IT-supported process where the involved partners cooperate to share competencies, satisfy customers, increase product quality and to reduce cost and TTM/TTP. The degree to which information is shared and communications are synchronized is the chief distinguishing factor, not the distance between partners
ROA Real Options Approach	The real option is a right but not an obligation to take action at a predetermined cost called the exercise price, for a predetermined period of time, which is the life of the option (Copeland & Antikarov, 2001)
RP Rapid Prototyping	The process of quickly generating prototypes or "dummies" of what a product will look like to the user/customer. Rapid prototyping may be done with paper prototypes such as sketches, with low-fidelity physical prototypes, computer visualization or video prototyping
Science	A series of systematic studies, observations or experiments leading to testable/falsifiable hypothesis and theories – set within an explanatory, theoretical framework and organized by general principles. See also technology
SG Stage-Gate™ process	A widely employed product development process that divides the development effort into distinct time-sequenced stages or phases separated by decision gates. Product teams must successfully complete a prescribed set of activities in each stage prior to obtaining management approval to proceed to the next stage of product development. A Stage-Gate™ process includes work-flow and decision-flow paths and defines the supporting systems and practices necessary to ensure the process's ongoing operation
SLA Service Level Agreement	It should define in a similar way as a contract the exact level of service between a provider and its clients/users, in a qualitative and quantitative (measurable way). This contract should also precisely define what could be penalties and back-up solutions in case of problems. SLA is especially important to define when an important part of your system or activity relies on third party providers. SLA is also a very good approach for services provided internally to your organization where you should also have a customer approach concern.
SMAS	'Separated' Mobile Applications and Services
SME Small and Medium-sized Enterprises	Micro, small and medium-sized enterprises represent 99 % of all enterprises in the European Union. The European Commission published in 2003 a revised definition of SMEs. According to this definition, micro-sized enterprises have less than 10 employees and a turnover less than 2 mill euro. A small enterprise has less than 50 employees and a turnover of less than 10 mill euro. Medium-sized enterprises have less than 250 employees and a turnover of less than 50 mill euro. http://europa.eu.int/comm/enterprise/enterprise_policy/sme_definition/index_en.htm Technology (mechanical inventions) Practical tools and machines for facilitating work. Until about 1750, improvements and inventions of mechanical contrivances, was done unrelated to any scientific work, or with technology sometimes leading the way to scientific discoveries, not the other way around. See also science
TTM Time-to-Market	The cycle time of product development from conception of a new product to initial sale of the new product. It is also a dimension of strategy to focus on getting products to market quickly
TTP Time-to-Profit	The cycle time of product development from conception of a new product to making a full return on investments. It is also a dimension of strategy to focus on getting products profitable quickly. It is a more long time view than focusing on TTM.

TQM Total Quality Management	A spirit and also an applied methodology of quality that one may implement at one's own level and pace depending on your own needs. TQM as a process was devised by W. Edwards Deming, focusing on "delighting the customer" by means of the statistical measurement and enhancement of the factors ("inputs") that determine the final quality of a good or service
VA/VE Value Analysis/ Value Engineering	A function-oriented, systematic team approach to providing value in a product or service. VA/VE may reduce costs while still maintaining or improving performance and quality
VC Value chain	One type of value configuration that describes a series of activities, with accompanying support functions, to increase product value, ref. Michael Porter e.a.. Especially relevant to companies/trades where the product has value added at each level in an 'activity chain'. The term is not to be confused with 'delivery process' for single products. See also VN and VW
VN Value Network	One type of value configuration that describes a network of roles and activities, with accompanying support functions, to increase product value. Especially relevant to companies/trades where a product's value increases proportionally with the number of users connected to the network, e.g. in the telecom business. See also VC and VW
VW Value Workshop	One type of value configuration that describes a workshop for value creation, with accompanying support functions. Especially relevant for describing activities/companies where a solution is tailored to a customer, after a 'diagnosis'. See also VC and VN