Handbook in Innovation Management
- Dynamic Business & Product Development

This handbook does not contain examples. On a separate basis, however, the author may be engaged for speeches, seminars, and coaching missions at which he will share his more then 30 years of practical experiences regarding all parts of innovation management including project management, sales, marketing, and product development

The book is used as course material in different courses. For efficient learning and administration e-learning courses are available and can be developed to suit individual wishes.

For more information contact:

Stig Ottosson, PhD

e-mail: stig.ottosson@tervix.com
Mobile: +46 708 905 714

CONTENT

FOREWORD BY THE AUTHOR

Building a new enterprise up from an idea to a sustainable business is something that only few people get the opportunity to experience. Therefore not so many books exist on innovation management written by people with personal experience. Also not so many books exist written by researchers who have studied innovation processes.

In my case I have carried through a number of innovation activities during the last 30 years. As I have a scientific background being PhD in physics, I have also always done what is called Insider Action Research on the innovation processes I have been involved in. This mix of being an industrialist and researcher has given me a rather unique possibility I think, to reflect on my own experiences and evaluate them with what other researchers have found and/or suggested from their studies mostly from outside different innovation projects.

My ambition with the book is to give general useful hints on how to successfully develop new businesses and new products. However, as the way of thinking is more important than simply learning to mechanically follow rules, I hope to give my readers a useful philosophy of innovation management to fall back on in actual innovation activities. This 'way of thinking' is particularly important as no two innovation process are quite alike.

My first experiences for the book date back to the late 1970's and especially from SKF New Products, for which I was general manager. SKF New Products was a subsidiary of the multinational enterprise SKF. At SKF New Products we developed new innovative businesses in different fields outside the core business of SKF. Looking back, the result was a big success although it took some years before this became visible. Thus, today Linear Actuators is an important part of the division SKF Linear Motion. The FlexLink System - now owned by the Dutch ABN AMRO Capital – is claimed to have given SKF a profit of about 150 MEUR.

Based on our experiences from SKF and from new experiences from my following work as patent broker I, in 1983, wrote my first book on innovation management in Swedish. That book has been upgraded and extended several times with more information as it became rather popular in the Swedish academic system. The present book is a combination of the information from the latest Swedish innovation book from 1999, information from my two other Swedish books in product development and project management, and a lot of research and field work in the area of innovation management.

To write a new book, even though it is based on ground material from earlier work, is a large undertaking and even Pippi Langstocking's inventor Astrid Lindgren had to rework each page more than ten times according to her memoirs. Therefore, when I was asked to write a new book in English I was not particularly enthusiastic. However, when I was offered the position of guest professor at Otto-von-Guericke University in Magdeburg (Germany) by professor Sándor Vajna financed by DAAD (Deutsche Akademische Austauchsdienst) for one year, I decided to try and make a go of writing this book. Also, while in Germany I got the opportunity to test the different chapters on my German students taking part in the academic courses I gave 2005 and 2006.

Therefore I am truly grateful to professor Vajna for his encouragement and our always stimulating dialogues. I am also deeply grateful to Dr Evastina Björk and Mr Lars Holmdahl for all the input they have given.

Gothenburg, August 2006

Stig Ottosson

1. INTRODUCTION

1.1 The difficult term "Innovation"

The term "Innovation" seems to derive from the Latin *novus* (Hsu 2005), which means new or young or novel. For most people "*to be innovative"* means to be creative and/or to make something new.

Unfortunately there is no single accepted definition of the term *"Innovation".* For some people it means a new idea, for others it means an invention (a materialized new idea), for some it means a new product (a developed invention), for some others it means the act of creating a new product or process, while for others it means to create a new business. One example of a definition that only covers the introduction of new ideas, services and practices on the market is from Wikipedia (http://en.wikipedia.org/wiki/Innovation):

> "Innovation is the introduction of new ideas, goods, services, and practices which are intended to be useful (though a number of unsuccessful innovations can be found throughout history). The main driver for innovation is often the courage and energy to better the world. An essential element for innovation is its application in a commercially successful way. Innovation has punctuated and changed human history (consider the development of electricity, steam engines, motor vehicles, et al)."

Thus "Innovation" can be both a noun and a verb with different starts and different time spans, which complicate life. However, if *innovation* is seen as a noun it becomes easy to handle the term as the act of developing an idea into a new business, which can then be called an *innovation process* done as an *innovation project*. In this book, therefore, by innovation we will mean a new product that has been sold and taken in use by at least one user. The *innovation process* here will cover all activities to bring forward such an innovation. The daily work is done in an organizational form as an *innovation project*.

1.2 Background

The earliest industrial use of the term Innovation seems to have been described by Joseph Schumpeter, who was born 1883 in Třešť then part of Austria-Hungary, now in the Czech Republic. Schumpeter felt that innovation was the impetus for economic development and in his thesis *The Theory of Economic Development* (1934) he claimed that, excluding any innovations and innovative activities will result in a stationary state. The hero of his story is the *entrepreneur*, who disturbs the equilibrium and thereby causes economic development. Today it is commonly accepted that without innovative activities, development in individual companies and society as a whole would stop. Therefore it is important that many people have a good knowledge of how the development of innovations is managed and how the work is done in the most efficient way – which is the overall aim of this book. From practical experience the author is convinced that "the most efficient way" is using dynamic principles, which is why the dynamic view is the guiding principle in this book.

Innovation development of technical products – which is a delimitation of the book - contains management aspects as well as commercial (sales and marketing), and technical aspects (product and

production development).

The scientific origin of the dynamic theory dates back to 1995 although entrepreneurs throughout time had to be dynamic in order to manage successfully. The dynamic theory in turn is based both on dynamic industrial innovation experience since the 1980's, in both large and small companies, mainly in Sweden, and on insider information from a large number of innovation and product development projects.

1.3 The sustainable company

Ideally the aim of every innovation process is to build up a new successful business with products that can successively be transformed into standard products and sold on one or more geographical markets. Figure 1-1 shows in principle the situation from the birth of a new product – i.e. from when new discoveries and/or new product ideas have emerged - to when the product is removed from production and sales. Until the product has been accepted by the market one is initially in a positive chaotic situation followed by a complex situation, which means that one is in what is called an "un-ordered domain" or "emergent order domain". From that domain one moves into the "ordered domain" which first consists of a knowable situation going towards a known situation. When the sales of the product start to slow down one can get into the "disordered domain" where different opinions exist on what to do resulting in an increased negative chaotic situation. This negative chaotic situation will also arise in the recovery period, which we will come back to, as well as every time sales drop radically. To avoid the negative chaos becoming too deep it is important to have started up new businesses early on that can successively take over when the sales drop is substantial at the end of the commercial product life cycle (PLC).
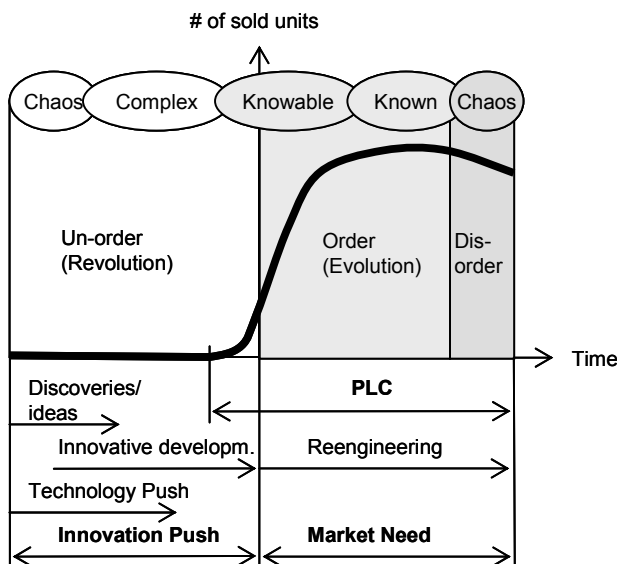
Figure 1-1: The process from the birth of an innovation until it is removed from sales

9

Based on theories from Kurtz & Snowden (2003) the different views of Un-order, Order, and Dis-order are summarized in figure 1-2. By "Complex" we mean un-linear systems while "complicated" systems are linear. Life is complex and machines are complicated.

	Innovation project		Standard business process		
	Un-order (emergent order)		Order		Dis-order
Reality	Positive chaos	Complex	Complicated	Known	Negative chaos
Cause & effect (C&E)	No C&E relationships perceivable	C&E are only coherent in retrospect	C&E separated over time and space	C&E relations repeatable, perceivable, and predicable	C&E understandable and chocking
Decision input	Ad-hoc actions	Pattern seeking	Analytical/ reductionist investigations	Follow ups & best practice	Ad-hoc actions
Planning	Day-to-day	Short term	Short and long term	Long term	Short and long term
Actions	Act-sense-respond	Probe-sense-respond	Sense-analyze-respond	Sense-categorize-respond	Act-sense-respond
Management	No	Entrepreneurial	Transformative	Administrative	Change
Organization	Informal	Planetary	Matrix	Line	Planetary

Figure 1-2: An innovation project transforms into a business process when it has passed the Un-ordered domain in figure 1-1

Discoveries in figure 1-1 are often the result of research in physics, medicine, chemistry and biology. Such discoveries transformed into possible technological solutions are in general seen as a *technology push*. The origin of a new product can also be the result of development done by an *inventor*. Independent of source, *innovative development* is needed to make a commercial product. From when the products have been sold and taken in use, *reengineering* takes place to ensure that the market need for the products is cultivated as long as the products are not regarded as old-fashioned by the market. Reengineering is, in general, easy to plan and the returns on investments can be calculated, which is often the opposite to the situation where innovative development is concerned. The PLC varies from about 6 months for games to 20 or more years for some mechanical products (Ottosson 1998).

When the *innovation push* results in sales taking off and the establishment of a *market need,* it is important in the production process to develop and follow strict rules in order to minimize uncertainty, and to avoid disturbances and negative chaotic situations. However a strong market tendency is to get ever more individually designed/composed products. Thus the market pushes the industrial process to be increasingly flexible, which means an unstable and heterogeneous situation for the industry.

To cope with the situation of flexibility and stability, chaos and order, revolution and evolution, two organizations living side by side are needed. For unique activities – such as new product development, production development, and new business development - the project organization is required for

"drawing up the map". To draw up the map means to reflect on and to learn from what is experienced from different tests as one has to deal with *complex* (unforeseeable) situations until a stable situation is reached. On the other hand, for repetitive work, such as mass production, one has to deal instead with foreseeable situations, which can be *complicated* but which seldom are complex. Thus, for stable/plannable situations a process organization is required symbolized by "following the map". While it is natural how to integrate the result of a change project into a process it is quite a tricky thing, to know how and when to integrate an innovation into the process of a company. Sometimes the business would be better off if innovations were to result in a separate company rather than trying to get them accepted in the process organization. Figure 1-3 shows in principle how a sustainable enterprise should deal with the activities for the future – projects - and the daily bread and butter activities – the process.
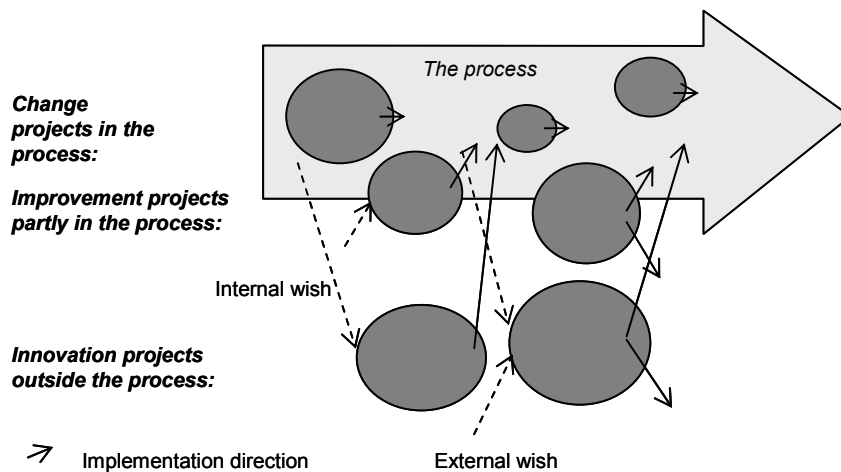
Figure 1-3: In a sustainable enterprise, processes and innovation projects live side by side with each other while change projects and improvement projects live totally or partly inside the process (Ottosson 2004)

1.4 Do we need a new view?

It is common for conventional methods to deal with the known domain in figure 1-2 which means that they use a costly and otherwise negative outsider management view instead of an insider leadership view that characterizes dynamic management. In general the start of a product development endeavor for the conventional methods is finding out "customer needs" or simply a "need" and thereafter defining important demands for the development. Need-based development is *reactive* in nature as most or all important demands are known or can be found before the development starts. Often also different solutions to reach targets set up during the initial development concept phase/stage are or can be known. Therefore need-based development, on which the conventional principles are based, is of the type reengineering.

The focus on *needs* has contributed to the portfolio development in larger companies changing in an alarming and dramatic way since the 1990's from new to the world innovations to improved & modified existing products (see table 1-1). Thus, in 2004 "businesses were preoccupied with minor modifications,

product tweaks, and minor responses to salespeople's requests, while true product development took a back seat" (Cooper 2005).

Development Project Type	% of Projects in the Development Portfolio		
	1990	2004	% Change from 1990
New to world – true innovations	20.4%	11.5%	43.7% decrease
New product lines to the company	38.8	27.1	30.1% decrease
Additions to existing product line in company	20.4	24.7	20.8% increase
Improvements & modifications to existing company products	20.4	36.7	80.1% increase
Total	100.0%	100.0%	

Table 1-1: Breakdown of the portfolio by project types 1990 and 2004 (Cooper 2005)

A connected trend in larger US industries using the conventional methods is that the more they use these methods the more the product development impact and profitability decrease. According to a large study (Adams & Boike 2004) new product sales fell from 33 % of total company sales in the mid-1990s to 28 % in 2004. The same study also showed that profits derived from new products went down from 33 % of business profits to 28 % over the same period. Cooper (2002) showed that the success rate was 18 % of "Me-too products", 58 % for "Products with moderate advantage", and 98 % for "Truly unique & superior products" (success and failure was measured from a financial, or profitability standpoint). A large study by Deloitte Research showed the paradox that companies were aware of the importance of innovations but did little to change the situation (Koudal 2005).

From these and other studies it seems like high time to turn to dynamic principles if more new successful innovations are to be developed.

1.5 From needs to wants and wishes

Innovative development is based more on a want or a wish than on a need. A *want* situation for a company is e.g. when a salesman has experienced that some users should benefit from having a product that has other features than the existing products on offer by the company. The salesman, therefore, should like to have a new product to sell that satisfies the expressed wants.

For users a *want* situation means a situation of less urgency then when the user has a need. To make a product that satisfies a want often means that new technical solutions must be developed eventually, including technology that is not yet available or too expensive to use.

One example of a want is when a sportsman wants new solutions when competitors have improved their

results. Another is when a surgeon needs new instruments to take care of the technical development e.g. in diagnostics. When the users are capable of finding their own solutions to such needs and the solutions can be patented, these inventors can be called professional or technological inventors (Ottosson 1983). The solutions reached by them are often of high quality and usability. Another notation of these inventors is *lead users* (von Hippel 2005).

When a want situation arises one generally has some time to develop a solution, which also is needed as the possibility to copy already existing solutions or parts of solutions is much lesser for want situations than for need situations. Instead of re-engineering, as is most common, a want situation requires a higher content of product design/innovative development. Therefore, it does not make sense to make long term detailed plans to reach the target as many unknown problems have to be solved along the way, destroying thoroughly developed plans.

A *wish situation* is when someone expresses a wish for a visionary product or solution. By asking people what they would like to have if there were no technical or economical limitations, a company can get some ideas on which to base further work. Another input for a company to get a feeling for what in some years can be a new market possibility is to study lead users and trends. Investigating new scientific breakthroughs in ground research (e.g. physics, chemistry and mathematics) and/or more applied research fields such as medicine, bioscience and ICT (Information and Communication Technology) can also bring ideas for new products. Investigating patents is another way of finding ideas.

When a wish situation is at hand one in general has time to develop a product solution but it is often quite impossible to predict when a solution will be ready. Thus an open end of the project is at hand, which is outside the classical definition of a project – which should have a clear limit of Cost, Time and Quality.

1.6 Walking through the labyrinth

The development of completely new products and businesses means that few experiences exist from which to benefit. Successful new product development therefore differs considerably from reengineering and the development of products and businesses for which much experience exists to build further from. When carrying out the innovation process the developers will often, especially in the beginning of the work, experience chaotic and complex situations. Until they reach a stable product situation, i.e. having reached into the complex domain in figure 1-1, it will feel like walking through a labyrinth (see figure 1-4). As the business/product developers often have to rely on very little and/or unreliable information they may have to make decisions that later often show to only bring them to dead ends. Therefore, they often have to go back and try again until they have found the successful path.
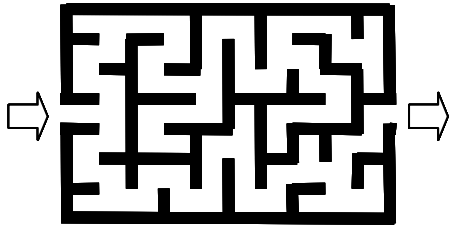
Figure 1-4: New product & business development is like passing through a labyrinth with high walls. The way to get through it is unknown until the labyrinth has been passed

The classical/conventional methods do not accept a labyrinth situation as base for business/product development and have few tools, strategies, or tactics to deal with uncertainty. The philosophical background for the dynamic principles is a view that we, more and more, have to benefit from changes and chaotic situations while the traditional management principles are focused on how to avoid change. Therefore to find philosophical support for how to handle chaotic and complex situations, inspiration has been taken from Quantum physics, Chaos theory and Complex Adaptive Systems while the principles behind the need-based principles are Newtonian mechanics, Taylorism and the Bureaucratic School (Ottosson 2003). Adopting the Dynamic Principles means making a leap in efficiency that sometimes is called to make a quantum leap. As the shape of the curves (see figure 1-5) is similar to *quantum leaps* in physics the term quantum leaps is sometimes used (e.g. Zohar 1997, Kaku 1998, Wheatley 2006).
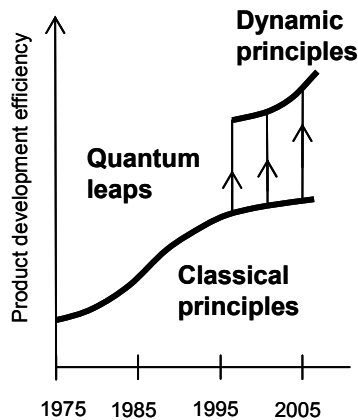
Figure 1-5: The more the Dynamical principles have developed the larger the Quantum leap benefits have been when going from the Classical principles to the new principles

As PLCs get shorter and shorter the dynamic view becomes more and more needed for all domains in figure 1-2.

14

2. TERMS USED IN THE BOOK

As there are no standards for terms used in product and innovation development, the central definitions the author has used in the book are explained below:

Business development is done to secure that the business of a company becomes successful sooner or later e.g. in economical terms. When a new business is developed based on a new product that is called *innovation development*. The development is done as an *innovation project* normally with the four integrated teams; sales, marketing, product, and production (for software products there is no production). The development process from idea to commercial product is called an *innovation process* (a *project* is a unique activity, while a *process* is a repeated activity).

For a new product to be an *innovation* it must have been sold at least to one customer (Ottosson 1999-B). The product should also have been used frequently. Thus, it is not enough to sell a new product to someone who never uses it or only uses it once or a few times. When many users are using the product and a need has been created in the market for the product, it has become a standard product. Thus, a *market pull* instead of an *innovation push* (Ottosson 2004) has been reached meaning that spontaneous orders start to come to the company.

A *product* is either tangible or intangible (e.g. a software program or a service provided on the Web) or a combination of both. More and more tangible products, in fact, are being produced with larger and larger intangible contents (e.g. cars, toys, etc.).

Tangible products of the type *goods* are special as they have both hard and soft values (Ottosson 1999-B). Hard values can be called *Functional values* while soft values are *Sensorial values* (what we experiences with our senses) and *Image values*. The hard values can be defined and measured objectively while the soft values will be viewed individually by each user. Also impressions will change with time and the mood of the user. Generally speaking, the soft values are getting more and more important for the customers and users e.g. as an increasing surplus of products with similar functional values means an increasing number of competing products to choose among for the customers.

A New Product is a product that is new both for the company producing it and for the market. Not to cheat the market the new technical content of the new product should be at least 60 % compared to the existing products of the company (by "new" content we mean newly developed or reengineered details and/or systems) (Ottosson 1999). The sensorial values of an existing product that is to be marketed as a new product should also be changed, so that the customers/users/consumers will experience the product as a new product. Thus, if e.g. a new refrigerator contains the same technical solutions as another refrigerator but is painted in a new color, it does not fulfill the demands to be a new product. Also, if the color of the new refrigerator is not changed and if the same disposition of the cabinet is used as for existing refrigerators but the whole cooling system is changed, it is not a new product.

By investigating and classifying patents the novelty of products has been classified in five levels as is shown in table 2-1

Table 2-1: Levels of novelty in investigated patents during the 1970's and 1980's (Altshuller 1988)

Level one	Routine design problems solved by methods well known within the specialty. No invention needed. About 32% of the solutions fell into this category.
Level two	Minor improvements to an existing system, by methods known within the industry. Usually with some compromise. About 45% of the solutions fell into this category.
Level three	Fundamental improvement to an existing system, by methods known outside the industry. Contradictions resolved. About 18% of the solutions fell into this category.
Level four	A new generation that uses a new principle to perform the primary functions of the system. Solution found more in science than in technology. About 4% of the solutions fell into this category.
Level five	A rare scientific discovery or pioneering invention of essentially a new system. About 1% of the solutions fell into this category.

Product Development means all activities to develop a product starting with a need, a want or a wish and ending with a product ready to sell and use. Seen from a philosophical point of view the driving force for developing a product should be "to improve quality of life for at least one individual without decreasing it for any other individuals and/or the environment" (Ottosson 1999-B). To ensure that this principle is not violated, laws and rules are agreed upon in the international political society.

With *New Product Development (NPD)* is meant the development of New Products.

It's a long time since one single inventor or engineer, isolated from the world, could develop a new product that would become a sale success. The contribution from inventors today often is to give input for the development of a new invention to be an innovation. Then the development work is generally done by a team of people with different skills and experiences working together in *projects* and sub-projects. When teams are formed with people from different disciplines such teams are often called *integrated teams* making *integrated product development*.

Product development builds on knowledge from basic research, applied research, and technological development (see figure 2-1). Basic research is normally done at universities although large companies can have units that perform basic research – IBM researches have e.g. got Nobel Prizes just to take one example. Applied research is in general done both at universities and research institutes. Technological development in industries is often called Research done at one place while the product development – or in short development - is done more locally. E.g. Autoliv, which makes safety equipment for cars, makes technological development (research) at its head office in Sweden and makes product development close to its customers in the different countries where they have their product development of the new cars.

Product development has as its aim to make products that can be sold while technological development does not have that aim. Research and development is often abbreviated R&D.
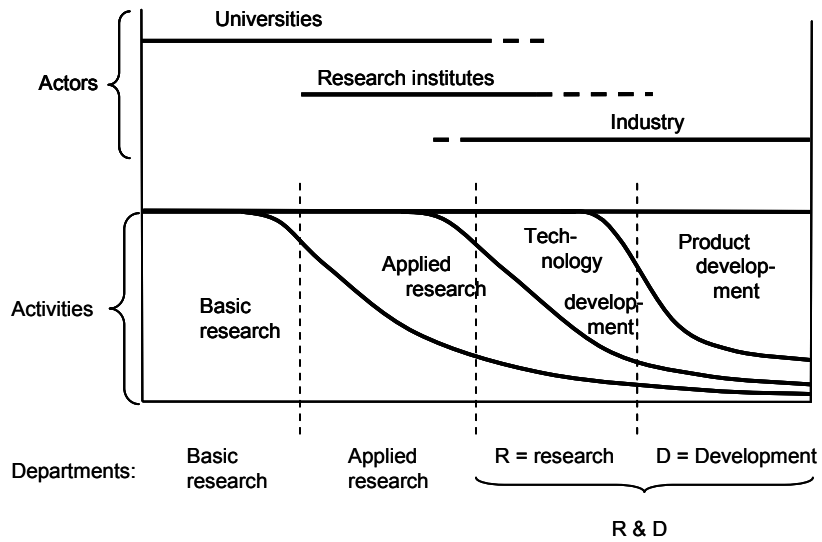
Figure 2-1: Actors and activities in product development related fields

3. INNOVATION MANAGEMENT

3.1 Innovation management is complex

Innovation projects can be of different sizes, duration, and complexity levels. The risk of failure in one or more respects - as overdrawn costs and time, low satisfaction rate, poor performance, burnt-out team members, etc. - is dependent on many factors. In figure 3-1 some important factors are shown that will influence the risk factor and the outcome of a project in general and an innovation project in particular.
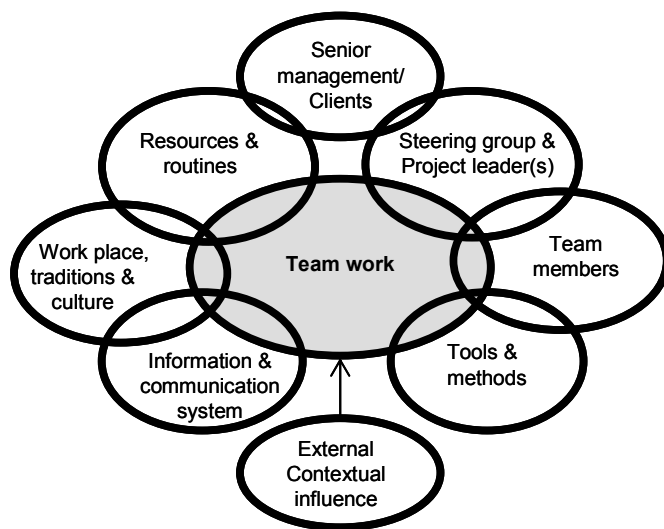
Figure 3-1: All projects are dependent on many factors that in turn are time dependent, making them truly complex/unforeseeable (Ottosson 2005)

Most of the factors in figure 3-1 are 'soft' and difficult to measure and handle. Unfortunately most research interest has been focused on tools and methods and sometimes it seems as if people think that if the 'right' tools are used a good result of a development process is guaranteed. That is as bad as believing that a good business plan for a new product will guarantee success, if only enough venture capital is available. In business-related research the researchers often claim that having a good business plan, a well thought business strategy and the right products, will guarantee success. In reality the success is heavily dependent on the work of the entrepreneur and her/his team. Endurance is also needed as it often takes 4-5 years to see if the new business will be a success or failure. That was e.g. the case for Ingvar Kamprad when he built up IKEA to the great success it is today giving him enormous private wealth. The same goes for Bill Gates and Microsoft. Surely the business plans they started out with are not the business plans that came to be the success stories. An example of how the business idea of IKEA developed in spite of the resistance Mr Kamprad experienced in the market is (Markides 2000, p 150):

> When Ingvar Kamprad, IKEA's founder, tried to crack this market, he was shut out at every turn. Barred from selling directly at trade fairs, he resorted to taking orders there. When that was forbidden, he contacted customers directly (initiating a profitable mail-order business, which necessitated that the

furniture be easy to ship). When Swedish manufacturers refused his business, Kamprad sourced from Poland, getting even better prices than before. Locked out of traditional outlets, Kamprad converted a factory into a warehouse and showroom, where explanatory tags, self-service, a colorful catalog, and the lure of instant availability—thanks to on-site stocking—were deliberately distinctive. In every instance, the strategy was driven as much by necessity as it was choice. . . . In hindsight, IKEA's positioning is indeed brilliant and is indeed a source of real and sustainable differentiation. The position, however, was as much a consequence of adaptability as it was of strategy. It was persistence—and experimentation under the strict discipline imposed by constrained resources—that allowed IKEA to build its furniture franchise.

Figure 3-2 shows in principle the importance of different "components" when making a successful innovation project. Note that the importance of the product – i.e. the product idea/invention/business idea - is very small and decreasing from when the innovation project started. Often it is only a door opener to a new business and in the long run the successful product will be quite different from the initial product idea/invention. A good entrepreneur will see to it that the business is good even with a poor product idea/invention/business idea to start with! A good product idea/invention/business idea with a not so good entrepreneur will be a disaster! Thus, the entrepreneur is critical to success and she/he is the critical factor for a long time after the start of the project.
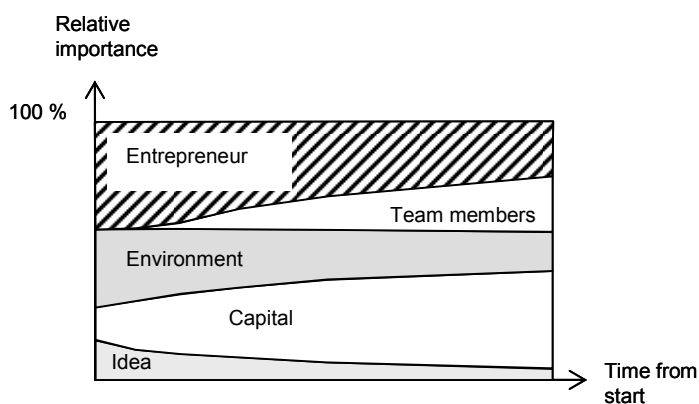
Figure 3-2: The success factors of an innovation project from the start and onwards

3.2 Leadership

To *lead* basically means to show the way for others to reach a goal. The activity to lead is called *leadership*.

No activities done by more than one person involved will function well without some kind of leadership (e.g. Stewart et al. 1995, Kelly 1998). If no formal leader is appointed self organization will occur and the leadership will probably be "jumping" between team members depending on situation and time.

19

Often three principally different ways of leadership are defined. They are:

- *Lassez-faire (free) leadership:* This type of leadership means that the team members have to organize themselves to be able to do the work. After some time an informal leader will generally be appointed by the team. However, if an informal leader does not appear, and if the team members can or will not cooperate with each other, the free leadership can lead to anarchy. Flat line and matrix organizations (organizations with few management layers) in large organizations will lead to Laissez-faire leadership if the managers on each level have more than about ten subordinates. This is especially the case if the leader is weak and has problems making decisions. In such cases the *"we-feeling "* will become dominant if the team members fit well together and no one takes personal advantage of the situation. On the other hand the *"I-feeling"* becomes dominant if an informal leader with an authoritarian leadership emerges in the group.

- *Authoritarian leadership:* The manager/leader decides everything on her/his own without first hearing the views of the subordinates. As orders go down and information goes up a line organization chart can be sketched to show this reality. The more authoritarian the leader gets the less the subordinates will be allowed to have direct contact with each other. The ultimate and optimal situation for the authoritarian leader is to exchange people with robots that will not cause emotional problems and that will not do things in ways other than what the leader has thought of and ordered. The security of the team members is dependent on to what degree the leader needs to be and is satisfied. To some extent the leader looks down on the subordinates and, in bad cases, can try to increase the respect for her/himself by turning one (or more) of the team members into a scapegoat or an object of abuse or ridicule. An introverted *"I-feeling"* becomes dominant in the hierarchical structure formed by this type of leadership.

- *Group oriented leadership:* The leader has in this case a softer/human touch acting more as a guiding parent for the team. Such a leadership does not mean that the leader has abdicated the position as leader but has chosen another way to get things done as she/he is convinced that the result will be reached quicker and better with less energy consuming conflicts if the subordinates can influence the work and are required to take responsibility for their own contributions. Therefore the leader starts dialogues about how to solve principal problems and to choose which directions to take when crossroads are reached. The decisions are, in general, taken in consensus and democratically. Doing so the team members will understand why a certain decision is taken and will thereby be positively motivated. Team members being encouraged to have cross contacts with each other supports the group oriented leadership and a *"we-feeling"* will develop in the team.

The three types of leadership executed by a leader are symbolized by:

- Trust (Black box thinking)
- Control
- Dynamic feed-back

The "Black box" leadership means that the leader hopes that things will be as agreed upon, – which they seldom are. Thus in this case the leader has no interest in looking into the box to influence the work being done there. When she/he imposes controls in the box at "gates" or "tollgates" or "milestones" in advance, she/he will get a better view of the situation but still mainly has to trust the information given. Based on the information given a Go or Kill decision will be taken at the control points about the further development of the project. Jumping into the box and giving feed-back on what the leader experiences means a situation when she/he knows what is going on and is better able to guide the project to a satisfactory conclusion.

The true commonly used line organization has as its base an authoritarian leadership. The softest management – an outsider management - is used when the manager only occasionally meets with her/his subordinates and only at these points do they feel pressurized. When the manager is at the centre of activities (insider management) most of the time and is of a dictatorial disposition, this is considered to be hard pressure, as the subordinates cannot escape from under the manager. Figure 3-3 shows the two management situations.

Figure 3-3 shows the two management situations.

● Manager　　　● Assistant　　　○ Sub manager　　　○ Team member
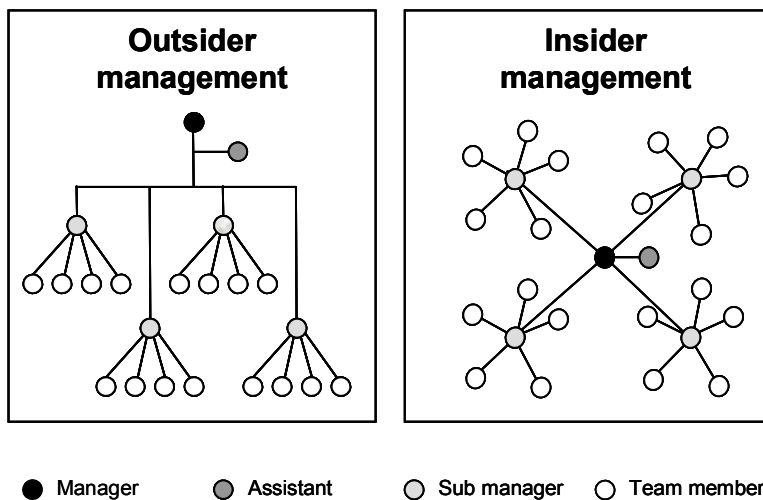
Figure 3-3: The traditional line organization means a softer management than insider management shown in the figure on the right.

The Laissez-faire situation means no formal leader/manager as is shown in figure 3-4. A similar situation will occur in a flat line organization with few middle managers and the flatter a line organization gets, the more dominant the Laissez-faire leadership will be. This is the result of the leader having few opportunities to maintain close contact with all her/his subordinates. However the more subordinates a leader or manger gets in a "flattening " process, the more natural it also gets for her/him to change over to an authoritarian leadership. At the same time the possibilities increase that one or more members of the group will step forward to become informal leaders in the absence of consistent manager/subordinate

contact. The informal leaders can, in the worst cases, be very dictatorial as their mental power over the group will be greater than that which a formal leader could gradually build up using punishment to create fear and insecurity among the team members.
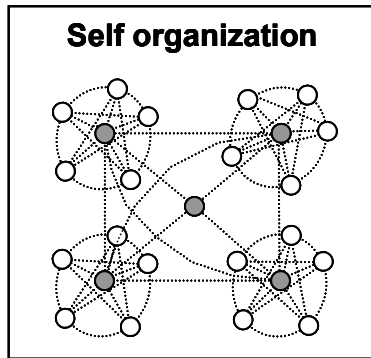
Figure 3-4: When no formal manager is appointed self organization will occur, meaning dialogues taking place between the team members in order to solve problems efficiently

The group-oriented leadership can be achieved when insider management is combined with self organization (see figure 3-5). When performing team work – as well as all types of work together with other people – group-oriented leadership is preferable for obvious reasons. However, in critical situations – when a negative chaos situation occurs or is emerging - an occasional authoritarian leadership can be needed to avoid chaos or to quickly get out of a chaos situation. When the democratic leader knows the team well such incidentally authoritarian leadership is normally well understood and accepted by the team. The "Dialogue" mentioned in the figure also means information sent by e-mail/intranet both inwards to the leader and to the other team members on the same level.
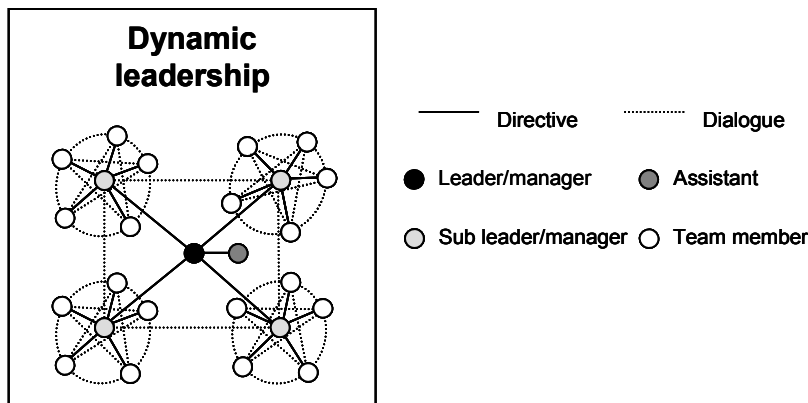
Figure 3-5: Exercising dynamic leadership means to be present in the middle of the activities allowing a controlled freedom in the team

To be able to practice a positive group leadership, the leader must:

- communicate a clear vision of the goal with the project,
- engage suitable sub-project leaders and to let them engage their people,
- draw up strategies and targets as well as giving guidelines for the work,
- break down the work and distribute work packages to groups and individuals,
- ensure that the team members work toward close and distant goals,
- notice and reward good work both on an emotional and practical level.

A leader who is present much of the time in the project work, who performs *Management by Walking Around – MBWA*, has natural possibilities to notice at an early stage when things are not going well and when dangerous attitudes start to emerge. She/he can, in such cases, immediately or quickly initiate changes in the work and gradually change attitudes in the group. Such changes demand pedagogical skills, patience and persistence. The deeper an unwanted attitude has gone, the more time the leader has to spend with the team members to ensure that a sustainable change will take place.

When the work goes satisfactorily, the leader must spend time making sure that the project is up-to-date. Therefore, project leaders must always strive to be a few steps ahead of the work. As a consequence, the project leaders – and especially entrepreneurs - must be very mobile to be able to be in frequent contact with the customers, society, researchers, experts and other important external people without losing contact with the project workers. By using MBWA, project leaders will know the real status of the projects long before written or oral reports reach them. Thus, dynamic project leaders are moving back and forth between being in the middle of the project work and being in the "market". They will act more than react and are not afraid of loosing control, as their horizontal and vertical feedback systems supported by the planetary thinking (see figure 3-5) will always provide them with correction possibilities when needed.

A metaphor of how the more bureaucratic/administrative project leader acts and how the

dynamic/entrepreneurial project leader acts is shown in figure 3-6. In classical mechanics, the same amount of work is needed to push or pull an object but in reality there is a big difference in efficiency when the object is a project team. To ensure that the distance does not grow too great between the project leader and her/his sub-project leaders and their teams, it is important not only to have an efficient administrative system and an early warning system when things start to go wrong. It is also important to have a dynamic control system in which the team members can continuously update what they have done and what they plan to do in the near future, such as one week ahead. With modern Intranet systems such activities have become easy to do. However, "writing on the wall" which we will come back to, has shown to be a good complement as not everybody reads Internet or Intranet information.

The manager   The entrepreneur
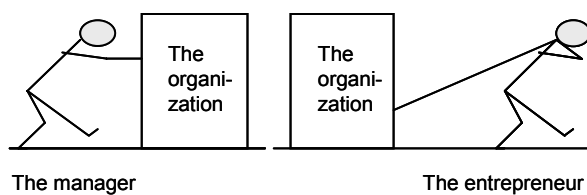
Figure 3-6: A bureaucratic/administrative project manager pushes the organization, mostly reactively, while a dynamic (entrepreneurial) project leader actively pulls the organization

Research on leadership since the 1980's has dealt a lot with change and the development of products, processes, organizations and people. The *transformative leaders* (the entrepreneurs) take care of progress and change while the *transactional leaders* (the managers/bosses) take care of the administration of the existent situation. Project leaders in general – and entrepreneurs in particular - should be transformative and not transactional, as the projects must be transformative. However it is not uncommon that, especially in large companies and public organizations (e.g. hospitals), administrative managers are appointed instead of entrepreneurial managers as project leaders. That is surely one reason why so many projects are not successful. Also it is quite common that planned projects are not transformed into performance projects, when that was the aim of the total exercise.

3.3 Innovation project organizations

At the start of a project a *Steering Group* is normally set up which will be responsible for appointing the project leader, financing the project and for the outcome of the project, except in cases where an individual starts a project on his/her own.

When a dynamic view is used the responsible Steering group can be called *New Business Board* as that name clearly tells what the group function is – not just to make a successful innovation but to form a new business with a life after the innovation project has finished. The New Business Board – which also can be called *Innovation Board* if it has a more limited mission - is an insider group from the project. To secure direct and undiluted information between the New Business Board and the project leader she/he should be a full member of the Board. Ideally one board member with experience from the commercialization of new products and one board member with experience of new product development will act as *"Comets"*

in the project (see figure 3-7) to support the project leader and to ensure that the Board members have the right information to make critical decisions when necessary. Another important mission for the comets is to give suggestions built on their experiences and to, in a narrative way, improve the knowledge of the team members. In addition the comets will help find out when "enough" good levels have been reached in the development, which is a problem for inexperienced team members and team members with low self confidence.

| ● Chairman | ● Project leader/manager | ○ Team member | ⊘ Board member - Comet |
| ⊘ Board member | ○ Project assistant | ○ Sub project manager | |
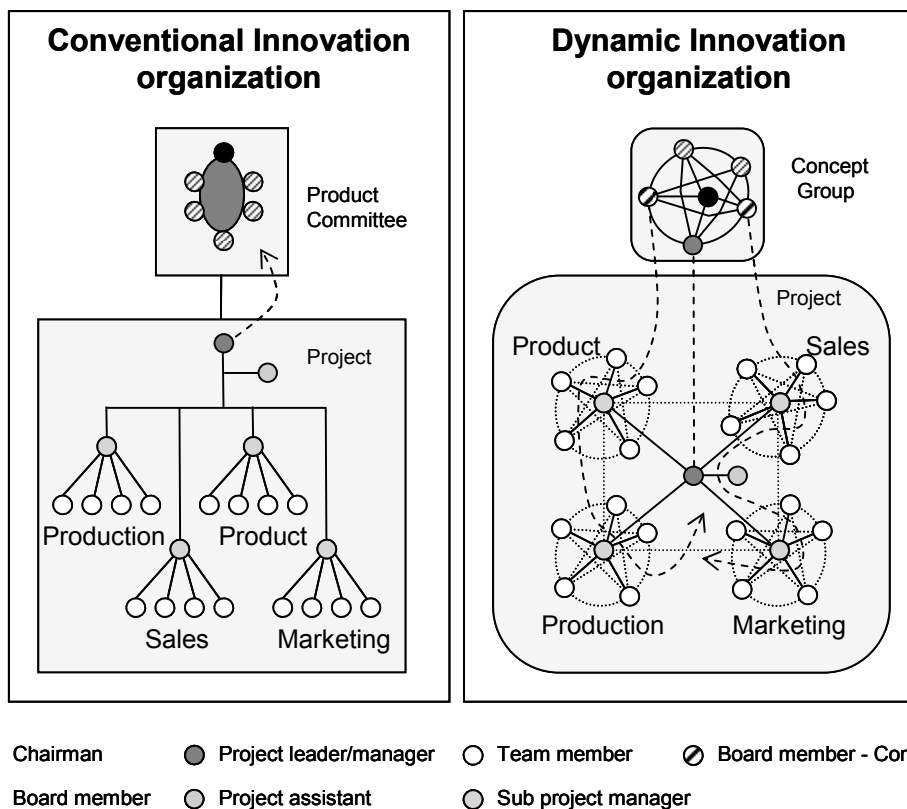
Figure 3-7: In the dynamic innovation organization the New Business Board is an insider board of the innovation project (c.f. fig. 3-5) which is opposite to the situation for the conventional innovation organization. In the dynamic organization the project leader is also board member.

As pointed out, for each team member in the Innovation Project and its sub-projects to be well informed reports using web support via Intranets are going to all who need to have the information instead of only going upwards as in the line organization.

As also explained, the insider management view means a tighter and softer control situation reducing the technical failure risks while the commercial risk is largely dependent on the quality of the entrepreneur and the sales people (Ottosson 1999). The reason for the reduced failure risk with an insider management view – supported with comets - is that projects will not continue too long in the wrong direction when problems occur or when other competing better solutions are experienced. This is because the New

Business Board, through the project leader and/or the comets, will get immediate information of such situations.

From when an innovation project starts to when it is transformed into ordinary company activities or when it is established as an own company (c.f. figure 1-2) the activities in the New Business Board and the Innovation Project follow the dynamic approach in principle as is seen in figure 3-8. (The total worked hours done by the board members and the project team will vary with time but by normalizing them to 100 % e.g. for each week it becomes easier to reflect on how the resources were used in each development step. The project box in figure 3-8 with its curves thus represents on the vertical axes 100 % work hours for each week. We will come back to this way of representation in chapter 7.3)
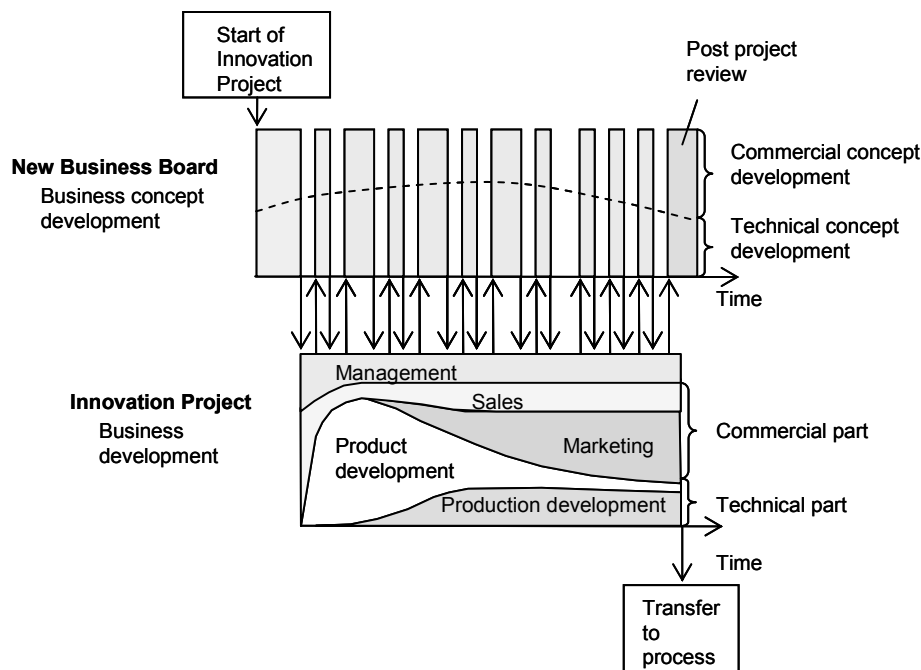
Figure 3-8: Between the New Business Board and the Innovation Project there must be a close connection in order to reduce failure risks

As the Board has the total responsibility for the innovation project it can – as is indicated in the figure - be rational to let one part of the board members have a special responsibility for the development of the commercial concept while the other part is responsible for the development of the technical concept. The interaction between the project and the board can be done through periodical reports & meetings, dialogues & deliberations, review meetings, milestone reports and/or reviews.

The conventional methods in general do not discuss sales of the innovations at all or regard sales as something that comes late in the development chain. However, early sales means faster and safer development than if a real customer and/or a real user is not directly or indirectly involved in the

development. Therefore early *Sales* is – as figure 3-8 shows - extremely important when dynamic innovation development is over.

Figure 3-8 also indicates that a minimum staff for each activity shall be used – which at the start and end of each activity means only the sub-project leaders. When product development (PD) needs more manpower the PD team is expanded. When less people are needed the team is reduced so as to always have a minimum of people working in the project. Having a minimum of team members at each moment of time means higher efficiency and lower costs.

A simultaneous start – a kick off - with all the people needed for the next development step is slow and costly, as it will take time to bring all the team members to the same understanding level before work can start efficiently. Instead, adding people when needed and starting every new work sequence with few high performing experts is an efficient principle of the dynamic business development method! In figure 3-9 an example of the manning of a conventional development (called SG in the figure) and a dynamic product development (DPD) sequence can be seen.
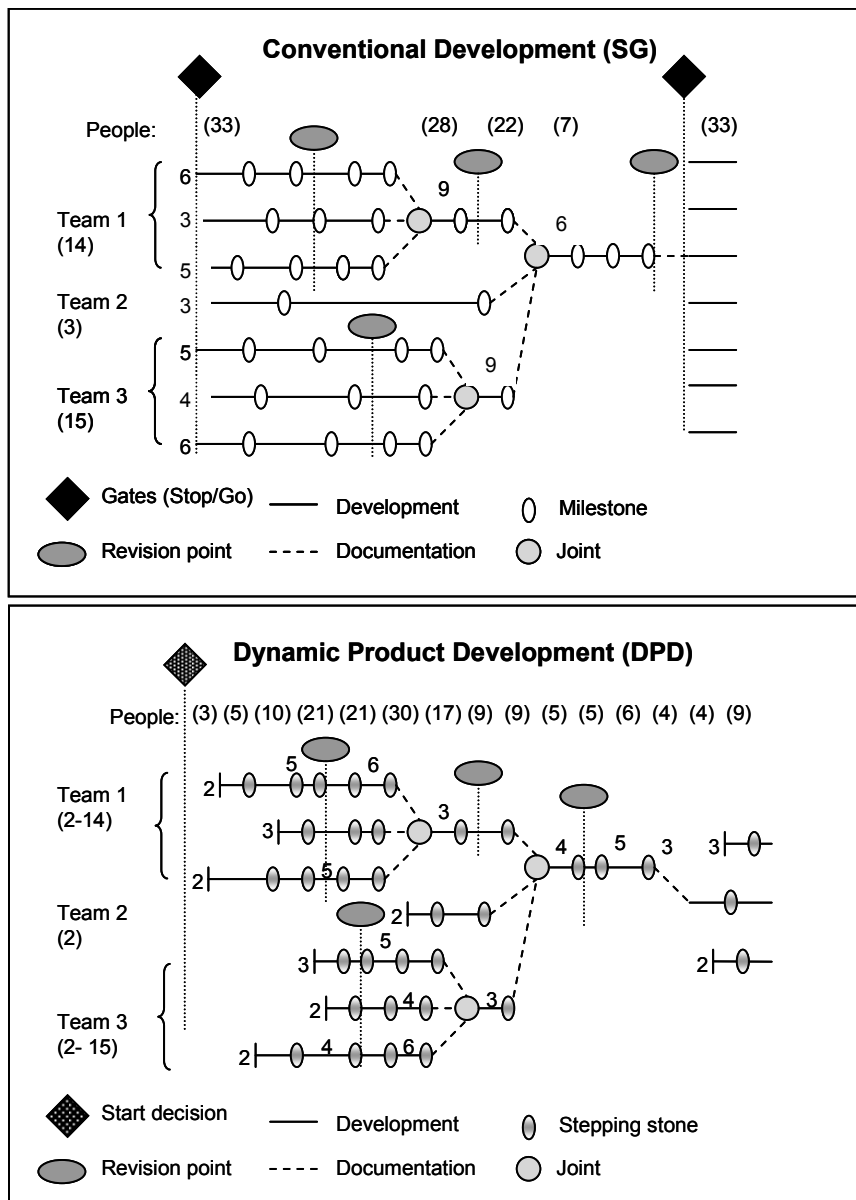
Figure 3-9: For Conventional Development more team members are needed than from Dynamic Product Development (see also figure 3-10)

[Stepping stones in DPD are like stones in turbulent water in a creak that can be used to jump from one side to the other. In military terms it equals "take the hill and be prepared to take the next hill and thereafter take the third hill". Milestones and gates in the conventional methods do not have the dynamics of stepping stones. Stepping stones will be dealt with again in chapter 7.5.]

28
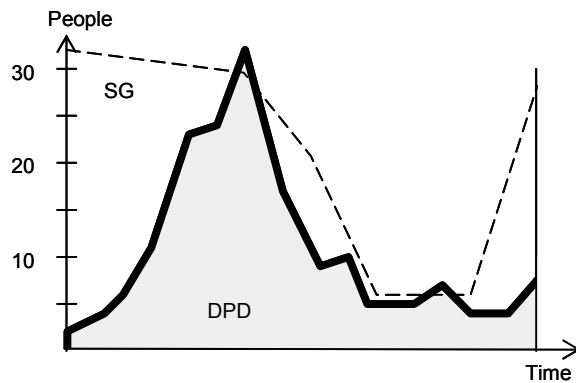
Figure 3-10: The two different ways of performing product development in figure 3-9 means a different use of manpower to reach the same goal

3.4 Project sizes

Most of what has been written about projects has its origin in the study of large or gigantic projects, which is easy to understand as the economical consequences of mistakes in big projects are big. Large organizations and large numbers are also fascinating for researchers and management consultants as such organizations represent a lot of power and importance. At the same time there is money available for studies and improvement in large organizations in a way that in general is not the case for small projects and small organizations.

What characterizes large projects is that they take a long time to complete and that many factors influence the result. Therefore it is difficult to draw conclusions from them on a detailed level, which is bad as the "devil is in the detail". Also the Chaos theories tell us that small changes are the origin of early exponential development until a critical mass has been reached at which point it is difficult or impossible to calm the situation down.

However, findings from large and gigantic projects are that sub-projects of no more than 6-10 team members make the most efficient teams (e.g. Quinn 1985, Cusamo 1997, Tabrizi & Walleight 1997). That is also in accordance with our experiences. We should keep in mind, therefore, that efficiency seems to decrease rapidly when more members are added above 5 – 10 team members for each sub-project. Communication becomes difficult when the number of communication routs increase with the addition of new team members.

An exact mathematical formula for the number of communication routs C depending on the number of team members N is shown in figure 3-11 together with some examples.

$$C = N(N-1)/2$$
where
C = No. of communication routs
N = No. of team members

N = 2
C = 1

N = 3
C = 3

N = 4
C = 6

N = 5
C = 10

N = 6
C = 15

N = 1000
C = 499500
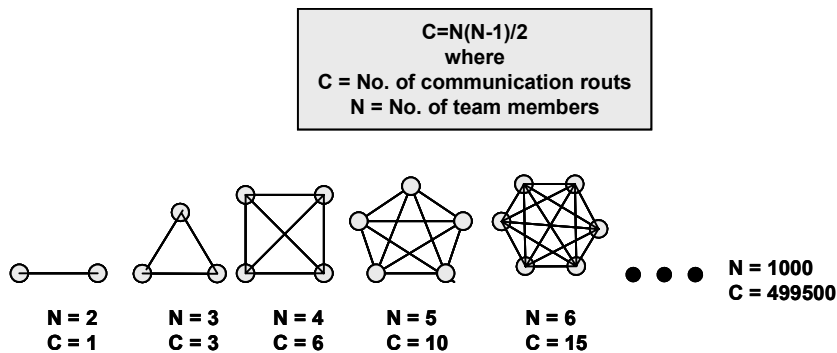
Figure 3-11: The number of communication routs depending on the number of team members

Thus, the number of communication routs grows by the square of the number of team members. Due to this formula and to practical experience, it is important to break down projects and sub-projects with many team members into smaller sub-projects giving each group specialized tasks to do. ISO 10006 uses the term *WBS – Work Breakdown Structure* to describe the goal of such a dividing process. The project leader and the sub-project leaders respectively, must be responsible for the break-down work.

It is clear that the efficiency factor between people can be quite large even though they have the same education. At Microsoft one has e.g. estimated the difference in productivity between the "best" software programmers and average programmers to be a factor 10 (Cusamo & Selby 1995). A consequence of that knowledge in combination with the formula in figure 3-12 is that it is better to have few very skilled people working in a team than having many average team members as the number of communication routs grow so fast.

Thus it is defendable to use one high performing expert and to give her/him, let's say, a salary that is ten times the average salary instead of using ten not so productive programmers. It is clear that ten not so productive programmers have to communicate more to be able to fulfill the task according to the communication formula. The more communication needed, the longer it will take to do the work. This conclusion is also in accordance with the so called Brooks law (Brooks 1975) saying that: "Adding manpower to a late software project makes it later". Brooks law is surely valid not only for software projects but for all types of projects!

3.5 Manning principles

It is common knowledge that when a development team is to be formed – and especially so for an innovation project as it is more complex than other projects - it is first of all important to find a project leader with a suitable personality profile for the mission both when things are running well and when unforeseen problems show up – which they tend to do in development projects. The view of life and the competence questions (knowledge and experience) are other important factors to take in consideration.

It is very important that the project leader be allowed to choose her/his closest subordinates her/himself. The same principle should apply when the subordinates in their turn start to recruit. Having that recruiting principle means that the personal "chemistry" will work well from the start. No one is going to choose

someone who is difficult to work with or has low work efficiency record. People coming successively to the project will be planned for so that they can start to work as soon as possible.

Unfortunately, it is often common that the human relations (HR) staff in an organization appoints project members and supplies the project leader with them. In severe cases the project leader is even appointed after the project team. An extremely inefficient start will be the result of such a manning principle. It will also create a difficult psychological situation when everyone has to find out how everyone else thinks, acts and behaves. Territory will be marked and efficient work will be low for a long time. To reach full efficiency from a simultaneously starting team can take months even if they are in the same place and have no work to do other than the project work.

When a team is to be set up, the different personalities that each team member has will be of great importance for the outcome of the work. Also, depending on the unique personality everybody has, she or he will be more or less suitable for the different topics to be dealt with in the project/sub-project. Examples of what are required in personal profiles are often that they shall be active, social, flexible, creative, enterprising, positive to changes, caretaking and warm-hearted. However, if the person is not competent in her/his work it does not help much to have the best soft values in the world. Knowledge will therefore be discussed in the next section.

How well two or more people interact is dependent on the task, the personality profiles that each of them have, and how well they will go together - how well the personal "chemistry" will work. Thus setting up a team with the best experts in the world, or forming a soccer team with the best players, doesn't guarantee success. Also it is important to match people with different profiles instead of matching people with similar personalities and knowledge.

One complication is that the personality is not constant over time but will change depending on the situation and the people the individual comes into contact with. Thus, while in an un-pressured situation someone may have one type of behaviour, when under stress or threatened, that same person may have another. Figure 3-12 shows an example of one player from two tests on soccer players that we performed during 2002. In this case the coach decided which profiles were more important.

	1	2	3	4	5	6	7	8	9	10		
Passive											Active	AQ
Without will											Enterprising	AQ
Careless											Careful	EQ
Unconcentrated											Concentrated	AQ
Retractive											Social	EQ
Cold-hearted											Warm-hearted	EQ
Nervous											Stable	AQ
Unsure											Sure	IQ
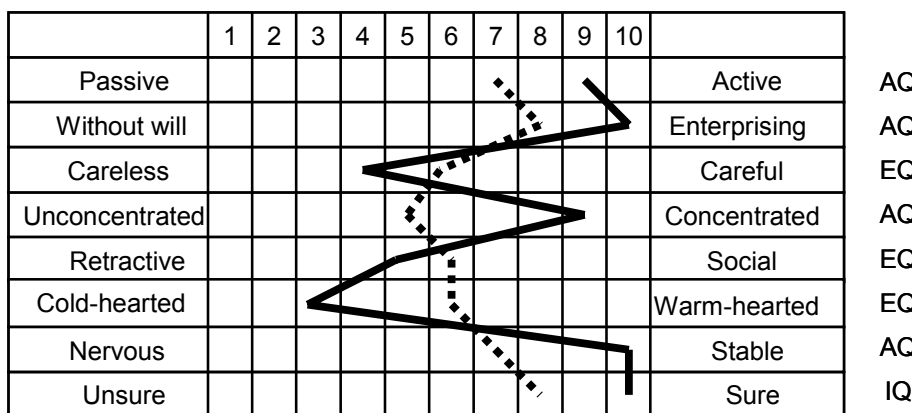
Figure 3-12: Important personality dimensions for soccer players. The solid line shows the behavior of

one player in relaxed situations. The dotted line shows his behavior when he was physically and mentally exhausted. To the right of the table are centers of gravity with regards to IQ (intelligence), EQ (social competence), and AQ (survival competence).

3.6 Knowledge and information generation

As everyone has her/his personality, everyone also has a different knowledge profile and different ability to increase ones own knowledge. Discussions about the term *knowledge* have been a philosophical topic for the last 25 centuries. Greek philosophers (e.g. Aristotle/Socrates and Platon) have already discussed knowledge as:

- Techne (Practical - Productive Knowledge)
- Episteme (Theoretical - Scientific Knowledge)
- Fronesis (Knowledge as Practical Wisdom)

The meaning of Techne and Episteme is rather obvious to us as e.g. that is how we have separated the university system from the practical world. When people speak about *Competence* they usually mean a combination of Techne and Episteme.

Fronesis is a more difficult term as it grows when <u>both</u> Techne and Episteme grow. Dynamic and life experienced people with broad knowledge and intuition are wiser than people who lacks one of these characteristics. Therefore an expert is not also automatically wise. The comets in the planetary organization need to be wise to fulfill their mission!

There exist many opinions of what knowledge is, if knowledge and information are the same thing, etc. However it seems logical to regard *knowledge* as something personal that becomes *information* when we express it to someone else either as spoken words or in written form. A big difference between the two ways of giving information is that spoken information evaporates fast if one does not make notes or recordings from a speech or a two way communication. Estimations tell that less than 20 % of the information that we get is used to build up new pictures of the world in our brains while the remaining part comes from pictures stored earlier in our brains (Wheatley & Kellner-Rogers 1999).

The personal ability to increase individual knowledge is dependent of many factors as e.g. ones own intelligence, creativity, ability and feelings in general. The ability to take in information and signals and to combine them with what one has so far accumulated on ones own, to know-why and -how to acquire new knowledge, is dependent e.g. on the mood, interest and motivation at each moment. This can be called a filtering effect. Being in a good mood, interested and motivated means that ones own filters are open to take in most information and a maximum of all incoming signals. Not being in a good mood, being uninterested and being unmotivated means that no or very little information and few signals will be able to be added to ones own existing knowledge and know-how. Figure 3-13 shows the complex reality in a simplified way.
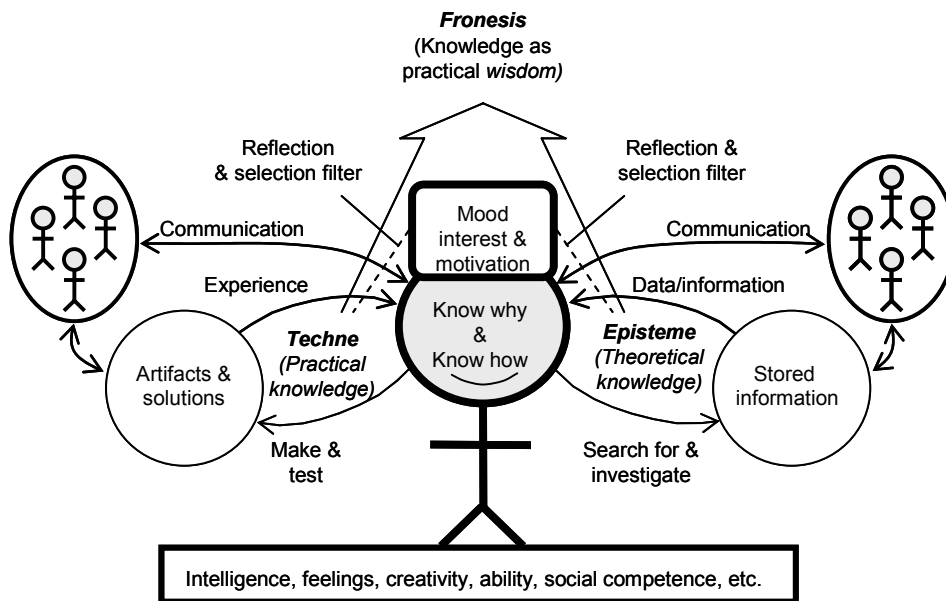
Figure 3-13: Individual knowledge and know-how is generated due to many factors of which some important ones are shown in the figure. Solutions in the figure are e.g. models, prototypes, manufactured products, etc. (Ottosson 2003-B)

The nature of *artifacts & solutions* is often difficult to understand as it is quite complex. The knowledge we acquire and the simplified theories we develop are normally stored in different ways, as in books, on files available on the web, etc. Depending on our own knowledge some *stored information* can be difficult to understand and evaluate. Other information is difficult or impossible to access as it can be qualified as secret material.

Every development process is both an iterative knowledge generation process and an iterative never ending information generation process. By going through stored information over and over again and by communicating with other people we can iteratively improve our knowledge.

As figure 3-13 shows, one important way to extend ones own knowledge is to collect and process information from other people through communication with them. If the individuals are geographically more than approximately 5 m away from each other however the total message transmitted and sensed with our five senses will rapidly decrease. (Branzell 1995). This is an important reason why it is vital that the project team members in sub-projects are localized together in localities without separating walls, which we will come back to.

Common for all information is that it can – and is – manipulated to be what the author - for good or bad reasons - wants it to be. Also reality is constructed from our thoughts of reality and there is no reality until that reality is perceived. Furthermore, no clear dividing line exists between ourselves and the reality we observe to exist outside of ourselves (Wolf 1989 p 128). Instead, reality depends upon our choices of what and how we choose to observe. These choices, in turn, depend upon our minds or, more specifically, the content of our thoughts and our mood, intentions, interest, our expectations, our desire for continuity, etc.

33

Not to be forgotten also is that the more we determine one side of reality, the less the other side is shown to us!

To deepen our understanding and knowledge of a "signaling" object or phenomena we also can - and must often - manipulate it or the environment around the object to see what kind of reactions we get from our different manipulative actions. To help us notice and evaluate e.g. weak signals we can also take help from "machines" that have been programmed to give us wanted information. We prefer often to call such information "artificial" implying that machines can think in a similar way as human beings do, which is not possible. This as a thought is not only a phenomena in our brains but also a result of how our brains actively interpret our experiences in the confrontations with the surrounding world. This is probably why all trials to design machines that think as humans have so far failed (Rose 2002).

When two individuals interact (communicate) with each other to solve a problem their collective knowledge is larger than when they do not interact. The more equal personality and knowledge the individuals have in principle the lower the collective knowledge will be implying that one – to get maximal result - should strive to compose teams with different personalities, knowledge, experiences, sex, religions, etc. The reason why the collective knowledge will be larger when people with different characteristics are brought together is that our "sleeping" knowledge from the depths of their memories will be pulled forward with the help of association tracks emerging in the communication and from our body language. This is e.g. why Brain storming can help to find new creative solutions (which we will revert to).

3.7 The entrepreneur

The project leader of an innovation project needs to be an *entrepreneur* to be able to build up a new successful business. Therefore we need to discuss the terms entrepreneur and entrepreneurship.

Not one single indisputable definition of entrepreneurship or entrepreneur exists. At the beginning of the last century Schumpeter's viewpoint (1934) was that entrepreneurs bring resources together in unusual combinations to generate profits. Marxist philosophers saw entrepreneurs as exploitative adventurers, representative of all that is negative in capitalism. Ronald Ronstadt (1984) defined *entrepreneurship* and the *entrepreneur* as: "… the dynamic process of creating incremental wealth". This wealth is created by individuals who assume major risks in terms of equity, time, and/or career commitments to provide value for some product or service. The product or service itself may or may not be new or unique but value must somehow be infused by the entrepreneur by securing and allocating the necessary skills and resources."

Wikipedia (http://en.wikipedia.org/wiki/Entrepreneur) has the following text:

> Entrepreneur is a loanword from the French language that refers to a person who undertakes and operates a new venture, and assumes some accountability for the inherent risks.

> Most commonly, the term entrepreneur applies to someone who establishes a new entity to offer a new or existing product or service into a new or existing market, whether for a profit or not-for-

profit outcome (see entredonneur). Business entrepreneurs often have strong beliefs about a market opportunity and are willing to accept a high level of personal, professional or financial risk to pursue that opportunity.

Research has demonstrated that there is such a thing as an "entrepreneurial type," with certain characteristics (such as having a father or a mother who was an entrepreneur) linked to the probability of someone being an entrepreneur themselves. There is little good evidence, however, that entrepreneurial type is linked to ultimate success of an entrepreneurial venture.

Business entrepreneurs are often highly regarded in US culture as being a critical component of its capitalistic society. Famous entrepreneurs include: Henry Ford (automobiles), J. Pierpont Morgan (banking), Thomas Edison (electricity/light bulbs), Bill Gates (computer operating systems and applications), Steve Jobs (computer hardware, software), Richard Branson (travel and media) and others.

Some distinguish business entrepreneurs as either "political entrepreneurs" or "market entrepreneurs."

Without going into details, in short, *entrepreneurship* tells how a good entrepreneur should behave in different situations in order to ensure that the new business she/he is forming will grow to become a stable business and company in the long run. In this book, we shall denote the term *entrepreneur* to a person that starts and develops a new business, building on a need, a want, a wish or new product idea and/or service idea that was not known to the public before. If e.g. the product idea emerges from a new invention made by an inventor, the business builder is clearly an entrepreneur. This is true even though the invention may be an incremental invention.

What then distinguishes an entrepreneur from a manager? As a rule, *managers* are *specialists* within their particular field and often do not possess a high level of *general expertise* which is needed for an entrepreneur. The *entrepreneur* is also the manager at the time of a company's start-up. Thus the entrepreneur differs from the traditional *company manager* principally by the company manager often being considered as not having more prioritized tasks than that of managing and coordinating the business. With the term manager, one also often imagines a person who has the responsibility for major operations rather than the initially small business that the entrepreneur may manage.

A comparison between a traditional project leader/manager and an entrepreneur is that the *project manager/leader*, does not generally have any real business role. An *innovative project*, also differs from other projects through the project not having a defined end, and that it instead transforms into a traditional company or an area of responsibility under the management of a product manager.

The entrepreneur's "compass" or "guiding rule" differs from that of the manager in many important aspects, as can be seen in table 3-2. Note that the same lines of each column should be read against each other, so that the entrepreneur, for example, prioritizes acting/testing/trading and not planning, which is the opposite of that which the typical manager generally does.

The compass of the entrepreneur	The compass of the manager
Action – frequent testing	Planning
Vision	Information
Social capital	Financial capital
Cash-flow control	Return on investment
Network resources	Own resources
Confidence	Contract
Organization	Structure
Engagement	Judging

Table 3-2: This synthesis shows the entrepreneur's and the manager's guiding rules (as per Sjöstrand 1992)

The entrepreneur's and the manager's respective focusing on concrete action, planning and vision can schematically be expressed as in figure 3-14.
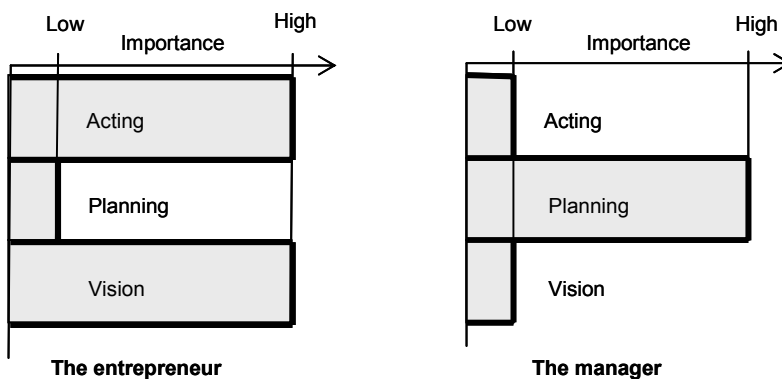
Figure 3-14: The entrepreneur's and the manager's respective focus (as per Johannisson 1992)

The *entrepreneur* has the vision as her/his guiding star, set well ahead in time, and uses the vision for tangible acting/testing that provides immediate feedback. To plan, and to wait to receive feedback from the plans will, for the entrepreneur, be static, bureaucratic and non-creative. The typical *manager* on the other hand wants to see good order, and hates chaotic situations and disorder - which are very important ingredients in a creative and dynamic business. She/he also gives priority to planning before concrete trading (Ottosson 2003).

Note that in this context, the focus of education at colleges and universities has in principle traditionally adopted the profile of the manager, which stimulates the *left cerebral hemisphere* - the analytical cerebral hemisphere of the human brain. Only in artistic educational disciplines such as for architects, industry designers, artists and actors is it the *right cerebral hemisphere* that is traditionally stimulated. The

entrepreneur must be able to move between creativity and analyses/chaos and order, which demand a different focus on education than the pure mathematical analytical focus. She/he in the daily work has to use complex logics instead of mathematical logics (see figure 3-15). [Mathematical logic is only a subset of complex logic in the same way as Newtonian mechanics is only a subset of Quantum physics (Ottosson 2002)].

Mathematical logic:

$A=B$
$B=C$ ⟹ $A=C$

Independent of time & situation

Complex logic:

A loves B
B loves C ⟹
A loves C
∘
A indifferent to C
∘
A hates C

Dependent of time, situation and X
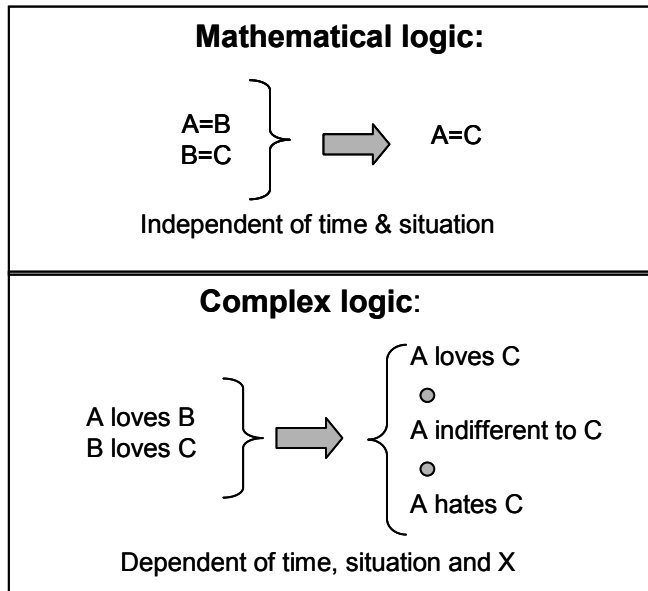
Figure 3-15: Mathematical logic is seldom applicable to complex situations (Björk 2003)

3.8 Group dynamics

As pointed out, to reach full efficiency of a simultaneously starting team can take a long time even if they are localized together and have no work to do other than the project work. One reason for that is that teams that come at the same time for a task will have to go through different stages to get to know each other before they can start to work efficiently. The five phases are (Granér 1994): The *Orientation phase*, the *Conflict phase*, the *Approaching phase,* the *Cooperation phase*, and the *Separation phase*. Figure 3-16 shows the relation between the phases.
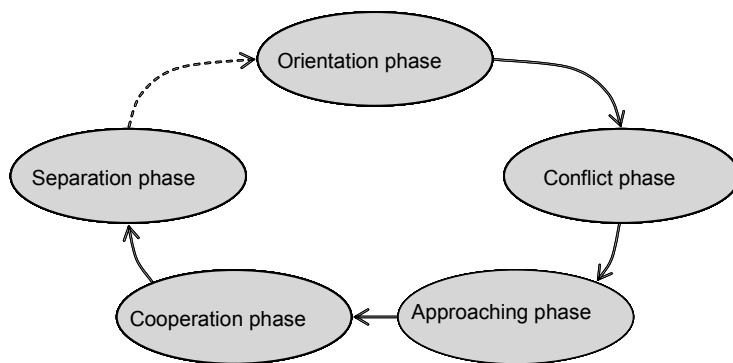
Figure 3-16: The five phases a team experiences when a simultaneous start is arranged with many people who do not know each other well in advance.

During the *orientation phase* – which is a socializing phase - the group members approach each other to get to understand how the other team members work and react as well as their opinions on different topics. How they finally get together will depend on the personalities and the 'chemistry' that will occur between each individual. In some cases two individuals will feel good together from the first meeting. In other cases they will feel as: "I simply can not work with that person!" If a formal manager has not been appointed one or more group members will take the initiatives to be chosen by the other group members to be their informal leader.

When the socializing has been going on for some time, the focus is moved to the doing of the work for which the project has been set up. As the start of a project contains many decisions and as each decision has many options, conflicts will arise when people start to argue for their view of how and in which order things should be done. The team has now come to the *conflict phase*. If the team members can not settle on the basic decisions and if a strong project leader does not make the decision, sub-groups will develop. In that situation hostility may arise between the sub-groups eventually leading to the point where they will not even speak with one another.

The conflict phase can develop into the *approaching phase* when some of the team members take the initiative to solve the problems that have been created between some other team members or sub-groups during the previous phase. Striving for harmony can result in everybody holding back information and views that may cause new fires to occur if they are outspoken. When different opinions occur the team members will compromise until a majority is in favor of a particular solution. The more team members in favor of a solution the better for the group harmony in this development phase. The more people there are in the group the longer it will take each time there is a dispute to reach a situation when productive work can be resumed. A drawback of majority decisions in project work is that they often lead to less radical solutions eventually resulting in products without edge or unique selling points (USP).

When the team members have gotten to know each other well after the first awaiting period, the conflict period and the approaching period the *cooperation phase* takes place. This is a sound period when the team members can give and take information from the other group members in a rather prestige-free way. It is not until this phase has been reached that real work can take place. In turn this means that the three preceding phases have often caused the team time delays so that it can be far behind schedule when they

finally reach the situation of being able to work well together.

When the group has completed the task or when it is clear that a new project needs to be set up, it is time to close down the initial project. The *separation phase* has now been reached. The separation phase can be like divorcing the other team members. For the team members to be able to go further in a healthy way a lot of energy should be spent on integrating memories, working through separation agony, and planning for a life outside the group. If the separation phase gets too long the problems will often be greater than if it is forced to be short (Granér 1994).

It is noteworthy that the separation phase does not exist for an innovation project in the same way as for other projects with a clear ending as it transforms into a business process for which it is important to keep the individuals and their knowledge together for a long time.

3.9 Number of projects per individual

If an individual is engaged in more than one project at a time, then each project will take longer to finish than if the projects are finished one by one. The reason for this is that when the work is to be switched from one project to the other the closing down of one and the starting up of the other means losses of time and energy (see figure 3-17). In the shown case thus upper Project 1 is finished T_1 time units before the lower Project 1 when the team members share their time with Project 2. Project 2 is finished T_2 time units before the lower case. For purely economical reasons, therefore, it is unwise to let people be engaged in more than one active project at a time. For personal reasons it is also unwise as the stress level will increase with every project except for the first, which can eventually lead to burn-out.
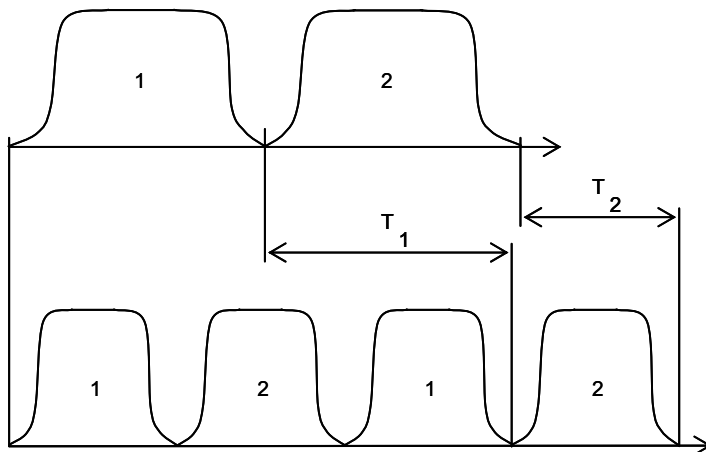
Figure 3-17: If a team has to work simultaneously with two projects it looses time with every switch. The figure shows the principle gain in time when two projects are allowed to finish one by one instead of working in parallel

It is strongly recommended that no one should be in more than one project at the same time, especially the project leader. When one project is finished each team member needs a recovery period before the next project starts because project work, which is generally very intense, is especially so coming towards the finish.

3.10 Dealing with stress and conflicts

Stress and conflicts occur in all projects. *Positive stress* can be advantageous for most people while *negative stress* is futile and often leads to communication difficulties and irritation. In more severe cases it can lead to headaches, sleeping problems, increased blood pressure, gastric ulcers and eventually burn-out.

Stress levels vary largely from person to person and have different manifestations. A project leader that has a tendency to easily get stressed will also stress her/his subordinates, which increases the risk of mistakes and conflict situations. A good project leader therefore is like a duck. The duck flows calmly on the water it seems, but under the surface it paddles furiously.

When some people get stressed they can have problems making decisions and will, in severe cases – such as burnt out – be paralyzed and even apathetic. Others will make decisions too quickly without having collected the necessary information on which to make them. Some will be just not nice and even aggressive when the perceived stress level gets too high.

An extremely stressful situation is when one is not allowed to use one's own knowledge and experiences even though the tasks to be done may require precisely that knowledge and experience, which therefore should be of great help. To be given under-qualified tasks and maybe also to be unfairly judged and treated – to be mobbed – causes hurt and bad feelings. Creative people can generate force out of such treatment while others can be totally broken.

Less stressful situations are when different opinions exist on how something should be done and who is going to do it. Different choices to be made can cause conflict leading to stressful situations. This is also the case when someone feels she/he has to work more than other team members who do not take their responsibilities seriously. Stress situations can be foreseen and somewhat neutralized by ensuring that the personal chemistry functions well between the team members at the recruitment stage. The fewer that are in a team or a sub-team, the more important the personal chemistry is to help avoid unnecessary stress and conflict situations.

In innovation projects there will be a heavy work load right from the start. Heavy work loads over long periods of time can be a health hazard, although different persons have different tolerance levels where fatigue is concerned. It is important that the project leader and the sub-project leaders keep an eye on how the different team members feel, which is accomplished by the use of *Management by Walking Around*. Using that management principle also helps to avoid misunderstandings in the organization as the leaders can see how people work and act. Being frequently present where the work is actually taking place also means that one gets a feeling of whether the 'climate' is good or not. The Planetary organization (see figure 3-5) is also in that respect better then the line organization.

When conflict occurs it is important to strive towards win-win situations, holding on to what is important and sacrificing what is not. To reach such a situation requires that the project leader intuits outspoken and unspoken wishes. She/he must also arrange for a dialogue and has to be creative and humble in order to find functional solutions. Note that discussions over the Internet easily lead to more complicated situations

that later must be solved with dialogues!

To lower the risk of too high stress levels everybody in a project would be well advised to follow the following good advice (Lorentzon & Dahlberg 1995):

- Arrange for spare time e.g. by listening to music, reading a book or simply going to see a movie.
- When you feel you are too busy try to calm down e.g. by sitting down and thinking over the situation.
- Set priorities and take away 'musts'.
- Set up limits for what you can do.
- Don't run away from conflicts or try to solve them immediately.
- Speak with someone when you feel stressed.
- Be physically active as that is the best way for the body to release stress. Walk e.g. half an hour every day.
- Do relaxation exercises

3.11 Burn out

The term '*burn out*' has been around since the 1990's. It was noticed especially in young software programmers and means a complex and severe situation for those concerned. When a person has been burnt out she/he will have a very long period – perhaps years – of recovery to get back to normal again.

The symptoms of an approaching burn- out situation are increasing difficulties in sleeping that can escalate to difficulties in eating. The stress hormone levels get more and more affected so that gradually the muscles get more and more tense thus reducing the flow of oxygen to the cells. In turn that causes aches and pains of different kinds, such as lumbago, stomach and intestine trouble, and infarct. When waste is stored in the cells the higher functions in the body are affected and the person starts to loose memory and concentration difficulties become more noticeable. She/he can swing between crying and being angry and will loose engagement, empathy and the ability to love. Judgment disappears and her/his movements become mechanical.

When someone has been burnt out all the warning signals have been ignored in a serious, inhuman, un-ethical and indefensible way! The project leaders are responsible for seeing that no team members reach burn-out.

4. SALES OF PRODUCT IDEAS & NEW PRODUCTS

4.1 The most important activity

Without sales all other activities to develop a new product is wasted money. Therefore sales can be said to be the most important activity in an innovation project. If the product can not be sold before it is developed then in many cases the question should be asked if the development should start at all. For radical new products this statement may be too far reaching but at least a strong interest must be able to be created with one or more "pioneer" customers. This is a very different view from the common view that the customer – which means majority buyers – should say what they need and will buy before the development can start. Having found a sufficiently large interest from the customers should signal that many already probably are working on finding a sales solution and that at the most a re-engineered product rather than an innovation is needed.

From the start of the innovation project ideally the entrepreneur her/himself should take care of the sales of the product idea in order to get the complete picture of the possibilities and problems. By testing and refining the product/business idea on different people, met casually or at planned meetings, the product/business idea is gradually improved and models of the product can be developed to meet the vague demands initially set. As soon as possible orders should be taken in.

The price of the first order can be low as it will probably not be able to cover the expensive production costs of the first new product anyhow. An agreement can also be reached with the customer that payment can be made if and when, after a test period, the product works to the customer's satisfaction. Customer commitment is crucial for starting up the development of a new product, while speculation that it will be possible to sell the product built on a business idea/plan should, in principle, be avoided. The author's own experiences looking back on 30 years of innovation activities tell clearly that the speculative way of working has been very costly while the other more practical way has brought profitable products to the company. As told, one such case – Flexlink Systems – brought extremely high profits to the mother company SKF AB.

Thus, as an important principle, the sales of a new product should come before the product development and before marketing (see figure 3-8). Built on the experiences from sales a marketing message is gradually built up. When the innovation has become established on the first market, there is generally a need for both marketers and sales personnel, who become increasingly specialized in fewer and fewer areas as the business operation grows. In time, great differences within a growing company is noticed between the professional roles of marketers and sales personnel. Linn (1990) explained this as the sellers and buyers forming a social community, which at the time of the purchasing decision often leads to the sellers trying to score points socially by giving the buyers a discount on the total price. For this reason the sellers will be more on the side of the buyers than of the company, which is one reason why there are, from time to time, strained relations between the marketers and the sales personnel in a mature company.

Typical activities in the sales team when an established sales situation has been achieved is seen in figure 4-1. Until a mature situation has been reached the different activities are initially handled by the

entrepreneur followed by more specialized team members when the economical situation permits that. In this chapter most of the activities needed early in the innovation project will be dealt with.
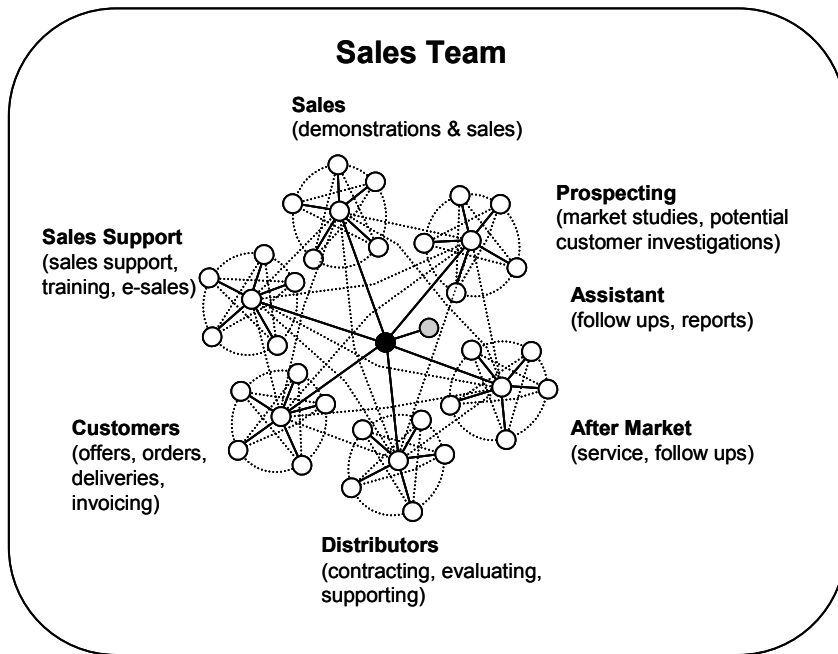
Figure 4-1: Different sales activities to take care of when the innovation has matured to be a standard product in the company

4.2 Psychological costs

New products often require users to change their behavior. Also, studies have shown that people irrationally overvalue benefits they currently possess relative to those they don't (Gourville 2006). Therefore one can speak of psychological costs associated with behavioral changes, which is why it is recommended to try to limit the need of behavioral change as much as possible when developing a new product. The best conditions under which to sell a new product is when the behavioral changes are limited and the product changes are significant against what is known in the market. If the product changes are large immaterial rights (patents and patterns) will help the company to monopolize the situation, thus reducing the need of price competitions. Figure 4-2 shows in principle the situation for sales people selling a new product.

Re-use of behavior (vertical axis: Low → High)

	Low ← Degree of product change involved → High
High	**"Easy sells"** Limited product changes, behavior changes	**"Smash hits"** Significant product changes, limited behavior changes
Low	**"Sure Failures"** Limited product changes, significant behavior changes	**"Long hauls"** Significant product changes, behavior changes

Degree of product change involved

Figure 4-2: The more companies change how products work, the more behavioral change the demand from the users (after Gourville 2006)

4.3 Early market contacts important

Selling is something many people do not like to do e.g. as they often have negative experiences of someone who has sold things to them that they did not need. However, to be successful with selling a product is more a question of selling a good story than hard-selling the product. We should also bear in mind that *"People LOVE to BUY, but HATE being sold".*

To be able to get the first order the salesman has first to *learn* about the product idea or the product and its background. She/he must be *excited* about it, *make* a convincing story, and then *tell* the story to other people she/he meets – one never knows who will be a customer! Start telling a little bit of the story, then shut up and wait for some comments or questions. If there is no such feed-back, tell a little more and shut up again. If there is no feed-back on this second try, either the person is not interested or you are telling the wrong story. Therefore, modify the story and test it on the next person. When you, sooner or later, have got the first order, you know what selling points were useful. However, for the next order you often need to adjust the message and add information. Having got a number of orders you can start to make supporting marketing material. Using the web pages means that the message can be changed every time new knowledge has been gained until a stable situation has been reached and it makes sense to print nice brochures. Don't be too discouraged in the early selling process, it is good to practice your stories on a friend or relative before you test them on unknown people.

Thus, the first order is often the most difficult one to close, and the less developed the product is, the greater the achievement. At the same time, the prospects for the future of a new business venture are best by far if at the concept stage one succeeds in selling the product to a *customer* who preferably is also to be the *user* of the product. *User influence* is thereby automatically built into the product, and the more demanding this user is, the better it is for the development work. This is because a demanding user forces the development to be adapted to the product that has already been sold, which prevents over-elaboration This is on condition that the product developers are not isolated from the user(s) of the product – which unfortunately is not uncommon in industry.

The difficulties that lie ahead when selling at the concept stage are both of a technological and of a market technical (psychological) nature (we will come back to the term "concept"). An early order then gives knowledge about the user/usage, but also a psychological lift, which means that life seems easier to the entrepreneur, the company and to others involved in the business. The business has thereby acquired an initial commercial base, in the shape of at least one actual customer. It is important to point out in this context that for both ethical/moral and practical reasons it is wrong to sell a product with whose technology one is not familiar. For example, to sell on the black market cancer medicine which is not tested and approved but which is based on faith in how the medicine might work is highly unethical, illegal and detrimental to one's own reputation.

The tactics of selling a product at the *concept stage*, i.e. before its product development has started, can seem bold to many. Nonetheless it is a fairly common method that is often used by small enterprises that lack the financial strength to develop the product first. In certain sectors it is also usual to sell development assignments that one can use for the development of one's own products and which the customer then can benefit from in the form of royalties on units sold to other buyers. This approach is often used for military products and systems.

If the product cannot or should not be sold at the concept stage, the goal should be to sell it as soon as there is a functioning prototype or series zero product to show. This prevents the risk of too much technological development without customer/user contact. The worst situation arises if sales of the product does not begin until it is fully developed and adapted for production. The greatest probability is that the wrong product will be developed with the wrong design and wrong properties if customer contacts occur this late in the development process. Note also that experience says that a user or user group that tests the product and perhaps also takes part in development, but does not make any financial commitment, in general does not provide as good input values to the product developers as when the group or someone whom the group represents additionally has made some financial commitment. The explanation is that when it costs nothing it is easy to have views that one then need not answer for when actually paying for the product.

The first order always means that the salesperson has succeeded in expressing the *customer benefits* of the product and managed to develop a *selling story*, which in turn indicates that it should be possible to sell the product to other customers. The more conceptual the product has been at the selling point, the higher the expectations of the new product. Above all therefore it is important in development to ensure that the *functional values* are at an acceptable level, i.e. that functionality exceeds a minimum level. The product must correspond at least to what are called *basic properties* or expected properties (Kano et al., 1996). These properties are often not mentioned by the customer, since they are to be considered as self-evident. For example, a car must have wheels and brakes.

The basic properties are often referred to as *expected requirements*. When a product meets such tacit demands, it does not mean that the customer/user becomes more satisfied with the product or company. However, there will be great disappointment if the product does not have the basic properties. Therefore it is important that the person who sells the product ensures that development takes place in such a way that the basic properties are secured. If this does not happen, then sales will be considerably more difficult, due to the negative publicity about the product that will spread.

The next level of demands that the seller must ensure reasonable compliance with is the *normal requirements*, since these correspond to the price that the customer has accepted for the product. Examples of normal requirements for a car – to take a product example everyone is familiar with - are acceleration performance, fuel consumption, quality and reliability. The customer/user often expresses wants about the normal requirements, and the better the normal requirements meet expectations, the greater the customer's/user's satisfaction. At the same time, the normal requirements mean increased costs in proportion to how extreme they become. Therefore the seller must also moderate the extent of the price-raising activities that often occur if the product developers and customers together are given carte blanche for interaction.

There is also a third level as regards expectations. This concerns *exciting requirements* and is a response to the customers'/users' tacit or unconscious wishes and demands. Unlike expected requirements, the exciting requirements are not taken for granted, but constitute positive and unexpected surprises for the customer when the product is delivered. These exciting values can be represented by simple and low-cost services and items such as for example the customer finding a bottle of wine on the back seat of a new car with a congratulatory message on the new purchase, the discovery that the fuel tank is full or that there is free recovery insurance. It is in the interests of the seller to ensure that some exciting requirements are included with the product upon delivery, since they contribute to the customer spreading favorable assessments, among the customer's circle of acquaintances.

4.4 Ways to reach the market

There are many ways for a producer to reach the market with a product. The producer can sell the product direct to the customer or via one or many levels (*middlemen*) between the producer and the customer (see figure 4-3). On the export market, sales can be wholly or partly done via the customer's sales company, via agents or the Internet. The figure includes agents, which are a category that is becoming increasingly frequent as the Internet is developed for direct deliveries from different suppliers. Agents otherwise give information to customers about different products and link customer and seller on a commission basis or via subscription fees.
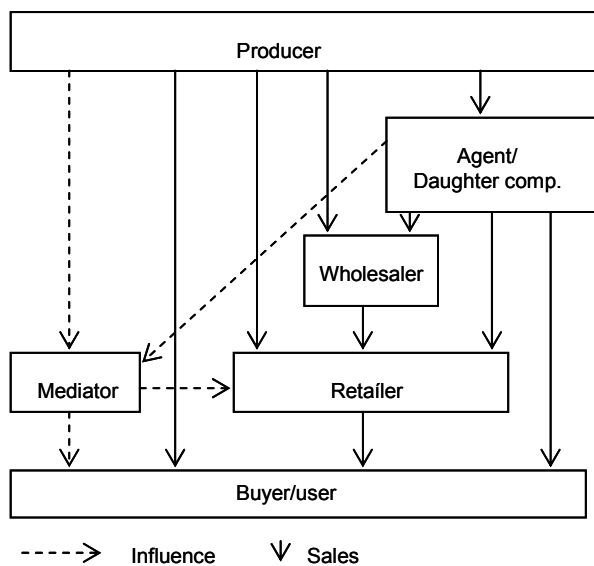
Figure 4-3: Examples of different options for manufacturers to reach the market

The more *middlemen* there are between customer and producer, the lower the profit margin for the producer, for the simple reason that there are more who will share the total profit margin. At the same time, volumes in general will be greater the more middlemen there are, when each middleman succeeds in selling well. The income reckoned in cash therefore will be greater than at lower sales volumes with a larger profit margin. When selling a new product, before an efficient production and distribution set-up is in place, it is natural – and appropriate – for direct sales to take place on the closest geographical domestic market.

Depending on the state of maturity of the product, the incentive of the customer and seller to bring about a sale will vary. For old well-tried products, such as for example screws, bearings and engines, one usually says that the customer takes the initiative to buy. For a completely new product the seller takes the initiative, since the product is not widely known. This can be illustrated in principle as in figure 4-4.
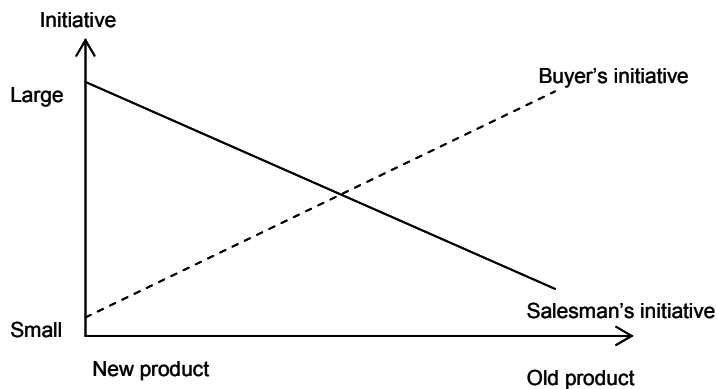
Figure 4-4: For a mature product it is mainly the customer who looks for the product, while the sellers look for customers for a new product

According to an old saying, "All business is local business". The time it takes to introduce a new product on a local market depends on how many middle stages there are between the producer and the customer/user. The quickest route to the market naturally is if the producer also sells the product. The longest time taken to reach a customer in another country is if one goes through a long series of middlemen. This can be illustrated in principle as in figure 4-5.
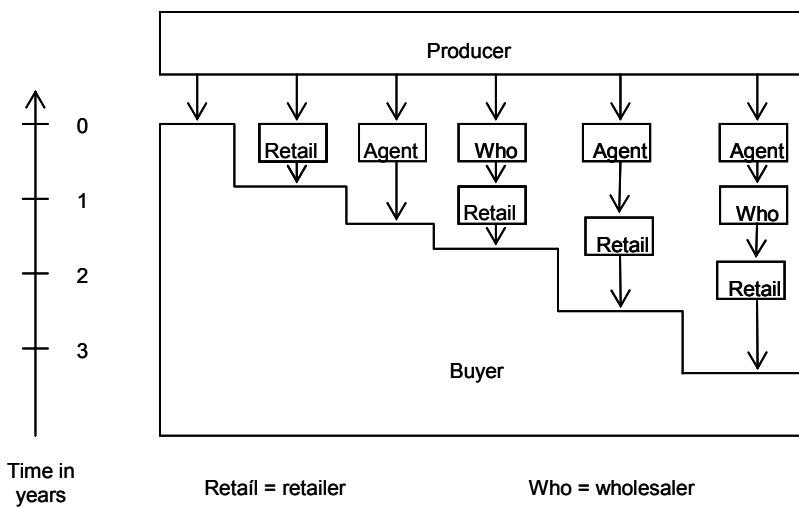
Figure 4-5: The time to introduction onto the market is based on the number of middlemen between the producer and customer/ consumer. The example times are for an industrial product

Some producers strive to reduce the number of middlemen between themselves and the market, regardless of whether they produce mature products or new products. The extreme case of this striving is to completely rely on personal and Internet sales or on TV-shops – and combinations of them. One important reason for making this effort to reduce the number of middlemen between oneself and the end user is that every middleman costs money, with reduced profitability as a consequence, unless the *end price* to the customer can be raised. Other reasons are that delivery can be sped up if the number of middlemen is reduced at the same time as the important direct contact with the market becomes faster, as long as

geographical distance is not too great. Proximity to the market, then, means that one's products may be more quickly supplied to the customers than without proximity. The company at the same time can also quickly modify products and the marketing methods in line with customers' changed preferences. This also enables better monitoring of competitors' actions and perhaps predictions of when rival products will be introduced onto the market.

However, for short term reasons some companies are outsourcing parts of the chain from product development to the delivery and service of sold products. This philosophy is strongly questioned by some researchers. When the sales price of products goes down the sharing of the decreasing margins with many will surely create problems in the long run.

The traditional wholesaler is the category that feels most affected when producers reduce the number of middlemen between themselves and the end customer/user. One way for wholesalers to avoid problems is to work nearer the market taking the retailer's role. Alternatively, they can take on a distributor's role, for example through a franchise set-up with local independent partners.

For a company about to introduce a new product on the market there is in general no better way to start sales than by that shown at the far left on the steps in figure 4-4. Starting one's own sales geographically as close to the company as possible is an important action. Thereby one reaches the customers/users as quickly as possible and receives immediate reactions of immense value to continued operations. However it is necessary at a later date to climb down the steps so that sales are broadened to new markets outside the local market, which is necessary for an income growth to take place. This can be done by the company setting up local offices and/or through joint action with retailers. To reach an *export market* requires setting up international web pages, subsidiaries, and/or contracting agents. The principle of this growth situation is principally shown in figure 4-6.
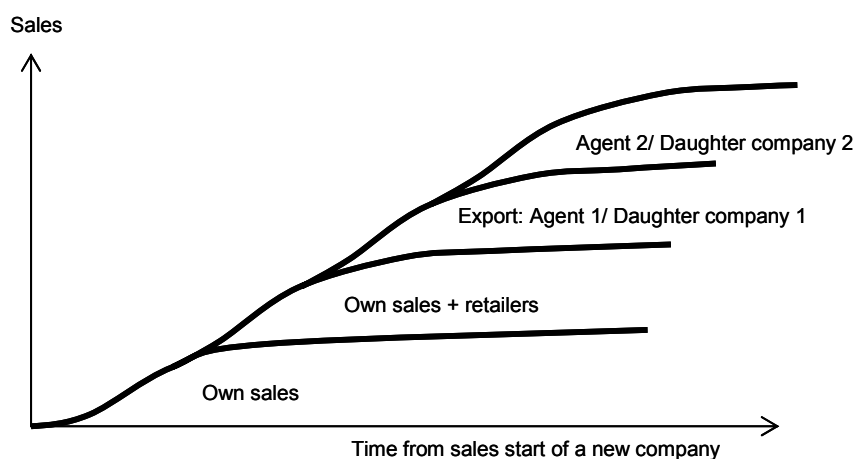
Figure 4-6: For increased income there is an eventual requirement for new geographical markets to be reached, either direct or via other channels

4.5 Expansion through distributors

From when the company has acquired some experiences through selling the products on the close geographical market where the company is situated, expansion can take place through distributors. *Distributors* are individuals who act as representatives of the company but who, through their own companies buy, market and sell the products. They in some way pay for the rights to do so and have promised to represent the company in ways that have been stipulated. The most well-known distributorship is "franchising", which e.g. is the main form MacDonalds has chosen for the expansion of their global fast food business.

Another distributor form that is on the increase is called "Multi Level Marketing – MLM". The idea behind MLM is that individuals act as sales people of the company in the form of micro enterprises. They are often organized in a binary network meaning that someone above gets commissions on the sales that the lower levels have made. If each new level distributor has to buy a minimum quantity of the products which they sell further at fixed prices, then in most countries this is regarded as illegal pyramid selling. The products are not sold through other market channels but through distributors thus giving them exclusive access to the products.

For the company MLM means that it does not need to set up a sales force for market expansion. It also does not need to pay advertising costs. The economical risks are low as the company will have few fixed costs. As the normal competition situation on an open market is not at hand the products can be priced higher or much higher than other equal products sold on the market.

A difficult question with MLM is the ethical/moral effect the system has as the distributors, to be successful, need to sell the products to their family and friends, i.e. people who have confidence in the distributor – or feel sorry for her/him. The friends become objects and when they have been convinced to buy they will often have a bad feeling afterwards as they could not say no to the distributor for friendship reasons. If the family members and friends also are recruited to become distributors themselves and are not successful in their work, a good friendship can abruptly be broken, eventually leading to social problems, which is not a desired situation for society.

A multilevel marketing company must guard against being classified as a pyramid. As MLM has its longest history in the USA it therefore is better to start controlling eventual MML marketing ideas with the American rules (www.mlmlaw.com/library/guides/primer.htm) before starting any MLM activities. We shall not treat MLM more here as many books are available on the topic. Tips and checklists on what to think of can also be found on the Internet (e.g. www.mlmstartup.com).

4.6 Recovery period

As a rule, sales are initially slow when introducing a new product on the market and not until a certain number of customers – the critical mass - have been reached they start to generate new customers based on the information of the product they have bought. This applies above all to groundbreaking new products, since customers most rarely queue up to be first to buy a new product. In order to start sales therefore, one needs to be highly active in making market contacts - networking. More than once, this

work will feel like an assault on an unconquerable mountain. Once one has learned how the product is to be sold and sales achieve lift-off, a relatively fast rise in sales is possible. To manage expansion, it is natural to appoint more personnel, build up stocks, etc.

When one has a feeling of euphoria at having succeeded, and growth is proceeding positively, one can suddenly run into the doldrums, with sales plummeting. It is natural to look for logical explanations for why sales have dropped off. Is the price of the product too high? Is the design wrong? Is the marketing wrong? Is the marketing material bad? Has the company the wrong sales personnel? Are the sales personnel lazy, or what is wrong? Questions abound, and panic grows as various countermoves fail to produce noticeable results. In a small company the drop in sales means that *liquidity problems* arise as the fixed costs begin to exceed sales revenue.

There can be many reasons for such a sales drop. The most significant reason however is usually that the early *pioneer buyers* or *innovators* above all note the *functional values* of the new product. When it is time for the later pioneer buyers to buy the product, there is a demand also that the product should have good *sensorial values* (what we experience with our senses) which maybe the first product does not fulfill. During the initial stage of selling, further direct sales take place, while in the subsequent stage – when the sensorial values are in focus – the company must use *relational marketing* to be successful.

If the sensorial values and the product's usefulness are improved and if there is a changeover to relational marketing, developments can often be turned back into a positive sales trend. The situation can be compared to that shown in figure 4-7. The *recovery period*, which is the time taken to reach the same sales volume as before the sudden drop, varies depending on the product, PLC of this type of product and how fast the sensorial values and sales methods can be changed.
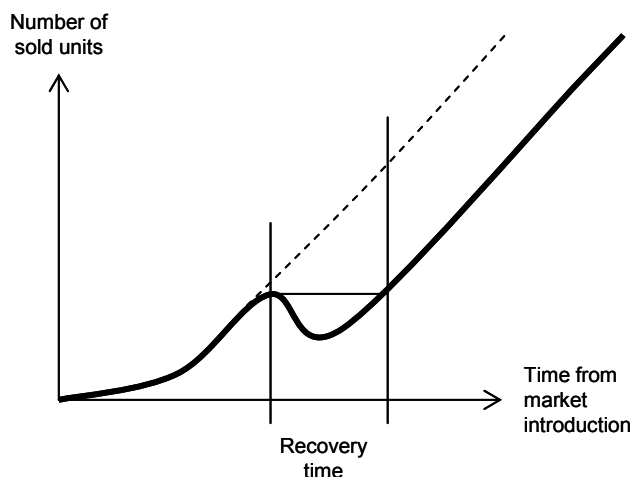
Figure 4-7: Recovery time (Ottosson 1999)

It is crucial to understand recovery time as a phenomenon, lest one worsens the situation with regard to the product's future prospects, if one runs into such a situation in practical innovative operations. An additional consequence is often that a product is abandoned, since the manufacturer is unaware of this

market phenomenon.

For groundbreaking new products/ systems there is generally a sector recovery rather than a recovery limited to the company. For example, sales of FFF machinery (FFF = Free Form Fabrication) developed in this way (FFF is used to produce prototypes direct from CAD files, which is further described in chapter 7.7). The IT business did it also in the early 2000's .

4.7 The seller's role

Everyone who buys a product must feel secure in some respect. This sense of security can consist of knowing that one can personally rectify a fault if the product does not function well. The buyer of an old car often has this attitude. A buyer without confidence in her/his own ability prefers to buy a well-known brand with an extensive service network. The buyer of a new product needs to feel confidence in the seller, since the product is unknown and the service is often poor. The buyer's only security if the product does not function is the seller's ability to rectify the problem.

In this respect the situation is considerably different from sales of established products. With established products, the buyer has a greater need to feel confidence in the manufacturing company than in the seller of the product. Confidence in the seller therefore becomes of secondary importance to the company as the product becomes older and better established. For many of our old standard products consequently, very little in the way of active selling is required. In extreme cases all that is required is receipt of orders, whereby there is little or no personal contact between the buyer and the seller. Internet sales produce the same effect.

In sales contacts, the sellers will receive many good hints as to what can be done with the product to improve it and/ or new applications for the product. It is extremely important that this information and the opinions are promptly fed back into the company, so that the company can utilize them in refining the product or in developing new products. One major advantage of a small organization is the ability to quickly capitalize on an opportunity that arises; while a large and unwieldy organization often "investigates to death" such opportunities.

When selling new products, the seller will often receive a "no" from a potential customer. This "no" contains information that the seller can use, partly to improve her/his argumentation on customer benefit, partly to determine to which buyer category the potential customer belongs (pioneer, early majority buyer, late majority buyer or latecomer). Below are a number of different "no's" and their possible meanings (concept by Billgert, 1998):

- No, I cannot afford it (really I want to buy, but have difficulty in financing)
- No, I cannot decide now (help me to gain support with internal marketing)
- No, the product has the wrong design/ weight/ performance/ form/ color/... (the price is right but adjustments are required)
- No, we are looking at other alternatives (they are arranging a situation containing several

competitors)

- No, I do not have time (respect this and get back later)

- No, I do not know enough (produce a short basis for decision)

- No, I do not speak to salespersons (call in a product developer)

- No, I cannot make a decision (talk to the boss)

- No, there are cheaper alternatives (interested but wants to test the pricing, make another offer)

- No! (interpersonal friction)

So a "no" is often a conditional "yes" if the situation changes and the seller learns to interpret and respond correctly.

4.8 Close contact gives results

A big marketing drive in the mass media, in the same way as a mass send-out to selected categories of people, in general produces meagre sales results. As regards *direct advertising,* when for example addresses have been bought from an address register, orders usually come from somewhere between one per thousand and a few per cent of the recipients of the direct advertising, which means that sales costs are high when postal services are used for distributing the advertising. When the *Internet* is used for direct advertising, then the response frequency is of minor importance, since the costs are little more than the time taken to search for e-mail addresses and to enter them in the address frame (note that local rules for internet marketing can exist!). Thus, it can be stated however that direct advertising, whether distributed by post or Internet, generally gives a meagre sales result. Really good sales results for a new product demand effective selling in the field by salespersons who can inspire confidence in themselves and who can utilize *market rhetoric* in a good way by focusing on customer benefits and selling a solution instead of a product.

In a similar way, advertising campaigns often produce no more than an insignificant lift in sales of new products, except possibly in the case of fashion-oriented consumer products. To produce costly *advertising material* and to run broad campaigns when the product is in an early stage of production therefore, is often an uneconomical way to use money. Naturally it is nice for the sellers to have at their disposal *brochures* in four-color print, professional *videos* or *CD/DVD/USB memories,* and to be able to refer to an advertising campaign. However, since sales are so strongly centered on the salesperson in the first stages, personal selling is often quite sufficient, along with perhaps simple brochures and videos from in-house production and CD/ DVD/USB recordings. It is also important to have a *business card* bearing a personal photo to enhance the personal touch and to raise the recollection value.

Considerable capital is usually invested in the introduction of new products via *trade fairs.* Fairs are certainly visited above all by people belonging to the categories "pioneer buyers" and "early majority buyers", which means that one can make many positive contacts, but results in the form of sold units are still frequently poor. One must usually settle for positive judgments, which must be taken for what they are. Even if all the visitors who visit a stand talk favorably about a product, there are very few who place an order. As always, it costs nothing to be favorable towards a product if there is no need to buy it. To

achieve a good result from a fair, the personnel must, therefore, actively make follow-up contacts and influence potential customers after the fair. Against this background one can assert that it is doubtful whether one should participate in fairs at early stages of development. Quicker results are achieved by investing capital and commitment in direct in-the-field sales.

Sales of new products then, generally demand a high level of activity in the field by the entrepreneurs and sellers, which cannot be replaced by marketing and passive receipt of orders. If sellers of mature products are commissioned to sell a new product, the experience is often a shock to those who are forced to acknowledge that the telephone is not ringing. They themselves must constantly make calls and actively arrange meetings and "sell themselves" to increase sales of the product. Selling new products is highly strenuous and can be a mental strain on a salesperson, since extremely close contact with the customers is needed. If problems occur then if the worst comes to the worst the customers can call the seller at any time of day, irrespective of holidays, to obtain a fast solution to the problem that has arisen.

Thus, to be able successfully to sell a new product demands in general then that the seller has direct contact with selected potential customers. As shown in figure 4-3, it is unusual for customers to seek sellers of new products. Therefore the seller must seek out the buyers and interest them in buying the products. In the beginning, when the entrepreneur alone runs sales, it is important that the entrepreneur spends large part of her/his time in the field selling/marketing the products. If this is not the case, then the entrepreneur in practice has little chance to start up the operation, just as she/he does not acquire the genuine understanding of the market that is required for the entrepreneur to make correct decisions, to make demands on the sellers that are subsequently appointed, etc. When one or more salespersons have been appointed, their work duties must give an even higher priority to sales in the field in comparison to in-house work.

The fact that early sales take place principally through close personal contacts means that a seller cannot make that many sales calls per day. Even so, the seller should be disciplined and be sure to make a certain number of calls every hour or day. Using modern technology and constantly updated financial data on the company via the Internet or from CD/ DVD disks, one can avoid unnecessary customer losses. With such information one can also set up suitable visiting rounds to potential buyers.

A sale is very rarely closed at the first meeting. This is because the buyer in general needs time to think over her/his circumstances before deciding to buy. Therefore, prompting and follow-ups are required a number of times before a purchase. These promptings and follow-ups can be done by phone and possibly also by letter or e-mail. It is only through such a work method that the right personal relationship can be achieved between the seller and the potential customers. The time it can take from first contact to order can be years!

When the product has got some foothold on the local market, one should be able to achieve an outcome of 50-60% of orders placed in relation to written offers made. To achieve such results, the seller has to have a range of products to offer as a complement to the main product.

4.9 Prospecting

To find completely new customers is a tricky thing and there is no safe way to be successful other than approaching a large number of people telling them the good story about the product over and over again. Thus looking at statistics and then to make intelligent judgments of prospects to contact does in reality not give much result. When the painful work to build up a stock of satisfied customers have been made, the key to increased success in sales is to ensure that those who already have the product are satisfied with it. This, after all, is what opens doors to new contacts and prospects.

Textbooks often tell us that "To find potential buyers one must analyze the requirements set for buyers as regards financial resources, preferences, geographical area, etc. Having done this, one should keep one's eyes and ears open for new buyer categories. For example, good sources are local newspapers, trade journals, interest organizations, radio and TV new items, etc." Unfortunately, we have in our different struggles to start up sales of new products and to increase the sales realized that this way of working often is the wrong way to do it. Our finding is that the result is proportional to the number of new contacts taken face to face with people wherever they happens to be – on the bus, in the cinema queue, at a club meeting, at a conference, etc. A large contact net will help in this work!

4.10 Making contact

Thus, spontaneous contacts in connection with different events and meetings are often good opportunities to create interest in a new product. To use persons who possess a large area of contact as door-openers is also a known method to create business opportunities. These *door-openers* may receive a fee on a commission basis on sales that go through their contact network.

Upon creating broader contacts, when one is confident of knowing which groups and persons should be contacted, then the *telephone* is a quick aid in setting up a contact and in sowing the seeds of interest in the new product. However, with an increasing number of companies using call centers, people get tired of selling telephone calls after working hours. Therefore, an e-mail contact can sometimes be more successful as the first step in agreeing on a meeting.

For products of some direct or indirect value (e.g. > 100 Euro) the telephone call should get across what product is being discussed and the fact that the aim of the meeting is to display the new product – which should give the buyer greater benefits than those that other products and services are assumed to offer (so-called *customer benefits*). The presentation over the telephone should not however be detailed. The prospecting telephone call therefore can be made by someone with relatively superficial knowledge of the product. Indeed it seems advantageous for the person calling not to know too much about the product. She/he is then not tempted to become too detailed during the conversation, thus losing sight of the aim to set up a meeting. If there is reason to believe that it will be difficult to arrange a meeting via a phone call, there is the alternative of going direct to the person in hopes of having a short meeting at once or later. This can occasionally be the only way to make contact with stressed-out managers. When they are sitting in an airplane or a train they are also approachable in a way that is not possible when they are involved in ordinary operations.

When an agreement has been reached on a meeting, one should make absolutely sure that the person called has noted the correct time and place for the meeting. If possible do not ask the person to come to the sales office, but go to the person instead. This avoids the cancellation of many meetings, at the same time as the setting and environment around the buyer help the seller to give appropriate information and use appropriate argumentation, i.e. to plan the sales tactics as well as possible. An on-site visit means also less inconvenience for the potential buyer. The only thing risked by the person is the time taken to listen to the presentation. If on the other hand the buyer is to come to the seller, the buyer will be considerably more inconvenienced, which reduces the likelihood of a meeting. In addition, this means that the seller misses valuable impressions gained from the buyer in her/his environment. To call on a person means, or at least is often perceived to mean, doing the person a favor, which gives a psychological advantage at the start of the conversation. It then becomes more difficult to dismiss the seller.

4.11 Sales techniques

There is abundant literature on sales techniques, sales psychology, body language etc. We will not go into these subjects at length here, since there is sufficient relevant documentation in good bookshops and Internet bookshops, as well as in every university library, college library and large public library. However some important matters will be pointed out that apply specifically to sales of new products.

Successful sales of new products are achieved if good two-way communication takes place between buyer and seller. If communication is good between other persons influencing buying, then the time to a purchase decision is shortened. Therefore, one should strive as quickly as possible to arrive at a situation where the potential customer and other influencing persons become involved and actively participatory in discussions about the product. This can be achieved by asking questions that invite involvement. The potential customer and others should also – if possible – hold the product and/or test it, so that they gain a feeling of involvement with the product. A visual impression alone will not give this effect.

To reach a situation where the potential buyer and other influencers become actively interested and involved in the product, demands that the seller acts pedagogically and psychologically. Expressions and body language need to be interpreted so that each personal meeting is adapted to give the best sales result. Stereotype and well-practiced sales conversations become impersonal and uninspiring. Personally planned meetings without the use of too much ready sales material, therefore, always provide better opportunities for contact and shared enthusiasm.

A seller who occasionally can remain silent forces the potential customer and other influencers to talk and thereby to reveal their opinions on the product. Silence as a sales instrument is often a highly effective tool to resolve a deadlock. This is because most people shun silence; something that may be interesting to try out on one's own acquaintances on some occasion. If in addition it can be arranged for the prospective buyers to hold the product, it is practically inevitable that they will start speaking about it. Since it is unpleasant to say negative things about a new product, it comes naturally to most people to say something positive, which gives the seller an opportunity to reinforce these judgments. (This reasoning from an *ethical* point of view presupposes that the seller is convinced of the quality of the product and of its benefit to the customer/user).

The seller of a new product should be unassuming, considerate and honest. It is the customer who is the important person and who is to make a sacrifice for the seller. Everything that can disturb or hurt the customer therefore should be avoided. To be humble and considerate helps to prevent personal friction. A proverb says that honesty is the best policy, and it is in general better to admit that one does not know everything than to give a reply that perhaps is incorrect. In addition, unanswered questions give the seller an opportunity to get back to the buyer and to keep up the dialogue until a purchase takes place.

At all meetings with potential customers it is important to achieve a feeling of personal community, which leads to confidence and purchase of the product. Each seller should therefore as quickly and as discretely as possible work through the wall of reservation and reticence that we all have when encountering an unknown person. If on top of this the stranger has come in order to sell a product that the person has not planned to buy, the defensive instinct is stronger than otherwise. For this reason it is advantageous not to begin sales efforts with completely unknown individuals, but with someone with whom one has already built up some confidence or relation. To be recommended by someone who knows the individual is considerably more favorable than contacting a completely unknown person oneself. When one has later succeeded in securing one satisfied customer, this correspondingly often automatically leads to one finding other potential buyers.

In all selling one must try to avoid receiving a "no", even though the meaning of a "no" according to the above can be a "yes" with reservations. To turn a definite "no" into a "yes" is prestigious and always takes a long time, as well as demanding patience and tact to achieve success. Therefore, never drive matters to a definite "no", but break off the attempted sale and keep the dialogue going until the customer is ready to say "yes". Most need time to mull over a decision to buy. One should therefore never be too anxious to force a decision before the customer is ready for it. If the customer is forced into making too early a decision, the easiest decision for the customer is a definite "no". When there are purchase signals, it is time to act fast and have the order signed. Good sellers feel when the time is right.

When selling a new product, then, the task is to create confidence and as far as possible to avoid obstructing factors and effects. For example to be interrupted by a mobile phone is perceived by most people as very irritating. Confidence is created to a large extent through language and as regards language, "when in Rome, do as the Romans do", is an old but wise rule which will make it easier for the seller to become accepted by her/his prospective customer. To use simple language reduces the risk of misunderstanding even if the person one meets has an extensive vocabulary.

The use of neutral and inconspicuous dress is recommended to avoid putting potential customers in a defensive mode that will need to be dealt with. A seller of new products who travels around in expensive cars and otherwise is surrounded by expensive accessories, sends out signals that she/he charges too much for the products. (This is however not the case for MLM distributors when recruiting other distributors to their network). In many cultures it is wrong to parade one's success in this way when marketing new products. In the same way it is wrong to dress down too much when meeting persons with a lifestyle of a certain standard. Therefore it is important to have salespersons that fit into the environment. For example, there is a big difference between selling motorbikes, pharmaceuticals and office equipment.

A sales meeting should be pedagogically prepared but should not be perceived as too well-rehearsed, lest the spontaneity be lost. In all *pedagogics*, repetition is the mother of knowledge. Since it is of the utmost importance that the buyer should learn to understand and have confidence in the product, it is important to make diligent use of repetition. Talk about the product and demonstrate it in different ways, so that the repetition is not felt tiresome. Use questions to check that the buyer has understood the message. *Dialogue* then is more important than *discussion* when selling a new product.

As mentioned earlier, the potential customer in general is ready to buy the product when she/he begins to talk about the product as if she/he already owned it. Once the individual has bought the product it is time to get her/him to feel proud of it without feeling abandoned by the seller. Consequently, stay in touch with the buyer and quickly deal with any faults and misunderstandings. This will ensure that a valuable reference person and ambassador for the product has been gained. In this person's circle of acquaintances, as has been mentioned, there are probably new potential customers who can be approached. In time the buyer will also be ready to replace the first product with a new, improved or further evolved product, which is a reason to take good care of this customer. A dissatisfied customer tells many of her/his experiences, while a satisfied customer seldom mentions the fact to anyone (e.g. Kriegel and Patler 1991).

One trap that many sellers fall into is to speak badly or disparagingly about a competitor or a rival product. This always backfires sooner or later. One's own product is supposed to be so superior that one does not need to argue in a negative manner. Sales based on the seller's success in proving how bad another product is are not particularly successful sales. A customer who has bought a product for negative reasons in addition is hardly a good ambassador for the new product.

Another trap for sellers of new products is to focus on prices as the buyer of a new product does not buy the product primarily because it is cheap. To focus on the price therefore is to stress the wrong aspect. The focus must instead be on the *customer benefit* of the product. If this is accepted by the buyer, the price will often be a minor issue.

Many sellers give away products and promotional material. To give away products is a questionable marketing method, since the recipient does nothing in return. Gifts of this type are usually poorly utilized since there is little commitment from the recipient. Different types of promotional material that have nothing to do with the product hardly provide an incentive for the customer to buy the product. However, such gestures do reinforce the *image value* of the company and its products.

To summarize, one cannot overemphasize the importance that the seller acts as a fellow human being and helps the customer when necessary. A seller who lacks the ability to understand a customer's problems, preferences, wishes etc. will find it difficult to sell a new product. The term "salesman/saleswoman" can be an unsuitable one to use in this context. To use the term "account manager" on one's business card can also be unsuitable. A better choice than the title of "salesman/woman" on a business card would be "applications engineer", "service technician", or "representative".

4.12 Easily made mistakes

To build a loyal customer base demands skilled handling, takes a long time and is laborious. The work can quickly be undone if the customers and users are not cared for in an exemplary way. This loss means that one also loses the persons who support the business with free advertising in the form of positive judgments and recommendations. If one does not tend the customer base, one is forced continuously to build up a new customer base, which costs perhaps ten times more in all respects than properly tending one's existing customer base.

A common mistake made by sellers is to promise more than they can deliver. This creates unnecessary irritation among customers. Confidence in the seller and the seller's company is thereby eroded. It is always better to promise less and deliver more, which leads to positive customer reactions to the seller and the company. Even if, in one's eagerness to sell, one finds it easy to make grand promises, in practice it is a virtue to be as modest as possible in making promises. This applies especially if the seller is not certain of being able to keep the promises. So – have generous safety margins in every respect when making promises to customers. Take along the person or persons developing/adapting the product to visit the customer, to prevent misunderstandings and unpleasantness upon or after delivery. Check also during this work that the product really turns out as promised. User involvement is recommended in the product development process!

Another mistake, and an unethical one, is to sell too many units of the product to a customer or to sell products without knowing whether or not they will bring benefit to that customer. Fairly soon the customer will discover that she/he has been manipulated in a way that will not improve her/his opinion of either the product, the seller or the company. If the wrong product has been bought unintentionally or for some other reason, the company should rectify the matter as soon as possible. If the buyer is a retailer, it is important in the same way to support her/him in different ways, so that the products do not "die on the shelf". This will ensure an eventual repeat purchase.

4.13 Own sales or sales via co-operation partners?

As mentioned previously, the quickest way to reach the market is generally with a sales force of one's own. In addition to this important advantage, there are a number of other advantages to having one's own sales force compared to sales via co-operation partners. Examples of advantages are:

- The salespersons can devote themselves fully to selling the company's own products without portioning out their time to other companies. If a situation arises where a choice has to be made, the salespersons divide their time in proportion to the margin that they receive in relation to how easy the sales work is.
- The sales force can be more easily trained and developed to an acceptable skills level, and continuous internal training is made possible.
- The company's own sales efforts can be aimed at tasks that do not give immediate results, such as market studies, the launch of new products, customer services, etc.

- Key customers expect service direct from the company. The customer thereby receives direct information.
- With its own sales force, management receives good reports and feedback about the market, competitors, etc., which permits quick decisions on re-orientation.

However, to build up a sales force requires capital and time, which are not always available. This leads to attempts to run sales through retailers, wholesalers or agents, who thereby become close co-operation partners. If trade is not to be solely via the Internet, the choice of retailers, wholesalers and agents is of major importance to how fast the business will develop.

When choosing co-operation partners, the persons in the organization constitute the most important factor to a positive or negative decision. The size of the company on the other hand is of less interest to how successful sales will be. In addition, one should often avoid the market leader or the second biggest company in a sector. The third company in size however, usually is "hungry" for growth and therefore provides optimal work input and commitment. If one works in a large organization, though, it can be difficult to admit that it is not the organization and its good economy that matter, but the people in the organization, their drive and their incentive.

In choosing retailers, wholesalers and agents on any market, a careful summary of the requirements made of prospective co-operation partners should be made before beginning the search and the time-consuming discussions that this entails. Even if the desired characteristics will vary between companies, the following guidelines are worthy of consideration:

- The co-operation partner should sell her/his present products to the same customer category as for the new product.
- The new product should fit in with the rest of the co-operation partner's range, so that the employees have experience, knowledge and contacts that are directly applicable to the new product.
- The co-operation partner's existing products should not compete with the new product. A limited overlap may be accepted, however, if there are otherwise marked differences.
- The co-operation partner's sales methods and approach to selling etc. should be in agreement with one's own opinions. If one's own business sells for example on technological know-how rather than price, then the co-operation partner should do this for the rest of the range.
- The co-operation partner should be financially strong enough to finance her/his outstanding commission and day-to-day costs.
- The co-operation partner should have a good reputation on the market and should be able to refer to previous good results in establishing new products. The co-operation partner must be a serious-minded representative, so that she/he will give the customer the security that is necessary when selling the new products.

The choice of agent, wholesaler or a retailer should never be made without a preliminary detailed financial investigation of the company and a visit to its own premises. Personal interaction between producer and retailer must also be good for the best results. At the slightest doubt on any of these points, one should try to find another potential retailer, even though this means a loss of tempo in the short term. When choosing co-operation partners in other countries, the issue is even greater than as described above for reasons of culture, language and other factors. Consultants on the spot are often of invaluable help in this work. Since every country has its own regulations and laws, one should always hire legal staff in the country in question when drafting contracts.

To appoint employees and to choose co-operation partners takes time and means a risk if one does not already know the persons well. If personal interaction is not right or if one has a feeling that problems of one sort or another can arise, without being able to put a finger on anything, one should definitely choose another employee or co-operation partner. Unfortunately you can never have everything you want, and must often compromise on wishes and wants. For example, one may wish for a co-operation partner in a stronger financial position, at the same time as this usually means a partner who is less "hungry" to accomplish a good result with the new product.

Finally, something should be said about the problems of operating in a large organization. To refuse to accept parts of the mother company's sales organization for selling a new product is easier said than done, but even so, one should put forward this view if one feels that this organization will not function in the best way. The only thing that counts in such organizations is in fact the financial result. Consent hinders good results, to the disadvantage of both one's own business and that of the mother company. In addition, competition is always valuable also to the sales organization of the mother company if one chooses another sales channel.

4-14 Improvement Feedback

For any company, potential and real customers are of extreme importance as they are the direct or indirect channels for the company to create cash flow. Entrepreneurs and managers therefore need to get improvement feedback from the field with the aim of enhancing the cash flow and/or to acknowledge the staff for good work if no improvements or trimmings are needed.

The improvement feedback of the sales organization can be arranged in different ways. The most natural, cheapest, and fastest way is to act oneself as a potential customer checking out home pages and marketing material, and by listening to and/or recording how the team members answer telephone calls and/or how they act when in contact with other people. A second way is to let external people do the same work. A third way is to ask potential or real customers for their impressions and experiences as a result of their contacts with the company and its sales organization, which is done by interviewing them or sending a survey to them by post, e-mail or by using a web-based survey. A forth way is to let someone act as a potential customer or customer without telling the organization about who will act as the "Mystery shopper" (e.g. Stucker. 2002) and where and when this person or these people will do their secret investigations.

For a company to keep the users happy not to spread bad rumors about the products and/or the company, the attitude and work done by the service organization is of utter importance. To check this management can use the same improvement feedback arrangement as for checking up on the sales organization. However instead of using mystery shoppers they can let some users of the products contact the service people to repair a product with prearranged errors. Doing one's own rigged tests is far better then being faced with a TV team having made similar rigged tests with the sole aim of blackmailing a company.

Observations, dialogues, interviews, and surveys

Observations, dialogues, and interviews

Observational studies are used to get feedback on how associates act and how potential and real customers and users view a company and/or a product. Observations allow the investigators to study the associates and the users in real contexts as well as in laboratory experiments. The observers can either be silent only observing, noting and recording or be communicative during their observations.

Normally, observations and so called ethnographic studies are used to study life in society but they are also used to study working life in companies, which does not imply living with the staff but being present e.g. when the staff members are working (Bragd 2002). In such cases the investigator observes what is going on, records meetings, tapes, video, takes photos, makes notes, interviews people, collects documents and initiates dialogues to ascertain that she/he has understood things correctly.

The difference between dialogues and interviews is that in a dialogue one is free to speak with another person while one in an interview mainly follows a list of questions prepared beforehand. In both cases the person engaged to get information can follow up on statements and answers that seem to need clarification. The information written down is biased by the view of the investigator meaning that it is based on her/his view and experience of life. When simple questions are used and many people have taken part, the answers can be statistically treated to see patterns.

Some disadvantages with these types of investigation are the risks of not seeing things with fresh eyes and the risk of assuming too much when interviewing, and as a result not probing deep enough. The investigator may think she/he knows the answer and does not expose his thinking to alternative reframing. These factors pose considerable challenges to the investigator and require rigorous introspection and reflection on experience. In addition, there is the tricky job of handling organizational politics and loyalty issues towards key persons and the company as the whole.

Something that has also been found and which is worthy of note is that – especially when performing telephone interviews - interviewer intonation may affect the outcome of yes/no or agree/disagree surveys and so produce a larger number of positive responses than expected (Eaden et al 1999). Further, interviews can be problematic since: "… detailed analysis reveals the interview not simply as an opportunity for knowledge to be transmitted … but rather as an interactional accomplishment in which knowledge is constructed by interviewer and interviewee during the course of the interview. Interviewers are no longer

simply conduits for answers but rather are deeply implicated in the production of answers" Schneider (2000).

Some advantages with this type of investigations are:

- There is a minimum risk of losing valuable information/data due to forgetfulness or incorrect reconstruction. When reconstructing past events, there are risks of misunderstandings. The investigator has no opportunity to consider the circumstances outside or inside the studied process that may have influenced the result.

- Firsthand information eliminates the influence of other people's understanding of the situation and their ways of expressing it.

- Opportunities exist to rapidly correct interview manuals or to clarify misunderstandings between the questioners and the respondents.

- Unspoken information - that is extremely difficult to take into consideration when using classical research methods - is captured in a natural way.

Surveys/questionnaires

If statistical results are required, quantitative investigations must be used based on questionnaires/surveys. Such methods rely on the identification and election of a few variables out of a myriad of possibilities. The results are statistically processed and presented as numbers in the form of tables and diagrams. The investigator is in this case isolated from direct, personal, observations of activities.

The answers from those that care to answer the questionnaires are analyzed with statistical methods. It is commonly felt that this safeguards against subjectivity, which is questionable for different reasons as sayings such as "a fool with a tool is still a fool" or "garbage in, garbage out" try to tell us.

However, a questionnaire can be a useful data collection tool when the following conditions are met (Marshall 2005):

1. The target audience can be clearly defined and identified.

2. The majority of respondents know what is asked of them.

3. The focus of the analysis is numerical i.e. the questionnaire yields quantitative data.

It is claimed that with careful planning, questionnaires can achieve good response rates and provide anonymity; the latter may encourage more honest and frank answers, than interviews.

One apparent weakness of the quantitative survey method compared to more qualitative methods is that theory in use, and other information, might go totally undetected because the investigator is isolated from what is really happening (Davis 1998). One simply has very little basis for a sound decision as regards how to improve the situation.

Although well designed (Rowley 2004):

- Surveys/questionnaires are blunt instruments, as only that which is asked will be answered.

- The investigator must second-guess the respondent and very little qualitatively new information is gained.

Other disadvantages are (Marshall 2005):

- The investigator generally has no idea if the questionnaire was filled in by the respondent it was meant for.

- If there are confusions caused by the questionnaire the researcher cannot clarify these.

- There is little flexibility for respondents to present their own perspective on issues unless there are several open questions.

Questionnaires can give rise to very poor response rates yielding non-respondent bias. In general, the lower the response rate the higher the probability of non-response error (Eaden et al 1999). Poor response rate can lead to bias because some groups are less likely than other groups to fill in a questionnaire (Williams 2003). Already a non-response rate of higher than 10% may bias the results (Marshall 2005). If direct mail surveys are used, every effort should be made to obtain returns of at least 80 to 90% or more.

There are several tactics described in the literature of how to increase response rate:

- Simplification of the questions (Eaden et al 1999).

- Shorter questionnaire (Edwards et al 2004).

- Small monetary incentives (Engle and Hunton 2004).

- The use of stamps both on the outgoing and incoming mail (Glascoff 2001).

- Paying out money beforehand is much more effective than paying afterwards (Downes-Le Guin et al 2002).

However, the following actions have not showed to increase the response rates (Kellerman and Herold 2001): pre-notification of survey recipients, personalizing the survey mail out package, and non-monetary incentives.

Mystery Shopping

Mystery shoppers engage front line employees in everyday customer service situations to provide management with a true, unbiased measurement of customer service and experience. Through their eyes the managers can understand what their teams do well and can build on identified strengths. The mysterious shoppers can also uncover hidden deficits where training sessions would be more beneficial. They visit stores, restaurants, banks, salons, movie theatres, hotels and other businesses as "undercover customers" and get paid for providing valuable customer service feedback to businesses. For cheaper products they can even keep the product after the secret investigation or get it reduced in price, which is especially important when the product is a service.

Thus, mystery shopper reports can be invaluable tools in measuring customer satisfaction and experience, along with salesmanship, professionalism, compliance, closing skills, follow up, etc. The reports shall provide feedback in support of training, performance reviews and incentive programs. Most important: Detailed feedback can help to resolve problems, before customers or markets are lost. Additionally, it can help to recognize and reward "superstars" before loosing them to mediocrity or to the competition.

Before an investigation is done by a mystery shopper she/he is often trained to memorize a check list, which shall be the minimum of information the company wants to have investigated. This is because being a mystery shopper means that she/he cannot use a written check lists or a piece of paper to take notes on during the investigation as that would be a give-away to those being investigated. Therefore, so as not to forget any valuable information, a recommendation should be filled out as fast as possible after the investigation or simple notes made that can be elaborated on later. Using a Dictaphone from which a report can be later typed is even better.

On-site shopping

The point-of-sale is the critical moment of truth in determining whether a customer is satisfied or not. Evaluation of the interaction between the mystery shopper and the front end people is therefore important in understanding the type of service the customer is receiving and whether sales associates or team members are following prescribed procedures and protocols, if they make use of opportunities, if they are creative, etc. In essence, on-site shopping give management input to look at sales and service efforts from two perspectives - the customer or guest's, as well as the organization's. It doesn't matter if the evaluation is for a retail store, a restaurant, a car dealership, an apartment development, or an amusement park.

On-site shopping also has the advantage of the investigators being able to assess the physical aspects of the location including: the cleanliness and upkeep of the facility, the proper use of merchandising and marketing materials, the appearance of the staff and their attire (including uniforms), product presentation and demonstration, etc.

Phone Shopping

Sometimes customers make contact over the telephone with a company before visiting it or an outlet of the company. It is not uncommon for customers to call a location before visiting it to find out where it is located and to get directions or to make an appointment. The first impressions are always important and if the potential customer gets a bad feeling she/he can even decide not to visit the company.

Phone Shops can be used to evaluate a number of different dimensions of the telephone transaction. Was the telephone answered in a prompt manner? Having the phone ring too many times, or placing the customer on hold for an extended time, is not a good way to start. Did the tone and manner of the associate reflect the spirit and attitude you're trying to project? Was the associate able to speak intelligibly and correctly answer the questions the customer had? Did the associate address them in a welcoming manner and invite them to visit? All of these elements can be evaluated through the use of quick, low-cost telephone mystery shops.

The best way to fully appreciate the telephone interaction between an associate and the customer is by recording the call as part of the telephone mystery shop. Recording of the phone shops provides a training vehicle to sit down with the associate to point out strong and weak areas. Note that the recordings shall not be made available to anyone other than the associate and her/his closest manager! Before Phone Shops are done all associates shall be informed that such investigations will take place – which can have a positive side effect in itself with regards the positive way potential customers will be handled.

Internet/web shopping

For an increasing number of industries, customer contact is initiated over the Internet or via the web pages. The speed and quality of the response over the Internet or via the web page is just as important as an interaction in person or over the phone. Internet/web Mystery Shops evaluate response time to inquiries or orders. However, not only is the timeliness important, but the quality of the interaction is as well. Potential customers want their questions answered. Sales managers want potential customers to be taken through the sales process effectively resulting in successful transactions and revenue. A special interest should be to measure how efficient the web pages are meaning how long time it takes from entering the web page until wanted information is found and wanted actions are taken and the web pages are left.

5. MARKETING OF NEW PRODUCTS

5.1 The basics of marketing

The word "*market*" is derived from the Latin "mercatus", which means 'trade'. As early as the Classical era there were marketplaces where suppliers marketed their goods and services. When the buyer and seller had agreed on a price, the change of ownership took place through the buyer providing something in order to receive the product/article/service. At the small market – as in today's large market – the idea was to display the goods, to create interest in them and to persuade passers-by to buy the goods. *Rhetoric*, i.e. the art of persuasion, became an important skill at an early date. Aristotle is purported to have said: "Rhetoric is the art of finding that which best serves to persuade – whatever the issue".

A trend is that rhetoric in the form of speaking persuasively has been taken over in today's society by *market rhetoric* (e.g. Hedlund and Johannesson 1993). Also, Price-setting today is about agreeing on a total price including a basic price and other price-influencing factors in both a short-term and a long-term context. Examples of overall pricing are shown in figure 5-1. The bartering transactions frequent in classical times are less common nowadays, although such transactions do occur, in Internet aided and otherwise organized forms.
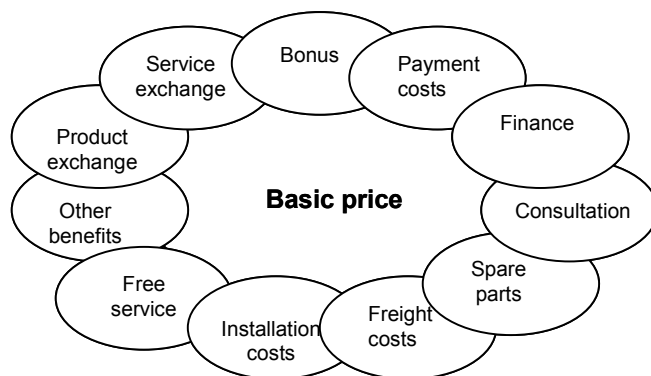
Figure 5-1: Example of overall pricing on which to negotiate when sellers and buyers are to agree

Today the marketplace is no longer as defined and clear-cut as in the Classical era and Internet is rapidly becoming a global marketplace where buyers and sellers agree to a transaction without meeting. Gradually also marketing and selling have become two different but interrelated activities. Especially in the innovation process they go close hand in hand.

Marketing is in the academic world a scientific topic while *selling* in general is seen as unscientific or artistic. Marketing more and more means giving general information about a product or a service, creating interest in it, informing the customers/users/consumers of its usefulness and eventually also stating its selling price. Marketing a product is difficult to carry out if the product has no *brand name, which is* why branding is an important marketing activity.

Marketing is done principally by marketers and sales personnel, but all employees in the company contribute to the marketing of the company and its products. The switchboard operator for example

influences in a positive way the potential buyer's attitude towards the company when the caller is received in a swift, pleasant and efficient way. The automatic answering system, which is becoming more and more common asking the caller to press buttons step by step to end up in nowhere has the opposite effect.

Furthermore, research has shown that engineers at companies selling industrial products often have closer and more long-term pre-purchase relations with customers than sales personnel and marketers have (e.g. Rylander 1995). Experience, however, tells us that the same engineers can destroy business opportunities by discussing prices with customers. Thus, it is important to get engineers letting the sales people take care of the complex pricing of the product as the basic price is only one part of the total deal, which figure 5-1 shows an example of.

To note is that the basic price in figure 5-1 is more and more going in the direction of zero and that revenues have to be taken out in other ways as on service, added functionality, advertisement, etc.

5.2 Market organization

Thus, the basic aims of marketing is to make customers wanting to buy the products and to make it easier for the sales people to sell the products. To fulfill these aims many activities are needed. Figure 5-2 shows an example of an organization developed to take care of different activities within the field of marketing for a mature business. During the innovation process initially the entrepreneur has to cover all the areas successively bringing in people who take care of the different activities when the business grows.
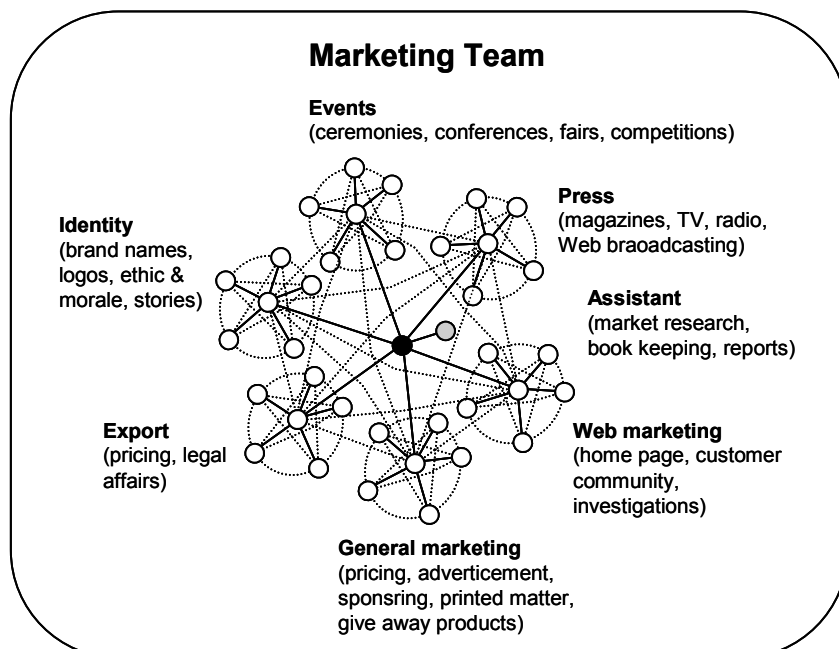
Figure 5-2: In a mature market organization many activities have to be covered

68

5.3 Aim of marketing

Classical marketing basically was a question of price and demand, i.e. how in the long term to optimize one's income from the product or products that the company provides currently and in the future. The change of ownership of the product(s) in each case should take place in a manner as advantageous as possible to the seller, while the buyer shall perceive the value of the product to be greater than the agreed price. This difference can be called the *metavalue* (Linn 1985).

When companies started to face a situation of an increased number of competing products, marketing got a wider mission, i.e. to display the product, to create interest, to persuade, and to set prices so as to ensure that the company was able to exchange its products for money at the best possible profit. Today, when we have a surplus of products offered, services and labor, marketing has an intricate position to secure profitability in a wide perspective including giving away the basic products free of charge.

To note also is that marketing need not have a commercial aim. Pressure groups, such as *Greenpeace*, religious movements, gay movments, etc. pursue three of the aims of marketing (to display the product, to create interest and to persuade), without normally negotiating a price. Such pressure groups can be significant to the marketing of commercial products, since they are often *trendsetters*. In the case of Greenpeace, for example, its activities have contributed to increased environmental awareness, which has meant that the environmental dimension now has an increasing importance in marketing. Entrepreneurs generally need to identify trends and trendsetters at an early stage, as they provide conditions for new products and innovative businesses.

If it is the goal of the company to remain on the market for a long period, then it is important that the customers/users are content, not only at the moment of purchase, but throughout the practical life of the product. Good customer service, well-designed manuals and environmentally adapted/recyclable solutions are some examples of important issues for the company in this respect. These factors affect whether a repeat purchase will take place in the short term and whether the customers/users are to contribute to the spread of favorable judgments on the company and the products. Research shows that customer loyalty has enormous significance to a company's long-term profitability (e.g. Bhote 1996). Research also shows that a customer/user may be "loyal" to two or more companies at the same time. For example, in a family there can be two different makes of car to which loyalty is shown when changing cars. (A better term than a loyal customer is a returning customer).

Customer loyalty is built up successively in what may be termed relational stages in four steps (Flodhammar et al. 1991). The four steps – of which only the first counts initially for innovations - are:

1. Non-customer: the individual has little or no knowledge of the supplier and the supplier's offers, has never bought from the supplier, and has no plans to do so.
2. Potential customer: is aware of the supplier and the supplier's offers, and perceives a need for the product.
3. Customer: has bought at least once.

4. Loyal/returning customer: has bought several times and/ or buys most required products from the supplier.

A customer may be a consumer and/or *user*. To be a *consumer* means to consume the product, which in turn means that the time during which the consumer utilizes the product is often short (e.g. one day for a tablet with a depot effect). If the term 'use up' is used, then the utilization time is longer (the oil in a boiler for example is used up over an entire year per fill-up). When a product is used then it is temporarily used up and after a certain inactive period it regains its original value (the farmer uses the soil, which after fertilization regains its growing power). When using the product it is not used up in a short-term perspective, but it is subjected to wear to varying degrees depending on the choice of material, constructional solutions, service, external influence, etc.

Everyday usage is often careless over the meaning of the different terms. For example, can the users of a microwave oven or a car be consumers of such products? On the other hand, there is no doubt that they are consumers of the energy required to operate the products. However, in marketing it is important to observe the differences between the different terms, since *market rhetoric* is designed differently, depending on the form of usage that is intended for the product. Also, it is extremely important to distinguish between customers and users. Customers are most important to marketers and to sales personnel. To product developers however, *users/usage* is of more importance. Product developers need also to consider that users can be divided into *primary users* (i.e. principal users) and *secondary users* (i.e. temporary users).

When trying to describe the term marketing, one can begin either from the customer's/user's situation or the company's situation. Figure 5-3 shows an example of how the company is put in the focus of marketing.
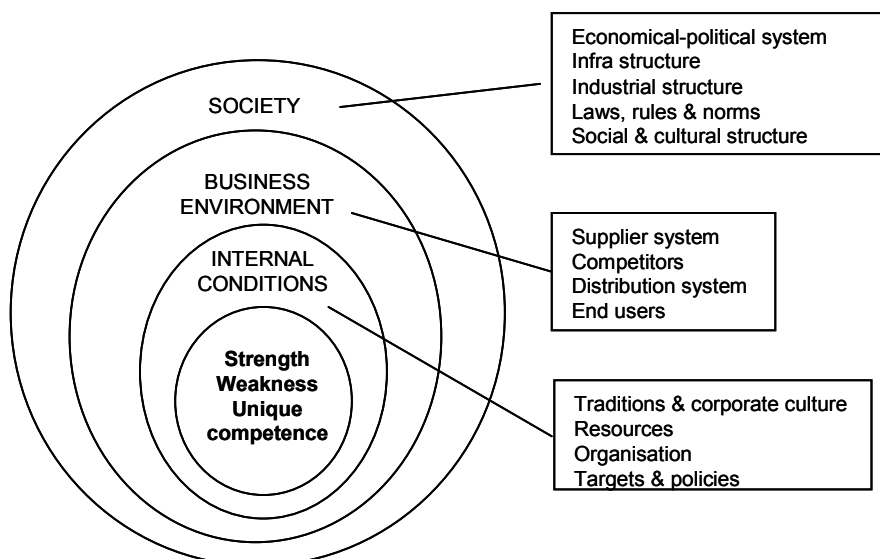
Figure 5-3: Internal and external framework for marketing when the company is put in the focus of the process (from Lekvall and Wahlbin 1993). This can also be called Business – User – Society (BUS),

70

which is of great importance for product developers to think of in their work

In innovative businesses it is important to create one's own framework for marketing, since in general there are few historical facts and conventions to fall back on. When the customer is placed at the centre, one should ensure that it is not merely the core product that is included in the assessment, but that also everything is assessed that the customers perceive around the product and which noticeably affects the decision to purchase. Marketing in this case aims to make an overall offer to the customer, including both "hardware" and "software", so that the company thereby achieves optimum short-term and long-term profitability – something that always represents a contradiction. Figure 5-4 shows an example of the complexity in the composition of different marketing activities.
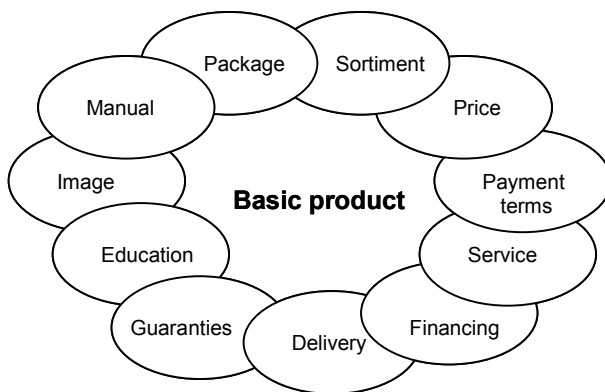
Figure 5-4: When the customer is placed at the centre of marketing activities, the product becomes merely a part of the total offer

5.4 Different categories of buyer and user

Marketing literature often states that success in product sales demands a suitable choice of four Ps (McCarthy 1968). These Ps stand for price, place, product and persuasion/promotion for successful marketing. Kotler & Keith (1972) complemented these four P's with four O's (Object of purchase, Objectives of purchase, Organization for purchasing and Operations of purchasing organization). Today we know that neither McCarthy's four Ps nor Kotler's four Os are sufficient for successful marketing and sales. This is above all because the crucial human, irrational dimension has been ignored in their models. Marketing via personal influence, where the rational and irrational factors constantly may be influenced and the message thereby amended, is particularly important in selling new products. However, energy and commitment may be devoted to individuals who will not buy the product until they know that it has been previously bought and used by others.

From when the sales start to take off it is important to know the *target group* for the marketing as well as where the group is geographically located, since this has a major influence on the choice of message. Furthermore, in selecting the target group, it is vital to consider that as regards the experience of the buyers, they can be roughly divided into four different *buyer categories*. These buyer categories are called

pioneers, early majority buyers, *late majority buyers* and *latecomers (laggards)*. The number of possible *buyers* from the launch of a new product and on – until the latecomers have bought the product – is shown in principle in figure 5-5. As shown in the figure, the pioneer group can be divided into what is known as early pioneers (innovators) and late pioneers (emulators/early adopters).

Number of buyers

34 %
(Early majority)

34 %
(Late majority)

Time from
introduction

2,5 %
(Innovators)

13,5 %
(Early adopters)

16 %
(Laggards)
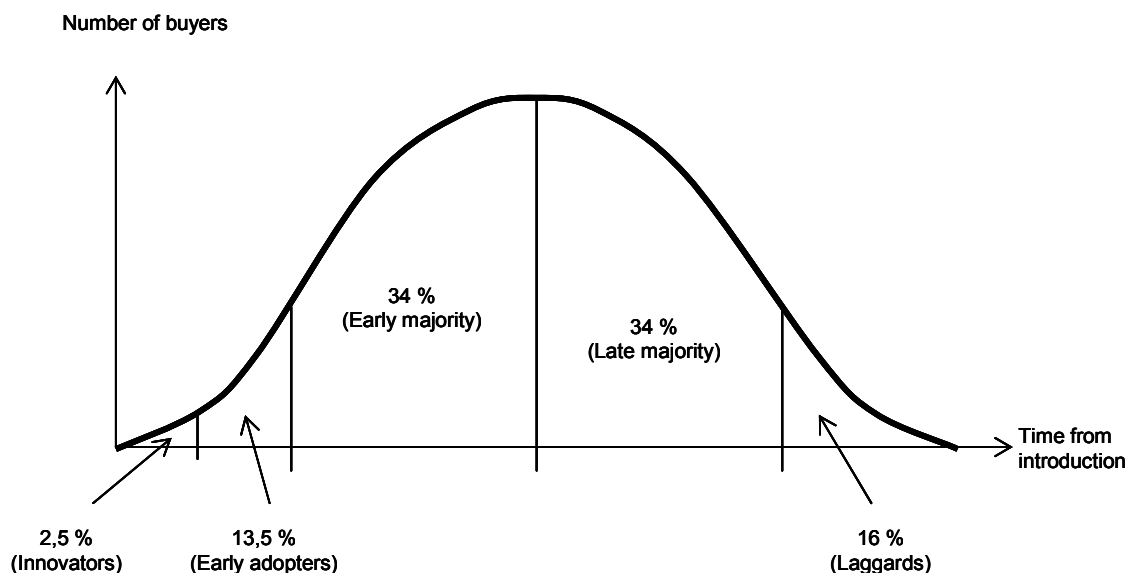
Figure 5-5: The number of first-time buyers of an article/product (or an opinion) is small at first, and will then increase and peak. The theoretical curve will then turn down until the product is removed from the market

Even though each person has a basic mindset that fits one buyer category more than another, we act in different ways with regard to different situations and to different products and opinions. Most people therefore can certainly remember being ahead of most or many others as regards some purchases or opinions. In other cases they have waited before accepting a new product or opinion until others appear to have accepted them. Thus there are no pioneers who act as pioneers in every situation. However, the probability that a clear pioneer in one respect is a pioneer also in another however is greater than that a clear latecomer should suddenly act like a pioneer.

The normal distribution curve in figure 5-5 is meant to provide a mental picture of what in principle happens to a product on the market during the entire commercial *product lifecycle (PLC)* (c.f. figure 1-1), i.e. from its launch on the market until it is removed from the market by the company. In reality the curve is only very rarely normally distributed: it is usually biased one way or the other for each individual product. In certain cases the number of pioneers is only a few per cent of all first-time buyers, while in other cases it could be around ten per cent of all first-time buyers if the product is longed for and meets a pent-up need. Due to natural disasters, military and trade conflicts, terrorist attacks, or due to new laws and regulations, sales can abruptly cease. Even if a new product is in great demand – e.g. a vaccine against a disease – and the number thereby can be appraised, it is difficult to estimate time-wise how sales will take place in reality, as marketing and sales are merely two influencing factors. Other equally important

factors are for example the purchasing power of the target group, the economic climate, weather conditions, competitors' countermoves, sales channels, political measures, etc. Extensive business planning before market launch is therefore often wasted time and money.

The important point to bear in mind regarding figure 5-5 then is that there are different buyer categories with different preferences, buying behaviors, etc. Without this insight, marketing - and sales - will be ineffectual. An entrepreneur, who for example thinks that his company can skip the pioneer buyers and aim the drive at early majority buyers, is not likely to be especially successful.

Pioneers are persons who by nature often want the latest type of products and enjoy displaying their new products. Pioneers therefore are a kind of ambassadors for their new products, provided that they are not too dissatisfied, for example with the quality. In general they are also prepared to pay a high price simply to be first to own their new product. There are pioneers both for the consumer product category and for example among buyers of hardware for a company. Constructers, buyers and secretaries then can be divided into the different buyer categories. It is important to remember also that those who make purchasing decisions regarding a new product are never companies, but one or more individuals in the company.

Even if it is desirable to quickly reach the early majority group of first-time buyers, it is still not possible to reach this group without first having won the pioneer group. For this reason, it is an erroneous approach to carry out price and perception control of a statistically selected group before the launch of a new product. Tests like this will show a forced situation where time is frozen at a stage later than the initial stage. When sales then take place, time is moved back to point zero. If one goes by statistical tests then one's aim will usually be wrong. This is because one then tries to sell the innovation to the majority group of buyers – which time-wise is not prepared to buy the product. At the same time, the pioneers will not want the product, since it is not made for them. Although one feels that one has done everything right, sales are often poor if faith has been put in this type of statistics and statistical surveys.

The only initial interest one should nurture when marketing new products is in finding out how some pioneers perceive the product. If possible, as we have mentioned previously, before developing and manufacturing the product, one should also sell the product concept to a single representative of these pioneers. Thereby the product will be used and evaluated at an early stage, while this will help the product developers to focus their efforts on producing a product that is attractive to the buyer. When, after possible modifications and new user tests, the time arrives to sell the product on a broad front, it is also time to concentrate efforts on the pioneers. Recurring market tests, then, give a picture of how quickly the product is accepted on the market, whereby it is possible later to produce the right curve as regards first-time buyer behavior. Such knowledge can be of great value before a launch on markets in new geographical areas and also before subsequent launches on the home market.

When customers/buyers and users are not the same person, the focus must be on *pioneer users* and not on *pioneer buyers*. If the pioneer users are not satisfied with the product and what surrounds it, they will inform the pioneer buyers of their negative opinions, whereby it will be difficult to get sales off the ground. Buyers/users with negative opinions will also inform many others of their adverse experience,

73

which will further hamper sales efforts. If this happens, then there will be a drastic rise in the cost of marketing to counter the negative marketing that takes place outside the company's control.

If the company, salesperson or pioneer buyer gives away the product to a user/consumer who mentally belongs to a later user category, this user will often not use the product voluntarily. Worst of all is if the pioneer buyer gives the product to a user who is a latecomer by nature. One can then be practically sure that the product will not be used. If for example a seller of treatment equipment does not find one or several pioneer users among care personnel, the product will remain unused no matter how good the seller's contacts are with the medical authorities' buyers. In this case it is often necessary for the seller instead to interest a "pioneer patient" in the product, who dares to test it. It is also important to ensure that health and safety officers and doctors form a favorable opinion of the product. To establish a new product successfully means putting the focus on finding and linking as many pioneers as possible, among buyers, users and other influential people.

When many individuals influence the purchase of a product, and marketing and sales include this in their planning, one can speak of relational marketing. Gummesson (2002) has identified 30 important relations (30 Rs), which should be considered in connection with *relational marketing*. These 30 Rs are divided by Gummesson into classic market relations, special market relations, mega-relations (relations above the market) and nano-relations (relations below the market, i.e. directed towards the company). In practice however it is sufficient to remember that a deal is often based on relations in many directions. A patient hoist for example generally has one *buyer/customer* (the medical authorities' buyer), many users (e.g. paramedics, nurses, patients and relatives) and many pressure groups (doctors, health and safety officers, relatives, supervisory authorities, etc.). Each of all these or other categories affects the company's possibilities to sell its product.

5.5 What does the customer pay for?

When setting up new innovative businesses it is important to please the buyers and users as much as possible, which can be achieved only if the functional and sensorial values of the product are good enough and the after-sales is good. If so, a positive development of the *image value* will grow, i.e. both the brand name of the product and the company name. The functional and sensorial values are what the technically devoted product developers have to be responsible for while the team members responsible for the marketing of the new products must focus on the unique product values – the so-called unique selling points (USPs) – and on the creation and the telling of a good story about the product (Godin 2005). To do that a close interaction is needed both with the technical team members and the sales people.

To maximize the *functional values* means to ensure that the product functions trouble-free both in the short term and the long term. If the producer does not ensure that the functional values are what the customers/users have reason to expect, then even the most massive marketing drive will not sway the customers/users back to a favorable opinion. The first pre-requisite for a successful business operation then is to ensure that the functional values correspond to the price level and image that the product has been given. For unique solutions eventually *patents* should be applied for.

For a purchase to take place there is also a requirement that the product's *sensorial values* (also called *perceptual values*) are satisfactory (Ottosson 1999-B). The sensorial values consist mainly of form, color, finish, smell, taste and sound. To maximize the sensorial values means to ensure that the product semantics is good, that the product is well-designed and ergonomically made, that the packaging is well-designed and functional, that the controls and buttons are easy to understand and use, that functional descriptions are user-friendly, that the product is environmentally-adapted, and so on. [*Product semantics* is a field of thought based on the idea that a product's form should readily communicate the function of the product. Thus, a product with good product semantics would typically not require the user to read a manual before beginning to use it.]

The marketing must constantly aim to strengthen image values. *Image values* are values at a higher level than, and outside, the product itself. Image values therefore can be said to be environmentally specific and are "ego-reinforcing". Important image values include the *brand name*, recognition marks (logos) and the company name. Car manufacturers for example try to ensure that buyers in some way recognize new models too and associate them with the brand names and traditions of the earlier generations of cars. In choosing between two equal products, recognition of the company name and brand names is an important factor. As buyers we act more or less rationally depending on what feelings we have regarding the product. Our choices are steered by irrationally or rationally-based motives. The biggest decisions appear to be those that are most influenced by our feelings (Linn 1990). In all marketing therefore it is important actively to profile and protect one's company name and brand names so that potential buyers do not buy similar products from other companies. To protect the *image values* of form and text the company should apply for *trademark protection* and should assert its rights by claiming *copyright* on the product.

5.6 Market segmenting

A classical marketing view is that successful marketing is based on the ability to identify, analyze and develop attractive market segments. Few companies have the resources to target all possible market segments, but must choose the market segments that it is thought will give the best financial results. The product life and one's own financial situation decide how long term the company's approach can be in choosing market segments. However, when first selling the business/product idea this analytical way of working is often unsuccessful and the sales people therefore have to "shoot" in different directions to eventually get a customer. When having one or more customers the marketers can use analytical methods to take better care of that market segment.

To identify possible customers and market segments means to find interesting portions of the total market that can be targeted. To acquire many suggestions to choose between, it is important to be creative and to list as many different alternatives as one can and to start to approach the ones that feel most interesting as soon as possible. This is the mission of the sales people. Judgment points are future possible market size, geographical location and one's own possibility to meet expected requirements, etc.

A suitable method to use in the creative process to find possible customers and market segments is to start up dialogues with different people. Relaxed dialogues in small groups (max. six persons!) over coffee can e.g. be rewarding to obtain practicable ideas. Conversations (dialogues) with users, customers and experts

are also important possibilities as are meetings in different networks. If this still does not produce results, then brainstorming is a possibility, which of course can also be used in parallel with the different dialogues. (Brainstorming is treated in the next chapter.)

When the different market segments have been evaluated, it is time to decide which of them is/are to be targeted first and what approach is to be used by the sales people. Occasionally this is referred to as "Niche Marketing". To position a product, however, also means to develop the product's functional and sensorial values to fit the chosen market segment.

If one can choose a customer/user to co-operate with in the product development, then a demanding customer should be chosen. In an intensive exchange between developers and a primary customer/ primary user, conflict situations can arise which may be perceived as difficult to handle. They are however extremely useful to the product development process. Customers/users, which purely make demands without making suggestions for solutions, are of course of less value than customers/users which make demands but also suggest solutions.

Observe that it is not always the case that customers/users/consumers are aware of their "real" needs (Axelsson 1996). In certain cases (e.g. children, the disabled and the elderly) there are no or few communication possibilities with them, which means that company representatives must have ample experience of their own to be able to make correct assessments (Björk 2003). For radically new products customers who have only old products for comparison will not be of much help.

5.7 Price-setting new products

Every entrepreneur and company leader must strive as quickly as possible to achieve an aggregate income that exceeds aggregate expenses in the business. Thereby money is achieved for development, investment and accumulation of reserves for future economic strain or future needs. *Income* or *revenue*, to use another term, is often directly dependent on the price-setting and the discounts offered. However, the classical view of pricing is undergoing change as we in the Internet world see many products that are given away free of charge meaning that the users will pay for *secondary products* instead of *primary products* or for extensions of the primary products and/or services. Here we will mainly discuss the pricing of primary products in the classical view as the new view means no pricing at all. For industrial products and many consumer products the traditional pricing is still relevant and will be so even in the future.

While price-setting new products is difficult to carry out a price-setting strategy strongly affects the company's profit margins. Some reasons for this are that until a few new products have been sold there is no generally accepted price level to relate the price to, there is no information available concerning price-sensitivity, there is no information available concerning competitor reactions before the new product has been launched, there is no knowledge concerning customer reactions to the new products before they have been introduced to the market, and that therefore there is a lack of knowledge about which marketing and sales arguments give the best effect.

When price-setting a groundbreaking new product the first thing to do therefore is to gain an impression of

the usefulness the product will have to the customer/user. Then through practical tests one must investigate which price is the highest that can be set without making the product impossible to sell to the buyer category 'pioneers'. This is done mainly through actual attempts to sell to some selected customers. If the customer buys direct without discussing the price, then the price is probably too low. If the reaction is favorable to the product but not to the price, then this can always be adjusted downwards so that a price level acceptable to the customer is reached.

If it is difficult to sell the product at the set price, introductory offers can be made. An alternative is to reduce the price. Note however that the method of asking a possible customer to suggest a price seldom gives a correct price indication unless one has first indicated a price. This applies especially if the customer is hesitant about buying the product.

There is no right price for a groundbreaking new product, since the product value will vary for each buyer/user. The price to be determined then is the price that corresponds to the usefulness that the product has to a sufficiently large number of users. The manufacturing cost has little or nothing to do with the usefulness a product has to a user. Unfortunately many engineers see it as almost immoral to set prices in any other way than in proportion to the manufacturing cost. This attitude is regrettable. The conceptual difference between *engineering price-setting* and *market-oriented price-setting* may be illustrated by the two following models:

Engineering price-setting: **Market-oriented price-setting:**

Costs + margin = price **Price – costs = margin**

A variant of market oriented price-setting is "strategic pricing" used when the market is well-known – which is the opposite to the situation for innovations. According to Kim & Mauborgne (2005) when strategic pricing is done one first has to set a strategic price to reach the mass of customers. Next step is to set a target profit and by subtracting the profit from the price the accepted cost appears. Knowing the acceptable cost different possibilities to reach that cost level are investigated including finding cheap production possibilities, re-designing the product, changing material in the product, etc.

The biggest cost is often the manufacturing cost of the product if the product comprises a good deal of hardware. For software-based products the manufacturing cost is always low or insignificant. If the price that can be set for the next stage in the sales chain for a hardware-based product is lower than three to four times the manufacturing price, one should as a rule not begin to manufacture and sell the product. The mark-up factor however is not a fixed factor and varies by product and sector. In pharmaceuticals with a long development period, the factor needs to be very high to cover future R&D. For extremely expensive products like aircraft, boats, nuclear plants etc., it is often not possible to have a factor exceeding 1,5 while for products with low prices one needs a mark-up factor in the region of 5 - 10. Price-setting of software-based products cannot be compared with the manufacturing price at all, but must be based on the use of the product and the number of potential buyers.

When price-setting a new product it is important to remember that once the product has been launched on the market, it is extremely difficult to raise an initial price that was too low. Instead of a large price rise, one must make small rises (e.g. 5 – 10 %) over a long period. in order to avoid too raucous protests from sellers and customers. If on the other hand the initial price is set too high, there is always a possibility to reduce the price, at the same time as a price reduction is always greeted positively by the market – which is never the case with a price rise. Experience shows, above all, that sales personnel often side with their customers every time the company introduces major price rises. Thereby the company encounters an internal conflict with the sales personnel and an external conflict with the customers when prices are increased.

If a number of units have been sold at a high price which the company nevertheless wants to reduce, for example owing to the appearance of a competitor with lower prices, it is important not to irritate or disappoint the first buyers by suddenly offering the same product at a lower price. The ambassadors for the product, which the first pleased buyers are, will no longer benefit the company in such a case, since they feel cheated. This is serious, since the "jungle telegraph" information on the market is very important for all new products. When reducing the price the product must be modified somewhat so that the market perceives the new version as a somewhat cheaper product sold at a lower price, at the same time as the first version should remain on the market mainly in its original design at the same price or a price close to it or even maybe higher.

For *substitute products*, which are intended for sale on an existing market, there is relatively little scope for free price-setting. In this case it is usual to assume that the competitors' price level is the starting-point for one's own price-setting. A small price rise of, for example 10-20 %, can often be justified by product and/or user advantages. If this tactic is used, it is more difficult for competitors to take countermeasures. They can scarcely raise their prices because a competitor has entered the market at a higher price! If on the other hand one enters the market at a lower price, there is a great risk that this measure will start a local price war which can be pursued successfully only by a player with plenty of money or one that has accumulated reserves for a long time.

By and large before the launch of a new product it is always crucial to consider what the competitors will do when they suddenly discover the new player. A new competitor is never welcome on the market by them and in order to spotlight the competitors' potential, one can have some colleagues or friends pretend to be competitors in an imaginary *market strategy game*. A "war game" of this type leads to the unconscious and conscious formation of an action plan to be used when the real market game starts, i.e. when the product is launched on the market.

Personal experience of the introduction of *groundbreaking new products* shows that the remarkable situation often arises where pioneer buyers are not interested in buying the products if their price is set too low, whereas a high price often increases interest in the products. Pioneers, then, seldom wish to buy a product because it is cheap, but rather because it satisfies a personal want for something unique, or a wish to be noticed, etc. Too low price-setting therefore seems even to be able to produce a repellent effect on the pioneers, both in a market perspective and from the point of view of coverage. The principles of this situation can be illustrated as in figure 5-6.

Sales price
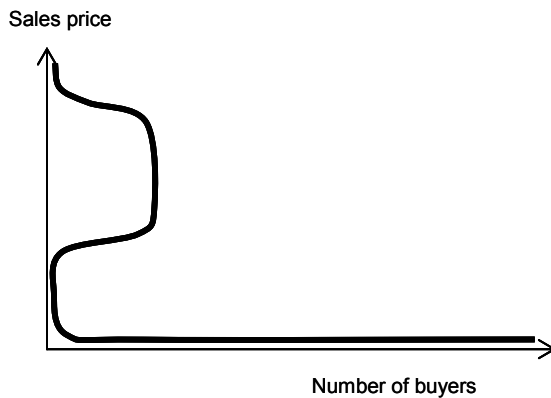
Number of buyers

Figure 5-6: Number of buyers as a function of the price-setting upon introduction of a groundbreaking new product

When the pioneers have been provided with the new products, then *product differentiation* is required (i.e. user adaptation) to reach the so-called early majority group. Product differentiation is done above all in order that the more sophisticated pioneer version is upgraded for the pioneer group's repeat purchase at the same time as the simpler, cheaper version should be launched, which is adapted to the early majority group. For these two groups it is suitable to implement a stepped price-setting as shown in figure 5-7. If one does not make such a product and price differentiation, the number of buyers can diminish unfavorably.

Sales price
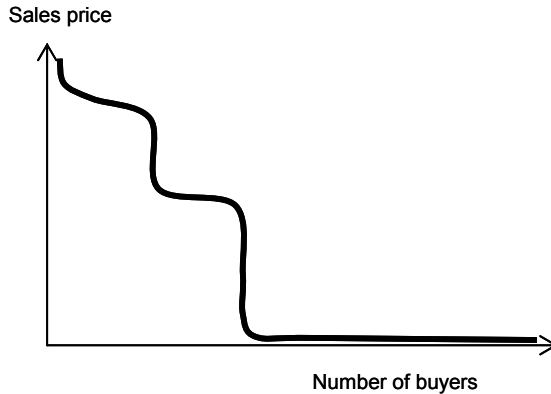
Number of buyers

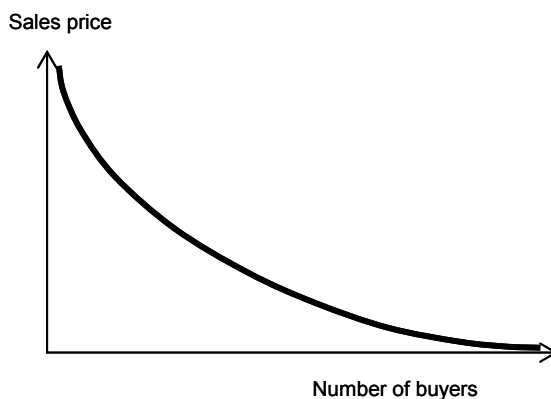**Figure 5-7:** Number of buyers as a function of the price-setting when the so-called early majority group is to be reached

When the late majority group is eventually to be targeted, the usual procedure is to issue an even cheaper version of the product. At the same time one must also reduce prices in the rest of the range so as not to lose market shares. At this stage the price-setting can be as in figure 5-8.

Figure 5-8: Number of buyers as a function of price-setting when the so-called majority group is to be reached

Price-setting when the latecomers are due to be targeted may be characterized by the asymptotic curve commonly used to illustrate how price-setting influences sales volume. This curve, which is shown in figure 5-9, is often appropriate for mature products and sectors.

Figure 5-9: Number of buyers as a function of price-setting for a mature product

Investigations have shown that costs and selling prices usually drop by 70-80 % for each doubling of the cumulative sales volume of an article when it is established and accepted by the market (e.g. Utterback 1994). Gordon Moore – former chairman of the board of Intel – suggested that every 18 months the number of transistors is doubled in computer memories without price increases for the customers. His assumptions held for 30 years, which is why one talks about *Moore's law*. These experiences are important to bear in mind, and emphasize the importance that initial price-setting should be at a sufficiently high level to allow the establishment of business operations with long-term profitability.

When a mature level has been reached for the products, many large companies tend to measure their progress in market shares. They then pay careful attention to how their market shares change over time. Through temporary price cuts or other marketing activities a competitor can, for example, temporarily win market shares on a local market unless the company quickly responds to the challenge. If a competitor is permitted to operate for a long period at a lower price level, thereby gaining a larger share of the market,

then customer loyalty towards this company will increase at the same time. If the competitor then raises its prices to the normal level, it will as a rule retain a larger market share than before the price reduction. The term *hysteres* (meaning lasting) has been borrowed from physics to denote this effect. The retained higher market share is correspondingly called the *remanence* (Simon 1997).

If the company does not itself sell the product to the end customers, it is important when price-setting to ensure that sufficient scope is left for the retailers' mark-up. It is usual for prices to double at each middle step between the manufacturer and the customer. Since one cannot generally have one price locally and higher prices on other markets, since there are contacts between both buyers and retailers on different markets and web technology is pushing this development forwards, an end price must be applied that is fairly uniform on all markets. Upon launch on the home market therefore, one must use the price that the planned retailers should use. Thereby much-needed margins for the business operation are created in the initial phase.

5.8 The first general marketing

Every new product should have unique properties and potential as regards marketing. Despite this the overall principles of marketing are the same, irrespective of whether they are applied to an advanced industrial product or a simple consumer product. One has free hands to the greatest degree when dealing with a groundbreaking product in a new field. For a *groundbreaking new product* in a mature operational sector, there is still a large degree of freedom even though habits are hard to break, except over a very long period. For new *substitute products* there is often freedom only as regards price competition and good service.

The first marketing of a new product begins when the inventor or entrepreneur starts to display the product or a prototype to someone to obtain opinions about the product, to sell the prototype, to collect user experiences and/or to bring development capital into the business. This first marketing then usually takes place without the existence of a commercial version of the product. It is therefore important not to give the product unnecessary negative PR, for which it might then suffer at a later development stage.

Unfortunately inventors are often guilty of exposing their inventions in the media in a way that later makes it difficult for a product developer in a reasonable manner to capitalize on the interest generated by the exposure. Exposure that comes too early and is too broad can, in addition, give rise to rival products. The first general marketing thereby without exception should be in a small circle and not aimed at the general public. Public marketing in addition should never take place until the product is at a stage of development where it will be ready for delivery in a reasonable time, i.e. a stage where the critical technical solutions have been tested with satisfactory results, so that the producer is sure of being able to deliver functional products after the final touches.

From the initial development stage and on the entrepreneur must quickly obtain as many opinions as possible on the product/product concept from the pioneer buyers and the primary users. After that, suitable decisions may be made. Sources of information may be for example decision-makers, installers and end users. The more opinion input at an early stage and the more complex the marketing concept is, the

cheaper and more correctly oriented the production will become, and the more effective the subsequent sales will be. If such information is not gathered until after the product has been developed then mental readiness to change direction will diminish.

In the first general marketing it is often better to show computer models and real models to knowledgeable and development-oriented people than to delay this contact until a functional prototype is available, which is closer to a production version. If frank views on the ideas are desired, then CAD drawings and computer animations should maybe not be shown, since the general public perceives them as finished and as something that cannot be influenced. If on the other hand the invention is shown in a rough prototype version, then this in general gives negative publicity, since many people thereby form an unfavorable attitude towards the product.

This is because only a very few people appear to possess the ability to imagine a product other than the prototype which they see before them, with its apparently obvious shortcomings. This applies even to development managers, who otherwise, one assumes, have the potential and knowledge to see possibilities rather than obstacles. To show a prototype that for example is functional but not yet well-designed, i.e. which does not satisfy the *sensorial values*, means that one does not acquire the necessary views that are sought after. In addition, the test persons form a negative basic attitude towards the product if it is unattractive or ungainly.

In initial contacts with the market, the entrepreneur will often receive answers that conflict with the entrepreneur's own opinion. It is then important for the entrepreneur to analyze critically and to interpret these answers. The answers are always dependent on how the questions have been worded and on the respondent's own values, the product design and so on. The entrepreneur, who is breaking new ground, in this context must remember to not slavishly follow the assumed majority opinion. It is the task of the entrepreneur in the long term to persuade the majority in the chosen market segment to adapt to something new. This is the precise significance of effective marketing of an innovation.

As has been pointed out, surveys using statistically composed groups (panels) seldom give the entrepreneur guidance in the right direction. This is because groups composed in this way encompass a majority that is conservative by nature. The important minority of development-oriented pioneers that exists in the group will thereby not be noticed. *Focus groups* are also questionable to get advices from as one or few individuals of such groups will influence the others to adopt a similar opinion as themselves.

Sales and marketing of the first commercial product should take place locally, or geographically as close as humanly possible to the operational centre of the business. There are many reasons for this. The most important reason is that it is the only way to study at close hand how the product is handled and how it functions when somebody not particularly careful and with little or no training uses the product: there are often many unpleasant surprises soon after the launch, no matter how carefully the product has been tested before taking this step.

The lessons learned about the product on the first and local sales market cannot be digested if the first sales take place far away. Another important reason is that a fault can quickly be rectified if the customer

is close to the company. The customer/user thereby does not lose confidence in the product and the seller/company. Awareness of a problem at the same time will then quickly spread in the company. If the product has been sold far away, then bad-will is created if for practical reasons it takes a long time for the problem to be resolved. Also when sales have been contracted out it is critical to retain one's own sales and marketing on a local market so that there is direct contact with the users at least in one area. Thereby more realistic demands can be made on new sales channels on other geographical markets.

Today the need for printed marketing material is very low as the Web has taken over as an information channel also offering new communication possibilities. Web pages - which are frequently updated e.g. through efficient content management systems (i.e. web publishing tools) - is therefore of utter importance as a marketing channel for early sales. In addition information can be provided through advertisements in different media. Getting newspaper articles published is far better than paying for advertising as such information is perceived to be objective, unlike the company's own production of marketing material.

Participation in *trade fairs* is another way to spread information about a new product to a wider circle of people. Preparations for taking part in a trade fair however means that considerable time is taken from direct selling of the products. Participation in fairs also means big costs for exhibition stands, exhibition material and salaries. There are often high expectations of sales after participation in a fair, which, however, seldom results in actual sales. Nevertheless, it is useful to have a fair as a target for completion of a new product, since this drives development, both in a technical perspective and as regards production of selling marketing material.

Marketing of new products via *flyers* and *advertisements* do not usually give measurable sales results in the early stages. *TV shopping channels* on the other hand are reported to have a positive sales effect if the activity is repeated often and the broadcasts are long and exhaustive, which also means a very expensive way of marketing. Radio advertising can be effective if one can explain the product in simple terms and/or put across a message. Radio advertising is also fairly expensive.

Marketing of new products via hand-outs of *free samples* is a very dubious way to market products, since to receive something without doing anything in return does not create a feeling of identity with the product. Therefore, free samples seldom lead to the recruitment of ambassadors for the product, except possibly in the case where the recipient is a reporter who in her/his medium, for example via an *article*, spreads positive judgments on the product. On this subject one might also add that there are those who consider that an article has twenty times more marketing value than a purchased advertisement. There are then double reasons to try to arrange articles and news items about new products.

5.9 Marketing on a broad front

When the product is to be marketed on a larger scale, after the first version of the product is ready, the marketing material must reflect the company and the products in a professional way. The individual marketing material – web pages and printed material - must allocate the right article (function, form, quality, weight, color etc.) to the "right" markets and with the profitability that will sustain the company's existence and expansion, so that the owner and employees are ensured a reasonable share of the profits.

When enough experience has been gained from the marketing and sales of the product and the product has been accepted by the market, it can be time to broaden the geographical market that is being addressed. Perhaps it can also be worthwhile to consider transferring the marketing and sales work to another, larger organization. To transfer marketing rights means to relinquish direct contact with the market. One thereby loses an important source of information and so becomes dependent on indirect and filtered information. It is therefore important to carefully consider whether or not to transfer the entire marketing rights and if so how first-hand information from the market is to be made available.

When the home market begins to develop positively, it is time to begin the *export drive*. This too must be carefully planned. The company's new organization on the new market or the new co-operation partner may not be left "without a rudder" if developments are to be positive. Every new market that is opened needs a contact person in the exporting company. This person will be overwhelmed with work during the first months after the launch on each new market. Therefore the start of the export drives should be staggered for different new markets. This will prevent overload in the exporting company and will prevent inadequate backup during the sensitive start-up period in each individual market.

The advertising material that is needed when marketing takes place on a broad front should be advanced and designed with a view to the target group early majority buyers. The message must be professionally designed and the images must be of good quality, four-color printing should be used, video recordings must not be amateurish, web pages must be professional, etc. Note in this respect that Internet home pages that are not upgraded often (at least monthly) give negative signals to the market as the market draws the conclusion that it is not worth the effort to check the home page as it is never upgraded.

The marketing and sales budget will often rise considerably if a continued expansive development is to be sustained. Note in this context that packaging, instructions and marketing material should be designed individually and locally in each market, since means of expression and culture differ between countries and also within countries. If such material is produced in the home country then it will not be perceived in the intended way in other countries. *Glocal* thinking – i.e. a combination of global thinking and local thinking – means that the local partner/business designs the marketing material in keeping with local needs and in the local partner's language.

5.10 Web marketing

Since the late-1990s, the *Internet* has constituted an important option for marketing a company and its products via the company's *website* or *web pages,* as they are also called. One is on the *World Wide Web (WWW)* when "surfing the net" (a web is literally a kind of network). The great advantage of web technology is that one can instantaneously reach both employees within the company and customers the world around, and this at no extra cost except for connecting charges and the cost of producing the website. Seen from a commercial perspective (so-called electronic commerce), the Internet means that companies and individuals simultaneously can offer their products round the world and round the clock, provided there are no language problems.

Via the Web, customers can obtain information on delivery times, prices and delivery terms, after which

they can place their orders, also via the Web. In addition, the web pages (web pages are also known as homepage) do away with middle steps that increase costs to the market that non-web business entails. Via an internal automatic counter the company can see how many visitors each web page has had. One can thereby monitor interest in the information at different points in time. One direct effect of this is that one obtains an indication of when it is time to change the homepage.

Figure 5-10 shows, in principle, how different pieces are connected to each other when web based solutions are used for information and communication. When someone authorized wants to change the content of a web page named e.g. www.page.com, she/he opens the content management tool that e.g. has the address www.page.com/webadmin. Now she/he can work on the web pages in the content management system and look at it only on her/his computer. When she/he is satisfied she/he can store the changes on the web server meaning that the edited web pages are then public. Thus, the content management tool is stored at its own address on the chosen web server on which the public web pages are also stored.
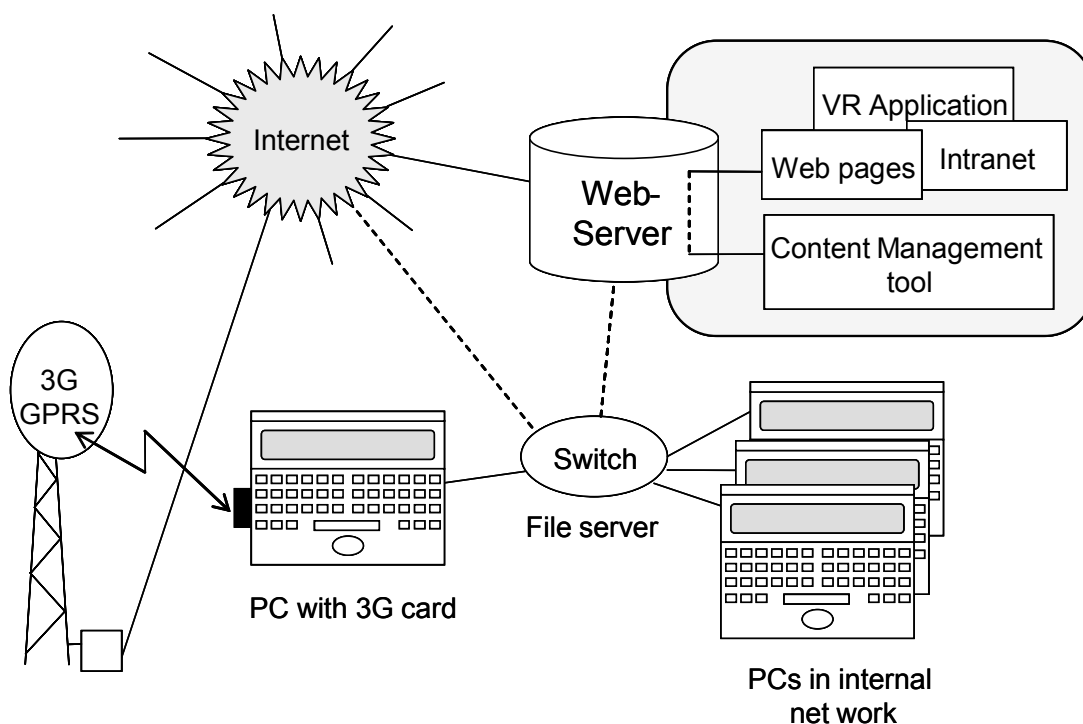
Figure 5-10: The web system offers the possibility to work from any computer sharing information (Ottosson & Holmdahl 2006)

Internet used internally within a company is often called *Intranet*. When only certain persons or other companies are permitted to access information that is available on the Intranet, one talks also of an *Extranet*. In an Extranet, then, use is limited to persons with authorization to access the information. For example, such sensitive information could include price lists to retailers, hospital records, survey documentation, etc. Using so-called *firewalls*, which are a combination of software and hardware, one

protects the company's networks from hostile attack from persons using the Internet. Firewalls are used also to prevent an Intranet user from accessing an Internet resource that could be harmful to the company's own networks.

On the website one can enter all the information one wishes to pass on, with no real limits. When different types of information are utilized simultaneously, this is called *multimedia*. An example of a multimedia presentation is when one uses text, graphics, video and music. For more effective market communication than that permitted by the use of IT as a brochure or a video, one can utilize what is known as *Virtual Reality (VR)*. VR means that the potential customer and user can twist, turn, move and manipulate the product as seen on the screen, either to instructions or according to the customer's/user's own whims. The observer can also change her/his position as shown on the screen or monitor. Instead of being passively fed with information, in VR one can thus actively steer one's search for information, while the computer instantly (ten times or more per second) gives new images. This is termed interactive real-time communication with the computer.

In what is called a *Virtual Showroom,* on the computer screen one can – without transferring oneself to a real showroom – inspect a product, or a product idea from different viewing angles with the help of VR technology and the Internet. Through VR one can instantly change colors, design and equipment options in a way that is not possible in reality without moving oneself between different objects. One can also quickly place the product in different environments in a way that is not possible in reality. For example one can first see the product in an arctic setting, and then place the product in a desert setting, etc.

Just to take one example of the use of VR in marketing and selling: A motorcycle dealer in an area of few people and far away from a large city can, in general, not afford to buy many motorcycles for show to potential customers. With a VR-application downloaded in his computer he can buy only one standard motorcycle, which the potential customers can ride to get the right feeling of the vehicle. Then he can let the customer try different colors and different equipment on the VR-application. In so doing the customer should find it easy to order a motorcycle with the desired color and equipment. Far better than downloading a VR application on one computer via e.g. CDs, would be if the producer – or marketer – of the motorcycles were to provide web based VR applications. In so doing, the producer/marketer can easily make changes as often as he wants. The customer can in his home or anywhere where there is an Internet connection use the web VR application.

A closely related alternative to a Virtual Showroom is trade via the Internet, a medium called *Virtual Shopping* or *eBusiness*. This means that the customer with the help of a computer mouse strolls around a shop and requests product information and the prices of interesting products. The customer then places the products in a "basket". In an inset frame on the customer's computer screen, the different products are shown that have been placed in the basket, and the running total price of the goods. If the customer knows what she/he wants without making a virtual tour of the shop then she/he can also add named products. Payment for the products is made through the usual credit card or using electronic cash downloaded from the customer's account. When payment has been made, the goods are delivered to the desired place by the delivery service in the same way as mail order.

When IT-ordering more complicated products, the company receiving the order can in a fraction of a second exchange drawings, images and other information with its suppliers wherever they are in the world. After delivery, the supplier can then wholly or partly replace traditional instruction, repair and service books with similar information on the Internet. In addition, the information can be continuously updated in a much simpler way than when reprinting is required of corresponding printed matter that uses paper as the transmitting medium. Further, the customer can be kept informed in a simple way about delivery status via the Internet. Customer follow-up can therefore be done more efficiently than via telephone or letter/fax, and different forms of information and offers can be adapted in a personal way.

Another possibility offered by the web technology is to send information immediately to recipients around the world by recording it in the same way as a TV or radio live broadcast. With the help of this technology one broadcasts the signals via broadband cables or via satellite to a server, which in turn uploads the material onto the web pages. If there is a *broadband connection* to the users, they can see the broadcast at a quality similar to an ordinary television live broadcast.

The major advantages of the Internet compared to other media channels of communication are its speed and cost-efficiency. Printed matter is expensive to produce and quickly becomes out of date, which is why there is a trend as far as possible – according to customers' IT habits – to concentrate on more simple printed matter linked to updated detailed information on the home pages. Web pages however should not be copies of printed advertising material, but special information with links to more detailed material for those wishing for more information. For example, one can provide links to comparison tests that a magazine has carried out, or to statements by the constructors of a product, etc.

For the administration and updating of the web pages efficient Content Management systems – CMS – should be used which means that changes can be made without knowledge in programming. With such systems many in the organization can make changes. The more people that can make changes on the web pages, the more actual the web pages can be.

[Content management systems are developed for the users to work with the web pages without them having programming knowledge (e.g. HTML programming). With the new systems it is easy to work on the web pages e.g. to change text, add new text, pictures, videos, banners, calendars, forms, etc. Technically, a content management system is placed on a web server in parallel with the public web page (see figure 5-10). Thus, the content management system is computer independent as long as an Internet connection exists to the PC/Lap top in use. With 3G connections the user today is rather independent of geographical location to make changes of the web pages with the help of the content management system used.]

Websites that take a long time to open are perceived as irritating by visitors, since the computer is locked during the time it takes to open the page with its images. Web pages that feature a choice of colors that make them difficult to read in a black-and white printout have less value to the recipient of the information.

If customers and users cannot find the company's home page, among all the millions of home pages in

existence, then marketing via the Internet becomes a waste of time. The following guidelines therefore should be observed for successful use of the Internet in marketing:

- Notify customers and business partners of the home page address and inform them via business cards, brochures, writing paper, etc.
- Register the home page on the biggest search engines on the Internet, i.e. the most visited web pages that enable searches by subject, company etc.
- Ensure that the Web addresses (the so-called domain names) are as simple and logical as possible, so that they are easy to remember or guess. For a company operating internationally it is important to have several domain names. www.volvo.se, www.volvo.com, www.volvo.de, etc. are examples of simple and logical addresses to Volvo, depending on where the customer is located.
- Advertise on other web pages with links to your own address.
- Send direct advertising to the email addresses of potential customers (so-called "push-publishing"). Note however that there are legal rules e.g. saying that the receiver in advance must have accepted the advertisement to be sent.
- Build up an personal bank of addresses, by offering readers automatic information when something new is on the web pages.
- Change the web pages as soon as there is something new to report.
- Read contact information often and give prompt replies and reactions to messages and questions that have arrived.

Finally it should be emphasized that for a good marketing effect, web pages should be designed by skilled marketers and designers, not by persons whose only qualification is enthusiasm about computers. Do not then overlook the potential of the Web as a marketing channel. See web pages as a natural and important part of the company's marketing activities in the same way as when marketing takes place through newspapers!

5.11 Viral marketing

Viral marketing and *viral advertising* refer to marketing techniques that seek to exploit pre-existing social networks to produce exponential increases in brand awareness, through viral processes similar to the spread of an epidemic. It is word-of-mouth delivered and enhanced online; it harnesses the network effect of the Internet and can be very useful in reaching a large number of people rapidly.

According to Wikipedia (http://en.wikipedia.org/wiki/Viral_marketing) *viral marketing* is sometimes used to describe some sorts of Internet-based stealth marketing campaigns, including the use of blogs, seemingly amateur web sites, and other forms of astrosurfing to create word of mouth for a new product or service. Often the ultimate goal of viral marketing campaigns is to generate media coverage via "offbeat" stories worth many times more than the campaigning company's advertising budget.

Also according to Wikipedia, the term *viral advertising* refers to the idea that people will pass on and share interesting and entertaining content; this is often sponsored by a brand, which is looking to build awareness of a product or service. These viral commercials often take the form of funny video clips, or interactive Flash games, images, and even text.

Viral marketing is popular because of the ease of executing the marketing campaign, relative low-cost (compared to direct mail), good targeting, and the high and rapid response rate. The main strength of viral marketing is its ability to obtain a large number of interested people at a low cost. The main weakness is that sometimes messages can look like e-mail spam and this creates the risk of damaging the brand. The 'from' and 'subject' lines then become very important in order to remedy this problem (Tell-A-Friend principle); for example, when sending a link or webpage, sometimes the subject line is "(Name of person here) thought you would like this page". The receiver will then recognize the name and know that it is not unsolicited.

The most difficult task for any company is to acquire and retain a large customer base. Through the use of the Internet and the effects of e-mail advertising, the business-to-consumer (B2C) efforts have a greater impact than many other tools of marketing. Viral marketing is a technique that avoids the annoyance of spam mail; it encourages users of a specific product or service to tell a friend. This would be a positive word-of-mouth recommendation.

5.12 Business cards

It is important in all marketing to make a positive and lasting impression on one's contacts. As mentioned all employees in the company are marketers. One important way to achieve the goal of a lasting impression is to leave behind a *business card*. A business card must show the person's name, company name, address, phone numbers, fax, web address and e-mail address. The font and general design should be selected for the greatest possible readability. One should however avoid advertising on a business card as the information quickly gets out of date. One should also avoid folded business cards as it is usual for recipients to insert business cards that they have received in plastic sections of e.g. a wallet. For the same reason one should choose a standardized format for the business cards.

In order to be able to send e.g. brochures in a quick, simple and personal way, at small extra cost, one can also have some memo cards made at the same time as the business cards are printed – cards bearing the same information as the business cards, but with some space for a few handwritten lines. A suitable format for the memo card is that of an ordinary postcard.

As was told in chapter 4, selling new products is largely a question of "selling yourself". For this reason it is important to stress the importance of having a photo of oneself on one's business card and on the memo card. The lasting value of business cards and memo cards is perhaps a thousand times greater than if there is no photo.

6. FINANCING

6.1 The term "financing"

Every innovation project has to be financed either totally before the start of the project or step by step when the project develops.

To *finance* an operation means to acquire *liquid assets* (i.e. money) in order to be able to pay current or future debts for running a business, and in order to be able to finance (i.e. pay for) planned development and investments. Also some unplanned costs must be prepared for which can differ depending on e.g. maturity of the business, branch, etc. The principles of financing are the same regardless of whether we are talking about a company, a public body, an organization or a household.

When speaking of a company's or a person's *financial strength* one means their capacity to finance their own or other operations. Financial strength in turn is dependent on how liquid the company or person is, i.e. how good the capability is to obtain liquid assets at short notice.

Internal financing or *self financing* means converting one's own assets and reserves into capital that can be used as payment or to use the assets directly as payment or in a transaction where the official valuation varies depending on the purpose of the valuation. A patent or brand name can be assigned great value, for example if the company wishes to show large intangible assets. Especially if the company pays with a new share issue, this can be attractive to the inventor or owner of the rights.

External financing means acquiring capital principally through borrowing or through a new issue of shares when the operation to be financed is in a limited company. In external financing the *financier* normally wants to gain an overview of the value of the business as well as its financial resources after external financing. If the financier is not familiar with the business, then before financing the financier will often want to ensure that the capital made available is not dropped into a "black hole", or is not used in an unintended way in order to achieve increased value in the company. The financier therefore takes security measures. A term for such activities is to make "*due diligence*".

Examples of security a financier makes are: to demand a mortgage in the company, to demand a guarantee of some sort from the shareholders, to demand representation on the board, to demand an agreement that the company does not take different actions without the consent of the financier, etc. To arrange external financing therefore always takes time and for this reason must be planned in good time to avoid a crisis situation due to a lack of liquidity.

How financing has been carried out and what assets there are can be seen in the company's *balance sheet* (we will return later to bookkeeping requirements). Among the assets, one differentiates between fixed assets and current assets. *Fixed assets* are for example equipment, machines, buildings, and land. For knowledge-based companies the fixed assets are minimal and it is usually said that the company instead has extensive *human capital*, which is difficult to evaluate in ordinary financial terms. *Current assets,* which are sometimes referred to as *floating assets*, are for example liquid assets, inventory and

receivables. Financing consists of shareholders' equity and debts. The shareholders' equity consists of the owners' investments and prior liabilities that have not been distributed. The *liabilities* include bank loans, and trade accounts payable, payroll and taxes liabilities.

In order to try to gain an impression of how profitable a company is, it is common to use different forms of key ratio. This is called to carry out an *accounts analysis*, i.e. to make an analysis of the balance sheet in the latest annual report. The key ratio most often used is liquidity – to which we will pay great attention further on, *profitability*, which gives an idea of the company's ability to provide a return on invested capital and the *equity/assets* ratio, which indicates the company's ability to absorb losses. We will return later to the term equity/assets ratio.

The perception of the minimum suitable profitability of a company varies from sector to sector, the economic situation, the competitive situation and client structure. Generally however it can be said that the annual profits in the long run must exceed the costs of borrowed capital. The difference between the profits and the costs of borrowed capital is often called the *risk margin*. The relation between debts and shareholders' equity shows the *leverage*.

In order to describe retrospectively how the financing of a business has taken place, a *cash flow statement* is occasionally produced, which shows how the *cash flow* has been in the company during the year. For public companies, i.e. major limited liability companies with many shareholders, it is a requirement that the companies submit a cash flow statement to complement the annual report, which is submitted annually after the books are closed.

6.2 Financing in the early stages

An innovation project is often mainly financed with existing resources, existing equipment and with an input of unpaid or poorly paid work. When the innovation project has developed to the point where there is strong belief in the possibility of creating a successful, i.e. profitable business of the innovation project, then there is reason to set up a company to accommodate the new business. Up until the formation of a company for the innovation project, financing is usually completely through the owners of the project making available the necessary capital for the operation. If the owners do not possess sufficient equity they themselves must borrow capital, thereby also accepting full responsibility for the loan.

The most common business set-up chosen for an innovative operation is a newly started limited company. Here therefore only a limited company will be described. If another set-up is chosen it is easy to adapt the way of thinking and acting to those different demands.

6.3 Steer, accelerate and brake

To enable payment of goods and services and for investments, it is necessary that *liquid assets* - i.e. cash (money), postal giro assets and bank assets – are available in sufficient quantities when payment is due. In order that liquid assets shall be available to make payment on time there is in turn a need for current *result-based budgeting*, current *liquidity planning* and continuous *follow-up*.

In a one-man business the result-based budgeting and liquidity planning can be carried out fairly simply. As soon as the business has 4-5 employees, however, more sophisticated result-based budgeting and liquidity planning are required to ensure relatively secure development. Experience shows that many *entrepreneurs* under-achieve in this important work, which makes development unnecessarily risky. Unfortunately it seems that many entrepreneurs and their businesses incur expenses before financing is settled, an approach bringing high and unnecessary risks that would be best avoided. Figure 6-1 below shows in principle how a monthly result-based budget with linked liquidity planning is done. Vertical arrows mark mathematical calculations, while broken arrows denote copied values. The default liquidity values for each period show the financing need with the ambition shown in the result-based budget. If the tables are designed as a spreadsheet, then it is easy to carry out different simulations to show the financial sensitivity of the activity.

Current result-based budget

	Month 1	Month 2	Month 3	Months 4 -6	Months7 -12
Total income					
Total spendings					
Result					

Current liquidity plan

	Month 1	Month 2	Month 3	Months 4 -6	Months 7 -12	Next month
Start value						
Result						
Corrections						
End value						

Last month

Figure 6-1: Using monthly result-based budgets, liquidity can be estimated each month, whereby the financing needs can be predicted, with the ambition shown in the result-based budget (Ottosson 1997)

One way to reduce the load on liquidity within the budget is to arrange longer payment terms with the suppliers and to buy used equipment. *Pre-ordering* – which means that goods are ordered for e.g. a year's needs at a good unit price and then suborders and sub-invoices are received – is another method to avoid unnecessarily tying up capital. Liquidity can also be improved by one or more customers agreeing in advance to pay for work and/or services that will be supplied later. If the customer is wary, she/he may however demand bank guarantees for the sum advanced, which means that the company does not access the capital, but reduces the load on the overdraft facility (we will return to this term). The bank charges a fee for the guarantee, which may be up to 2 % of the sum guaranteed. However, this fee is often paid by the customer, since the purpose of the bank guarantee is to protect the customer's payment.

In all budgeting, revenue is the component that is most difficult to assess. When assessing how liquidity will change in the short and long term, it is crucial to continuously follow up changes in the *quotation status* and

order book. If enquiries diminish, it may be assumed that the number of orders will eventually diminish. If competitors make changes in e.g. pricing, however, then the influx of orders can diminish even if many quotations are supplied. Therefore the percentage of orders placed in relation to the number of quotations must be monitored carefully so that action can be taken in the event of a downturn. Experience shows that the proportion of orders in relation to quotations should be high in the early innovative stages. When the turnover increases opportunities decrease to achieve a large proportion of orders in relation to quotations. Note however that the time from the first contact to order can be long – even years!

Experience also says that no innovative business should be run without continuous upgrades at least once monthly of the result-based budget and liquidity planning. The upgrades are necessary in order that the financing needs should always be monitored and for a suitable rate of development to be maintained. If the current result-based budgeting and liquidity planning – with the assumptions regarding revenue and expenses (costs) that need to be made – indicate that the business will not be sufficiently *liquid* when payment for different commitments is due, i.e. that liquid assets will not be available in sufficient quantities, then resources must be acquired in other ways. The best way in this case is often to convert owned resources into liquid funds, which pre-supposes at least one buyer who is prepared to acquire the assets at an acceptable price. If internal financing (self-financing) with owned resources cannot take place, then external financing must be sought to handle the payments.

6.4 The dangers of poor liquidity planning

If budgeting and liquidity planning have been so poor that accrued debts cannot be paid in time, then the company must stop payments when it no longer has liquid assets with which to pay the debts. If it is not possible to reach agreements on postponed payments and/or agreements on reduced debts (so-called *composition*) with the suppliers and creditors when there is a long-term liquidity deficit, then the management/board must ask the courts to declare the company *bankrupt.* A creditor who has not received payment can also request that the company be declared bankrupt.

When a company goes bankrupt, a *receiver* takes over the winding up of the *bankruptcy estate*, i.e. the bankrupt company. Winding up means that the receiver as quickly as possible disposes of all assets as well as the business, i.e. the operation. From the revenue brought into the bankrupt estate from these sales, deductions are made for administration of the bankruptcy and the bankrupt estate's other costs. The surplus is then used to pay so-called *preferential creditors* (e.g. the state, the bank and the property owner). Suppliers and other non-preferential creditors in general receive no share from a bankruptcy, since the haste of winding up means little payment for the assets, something we will return to. If the creditors receive no dividend, then their shares in the company become completely worthless to them.

There is no legal obstacle to former shareholders making a bid for the business and/or the assets of a bankrupt estate. The management of a company approaching bankruptcy can also plan for continued business by selling operations and assets to a new company before the bankruptcy (so-called *technical knock-out*), whereby the loss of tempo in future business is less than if the receiver were first to take over operations and then sell them. Should the receiver consider the purchase sum insufficient after a technical knock-out, then the purchase may be declared invalid and be cancelled, or alternatively a supplementary

sum may be paid. From the community's point of view it is important that a bankrupt innovative operation continues under new and better conditions with the minimum of delay. At the same time, to suppliers and other creditors, as well as to shareholders, a technical knockout is *ethically* extremely dubious. It is then essential to continuously ensure that liquidity in the operation is acceptable to avoid stoppage of payments, and bankruptcy.

6.5 To create a limited company

The first financing in a newly-formed limited company is through the *shareholders* putting in capital as *shareholders' equity* and as proof of this they receive *shares* in the company and are registered as shareholders in the company's register of shareholders. The shareholders' equity is *venture capital* in the true sense of the word, since the investors may not make any demands, neither on a return, nor to receive their invested capital back from the company. When the shareholders have put in their capital and this has been registered in the country's corporate register, then the capital belongs to no one else, nor to any other company. This applies even if the company is a subsidiary of another company. The expectation that shareholders often express by their venture capital investment, is that value growth will be so good that the shares can eventually be sold at a profit and/or that the business will give a secure income.

A new limited company is formed when one or more people decide to start a company and at a meeting they decide what company rules shall apply and who may become shareholders. In legal terminology this is referred to as founding a company and that a *statutory meeting* is held and at the statutory meeting, decisions are made on the proposed *articles of association*, as well as appointing a *board* and *auditors*. If shares were not subscribed when the company was founded, then this is done at the statutory meeting by whoever is/are to be the first owner(s). There is a set minimum share capital and payment that may consist of so-called *non-cash assets,* i.e. payment in some way other than cash, whereby the valuation of the non-cash assets must be done by an independent evaluator.

When payment has been made for the shares, an application to register the limited company is submitted to the registration authority for limited companies in the country/state where the company is being registered. For registration of a limited company, i.e. in order for the company to be able to start trading, the application must be accompanied by the memorandum of association, proposed articles of association, minutes of the statutory meeting, proof that full payment for the shares has been made and a receipt for the registration fee. The application must be signed by the board member(s), deputy member(s), auditor and possible deputy auditor.

An alternative to registering a new company is to acquire and reconstruct an existing registered company. Reconstruction is done by calling an extraordinary shareholders' meeting and this meeting deciding on an amendment to the articles of association, as well as appointing a new board and new auditor(s). If the shareholders' equity is to be increased on top of existing equity in the company, this is done by new shareholders entering their names on a *subscription list*. When payment has been made, which also in this case can be done with non-cash assets, the signed amendment application can be sent in to the registration authority for limited companies, together with the new articles of association, minutes of the shareholders' meeting, subscription list and proof of payment of the registration fee.

As can be seen, the handling of an application for new registration is practically identical to that of an application to amend. The advantage of amending an existing company instead of registering a new company is that business can begin immediately in the old company's name until the new name has been approved by the registration authority. At the same time, there is always a risk that in existing companies that are taken over there are commitments which the seller does not, or prefers not to, remember and which may cause unpleasant situations later. Therefore, well-thought-out contracts are required between the new and old shareholders in order to cover such eventualities. When takeovers occur of companies in operation, there is existing bookkeeping that either may continue or may be transferred to a new bookkeeping system. Registration of a new company, however, requires that bookkeeping must begin from scratch.

After an application to the registration authority for new registration or amendment, the authority examines the application to ensure that all formalities have been observed in accordance with laws and regulations governing the documents that are submitted together with the application. The registration authority also examines whether the company name is being used by another company with a corresponding name and business. If any formalities have not been complied with, an order is issued to change for example the articles of association or the company name in order that the company can be registered. Not until the registration authority is satisfied and has approved the new registration can the company begin business under the new company name. In order to prevent another company starting up with a similar *company name,* registered in another business sector, the company name should be protected separately, as well as the *web addresses*, by registration in the country's domain as well as other common domains such as "com", "org", "nu", "eu", etc.

6.6 Shareholders' equity and share value

When a limited company has been started by shareholders investing money and/or non-cash assets in the company, then there exists what is called *shareholders' equity* in the company. The shareholders' equity then varies constantly depending on how the business develops. Put simply, the shareholders' equity at any moment can be calculated as the difference between assets and debts included in the month's balance sheet and in view of what has occurred since the bookkeeping was completed. The tax effect of any profit must also be included in such a calculation. Another way to calculate shareholders' equity is to combine the existing capital with any capital in the company's reserve fund, the company's premium reserve, profits or losses and from the sum of this calculation to deduct the tax on the book profit, if there is a profit.

As proof of invested venture capital, the *shareholder* or shareholders receive *shares* in the company. On the *share certificates* is printed, in addition to the company name, the number of shares each certificate corresponds to, the numbers in a number series allocated to the shares, and the share value. In relevant cases it shall state the type of shares represented by the certificate, i.e. what voting rights are linked to the shares. This is because in many countries/states it is legal to attach different voting rights to shares, which means that a shareholder who possesses "A" shares at the shareholders' meeting has e.g. ten times more votes per share than the "B" shares carry. In other countries/states only one type of share is permitted.

Every country/state has its demands on the *minimum equity* required. Depending on which business the company is running, it can be an advantage with respect to lenders and suppliers if the company has a

greater shareholders' equity than the current minimum equity. With a large shareholders' equity it can be perceived as though the owners thereby make greater commitment than if only the minimum required equity has been invested. A large shareholders' equity also increases confidence in the company among customers and employees, which facilitates operations. If the company has a large shareholders' equity, it means that the mathematically calculated *equity/assets ratio*, i.e. the relation between equity and total financing, is better than if the shareholders' equity is smaller. Whether or not the company founders choose to invest more capital than the minimum sum required by law upon starting up depends on their own capital resources, the type of business and the investments needed to make the business operationally meaningful. (An old rule of thumb says that the equity/assets ratio should be at least 50 %, which however is twice what many listed companies have.)

Shares are papers with a value, which can be sold on. The owner or owners of the shares are therefore listed in the *shareholders' register*, which is the company's list of current and previous shareholders. The shareholders' register shall also carry details of how many and which type of shares each shareholder owns, as well as when changes have taken place in their holdings. If the company has many shareholders and there are frequent changes among the shareholders, it can be suitable for the company instead to have the registration of shareholders take place via an official database. When computerized registration takes place instead of manual registration, share certificates are not normally issued in paper form, unless the owners specifically order this. Registration of shares then becomes something akin to bank procedures for individuals and companies with regards to their bank accounts. Linked to the printed or computer-registered share certificates, there are also *dividend coupons*, which give the shareholders the right to the annual dividends that the annual general meeting can vote to give to the shareholders.

The *share value* of the shares is the share value that the company's *articles of association* stipulate and which has been registered and approved by the public authorities in each country/state where the company is registered. The easiest way to see the nominal value is to look at the share certificate if available or by looking in the official register of limited companies in each country/state. The register of limited companies shows also the board members, and the accountant(s), etc. The nominal value is otherwise of little interest to shareholders. This is because as the company develops after start-up, the share value rises or falls with time, so that those who buy old or newly issued shares pay a higher or lower price for the shares than the nominal value.

Through bookkeeping activities the share value can be changed when the financial conditions in the company permit this. When the value per share rises, the annual general meeting for example can decide on a so-called *split*, which means for example that an old share can be split into two (or more) new shares, whereby the share value will be changed. When the company's value is lower than the equity indicates, there is reason to mark down the equity, whereby the share value of the shares is marked down to the new value.

Upward and downward adjustments of the share value are voted for at an *Extraordinary General Meeting* or at the *Annual General Meeting,* which must be held annually. Owing to the procedure involved, the share value is very seldom changed, while the actual share price changes all the time. For shares listed on a *stock market* or some other official or unofficial list, this is plain to see, since the market value can

change at intervals as short as seconds. The reason for this is that rumors and speculation as to how the company may develop or be affected by external factors can induce instability in the share price. In general, psychological factors are considerably more significant to the share price than what actually happens in the company, if there is public trading in the company' shares. Thus the "true" value of the company, represented by the company's business operations, leads one life, while the share price lives another.

6.7 Increase in shareholder's equity

In an operating limited company the general meeting can decide to increase the shareholders' equity by a new issue of shares, by which new share certificates are issued to old/new shareholders, which can include companies. New issues of shares in small and unlisted companies to new shareholders take place via *subscribed new issues* to one or more individuals via so-called *private placement,* i.e. non-public new issues. New shareholders can be people with plenty of capital who invest in growth companies, "*business angels",* so-called *venture capital companies* that invest in growth companies, or "ordinary" individuals. When a company turns to several individuals and/or companies before a subscribed new issue, an *issue prospectus* is normally published, which informs of the company's position, the conditions for the new issue and to what use the company intends to put the new capital.

The prospectus can be regarded as marketing material, which should be so sales-oriented that the new issue is *fully subscribed*, i.e. all the new shares are sold. To ensure that no false information is given the auditor should sign the prospectus. If full subscription is not achieved then the company can still decide to go ahead with the issue to those who have subscribed. Alternatively the new issue is cancelled. If *over-subscription* is achieved, i.e. if those interested do not all receive the quota of shares they wish for, this publicity is advantageous for the company and it indicates that additional new issues will have good prospects to achieve full subscription if no adverse situations occur in/for the company. When the company has enough shareholders and sufficient stability then an application can be submitted for listing on a stock market.

To determine the *issue price* of the new issue, one examines the company's book value, the size of the profits and the expected development of the company. Those who do not think that the company will achieve the development that the new issue prospectus is seeking support for, will not wish to participate in the new issue, whereas those who believe the predictions have reason to consider a purchase if they have liquid assets and have no better investment alternative. The *issue price* will normally be higher than the nominal value, and we will come back to this.

When *issues* take place at a premium, the difference between the premium price and the nominal value of the shares is transferred to some form of reserve funds in the company. The whole issue sum, then, increases the shareholders' equity in the company. When the sale of shares in the company takes place at a premium, the founders' right of decision over the business need not be undermined in the first round of offering shares to outsiders. In some countries, as has been said, there are additional possibilities to issue shares with different voting rights in order to preserve further the founders' power of decision.

It is important to underline that the issue price chosen or agreed upon, is not an unequivocal value, but the result of a compromise between the shareholders and the potential new influx of shareholders. To issue at a high price seems to be easiest before the company has been started up, i.e. as long as the company is selling expectations. This is due to the fact that as soon as business starts, there are real results to negotiate over, which is not a price-raising factor as long as any development is going on and there is uncertainty over the chances to succeed with the project.

6.8 Convertible debentures

An alternative to issuing capital as equity is to issue *convertible debentures*. Convertible debentures normally carry interest and at a given point in time, which is usually by agreement, may be exchanged for shares or may be redeemed for cash by the company. Whoever invests in convertible debentures runs the risk that the company may not be able to pay the interest or that the company may not be able to redeem the debentures when the time arrives. The value of the debentures will then be low, or zero if the company should go *bankrupt*. Contrary to when investing in shares, owners of convertible debentures enjoy a major advantage; they receive interest on their invested capital – if this has been agreed on.

If the business has developed well, the debenture holders can decide to convert their debentures into shares – and thereby receive a share in the future value growth – or to redeem their invested capital. The redemption right can also be converse, meaning that the company can decide if and when the investors may receive shares or have their debentures redeemed. The period of maturity of convertible debentures is normally not less than three years. The price at which the debenture is to be converted into shares is decided when issuing the debenture. Also, when issuing convertible debentures, negotiations are required between the company and the potential investors over the rate of interest, conversion rates and periods of maturity. A high rate of interest, for example, should mean a higher conversion price than if low interest is paid.

When the target sum has been received it is advantageous to create large reserves rather than shareholders' equity. This will prove useful should the capital be used up quickly, for example through lost customers, unexpected depreciation, accidents etc. Under European law, *compulsory liquidation* is often ordered when 50 % if the shareholders' equity has been used, which formally means that the company must then be declared bankrupt unless the shareholders invest new capital within a certain time. The capital in the reserves on the other hand can be completely used with no risk of compulsory liquidation of the company. This means that the company gets through critical situations better if there is a large reserve, unlike the case if all the capital is in the form of shareholders' equity.

On the subject of shareholders' equity it should be pointed out finally that the equity need not be in the form of money, but the capital may be converted into other assets, whose valuation is approved by the accountant when the books are closed every year. If the board suspects that the company has become insolvent, it must carry out a so-called *balance sheet verification*, which means that all the assets are valued in order that the board may determine whether or not the shareholders' equity is intact. If the company has used up more than 50 % of the shareholders' equity, then the business can be continued for a few more months, during which time the board members are personally financially responsible for any

new commitments made. It is not unusual for a company to take out an insurance against these board members' costs if the worst should come to the worst.

6.9 Incentive loans

In most cases, shareholders' equity in micro and small businesses is insufficient to finance the development of an innovative business into a profitable business. Capital must be added therefore in addition to new issues and the issue of convertible debentures, lest development be impeded.

Incentive loans, also known as contingent loans, are financed by the public via authorities or companies and organizations that have been delegated this task by the political system. The reason why incentive loans exist is that politicians wish to stimulate innovative business and the development of new products and processes. This is done in order to increase employment in the community and to reduce social and regional long-term vulnerability.

What distinguishes incentive loans from bank loans is that those supplying incentive loans do not require bank guarantees for the loan in the form of e.g. business mortgages, property mortgages, surety, bank guarantees, debt guarantees or security in the form of shares, bonds and inventory. Instead an agreement is signed with the company that sets out the conditions between the parties. The loans in general should not be entered as a debt on the balance sheet but should be seen as business income. If a project that has received an incentive loan proves unsuccessful, the incentive loans are written off. Repayment of incentive loans from a successful project can be agreed in the form of royalties paid on the income from the products or business. Alternatively, a fixed annual interest is implemented. In some cases the borrower after a time is offered the opportunity to pay off the debt at a rate that corresponds to e.g. 50 % of the total loan.

When an opportunity occurs to take an incentive loan to develop a new project, then this loan form should be chosen before the usual bank loans.

6.10 Bank loans

As a last resort, to acquire capital for the business the company may apply to borrow "hard" capital from a bank or financial institution. Such loan transactions usually require *bank security* in the form of assets such as equipment, property, inventory, etc. If sufficient security is not available for the loan, then the lender usually requires a *personal guarantee* from the owners. The loans may be short-term (i.e. temporary loans), long-term loans and/or as an overdraft facility. The idea of an *overdraft facility* otherwise is to absorb fluctuations in liquidity, which pre-supposes good liquidity planning in order to find the maximum liquidity requirement that the overdraft facility can accommodate.

The capital that the company can loan from banks is limited to approximately 60 % of the company's receivables and approximately 50 % of the company's assets after depreciation in machines, equipment and inventory. The banks' assessment of working capital is normally based on the previous year's audited final accounts. If the company is expansive, this means a problem, as an increased turnover from one year to the next demands at least 25 % of the increase in turnover to manage the expansion, and perhaps at least

that much again in product development. If the developing company increases its turnover by 2 MEUR from one year to the next, then for this increase it must in many cases have available at least a further 1 MEUR to manage the expansion. The most important reason for the need of increased working capital due to expansion is that a larger inventory is needed, there is a greater need for service, more staff needs to be trained, etc. In the books, loans shall be entered as debts.

In order to circumvent the problem of being assessed on old final accounts as a basis for new bank loans and an increased overdraft facility, instead of taking a bank loan the company can borrow capital on its outgoing invoices through so-called factoring. *Factoring* means that the company upon presenting its new invoices immediately receives e.g. 75 % of the invoiced sums and the remainder when the customer has paid the whole invoice. For monitoring the invoices and recovering unpaid invoices the company pays the factoring company a fee. For newly-started and growing companies, factoring can be a good opportunity to ensure that there is working capital to an extent that is commensurate with the company's rate of growth, if venture capital is not available as equity, additional shareholders' equity and/or convertible debentures. *Shareholders' contribution* means that in a liquidity crisis the shareholders lend capital to the company. The shareholders' contribution is then repaid only if and when the company has re-created its shareholders' equity and has the liquid assets with which to repay the shareholders' contribution after tax.

Investments through borrowed capital can sometimes be exchanged for a *leasing agreement,* whereby the capital requirement can be distributed over a longer period of time. The advantages of leasing are that the company's capital is not called upon so heavily, that the expenses become deductible the same year as acquisition, and exchange of the leased equipment is simpler. On the other hand the effect on accounting of leasing expenses is less favorable than that of the annual depreciation when the company has invested in machines, equipment and inventory. There are negative consequences also when leasing in the form of fixed and costly contractual commitments for many years. In addition, the possibilities for tax write-offs disappear. In some cases an unfavorable tie to a certain brand arises during the term of the contract. If cheap capital is available – i.e. low-interest loans and long repayment terms – then leasing is generally a more expensive method to acquire liquid assets than to take a bank loan.

As regards a *personal guarantee* there is reason to raise a warning finger here. As an individual, one must be wary when e.g. a bank requests a personal guarantee as security for a loan to a company. An important basic rule is never to sign a general guarantee! A limited-sum guarantee e.g. for 25.000 EUR to most people means a significant commitment if the guarantee needs to be realized. Firstly, the guaranteed sum needs to be paid with taxed assets. Secondly, fees and unpaid interest costs need to be met. Under current rules, payment must be made immediately, i.e. within 15 days, from the moment the bank makes a request for the realization of the guarantee. If there is a guarantee with no limit sum (so-called *general guarantee)* for a company with around 100.000 EUR in debts, then most people find it very difficult to manage the situation without going into *personal bankruptcy* if the company goes *bankrupt.* In addition to not signing a general guarantee, the businessman should also have implemented a *division of the joint estate* with her/his marriage partner so that the family is not affected if the business should fail. There is usually a two-year period of quarantine before the division is fully implemented, so one should not delay this measure if about to start up a risk-bearing enterprise.

6.11 Activated development costs

All development puts a strain on liquidity. In addition to liquidity problems during development investments, the company can also have problems with statement of income and balance sheet problems if the development costs are entered directly when they occur. This applies especially to small and newly started companies. The law however in some countries allows development costs to be entered as an investment comparable to other investments in machines and equipment. The development costs can therefore be written off over a maximum of five years, i.e. by a maximum of 20 % annually. It is good advice therefore to continually enter all development costs incurred in the form of salary, materials, consultation etc. When closing the books one can then decide how much of the costs paid are to be entered as a business asset. This is referred to as *activating the costs*. To estimate afterwards what has been invested in development has always proven to be difficult. Accountants least of all are unwilling to accept such reconstructions.

In this context it should be mentioned that independent business assessors often see *activated development costs* as something suspect. A desk, which is of quite marginal value in a bankruptcy, to them feels safe, since it is a true asset that can be seen and touched. Patents, drawings, software, documentation and other knowledge of how the company' products are manufactured on the other hand do not feel like true assets to them, despite the fact that these assets are what the company lives on. This illogical attitude is something that the business leader involved in development must live with. It should be mentioned also that in a *bankruptcy* it is often the order books, client registers, brand names and products that have substantial value, and not the desks, machines and other equipment (which are often bought for 20 % of their book value!).

In a newly started and expanding business, the company usually has no choice but to activate its development costs lest the company, for accounting reasons should be forced into bankruptcy, which is a problem in countries where this possibility does not exist. This since more than half the shareholders' equity may have been used up if the development costs are entered immediately. If the business is deemed to have a bright future, it is well worthwhile to accept an *impure auditors' report* in which the auditor states being unable to assess the value of the development costs. Nothing happens in practice, except that readers of the final accounts are made aware that according to the auditor the company has uncertain assets.

If the company can find an auditor with a more positive view towards the business, a change should be considered. Otherwise the company risks an impure auditors' report. During the development phase the company has sufficient resistance to survive without the added disadvantage of an impure auditors' report. This underlines how important it is to discuss questions regarding activating development costs before appointing a company auditor.

6.12 Company valuation

Buying a company to increase the rate of expansion is a tricky thing to do as in order to achieve a good result one is mixing different cultures.. Also the evaluation of value of the company to be bought is tricky as the book-keeping is made in accordance with what the authorities have decided. Therefore many things

are not taken up in the reports that may have a large value.

Thus, in principle a company can value its assets as high or low as it chooses in its accounting and thereby also in its annual report. In order that companies in their returns do not value their assets too high or low, there are laws governing how the so-called tax valuation is to be done. The auditor makes an annual assessment of the company's valuation of its assets and checks that the tax expense in the return is within the permitted framework. The auditor, then, does not make a valuation, fiscal or otherwise, of the company and its assets, but rather makes an assessment of whether the assets were calculated too high or too low. For inventory valuation, the guiding principle is e.g. the lowest value principle (i.e. acquisition or re-acquisition value). For fixed assets, their financial life applies. The auditor checks also that the VAT declaration has been correctly made and then endorses or rejects the adoption of the company's statement of income and balance sheet.

To study a company's statements of income and balance sheet in order to establish the *company's value* then, in general does not give the "true" value of the company, even though the auditor has endorsed adoption of the company's statements of income and balance sheet. In addition, the assets are both "tangible" and "intangible" as well as being of constantly varying value. Examples of *tangible assets* are machines and products. Examples of *intangible assets* are personnel, brand names, goodwill and activated development costs. Different assessments of these values are made by each person who tries to assess the value. In addition, the result depends on the purpose of the valuation. Someone buying a company for natural reasons values the company's assets low, while a seller will value the assets high.

To obtain different values for the company from the bookkeeping, one should begin by examining the statements of income and balance sheets several years back in time, while adding to the latest annual report the subsequent monthly statements. It is then a matter of repeatedly asking the company representative for different hard and soft information, to be thereby able to form as just and objective a picture as possible of the status quo and potential, vulnerability, etc. For large companies, the key ratios can be of some value, whereas the key ratios of small companies are generally of little value. Common valuations of companies based on these studies and conversations are liquidation value, net assets value, investment value and capital value as follows:

Liquidation value: Liquidation value = assets at market value – debts – possible tax effect – liquidations costs

Net assets value: Net assets value = assets at market value – debts – possible tax effect

Investment values: Investment value = expected annual return /discount factor + residual value

Expected annual return = expected annual yearly profit– costs of financing the purchase sum

Capital value: Capital value = net assets value + 10 x (expected annual profit – interest on financing for the book value)

The traditional valuation methods mentioned here serve their purpose as regards solid companies that have

been in operation for a number of years. The valuation models however are less useful or useless in valuing young and growing companies with no positive liquidation value, and with neither positive net assets value nor a positive investment value. High-tech companies, for example, are often valued high based on expectations and for a long time give negative values under classic measurement methods, while having high stock market value. Based on personal experience six apparently different valuations of the shareholders' equity in the company can be a more meaningful method. From these valuations one can then possibly agree on an interval within which the company's value lies at a given point in time.

When *issues* take place at a premium value compared to the share value, the difference between the premium value and the share value of the shares is transferred to the company's premium reserve. When a sale of shares in the company takes place at a premium price, the founders' deciding rights over the business need not be undermined during the first share offer to outsiders. In addition, in some countries there is a possibility to issue shares with different voting rights. If the former owners have a number of A-shares carrying many votes and all new owners receive B-shares, the deciding rights can be conserved fairly well by the founders over several rounds of new issues.

It is important to emphasize that the issue price chosen or agreed on is not a scientifically determined value, but the result of a compromise between the shareholders and the potential new shareholders. To issue at a high price seems easiest before the company has started up, i.e. as long as the company is selling expectations. As soon as business has begun there are real results to negotiate over, which does not raise prices as long as development is ongoing. For young and expansive businesses, the income or invoicing that the company has achieved is, however, an important measure.
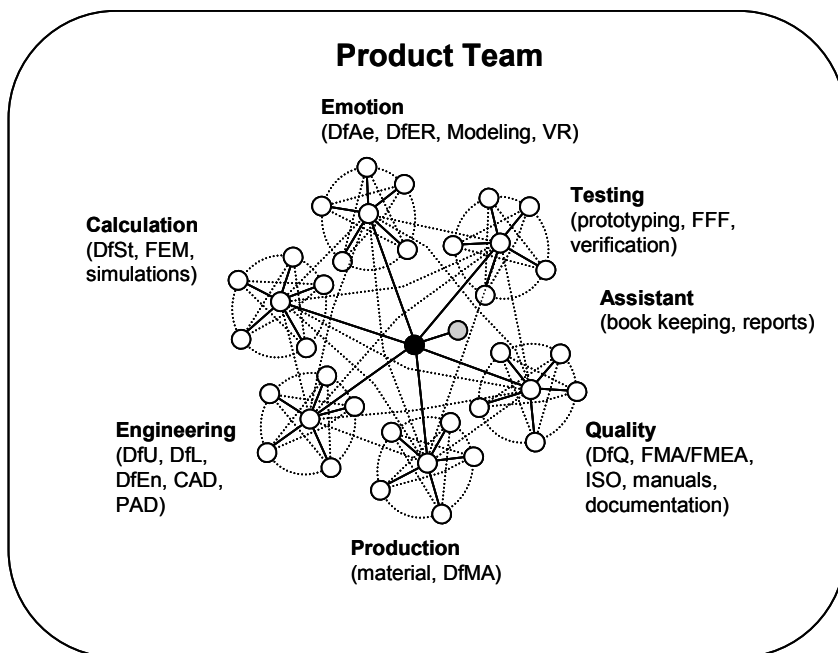
7. PRODUCT DEVELOPMENT

7.1 General topics

The project team

Today when innovative product development - as well as reengineering - is to be done, it is generally done as a project. When the product is developed, the responsibility for the product and needed changes in the future is transferred over to the standard business process e.g. under the leadership of a product manager.

In product development projects different topics need to be covered. Figure 7-1 shows an example of topics to be covered by different sub-projects for the development of a complicated product. As one basic principle of Dynamic Product Development (DPD) is to have a lean organization all the time, the manning must be flexible and dependent on what to do at each point of time (Ottosson 1999). Initially therefore only the project leader is engaged in the project. At the finish also the project leader is the last one to leave the project. In between the number of team members will vary all the time if the lean principle is to be utilized.

Figure 7-1: Different topics to cover when a complicated product is developed (the terms will be discussed later in the chapter)

The product developer

The individual team members in the product development team - as well as the project leader – always have their own view of life that will govern her/his work in the product development project independent

of the product development rules stated by the company (Bragd 2002, Jönsson 2004). This accounts also for the rules the company has on how to handle ethical/moral questions. A tight and friendly leadership is one nice way to foster required behavior by the company.

Independent of company climate, for each team member to be successful, she/he must, in the process of the work, keep in mind at all times three outer and three inner demands (see figure 7-2). The outer demands are: Business, User and Society together called the BUS demands (Ottosson 1999-B). With *Business* is meant that the company - or the non-profit organization - in some way shall benefit from the work being done. The *Users* of the products shall experience a higher quality of life by using the products. The product shall not violate the rules and laws of *Society*. Inner demands within the BUS frame that the team members have to focus on is that the *solutions* shall be functional with good semantics creating pleasure in the use of the products, that the development and production *cost* is kept at a low level, and that the development *time* is short. [Product semantics is based on the idea that a product's form should readily communicate the function of the product. Thus, a product with good product semantics would e.g. typically not require the user to read a manual before beginning using it.]
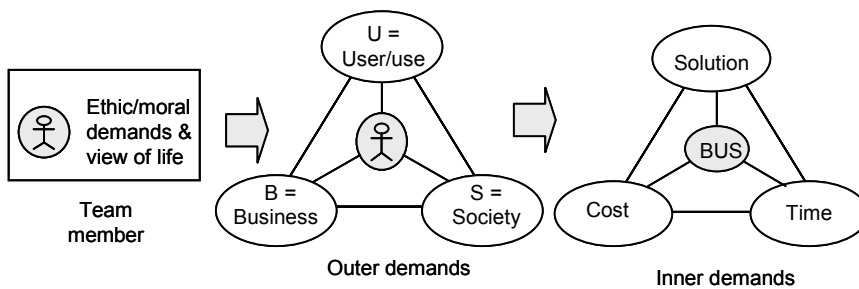
Figure 7-2: Outer and inner demands for each team member dealing with technical questions of the product development

When developing according to the principles of Dynamic Product Development (DPD), technically devoted product developers have to concentrate on the user/use (see figure 7-3), while the entrepreneur of an innovation project and the sales & marketing people have to focus on the customers *(*as has been explained *customers* are the ones that pay for a product or sign the invoices). In most cases the customers are not also the users - or the consumers. (The difference between users and consumers is that *users* use a product over and over again while the *consumers* benefit from the product once or a few times. Thus, consumers benefit from food or drinks just as they do from watching a movie.)
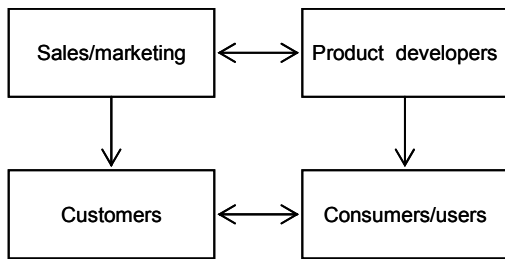
Figure 7-3: The sales/marketing people have another focus than the product developers

User categories

Contrary to other methods that place the emphasis on customers DPD has a clear user/use focus. To understand the user and the use of the product the product developer should act as a user and use the product as much as possible during the different development stages. If possible also one or a few demanding user(s) should use the product in its different appearances in the development process and comment on the solutions. This as it is far better to design *with*, than *for* someone (Rowland 2004). However, without empathic abilities of the product developers the result will not be good. DPD therefore can be said to be an *empathic design method*.

Users of products in general can be divided into different target groups depending on the aim and the situation. Benktsson (1993) presented a user pyramid to describe the market situation and to illustrate the fact that market segmentation should also deal with different users' abilities to handle a product (see figure 7-4). The areas in the user pyramid show in principle the relation between the number of users with different user abilities. It has been estimated (Arbetsterapeuten 2003) that between 10 and 15 % of the European population belongs to users with disabilities (disabled users).
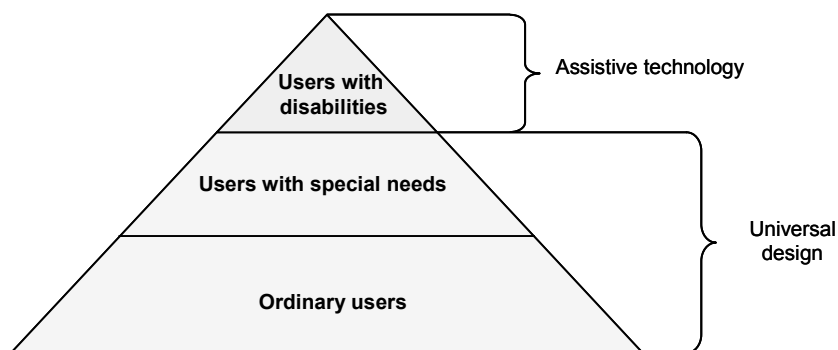
Figure 7-4: The user pyramid also showing when the terms Assistive technology and Universal design are used (Björk 2003)

Disabled users require assistive devices due to severe mobility problems and reduced body functions. The assistive products must have a high degree of both technical and practical functionality; otherwise the products will not work as intended. Disabled users do not have a freedom of choice of products as they

cannot compensate for practical disadvantages with standard products. This group of users is heterogeneous and consists of people with high individual demands. Some of the disabled users belong to the *lead user* category as described in chapter 1 (c.f. von Hippel 2005).

Users with special needs are individuals who have no recognized physical or mental impairment but who need some special modification of standard products in order to use them properly. For example, elderly people with minor disabilities - such as reduced strength, impaired hearing, etc. - belong to this group. Also elite sportsmen/women belong to this group of which some are *lead users*.

Ordinary users are able/capable individuals who are in a position to freely choose what kind of product or service they want or need. If necessary, ordinary users can to some degree adapt themselves both physically and mentally to poor technical solutions.

It is not relevant or possible to have a strict demarcation between different user groups, as some individuals will fit into more than one group. Although a schematic description it shows that users of products consist of groups that differ a great deal in terms of product requirements, which has some important consequences. One is that the extreme demands of disabled users mean that solutions found for them can be used rather easily as foundations for products for users with special needs. The other way around is more difficult. Also, as more individuals survive traumatic injuries thanks to increased medical and technical knowledge, more infants with impairments survive while people with cancer and other diseases live longer, the increase in the number of older adults with disabilities, all create a growing market in the care industry and add to the demands for assistive products.

When all user categories are taken into account in the development **process** it is sometimes called "Design for All". *Design for All* is difficult to achieve going upwards in the triangle in figure 7-4 (from ordinary users to special needs) while it is easier coming from the assistive technology side going downwards in the triangle. Design for disabled users calls for empathic capabilities of the developers. Basic medical knowledge is also valuable to have when developing solutions for disabled users.

Primary and secondary users

All the users in figure 7-4 can be either primary or secondary users. *Primary users* are often called *end users* – the person for whom the product/service is intended. They employ the product or service in the intended way (Hansen 1991). *Secondary users* are users who only occasionally use the product. The categorization of users as primary and secondary is relevant in terms of the different requirements that are applicable to the various user groups. The quality of the product means how well the product satisfies the demands for which it has been designed. Especially in the assistive technology field, it is often more important to be aware of the secondary user demands, as they *handle* the products more frequently than the primary users who *use* the product regularly.

Both categories need to be identified in the product development work to obtain product usability for all categories. One example (Björk 2003) can explain the importance of this differentiation:

> *A parent who secures a child in a child-seat in the family car is an example of a secondary user, while*

the child is the primary user. The parent focuses on the safety and comfort of the product as well as on a reasonable price and an attractive design. The taxi driver who takes the child to school is also a secondary user. But he/she requires a product that can be installed quickly, that withstands dirt, that is light weight, easy to clean, that takes little space when stored, etc. Thus parents and taxi drivers have different demands, which are important to consider in order achieving optimal product usability.

There are a number of user characteristics that can be predictors of the design for usability (DfU) for both user categories. Jordan (1998) has presented some user characteristics that should be considered in the development of new products:

- Earlier experience (of similar products)
- Cultural background (language, traditions)
- Special needs or a disability of some kind
- Age, sex and knowledge

Lack of usability can lead to minor frustration as well as life threatening situations for the individual. Norman (1988) and Magnusson (2001) reported that many people have difficulties with everyday items that cause annoyance and defeat their intended purpose. Unusable products also cost time and money. For example, difficulties in using computers can cost a company 5-10 % of total working time (Jordan 1998). Low levels of usability could mean that users employ just one product function out of several available. A long time needed to learn how to use the product, high service costs, and many customer complaints due to misuse are other results of low product usability. Four central components have been described as essential for good usability in a product (Jordan 1998, Nielsen 1993, Baber & Stanton1996):

- Effectiveness
- Learnability
- Satisfaction
- Easy to memorize

According to Jordan (1998), product effectiveness means the extent to which a goal or a task is achieved. *Effectiveness* is connected to the ability to learn easily how the product works (learnability). This is of great importance, for example, for products that are put back into service after a long break.

Learnability concerns the cost or the effort involved in becoming competent in handling a product or performing a task. Learnability can be particularly important in situations where training time is short, where the user has to teach her/himself or when reduced body functions put special demands on the learning process.

Satisfaction is the level of comfort experienced when using a product and how the product helps the users to achieve their goals. Satisfaction is connected to the individual and cannot be measured or tested objectively. Knowledge about the user and the environment increases the chances of creating product

satisfaction.

The ability to *memorize* how to use a product is dependent on several personal and environmental circumstances. The user should, for example, obtain memory prompts and cognitive support from the technology. Furthermore, the product should be self-explanatory. Effort should not be required to handle the technology, and the design should be self-explanatory, thus allowing the user to concentrate on performing the task. An important aspect that aids memory is the ease with which certain features of the construction can be visualised and that they give the right message. For example, a safety belt must make a clicking sound when it is properly adjusted, just as a camera must produce a click when a photo has been taken.

What a product communicates to a user is a kind of message on how it should be handled and used. If this message is falsely interpreted, the risk of misuse increases (Wikström 2002). Monö (1997) has described semantic functions aimed at analysing the communication aspects of products and defining a clear product message. In his view a product should:

- Describe its purpose, handling and mode of action
- Express its qualities
- Invite use and reactions
- Identify the purpose, type of product, product origin and product category

Products need to have good communicative abilities as, due to cognitive or language difficulties, users may have problems understanding abstract product messages, for example from an instruction manual.

The development of commercial products with good usability is a complex task in which 'hard' *functional values* as well as 'soft' values need to be satisfied. The soft values can, as explained in chapter 1, be divided into *sensorial values* and *image values*. The product development process must first satisfy the main/prime functional values and some secondary functional values before the sensorial values can be satisfied.

To identify and satisfy user characteristics, product developers require data input both before and during the development process. The reliability of data differs, depending on the data collection methods used in product and process development (Scheff & Starrin 1996, Ottosson 1999-B), which is shown in figure 7-5. [It is worth noting that the researcher performing Insider Action Research - IAR uses the same tools to study the total development process as the product developer uses for data collection, which we will come back to in chapter 9. The data achieved in product development projects is also useful as research data for a researcher performing IAR as project leader. Thus the data serves two purposes – research & product development.]
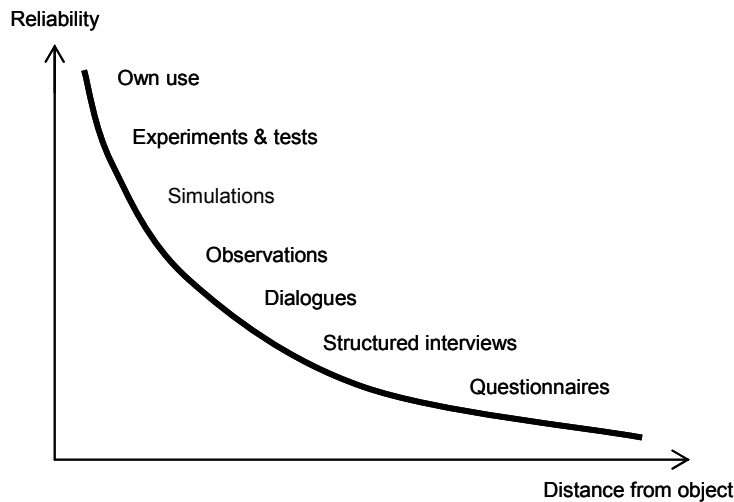
Figure 7-5: The reliability of different data collection methods is dependent on the distance from the object

## *Primary and secondary products*

In the same way as there are primary and secondary users there are also primary and secondary products. In this book the main product is the *primary product*. *Secondary products* are parts and systems that are needed for the function of the primary product. Examples of secondary products are supports, petrol, manuals, educational material, packages, service material, etc.

[Note that outside the product development field primary products are commodities produced by extractive industries such as farming, fishing, forestry, and mining.]

7.2 Concept development

When a new product is to be developed one first has to have a common *vision* of the final product or what it shall do. For the technical development of the product the vision has then to be transformed in a *target* with some important measurable demands what regards functionality (hard values) and some important soft sensorial values. Unfortunately, as long as we live in a changing world the target will move with time from when it first was defined until the product is ready.

The more visionary the product is the more the target will move. The more the target moves the longer it will take to develop the product. Therefore it is enough to plan only in broad outlines how to reach the target and to carefully plan only in short periods (e.g. one week) in the direction towards the present vision. The broken arrow line in figure 7-6 shows the dynamic principle – acting as a cruise missile – while the straight arrows show the situation when one shoots against a target which has moved from when the missile was fired until it reaches the target area.
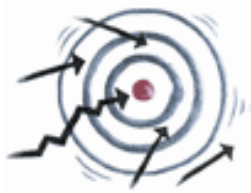
Figure 7-6: The target for the technical development will move with time which is why it is important to carefully plan only for the short next coming period

As the target for the technical development will move all the time from the start of the project until the project is finished, it is important to be dynamic/flexible in the development. The DPD method takes care of that reality through the use of many small decisions in the direction of the initially distant moving target using the principle of small frequent decisions – easily changed - all the way until the product is fully developed.

The target for the technical development is often called a "*Concept*", which in turn can be either a Concept Product or a Product Concept. When the technical development has as an aim to develop solutions that can be used later on in the development of specific products a *Concept Product* is created to guide the technical development. When the mission is to make a new product a *Product Concept* is created to guide the product development. Small companies normally cannot afford to make Concept Products to study a future situation as e.g. car manufacturers do when they make concept cars.

The actual concept the Innovation Project team has to work against at each moment of time is decided by the New Product Board as was shown in figure 3-8.

Contradictory to what is taught in general – that all demands must be set before the creation of a concept starts – we have found that one shall start only with one primary demand and 2-3 secondary demands and then start to create solutions for them. When one or more solutions have been found, more demands are added. These demands can result in that new solutions must be found or that the already found solutions can be complemented with new features. Using this principle, which is shown in figure 7-7, the work can go ahead at high speed to find a technical concept. Note that the adding and solving of new demands from when the first concept is formulated normally is done by the product team in close contact with the New Business Board as is shown in figure 3-8. This means that the Board makes solutions on levels 5 and 4 and that the product development team makes solutions on levels 3 to 1 in table 2-1.
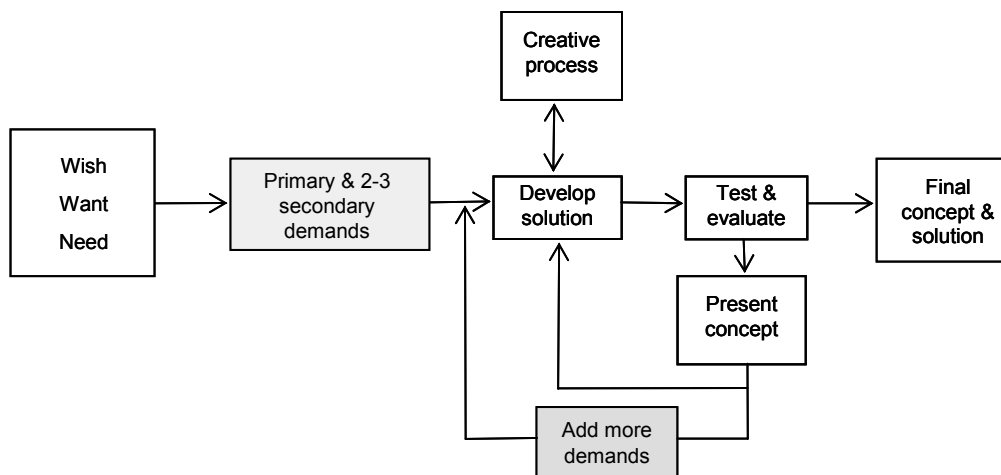
Figure 7-7: The concept development is an iterative process in DPD

To get information to develop the concept from level 4 successively to levels 3, 2, and 1 in table 2-1 one can use different data collection methods. Figure 7-5 showed some commonly used methods and their reliability. DPD suggests that methods shall be used that give high reliability although this means that a statistical reliability cannot be gained. In the same way as lead users do to develop solutions (see chapter 1), the developers need to make their own experiments and tests to be able to make a fast and cheap development. Smaller companies normally use dialogues, observations and simulations to get material to analyze and make decisions on, which however means a slower development start than acting as a lead user. Large companies and companies which adhere to the view of first finding out the "voice of the customer" have to use questionnaires and structured interviews to get their statistical material to make decisions on – which means a slow, costly and a rather risky way to work.

When a need, a want, or a wish of a product has been acknowledged for which a technical solution does not exist, it can take quite a long time to find a solution on which to base the concept. For those who take part – i.e. the Board members and the people they engage – they first have to be *prepared* on what kind of solution to develop (see figure 7-8). The acceptance of the mission – the storing of it in the active conscience of the brain - is called "*incubation*". As soon as the mission is stored the brain will start to work to find useful solutions on an abstract level. This thinking can be called Brain Aided Design (BAD) (Ottosson 1998-B). For a useful solution to show up - the *illumination* – it can take a long time if the need, want, or wish is complicated. To speed up the process different techniques are used, of which some common ones are shown in figure 7-7. When a useful solution has shown up – which in general is not the first solution or idea – it has to be *verified* against the target. The verification is a combination of testing and analyzing. From that point the project work can start (see figure 3-8).
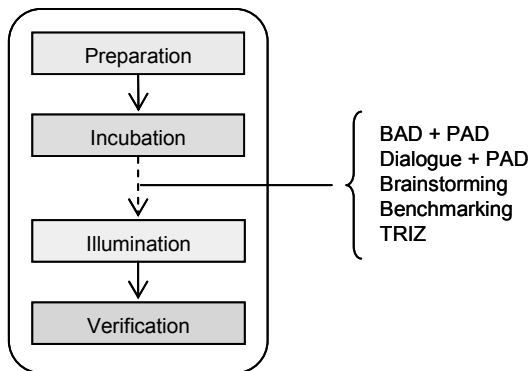
Figure 7-8: The creative process (Knellner 1975) and some methods to find solutions

The first method (BAD + PAD) in figure 7-8 to speed up the illumination means individual work starting with Brain Aided Design (BAD) and then to make sketches (PAD = Pencil Aided Design). BAD can be done anywhere, e.g. sitting in a car, watching the TV, etc. The thinking is mostly done on an abstract and un-dimensional level. When sketching the solutions found they will be on an abstract/principal level. The complex connection between the movements of the fingers holding the pen/pencil (preferably the three finger grip should be used for maximum movement of the hand!), the image feed-back registered by the eyes to the brain, and the processing by the conscious mind picking up solutions from the sub-conscious and un-conscious minds is important for the creative work. The more sketches that are drawn on the paper or a white or black board the more efficient the processing – the creativity – will be. (The computer mouse does not give the same feed-back between the hand and the brain. The eye's focus on the pen/pencil point and the result of the movement of it also is something else then the movement of the mouse creating a picture on the computer screen. Also, on the computer screen there is only one concrete picture for the eye to register which hinders creative thinking – the architect fears the empty paper, is a saying with some relevance.)

The second method (Dialogue + PAD) in figure 7-8 to speed up the illumination means to have a dialogue with other people combined with the making of sketches on a piece of paper or on a white or black board. The coffee break is e.g. a perfect situation for creative dialogues. Many innovation activities have started with a dialogue over a lunch or a dinner at which paper napkins and a pen has supported the creation of big ideas.

Instead of the informal dialogue a formal *Brainstorming* session can be used. Doing so, a handful of creative people are sitting together saying different nouns to a secretary who writes them down so that everybody can see them (e.g. on an overhead sheet or a white board). When thinking of each noun in connection with the problem to solve, new solutions can pop up. Thus, instead of the eyes registering a sketch they register a word when Brainstorming, which shows to give less good results for technical work but which can be good e.g. when looking for new marketing ideas, organizational solutions, etc.

By *Benchmarking* we mean that one investigates other solutions already existing to get ideas for what to do. When a problem has to be quickly solved, the easiest, cheapest, and safest way to do this is to copy an already existing and well functioning solution. Thus, by benchmarking other solutions and by evaluating

different solutions one can often quickly build up useful knowledge on how to solve a 'need'. Knowing what to do also means a good possibility to calculate the development time. Japanese companies are especially known to have used and use benchmarking to get knowledge quickly for bringing new products to the market (e.g. Mehri 2005). The problem with this way of working is that radical new products will seldom occur – only level 1 -3 solutions in table 2-1.

To find solutions on levels 3-5 in table 2-1 a method called *TRIZ* - which is a translation for the Russian "Theory of Inventive Problem Solving" – can be used. Using that method one first generalizes the given problem, instead of searching for a specific solution. The second step consists in finding a general solution to the generalized problem. This is done by identifying *contradictions* after which one in general benchmarks each of them using a computer data base with different solutions taken from millions of patents and laws from physics and chemistry. When the contradictions have been solved one then tries to find solutions to bridge the solutions to get one single product. E.g. a lap top shall be small when folded and large when using it, which creates two contradictions which call for innovative solutions.

There are two types of basic contradictions (Altshuller 1980):

- *Technical contradictions*: A desirable function A uses a second function B which has undesirable effects, either causing a third function C which is harmful or harming an existing function D. For example, one can evenly spread light over a large car park by having a tall lamp post. However, this requires a high strength post to hold the large light far above the ground. A (Distant light source) needs B (Tall strong post) which leads to C (High cost) and D (Difficult maintenance).
- *Physical contradictions*: Physical contradictions occur where the two opposing physical states are required, for example a blacksmith wants the horseshoe to be hot enough so the metal is workable. However, he would also like it to be cool enough to hold (the 'harmful' solution is to use tongs, which are not as easy to use as fingers).

[The one who started the work with TRIZ was the Soviet/Russian engineer Genrich Saulowitsch Altshuller who indeed had a very interesting life story that can be found e.g. on http://www.aitriz.org/altshuller.htm. Altshuller was born 1927 and died 1998.]

When a basic concept has been developed it is time for the Product Team to take on the concrete and detailed development of the concept. We have found that initially and when problems occur later in the development, BAD and PAD should be complemented with MAD (Model Aided Design) to make fast progress. To make MAD means to make simple models in as soft materials as possible so as to quickly understand the effects of the solutions with the help of as many senses as possible. For shaping and changing the models in their soft material, in principle a multifunctional Swiss Army knife in most cases is the only tool needed. Techno LEGO® can also be used to find out the mechanical functions of possible solutions. When solutions have been found one can benchmark other solutions before it is time to make Computer Aided Design (CAD). Figure 7-9 shows the dynamic principle.
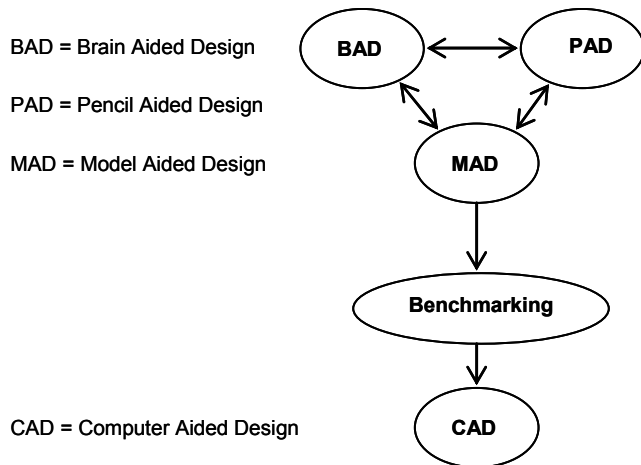
Figure 7-9: Initially when a concept is developed and later when problems occur, the ways of working shown in the figure have shown to be efficient

For need-based development – levels 1-3 in table 2-1 - one strives to only make benchmarking and CAD, which sometimes brings solutions that are not functional as critical thinking seems to disappear when only looking at the product on the computer screen – using only one sense. If the development continues too long for only one functional solution for which simple models have not been done and tested, the costs can be large. The worst is that time is lost when the product is developed only in the computer environment. The ideal situation is to develop a new product from scratch to a finished product as seen in figure 7-10.
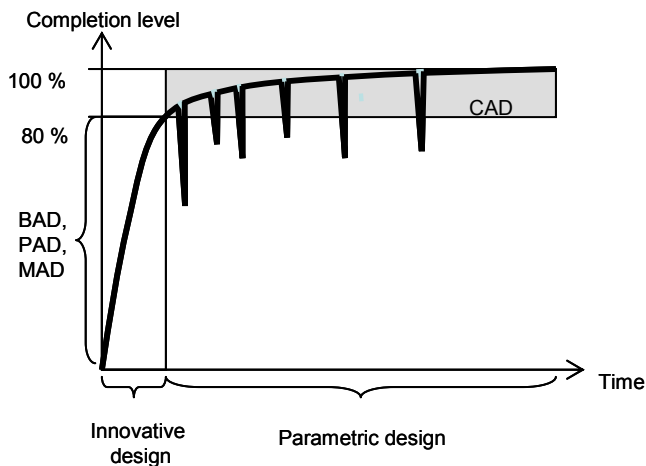
Figure 7-10: When problems occur in the development of a new product BAD, PAD, and MAD helps to find solutions to continue the CAD work

Planning of the product development process

When the basic product concept has been agreed upon a rough planning of the project is needed. This planning starts with setting the quality and/or performance of the product followed by setting a time when the development shall be finished. To manage to complete the development in time a preliminary manning is done after which the costs can be roughly estimated. If the quality/performance, time and cost do not match trimmings must be made meaning compromising between different wishes and opinions. The curves that can appear after such work can be as figure 7-11 shows
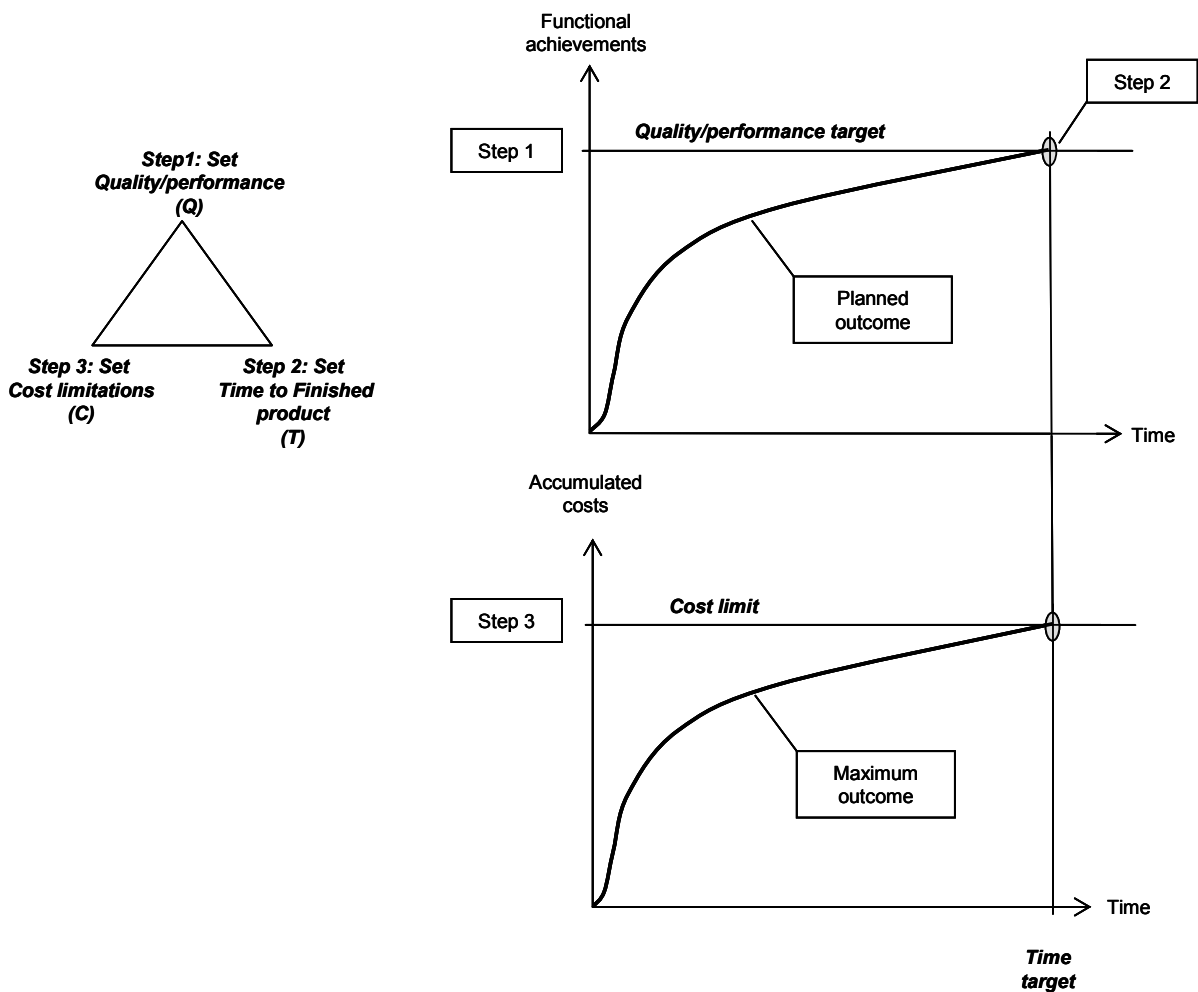
Figure 7-11: Initial planning curves of a NPD project with the first three steps marked out

When the work is being done the real curves will differ from the ideal curves and is often seen as a successful outcome if the project goes over time and costs don't go over 20 %. Figure 7-12 shows such a case. As the outcome will differ from the planned curve, the Concept Board and/or the Business Board will often add gates and or milestones to the planned curves so that the project leader has to inform them

when the milestones have been reached and/or clarify the situation at certain points of time – at the gates. However the gates have some very negative implications that we will come back to in the Appendix. Gates are not used in DPD of this reason.
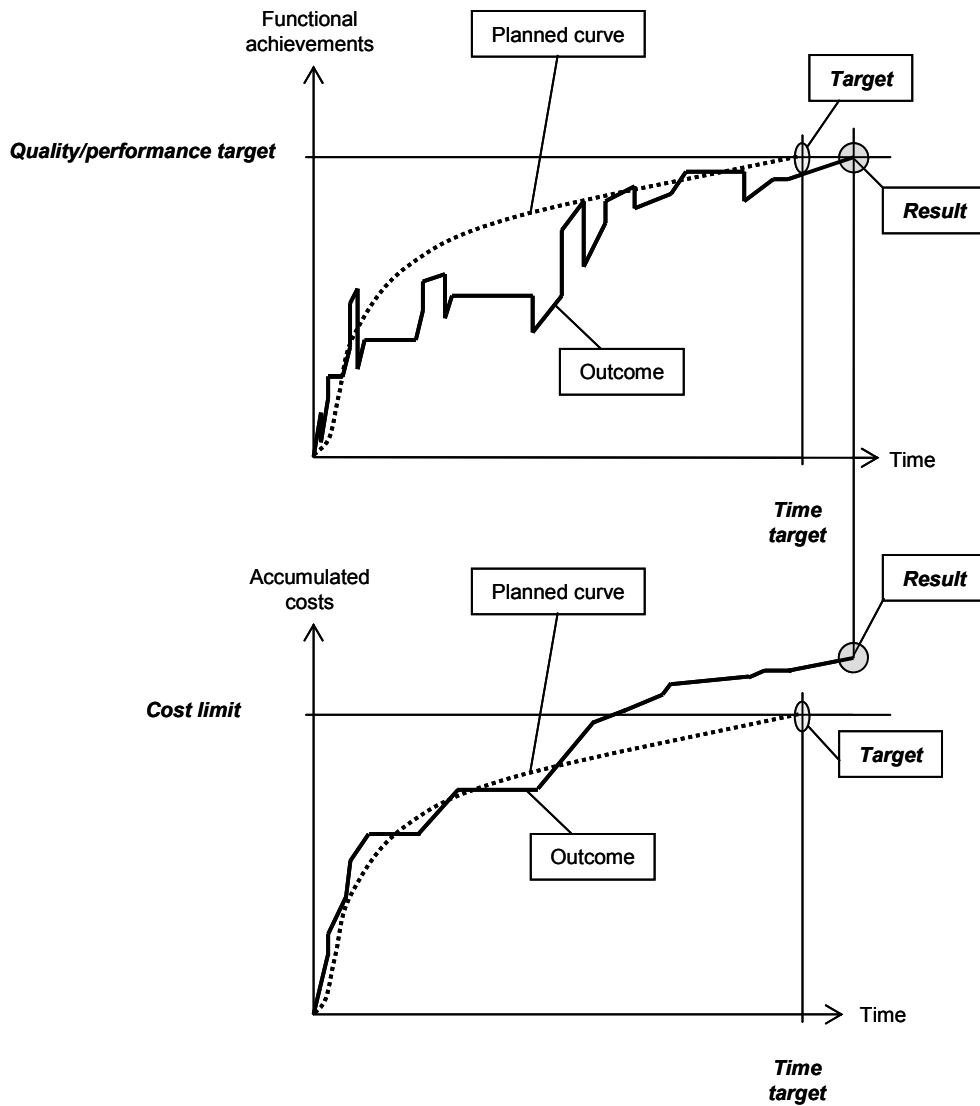
**Figure 7-12:** An example of the outcome of a project planned in advance as shown in figure 7-11

7.3 How to learn from the work?

As has been pointed out small changes are especially important in early phases of development. However, a problem is how to represent the small changes of a development process if the absolute measure of time differs for different activities within different time spans, defined e.g. by the phases/stages in the IPD/Stage-Gate® methods (see appendix). Figure 7-13 shows an example of this for a NPD project.
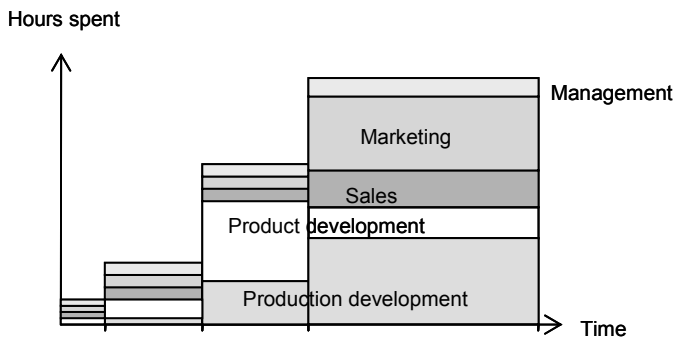
Figure 7-13: Time used in the initial phases/stages of a NPD project

To better understand what has been going on in the development process relative values measured in % instead of the absolute measures in hours – or money – should be studied (Ottosson 1996). Based on the information this transformation gives one can learn how to improve the development process for the next development endeavor(s). The simplest way to do the transformation from abstract values to relative values is to expand each phase/stage to the maximum level of the phases/stages as is shown in the upper picture of figure 7-14. After that the whole picture is compressed to give the end result as is shown in the lower picture of figure 7-14.
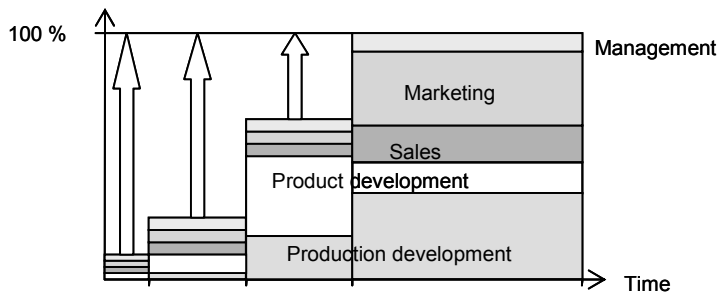
Figure 7-14: How to transform absolute measures to relative measures for a product development process

For the DPD method the phases/stages are reduced to as short a time span as weeks meaning that curves as is shown in figure 7-15 can be drawn. With such curves management can discuss development strategies in a qualitative way and researchers can use such curves to develop improved development methods. Note that every development process will differ as to how the relative curves look. However, it is important to underline that fixed gates/decision points set in beforehand means an inefficient way to perform product development as possibilities to take advantage of change situations that occur all the time in real life can not be capitalized on.
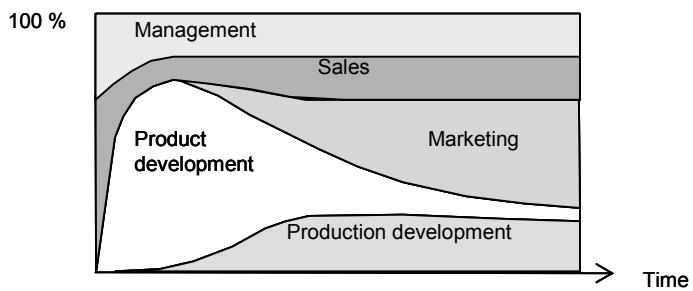
Figure 7-15: When the time spans are short (e.g. weeks) curves can be drawn on how the work has been done in a development project (Ottosson 1999)

7.4 Design philosophy

Following this representing form the different competences needed for 'hardware development' and the order in which these competencies are often needed is represented in the lower diagram of figure 7-16. This figure also shows in the upper diagram the relative time used both for the Technical Concept Group (white) and the Project Team (grey). In the lower diagram the grey part in the upper diagram is highlighted. In this lower picture also is a dashed line. Above this line system design takes part while detail design is done under the line. The abstract and concrete thinking mainly takes part in the technical concept development work in the upper picture.
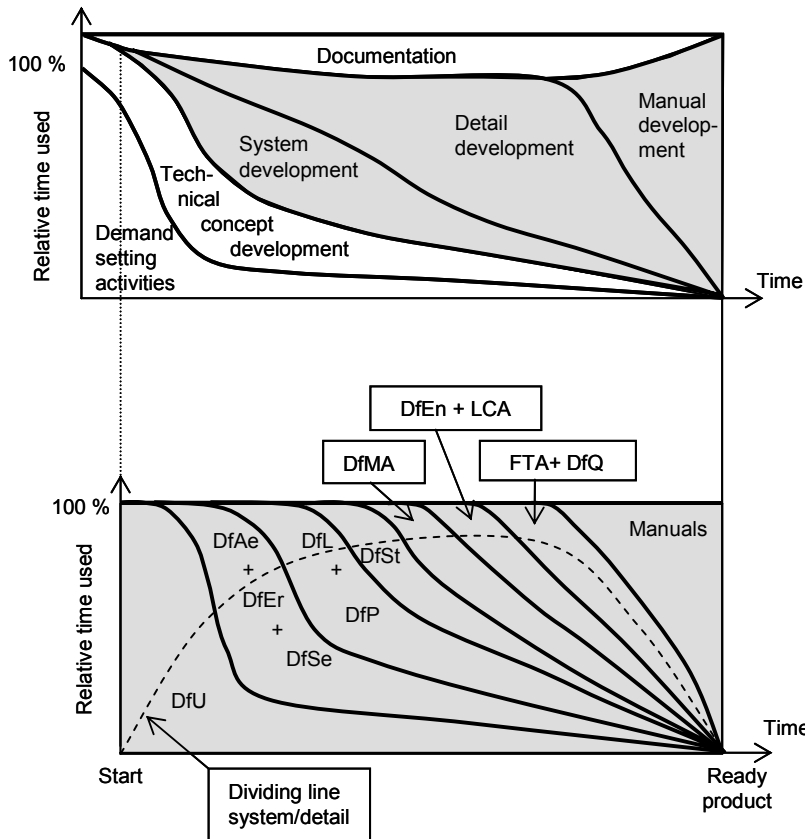
Figure 7-16: The order in which a new mechanical product is preferably developed. The upper diagram shows in white the efforts of the Technical Concept Group and in grey the efforts of the Technical Team. In the lower diagram the grey part in the upper diagram is highlighted

In figure 7-16 different DfX (or DFX) is used where 'Df' stands for *Design for* and the X is exchanged with one or two letters. 'U' stands for usability, 'Ae' for aesthetics, 'Er' for ergonomy, 'Se' for service (or maintainance), 'L' for Logistics, 'P' for packing, 'St' for stress, 'MA' for manufacture and assembly, 'En' for environment, and 'Q' for quality. DfX methodologies are tools to evaluate designs, typically at both system and detail levels (the grey areas in the upper diagram in figure 7-16).

As figure 7-16 shows the most important thing is first to focus on *design for usability*, which means to take care of the functional values. Frequent modeling helps to find a good solution. When a good solution has been found it is time to focus on the aesthetics of the product – the sensorial values – and the ergonomy of the product. DfEr is also called *human centered design* for which a standard called ISO 9241.5 exists. DfAe is normally done by industrial designers. A very special task for them is to design "invisible" products that do not draw attention e.g. to disabled users. This applies to military products as well as assistive hardware products for adult users. However, in recent years there has been a trend towards very visible, fancy, and attractive looking assistive hardware products for young disabled users. Two examples are wheelchairs and teeth braces.

As figure 7-16 also shows, the next step when the functional, aesthetic and ergonomic solutions have been

120

found is to see how the primary product can be transported in an economic way to the users. This demand will often cause new solutions to be found in the basic design. Therefore DfU, DfAe and DfEr must be taken into consideration again together with DfL.

When the logistic problems have been solved, figure 7-16 shows that the product must be dimensioned in a good way, which calls for Design for Stress (DfSt). The DfSt often causes DfU, DfAe, DfEr, and DfL to be worked over again. The same counts for the Design for Manufacture & Assembly (DfMA) as well as for its successor DfEn + LCA (Life Cycle Analyzes). After that it is time to check the quality (DfQ) and to try to find out which shortcomings the product may have in its use - which is called creating a Failure Tree Analyzes (FTA). When all these steps have been completed it is time to write manuals for the product.

The time it takes to fulfill the different DfX is dependent both on the individual team members, how many they are and perhaps most of all the delay times (grey sections in figure 7-17) for information acquisition and decisions. The information acquisition alone can take up to a quarter of the designers time (Aurisicchio et al. 2006) which is why the delay time – especially in larger organizations - can be considerable for each team member. The longer the delay time is and the more often it occurs then the longer it will take to reach maturity which is indicated in the figure. New insights often occur through contacts with other people, at conferences, when reading articles, books, etc. which can help to make instantaneous leaps in the development.
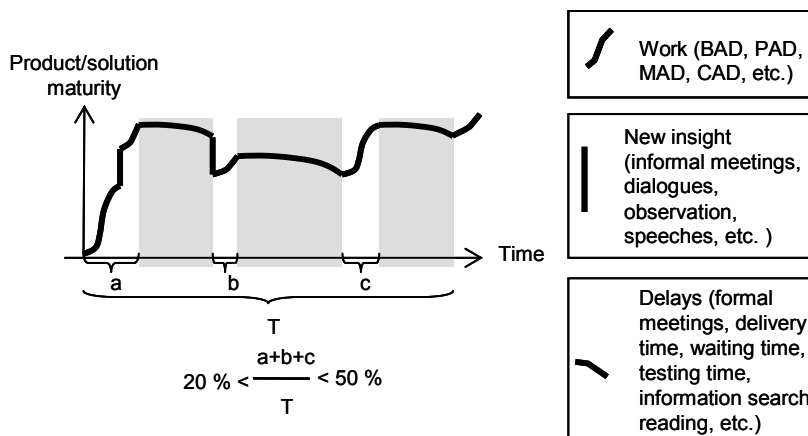
Figure 7-17: The delay time for each team member can be considerable

7.5 DPD rules of thumb

Figure 7-16 has more dimensions than the two shown which will influence the outcome of the work. Therefore some rules of thumb will be given.

Make useful scenarios

When developing a new product it is common to describe the demands in technical terms. However, it has shown to be better to create useful scenarios for the product developers that make what they have to do

more obvious for them. Thus, if a mobile telephone maker first gives the scenario that the phone shall be used in a sail boat competition around the world, it is easy for the product developers to imagine what can happen during such a competition. Next scenario, when the first is satisfied, can be that the phone shall be used by an alpinist who will climb Mount Everest. The third can be that the phone shall be used by a driver in the dessert Dakar rally. The telephone shall work well in all three environments and with the imaginable treatments it will get in the three cases – which also calls for empathy on the part of the product developers.

The framing principle

When a new product, especially one for many users is to be developed, there are two principles about how to go about the job. Either one starts to develop it for what can be termed a normal user or one starts to develop it for extreme users. In the first case one has to make a new solution when a new user appears. In the second case having made two solutions for extreme users one can make use of these solutions to easily find solutions for all users between the two extremes. Therefore, in DPD one starts to develop products for extreme users and situations instead of making single unique solutions.

In practice this is done by forming pairs of conflicting demands and finding which intersections of them are the most difficult, then finding solutions for the intersections. Example 7-18 shows when four extremes are taken into account when developing e.g. a new tool. In this example case D seems to be the most difficult one to satisfy followed by C. Next in turn to solve is case A. Case B seems not to be a problem at all to solve having solved the three other demands. Having solved the three intersecting demands D, C, and A one easily can solve the problems for E, F, and G. However if the main domain of users to target is in the marked area where the three users E, F, and G are, only the two solutions for cases D and B should be enough to cover the main domain. Probably two standard products will be needed in that case.
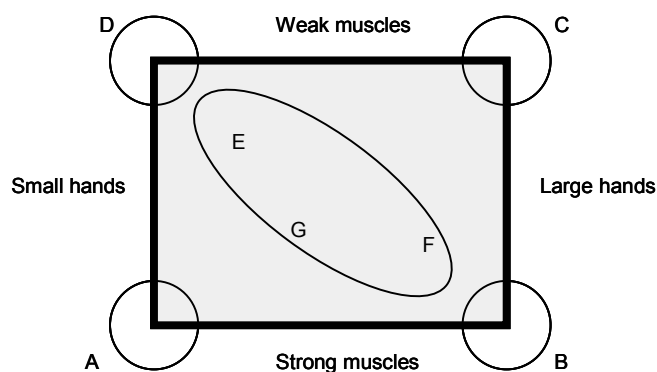
Figure 7-18: The framing principle means to first find solutions for the most difficult intersections between pairs of extreme pairs. In this case only two pairs of extremes are shown

Reinvent the wheel

This is a catchy phrase to remind us of the importance of being creative first, before looking at what others have done (c.f. figure 7-9. If one does not do it in this order one will be so influenced by what one sees that for a long time one's own creative ability will be seriously hampered. Reinventing the wheel is in general quickly done but also gives us an opportunity to invent a new wheel!

Co-location

The importance of co-location cannot be overstressed. Projects failing to yield expected benefits can be ascribed to this fact. Also the physical layout of the building is important (Haynes & Price 2004, Olson 2002), which the next chapter deals with. We shape our buildings, and afterwards our buildings shape us (Upitis 2004).

Teamwork depends heavily on constant communication and in co-located teams, team members frequently report that some of the best discussions occur spontaneously based on frequent interactions with collocated workers (Malhotra et al 2001). To note is that we humans have a bandwidth of approximately 10 Mbit/s when meeting face to face. All of this, except less than 20 bit/s (about 17 bit/s), is unconscious communication (Norrestranders 1999) not possible to make without meeting face to face.

Co-location of the team yields the following benefits (Holmdahl 2006):

1. The team stays focused. No stealing of team members' attention from other groups.
2. Short communication routs.
3. Easy to have impromptu meetings.
4. Facilitates the very important overhearing effect yielding efficient spreading of information.
    a. If for instance the project leader talks over the phone with the client, then the team, by overhearing the conversation is automatically informed.
    b. This also makes possible spontaneous problem solving which can happen when one team member hears about a problem and happens to have solutions to that problem.

When co-locating the team, the product, or a model, mock up, etc, of the product to be developed should – if possible - be placed in the center of the group. This has many advantages (Holmdahl 2006):

1. It reminds the team members of what they are there for, helping them to focus attention on the product.
2. It serves as a good visual aid for talks and discussions between team members themselves and between team members and visitors to the team.
3. It shows the status of the project if the most recent version is displayed.
4. Misunderstandings using product developers with different mother tongue languages will be minimized.

Co-location also means that the project leader can never "hide" in his room isolated from the team.

Stepping stones

In DPD stepping stones are used not to loose momentum in the work. The metaphor is like passing a creak or a small river stepping on stones (see figure 7-19). When one stone has been reached the next step shall be taken immediately not to loose balance and efficiently use the momentum in the movement. In reality that is done by first collecting an overview of the tracks to take, after which the planning of the next step can take place. When that step is almost finished the planning starts for the next step, and so on.
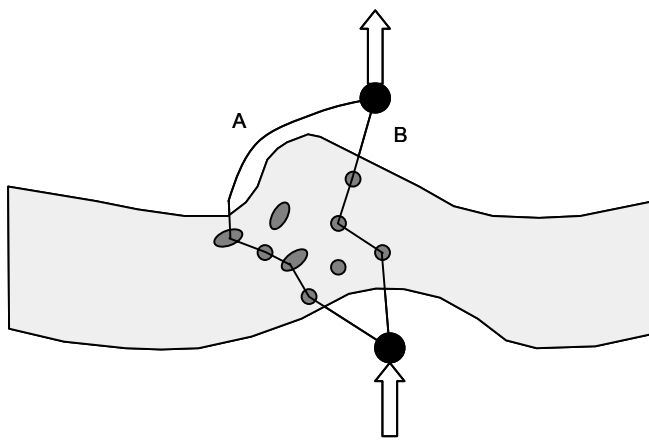
Figure 7-19: When crossing a creak or river one eventually can use stepping stones to cross quickly. Often different choices of stones to use will lead to the same result – marked with the traces A and B - but with different efforts and skills of the jumper

If one does not manage to reach the goal using one track, one has to step back and try another path - or to build a bridge between the too far separated stones. If this situation appears, it is important to inform the project leader and the other team members in the group about the situation, otherwise they will have the wrong perspective which can cause them to make wrong decisions.

The principle of flowing water

During the technical development it is essential to always look for emerging main problems and to attack them immediately with as much forces as needed. When the main problem has been solved it is often easy to solve the lesser problems. For the smaller problems the principle should be to go around them and to leave the solution of such problems to a special task force. Thereby the progress of the total process is not slowed down by the small problems.

This way of working when the main problem has been solved is called the "Flowing Water Principle". This as it has similarities to how water flows around obstacles (see figure 7-20). The important characteristic is the flexibility of flowing water and its momentum. If the obstacle is massive, water accumulates and eventually finds a weak point and breaks through. In the same way larger, perhaps

critical problems are attacked and resolutely solved with the combined force of team members and project resources.
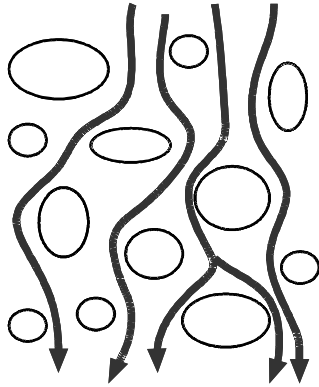

Figure 7-20: The metaphor of flowing water is used to solve problems without loosing momentum (Holmdahl 2006)

Switch between activities!

The principle of switching between activities is connected to the principles of stepping stones and flowing water. As tempo, initiative and money is lost if people spend their time waiting (e.g. Highsmith 2004, chapter 2) it is important that they have many activities to switch between. Therefore, if one for some reason cannot continue with what is at hand, one should shift over to what is the next most important thing to do until it is possible to go back and continue with the first activity/work-task. Successively working in this way the solutions will be better and better. Also it has shown that the creative capability benefits from switching between different activities if they are not too many (max. 6). [It has been found that the more experienced and skilled the designers are, the more they iterate between activities (Adams et al 2005).]

Often there is no need to follow a special order when different tasks have to be done to make a complete solution, which is exemplified in figure 7-21, when four tasks are to be fulfilled.
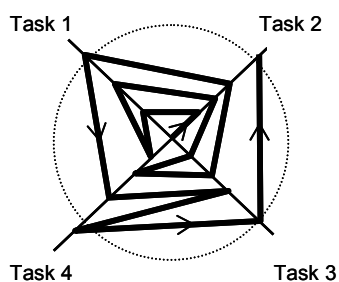
Figure 7-21: Shift between tasks when good-enough solutions have been reached

The Pareto Principle

There is a proverb: "Perfection is the enemy of the good". This guiding principle can be called the 'Pareto Principle' (e.g. Koch 1998). It tells that when working in product development one shall test a solution as soon as it is "good enough". Based on the results the solution is improved to another "good enough" level after which a new test takes place. After three such cycles an almost 100 % solution has been reached in a very short time. If one instead tries to reach 100 % directly it in reality shows that the time it will take to reach that level will be much longer.

[In 1907, Italian economist Vilfredo Pareto observed that 20 % of the people owned 80 % of the wealth. Often 20 % of the stock in a warehouse takes up 80 % of the space. 80 % of the stock often comes from 20 % of the suppliers. Also 80 % of the sales will come from 20 % of the sales staff. 20 % of the staff will cause 80 % of the problems, but another 20 % of the staff will provide 80 % of the production. Experienced project managers have noticed that 20 % of the work (the first 10 % and the last 10 %) consume 80 % of the time and resources.

In the late 1940s, quality guru Dr. Joseph M. Juran attributed the 80/20 Rule to Pareto, calling it the Pareto Principle. While it may be misnamed, Pareto Principle or Pareto's Law, as it sometimes is also called, can be a very effective management tool. The 80/20 Rule can be applied to almost anything, from the science of management to the physical world.]

Preliminary decisions

In traditional management literature a constant piece of advice is to make decisions as early as possible. By doing so, it is thought, the decisions will help to provide orientation for people working in the development process. For management that also means that it is easy to follow up on decisions that have been put in action. Thus by taking one step at a time it is believed that the development will be safe and efficient.

However, in reality it shows that the opposite way of acting – making early preliminary decisions and late final decisions - gives a safer and more efficient result. One important reason for this is that it is impossible to know in detail what will happen in the context of the development project. Having made a fixed early decision, therefore, means that the flexibility of the project is taken away as new information can not be taken into account during the process. Going back on a decision is frustrating and is often seen as bad management. Changing direction more than once often means that the confidence in the project leader is deteriorating with every step.

Explaining the reasons for going back on a final decision and motivating the team members for a new decision is a difficult process in general and especially difficult if hard facts do not exist as to why a new orientation is needed. When hard facts exist to make a new decision – and not only gut feelings – it often is too late to make the change causing the project to fail anyway.

Therefore, in DPD, one as a general rule makes final decisions as late as possible. Instead preliminary decisions are taken that are easy to change when required without mental blocks. This general rule of

course must be applied cautiously. It doesn't mean e.g. not ordering models and prototypes on which to make tests, or not hiring the competences necessary to speed up the pace. Needed investments must be taken but scrap material can be used for initial tests which is cheaper and faster than buying new test material. Taking preliminary decisions simply means maintaining the flexibility to make changes and take shortcuts when needed without causing mental difficulties. This principle is connected to the next rule – to make many small and few large decisions.

Make many small, and few large decisions

In all development the direction of the work has to be changed now and then. Reasons for changes are e.g. when unforeseen problems and external influences (e.g. new laws) occur. A metaphor of that is how to steer a small ship that has an autopilot and which is sensitive e.g. to swiftly-flowing water or strong winds (see figure 7-22). To reach a goal a new direction must be set every time an external (unwanted) influence occurs as well as when the skipper feels there might be a problem to avoid. Also, whenever short-cuts can be made they shall be tested according to the principles of DPD.
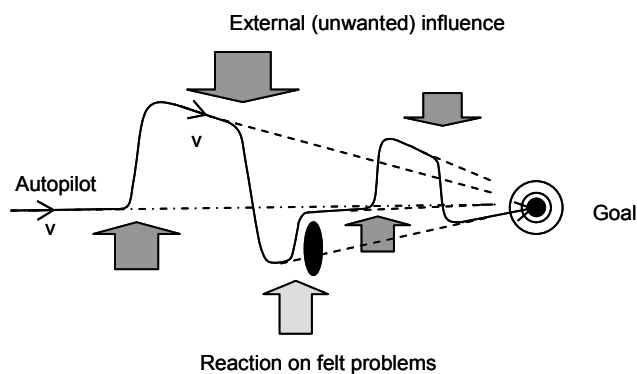
Figure 7-22: A skipper of a small boat must often change direction to reach a goal

Design & verify concurrently

Not many years ago engineering design of the part/system/total architecture was followed by the building of prototypes. The prototypes were then tested and test results were analyzed. Often there was no time for redesign in case of failure during testing, so the design engineer designed the parts sturdy enough to pass the test. This, of course, was a waste of raw material and money. This is case A in figure 7-23.
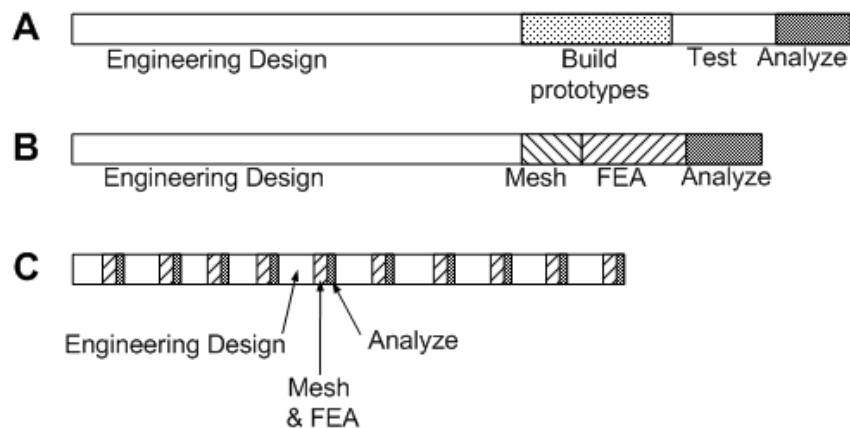
Figure 7-23: Comparison between different development strategies foremost in the automotive industry, A: old-fashioned, B: contemporary, and C: modern (Holmdahl 2006)

When CAD was introduced, CAD-drawings and later CAD-models were used for making test specimens. After some time it was realized that the CAD models could be meshed and used for Finite Element Analyzes (FEA) making the physical testing obsolete. This is case B in figure 7-23. (This has not completely happened, and will never happen as long as legislation in many countries demand physical tests, such as crash tests of automobiles).

Unfortunately, case B in figure 7-23 has the same drawback as case A - the waste of raw material and money. The reason for this is simple: in both cases physical tests and FEA are used at the end of the process to verify the design, not allowing any iterative design loops for reason of time shortage. Findings from FEA were not fed into the design process.

The method of DPD consists of short design-FEA-analyze steps, which is represented by case C in figure 7-23. By using modern software that works in the background of the CAD-program and automatically creates the mesh, the engineer can test and modify the design many times during a single day (Holmdahl 2006).

By starting out with a coarse FEA-model and making it finer and more precise as the design itself is developed it is possible in most cases to have the design verified the very instant that it is changed or a feature added. With this method, there is no need for a special validation activity after design is finished, because the design is already optimized as regards strength, noise and vibration, fluid dynamics, etc.

The method of case C allows for quick iterations. This is fortunate because the second time one does something it will be faster and better than the first time. For each iteration one gets to know the product and its characteristics better.

There is an additional meaning to the idea of starting with a coarse concept and then refining it in subsequent steps, sometimes iteratively, and that is that one develops it continuously from the start of the project until it is a finished product. This runs contrary to the established paradigm in engineering design,

128

but is never the less a more efficient strategy for developing products that fit the market situation at product launch. Thus, the mindset should be characterized by a preparedness for continuous concept development – which also figure 3-8 shows.

Using the walls

It is convenient to have large white-boards on the walls and video projectors for projecting for instance CAD-models on the white-board. Then the team can draw alternative concept solutions on the white-board on top of the projected image.

Highlighting important information is important as we, due to the excess of information we get via the Internet and Intranet, sometimes have difficulties focusing on important issues. Highlighting important information in other ways therefore becomes important. Some ways to do that is to make use of empty space on the walls in the project room. Some examples of how to use this rule is to:

1. Plot out time plans in as large a format as possible and then hang them on the wall next to where the team is located. Then they are always visible and will serve as a constant reminder (Smith and Reinertsen 1995). Changes to the time plan can be written directly on the plot with a red marker, making them very visible to the team.

2. Print out other important information for extra attention. Such information can be:
   a. Descriptions of the user of the product and pictures of its use.
   b. Pictures showing the styling and environment where the product is used.

3. Plot out drawings such as assemblies, sections, and matting surfaces and hang them on the wall together with marked conflict areas, unsolved problems, sketches, alternative concepts, etc.

Whenever a team member leans back or raises her/his eyes ideally the sight will fall on the wall meaning that the brain fills up with visual information that feeds the creative process of the subconscious mind.

Notebooks

Every team member – and the project leader(s) - shall make notes in her/his own notebook from meetings, when ideas or problems have occurred, etc. Looking back in the notebook now and then gives possibilities to reflect on the work done and why certain decisions were taken.

Thus, the records in the notebooks represent a large amount of design information and design related information such as:

- Fundamental design knowledge
- A rich source of design information and rationale that supports decision making
- Information for design audit purposes and a legal record for accountability and Intellectual Property issues.
- The results of analysis and modeling. This many also include failure as well as success.

- Informal information regarding suppliers and customers, including contact details and performance assessments.
- The outcome of discussions with experts and colleagues.

Clearly, the ability to access this wealth of potentially valuable information is highly desirable which is why the scanned books can be used and stored on the Intranet of the project. Doing so means:

- A more complete understanding of previous design issues and how they were resolved
- Information describing lessons learned and important background or contextual information
- A single accessible location for ideas, sketches and notes relating to a given project or design, improving the 'collective memory' of an organization
- Better support for concurrent and distributed design activities

Over the past decades a number of technologies for recording and managing written notes have been developed. They can be broadly split into:

- Enhanced or augmented paper-based logbooks
- Computers with pen based input
- Keyboard- or web-based logbooks.

None of these technologies can easily support the full range of information recorded in paper based logbooks and are particularly poor at supporting browsing (McAlpine et al 2006). In addition, existing attempts have not generally paid sufficient regard to how paper logbooks are used, or the well documented affordances of paper, such as simultaneous reading and writing and reminding through physical presence. Augmented paper-based systems are better in this regard, although they have their disadvantages, the primary one being synchronizing paper and electronic instances.

Thus, in general electronic technologies are not specifically designed for engineering and as such do not provide comprehensive support for the full range of essential engineering tasks, such as freeform sketching and annotating external documents (e.g. CAD drawings). Other more routine but important practical requirements such as portability, survivability and start-up time may also prove to be fundamental barriers to the uptake of an electronic logbook.

Therefore, the use of notebooks is still recommended. Notebooks also have a legal implication in case patentable inventions have been produced in the work. If many apply for the same solution at the same time the notebook can be the evidence needed to save the patent rights. Therefore it is important to also note dates and not to use a pencil when making the notes. This as information can easily be changed afterwards. Even when electronic storing is used, paper and physical copies should be saved in case the digital media breaks down or become inaccessible in the future e.g. when the technology changes.

If accidents happen with the products while in use the notebooks can be valuable source of information in court trials to find out whether the fault was caused by misuse or product deficiencies. Going back to the notebooks can in such cases give evidences as to why a certain solution was chosen.

Weekly reports

At the end of every week, each team member should briefly report that weeks work results and time, money and other resources spent, together with a brief plan for the coming week. The value of plans is in the planning, which can create preparedness for future actions to be a memory of the future (Cunha and Cunha 2002).

According to the principles of the Planetary organization described in chapter 3 the weekly short reports shall be sent simultaneously to the project or sub-project leader, to the other team members in the group, and to other people who need fast and direct information.

7.6 The S-curve

It can take a long time from when a *wish* is expressed until a functional principal solution has been created by someone wanting to make a new product that satisfies the wish. When at least one principal solution exists, the innovative development can result in a fast growth of the maturity level (see figure 7-24). Once a product has been exposed outside the company, a *want* can start to grow in the market and this can happen even though the first product is not completely ready or perfect. From that time a competitor can start to develop a competing product based mainly on the original product. When an early majority of customers have been reached, when a *market need* exists, many companies may be interested in making developed copies of the product.
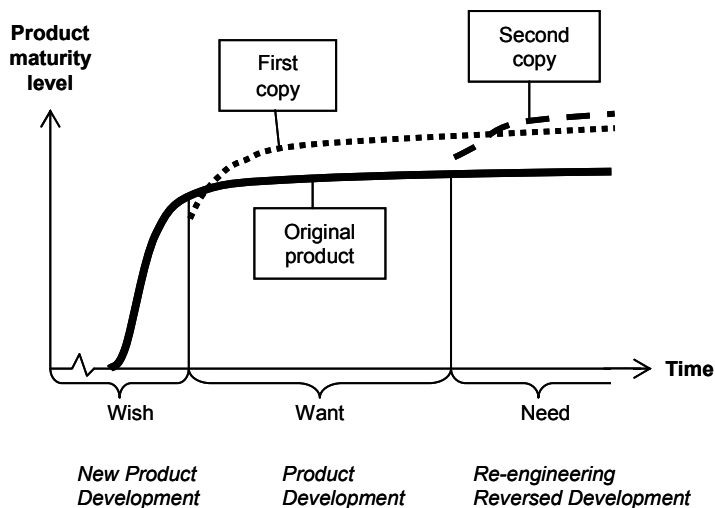
**Figure 7-24:** A principal situation from a wish to a need

In reality the S-shaped curve in figure 7-24 is not as smooth as pictured and can only be drawn in retrospect.

131

One real case (Careva Crossit) is shown in figure 7-25. The real curve is based on published findings (Björk 2003) and follow-up studies until May 2006 when the first user test of the zero production started. As can be seen it was not possible to draw the dotted S-curve until almost four years had elapsed. To note also is that it took about one year to find the first possible solution for the expressed wish despite the fact that a large market could be estimated if a useful solution could be found. [The success factor *endurance/sustainability* is not discussed a lot to date neither in business nor in research papers!]
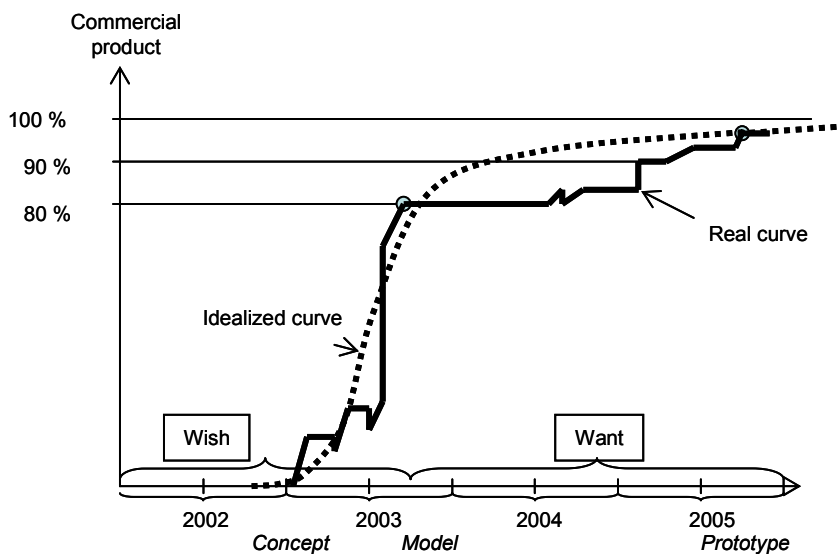
Figure 7-25: An example of a real development project.

In real product development projects achieved goals can be – and are! - lost. When a goal is reached or lost and regained again (see Goal 5 in figure 7-26 and compare going back in the labyrinth in figure 1-4) the Concept Board and/or the New Business Board shall be informed of eventual actions to be taken – which can include the stopping of the project. Informal *dialogues* are held often as well as *deliberations* e.g. when problems occur. The Board can also at any time revise the project. When major problems occur, the members of the Board must take part in the creative dialogues to find solutions as it is a common problem and not just a problem for the project leader and the team. Thus, the common Black-box view is not in agreement with DPD. Nor are gates/milestones used in other methods (see Appendix) as they have many negative effects on speed and efficiency (Ottosson 2004-C, Minderhoud & Fraser 2005).
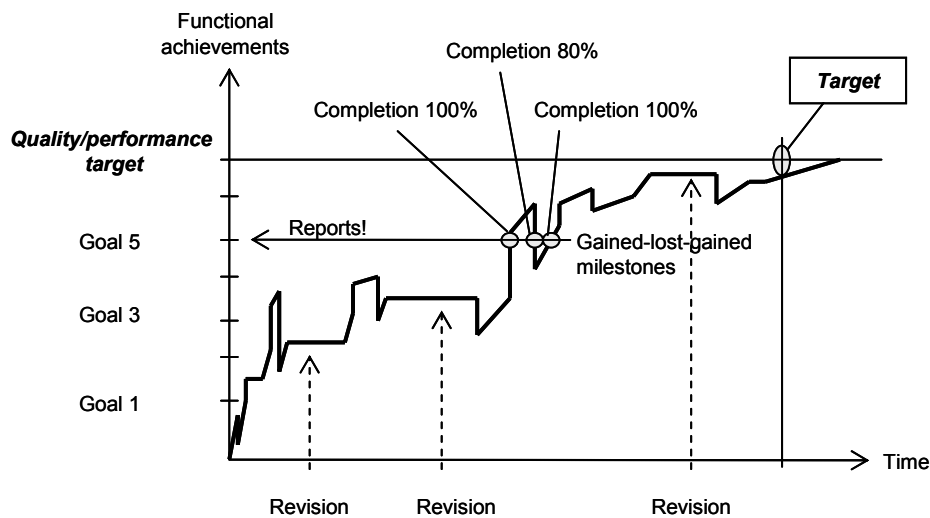
Figure 7-26: In DPD goals reached and lost shall be made known by the project leader or the comets to the other members of the Concept Board and/or the New Business Board. They can also at any time make revisions if they feel unsure of the situation

7.7 Verification

It is extremely important often to perform tests & simulations in the whole development process to make sure the product will function well in the hands of the users. To be able to quickly develop a functional prototype that pioneer buyers and users will like, it is also important in to produce many rough sketches, models and prototypes and to immediately test them on colleges and friends to obtain their feed-back. Note that verification with only one human sense is less reliable than using many senses, which is why it is better to have a model to touch – even a very simple one – than just a sketch, a drawing, a picture or an animation to look at. This since the eye often deceives our judgment even when the presentation is on paper in scale 1:1. This counts also for virtual reality (VR) although it has the advantage of involving more than the one sight sense.

Therefore, in our experience, it is important to produce models and prototypes that the product developers and test people can hold in their hands or touch. If models are practically impossible to make in scale 1:1, we have found the old recommendations of scales 1:2, 1:4, 1:10 to be recommendable.

Modeling

To be able to better understand a product idea models are done either as a physical model – which sometimes is called *Physical Mock-Up (PMU)* – or as a virtual model – which is called a *Digital Mock-Up (DMU)*.

Early in the development of smaller products or scaled down versions of larger products soft material should be used to make physical models. This as simple materials are quick and easy to change. From our experience, clay, paper, wood, etc., should therefore be used before using harder material. Quote: "When a model starts to harden up, so also does the thinking." (Schrage 2000, p 79). The strength of rough

133

prototyping media is also that they encourage playing with ideas, possibilities and potential at low cost. To make sure that design intentions are met, rapid prototyping from CAD files is often useful when function and dimensions are decided after some idea iterations.

Our experience has shown that the more people involved in the development process, the more important it is that models and prototypes are given to as many people as possible. This is due to the fact that models and prototypes are produced to answer questions and to give impulses for development that cannot be described in written or spoken form. Important to bear in mind is also that prototypes and simulations are always 'political', while managing prototypes and simulations is about managing power and influence.

The productivity of prototype-driven design measured in user satisfaction per man-hour has been shown to be 'superior' (Schrage 2000, p 73). One reason is that the product development team – and test users - have the same mental picture to work from when they are all able to touch the model and later the physical prototypes. For design studies – especially of large objects – digital mock-ups serve the same purpose.

Models are thus important visualizing tools for developers, managers, users, and customers. Models help us to get a better understanding of ourselves and our priorities and help us to avoid mistakes and misunderstandings.

Prototyping

After the modeling has been made it is time to make functional prototypes. Also in this case it is important to use simple solutions to quickly get a functional solution in reality. Making a mechanical product this can e.g. mean using parts from scrapped products to be able to speed up the pace. Making software products it can mean using open source solutions.

As a rule, the more simulations, prototypes and prototyping cycles used per unit of time, the more useful and technically perfect the final product will be. Note, however, that frequent prototyping easily leads to adding an increasing number of features to make the prototype even better so that the product will finally have more features than the user actually needs or wants to pay for. This is a problem also in software development.

To cut down development costs and to shorten 'Time to Market', many attempts have been made to cut down on the number of prototypes in the development process. Such business cultures are sometimes called specification cultures ('spec-cultures'), which are the opposite of prototype-driven cultures, of which DPD is an example, because everything cannot be seen theoretically. According to our observations, it is not unusual for companies to even spend thousands of hours developing detailed specifications that are invalidated by the initial prototype or the initial market confrontation. 'Spec-driven cultures' draw heavily from market-research data – which is of little use for innovations - before concepts are moved into the prototyping cycle. In prototyping cultures, prototypes are typically used to elicit market feedback well before final versions of the product are tested.

Rapid Prototyping

Rapid Prototyping, or *Freeform Fabrication (FFF)*, is the name given to a number of related technologies that are used to fabricate physical objects directly from CAD data sources. These methods are unique in that they add and bond materials in layers to form objects. Such FFF systems are also known as Solid Freeform Fabrication (SFF) and/or layered manufacturing. They offer advantages in many applications compared to classical subtractive fabrication methods such as milling or turning:

- Objects can be formed with any geometric complexity or intricacy without the need for elaborate machine setup or final assembly.

- Objects can be made from multiple materials, or as composites, and can even be varied in a controlled fashion at any location in an object.

- Solid freeform fabrication systems reduce the construction of complex objects to a manageable, straightforward, and relatively fast process.

- Simultaneous production and assembly means that products impossible to manufacture otherwise can be produced.

These properties have resulted in their wide use as a way to reduce *Time to Market* by faster getting product models. Thus, they are used by engineers to better understand and communicate their product designs. Surgeons, architects, artists and individuals from many other disciplines also routinely use the technology.

Free Form Fabrication (FFF®) technology is also used for *Direct Manufacturing* of fully dense parts from metal powder. The technology is in that case based on Electron Beam Melting (EBM) and parts are manufactured by melting metal powder and building up the parts layer-by-layer.

The names of specific processes when making soft FFF models/products are often used as synonyms for the entire field of rapid prototyping. Among these are stereolithography (SLA for stereolithography apparatus), selective laser sintering (SLS), fused deposition modeling (FDM), laminated object manufacturing (LOM), inkjet-based systems and three dimensional printing (3DP). Each of these technologies - and the many other rapid prototyping processes - has its singular strengths and weaknesses.

Thus with Rapid Prototyping the fabrication of custom objects can be made when 3D computer files exist of the object. The basic operation of any FFF/SFF system consists of slicing a 3D computer model into thin cross sections, translating the result into 2D position information, and using this data to control the placement of solid material (plastics or metals). This process is repeated for each cross section and the object is built up one layer at a time. FFF/SFF has historically been associated with manufacturing environments, where it is used for the rapid production of visual models, low-run tooling, and functional objects. The impact of FFF/SFF goes far beyond these applications and the additive nature of FFF/SFF techniques offers great promise for producing objects with unique material combinations and geometries which could not be attained by traditional manufacturing methods. Because of this, solid Freeform

Fabrication is seeing increased use in fields as diverse as biomedical engineering, electronics, aerospace, architecture, and archeology.

Scanning

When a physical object exists that is going to be further developed or manufactured in more than one copy, it is needed to get the information of the surfaces digitalized. This can be done by scanning the object sending the measured points to the computer. Such scanning can be made optically (non-contact scanning) or by having a needle that touches the surfaces of the object (contact scanning). Contact scanners have a precision around 0,1 mm, allowing the measure of 90 points by section with a minimum passage between the sections of 1 mm. 3D laser and fringe projection based scanners have a resolution of about 0,1 mm and the distance between section varies with minimum increments of 0,5 mm.

A critical part of non-contact systems is the telemetric system based on a laser measuring systems with high-resolution linear CCD sensors, in a double configuration.

[A CCD (Charge-Coupled Device) is an image sensor, consisting of an integrated circuit containing an array of linked, or coupled, capacitors sensitive to the light. Under the control of an external circuit, each capacitor can transfer its electric charge to one or other of its neighbors. CCDs are used in digital photography and astronomy (particularly in photometry), optical and UV spectroscopy and high speed techniques such as lucky imaging.]

Depending on how far away the laser strikes a surface, the laser dot appears at different places in the camera's field of view. This technique is called triangulation.

[The triangulation 3D laser scanner is an active scanner that uses laser light to probe the environment. The 3D laser scanner shines on the subject and exploit a camera to look for the location of the laser dot. Depending on how far away the laser strikes a surface, the laser dot appears at different places in the camera's field of view. The term "triangulation" is used because the laser dot, the camera and the laser emitter form a triangle. The length of one side of the triangle, the distance between the camera and the laser emitter is known. The angle of the laser emitter corner is also known. The angle of the camera corner can be determined by looking at the location of the laser dot in the camera's field of view. These three pieces of information fully determine the shape and size of the triangle and give the location of the laser dot corner of the triangle. In most cases a laser stripe, instead of a single laser dot, is swept across the object to speed up the acquisition process.]

Although it may seem simple having all the equipment and software needed to scan an object, a complication is that CAD systems use vector files and that scanners produce raster files. *Raster files* are fundamentally different from *vector files*. If one draws a circle with the CAD software, it is stored as a circle. The software knows the radius, line thickness, line type and center point. The circle is 'intelligent' because any part of the circle 'knows' that it is part of the circle and 'knows' what the rest of the circle looks like. The raster file created when an object in three dimensions (3D) – or a drawing in two dimensions (2D) - is scanned consists of many individual dots or pixels. The scanned image therefore is

'dumb' because the pixels form a shape but each pixel does not 'know' that it is part of the shape. Therefore some transformation work from the raster information to the vector world is needed.

2D Scanners are able to scan different types of media such as paper, sepia, vellum and transparencies. Such a scanner contains an electronic camera and a light source. The drawing is fed through the scanner or the other way around and the details are seen by the camera then saved as an electronic file. A *raster* (or bit-map) file is created. Because of the demands for high image quality when scanning technical drawings, scanners have a contrast setting called *thresholding*. This allows for the scanning of poor quality documents by distinguishing between the faded, dirty background of the document and the actual drawing or foreground information. When the image exists a CAD file must manually be made. Going direct from a drawing to a CAD file is of course another possibility. To note is that in that case it is easy to forget something when there is a distance between the drawing and the screen where the new image is to be created.

The accuracy of a scanner is measured in *Dots per Inch*, or *DPI*. This is the number of pixels, or dots, that the scanner sees for every inch of paper. The higher the DPI means more dots are produced creating a more accurate scan.

Two types of resolution are quoted by scanner manufacturers, *optical* and *interpolated*. Optical resolution is the true resolution of the scanner. Interpolated resolution is an increased resolution derived by software. When assessing resolution needs, one shall pay attention to the optical resolution. Optical resolution can be calculated by dividing the scan width into the total number of CCD (Charged Coupled Device) pixels.

Thus, two types of imaging technologies are used for 3D scanning; CCD and direct contact array. The most widely used scanning technology today is the CCD. In an effort to reduce the cost of scanners, however some manufacturers have adopted the direct contact array, which, especially for large objects, is a feasible way of scanning. When the objects to be measured are soft or partly liquid only CCD can be used. As with 2D scanning, 3D scanning needs manual work to get the vector files right.

High image quality with speed is the goal for scanner manufacturers. This has been more of a challenge for devices using direct contact array technology. Direct contact arrays use a limited LED source with a one-piece array while CCD technology links together multiple arrays. Advances with fiber optical sources help to eliminate this deficiency, but superior images at higher speeds are more easily accomplished with CCD technology. This is largely due to the use of full spectrum light sources. Multiple CCD units require calibration or alignment that can affect the integrity of the scan if not properly aligned. Multiple CCD units also offer the advantage of creating higher "optical" resolutions.

[A *light-emitting diode (LED)* is a semiconductor device that emits incoherent narrow-spectrum light when electrically biased in the forward direction. This effect is a form of electroluminescence. The color of the emitted light depends on the chemical composition of the semiconducting material used, and can be near-ultraviolet, visible or infrared. LED is the future of lighting for both energy reasons and usability.]

Virtual reality

VR means that an individual encounters 'synthesized' experiences created by computers and performed in such a way that the experiences to some degree are experienced as real by the user. The individual will through uncontrolled and controlled reactions in real time influence the computer generated VR (Ottosson 2002-B).

Virtual refers to its computer-generated existence; some prefer the term "cyber" to reinforce the point. *Reality* is the more controversial term. Realism debates whirl around what levels of realistic detail are needed and affordable. Practitioners can choose types and amounts of reality varying from "objective" to "novel" and from specific to variable, or nonspecific.

VR has five main components which are variable according to the instructional context requirements:

- dimensionality,
- motion or animation,
- interaction,
- viewpoint or frame of reference, and
- immersion, or embodiment, through enhanced multi-sensory experiences.

As VR uses 2D technology and as CAD files normally are 3D, some work is needed to go from CAD files to VR files and vice versa. Input for a VR presentation is often CAD files but going direct from BAD (Brain Aided Design), PAD (Pencil Aided Design), and MAD (Model Aided Design) (Ottosson 1998-B) creating VR files (see figure 7-27) is maybe an easier way to work. When the surfaces in the VR files have been 'painted' onto the VR 2D surfaces, the presentation of the VR can be done with HDM (Head Mounted Displays), Cave, CD and Web as well as combinations of them.
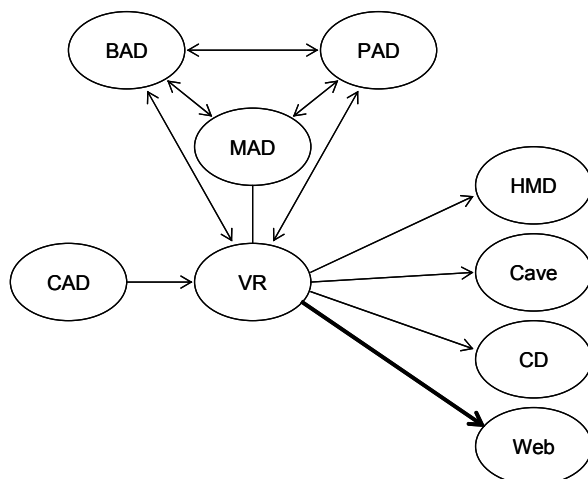
Figure 7-27: Input for a VR presentation is BAD (Brain Aided Design), PAD (Pencil Aided Design), MAD (Model Aided Design) and CAD (Computer Aided Design) (Ottosson & Holmdahl 2006).

By combining a *Content Management System (CMS)* and a VR file transformed as a compressed VR file, the VR application can be used as an ordinary web application. This in turn means that more people can be involved e.g. in the decision-making process of a new product design, a new production line, or simply the purchase of a product. If the possibilities to chat over the web page are used a fast market investigation at virtually no costs can be carried out instead of the heavy to use and costly method of Quality Function Deployment (QFD) and other methods for collecting and analyzing customer opinions about a product.

The step from having engineers and designers as the only users of a VR application to letting anyone, without geographical restraints use it opens up new dimensions in decision taking not only in industry but also in society as a whole, where web based VR, for example in urban planning could help deepen democratic decision-making. What is needed for that step is to simply develop and add a VR-module to an ordinary content management system.

The sequence from having an ordinary VR file to the publishing of it on a web page is:

1. Compress the VR file
2. Import the VR file to a CMS with a web module
3. Publish the VR file on a web page

Augmented Reality

When (real) Reality is combined with Virtual Reality we get what is called Augmented Reality (AR). The determination of Augmented Reality compared to Virtual Reality (VR) is achieved by the direct integration of the real surrounding, e.g. in form of a live-video stream. Thereby considerable parts of former digitalization effort can be cut off using AR-technology as they will be replaced by digital photos or videos.

With AR-systems visual 3D-information can be integrated seamlessly into the real surrounding. Powerful solutions allow the realization of the AR-visualization in real-time whereas the field of view of the user will be extended by context-specific virtual information. AR and its applications can be used to support users at their work-related tasks, minimize digitalization efforts or enable innovative ways to visualize products. With AR virtual information content will be communicated more user-friendly and effectively in direct context with the real environment.

From the software engineering side an AR-system consists of three basic components:

- Tracking component, e.g. optical camera tracking
- Database system with scene generator
- Visualization component, e.g. software-rendering

From the hardware side an AR-system can be realized with standard components only. For application reasons special hardware components can be helpful such as wearable PCs or robust industry cameras.

The ability to see the superimposed data and see the real world at the same time allows workers to be head-up and hands-free as they do their jobs by receiving just the information they need, where and as they need it, with complete situational awareness. Workers are able to stay focused on the task rather than having to look away at a handheld device or by walking back and forth to a computer terminal.

To achieve this the HMD (Head Mounted Display) optically guides an image directly to the user's eye. The specially-coated ocular piece is optimized to allow the image to be reflected into the user's eye, while simultaneously allowing the user to continuously see the outside world unhindered. Users can adjust the optical focus of the image, placing it precisely at the her/his working distance. The result is striking clarity of combined image data and the real-world.

Rendering

Rendering is the process of generating an image from a model defined from the scanning of a real model, by the creation of a digital model or by the creation of a virtual model. The rendering is done by a software program. The model, independent of how it is gained, is a description of three dimensional objects in a strictly defined language or data structure used by the software program. It would contain geometry, viewpoint, texture and lighting information.

Rendering is one of the major sub-topics of 3D computer graphics, and is in practice always connected to the others. In the 'graphics pipeline' it's the last major step, giving the final appearance to the models and animation. With the increasing sophistication of computer graphics since the 1970s onward, it has become a more distinct subject. On the inside, a renderer is a carefully engineered program, based on a selective mixture of disciplines related to: light physics, visual perception, mathematics, and software development.

In the case of 3D graphics, rendering may be done slowly, as in pre-rendering, or in real time. Pre-rendering is a computationally intensive process that is typically used for movie creation, while real-time rendering is often done for 3D video games which rely on the use of graphics cards with 3D hardware accelerators.

One problem that any rendering system must deal with, no matter which approach it takes, is the *sampling problem*. Essentially, the rendering process tries to depict a continuous function from image space to colors by using a finite number of pixels.

If a naive rendering algorithm is used, high frequencies in the image function will cause ugly aliasing to be present in the final image. *Aliasing* typically manifests itself as jaggies, or jagged edges on objects where the pixel grid is visible. In order to remove aliasing, all rendering algorithms must filter the image function to remove high frequencies, a process called antialiasing.

[In statistics, signal processing, and related disciplines, *aliasing* is an effect that causes different continuous signals to become indistinguishable (or *aliases* of one another) when sampled (Wikipedia). When this happens, the original signal cannot be uniquely reconstructed from the sampled signal. Aliasing can take place either in time, temporal aliasing, or in space, spatial aliasing.

Aliasing is a major concern in the analog-to-digital conversion of video and audio signals: improper sampling of the analog signal will cause high-frequency components to be aliased with genuine low-frequency ones, and be incorrectly reconstructed as such during the subsequent digital-to-analog conversion. To prevent this problem, the signals must be appropriately filtered before sampling.

It is also a major concern in digital imaging and computer graphics, where it may give rise to moiré patterns (when the original image is finely textured) or jagged outlines (when the original has sharp contrasting edges, e.g. screen fonts). Anti-aliasing techniques are used to reduce such artifacts.]

7-8 Making manuals

For most products a good manual is needed so that the product will be used as intended and to protect the user and the environment. To note is that the manuals produced are also legal documents that will be used as evidences if a severe accident should occur. Therefore, primarily for these two reasons, it is important to ensure that the manuals are written properly.

The production of good manuals is tight and concise work. For written texts the following rules of thumb are used by Ericsson (Alströmer 1998):

- Writing of the first edition 6-10 hours/page
- First review by two reviewers: 0,5 – 1 hour/page and reviewer
- First to fourth correction : 0,5 – 1 hour/page
- Second to fifth review: 0,5 – 1 hour/page and reviewer
- Final review by the author and 3-5 reviewer: 0,5 – 1 hour/page and person

In addition to all this work there has to be meetings and dialogues on what to write and how to present the message. It is also best to bring some users in to test the manuals while observing how they treat the message.

To supplement the text – or the other way around - it is advisable to make illustrations or take photos of the use of the product. On the web page videos can be shown together with the manuals. The big advantage with good illustrations/pictures is that they are language independent and give the user immediate information that is difficult to explain in words. The old saying that a picture tells more than 1000 words is worth keeping in mind when writing manuals!

7.9 Packaging design

Product profiling

For many consumer products the design of the packaging is more important than the primary product itself. Therefore the fight for brand positioning is increasingly waged in the aisles of mass marketers; packaging design has become one of the key differentiators in the battle for consumer sales. However,

also for so called producer products, OEM products (*original equipment **m**anufacturer*), and spare parts the packaging is important for the image of the company producing the products.

Examples of package material used are:

- Paperboard Packaging
- Metal Packaging (steel, aluminum, tin, etc.)
- Rigid and Flexible Plastic Packaging
- Glass Packaging

Examples of usage of packages are:

- Food & Beverage Packaging
- Pharmaceutical Packaging
- Health & Beauty Aid Packaging
- Technology Packaging
- Industrial Packaging
- Tools & Hardware Packaging

Function of packages

Except for sending a positive message of the primary product, the functional value of the package is to protect the primary product and in some cases also to protect the user from the primary product. Many products cannot exist without a package, which counts for liquids and gases as well as for some dangerous metals. The same counts for hot or cold products and for products that easily absorb damp, and smell and taste.

As for any product the functional value of the package demands a proper use first of DfU. The sensorial and image values of the package need a combination of DfAe and DfEr. Thus figure 7-10 is valid also for the development of packages.

The function of the package is dependent on how and when it is used. Three distinct situations, which partly are overlapping, are *transport*, *storage*, and *release* (see figure 7-21). Transport and storage, which often are interchanging situations in the chain from the producer to the user/consumer, belong to logistics/material handling/material administration. Logistic costs are often in the range of 30 % of the total cost for the product. Therefore it is extremely important that the package is so designed that the value of the primary product is not destroyed or decreased during transport, storing, or release as well as that cost efficient solutions are chosen by the developers. As there is a difference in time between the three activities in figure 7-28 the short duration of the release activity is grey in the figure. In the development process *release* is also dealt with after the two other activities have got their solutions.
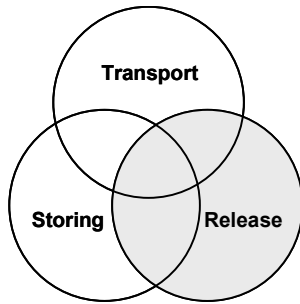
Figure 7-28: A well designed package shall function well during transport, storage, and release of the primary product.

When the package with its content is being transported there will always be vibrations and shakings. To some degree the total package solution shall shelter the primary product from dangerous impacts from such vibrations and shakings. The package shall also work as protection and shock absorber if the package is hit or if the package with content falls as well as when it is handled carelessly by the transport or store staff. For some packages there are norms and rules to follow in the development work but often one's own imagination is needed to make good package solutions, which is done e.g. with demands found in brainstorming sessions.

Due to vibrations and shakings during transport wearing will occur on the package. It will also be exposed to different temperatures and humidity during longer transport cycles. Combinations of these impacts on the package have to be taken into consideration early in the development process so that the package will fulfill its mission as desired. Otherwise the image value of the primary product can decrease disastrously.

Also storage vibrations and shakings can occur through the body of the building but normally that should not be a problem for the package. Another problem, which is the same problem as for the transport situation, is that the storing staff tries to tightly pack the goods. The package therefore must be designed not to collapse when other packages and other objects are piled on top of it. By using module thinking and by utilizing packaging possibilities in the CAD programs, efficient storing can be achieved. By implementing special solutions where the package will get higher loads e.g. from belts, ropes, and chains the risk of collapses during transport and storage will decrease. Preparing collapse zones can also be used to protect vital parts of the primary product if large forces should attack the package.

When the primary product has to be transported and stored deep frozen, ice will build that can cause problems in the handling of the packages. Much care must be taken to make the work easy and safe for the staff working in the arctic environment that is a reality in this case.

A special situation occurs with long time storing, such as attacks from animals, insects, and microbes/micro organisms including fungus (e.g. mold). If the primary product is not to be damaged the package must, in such cases, be developed with special care with regards to the selection of material. Also preventing rust for long-time storage has to be taken into account when designing the package.

When the primary product has reached the user – or the point of use - it has to be released from the package and the package material taken care of – which calls for correct material labels on each piece of the package. If at all possible special tools should not be needed for the release, other then for theft attractive products.

Passive, registering, and active packages

Packages can be passive, registering, and active. Passive packages are 'unintelligent' while active packages are 'intelligent' as they act on themselves depending on what happens with the package. Therefore active packages have different sensors that check up the state of the package and the primary product. Depending on the information they send further to a pre-programmed internal system in the package, preventative actions can be taken. Registering packages will only register information about the package and the product so that afterwards we can find out what has happened – like the "Black box" information in crashed airplanes and cars. Passive packages have no sensors.

Active packages can send an alarm signal over the mobile phone to a guard e.g. if a thief tries to steal the product. At the same time the built-in micro computers can initiate counter actions like starting a high sound alarm or a gas evaporating system. If the thief still tries to get hold of the product the intelligent system can destroy vital parts of the product so that it will not be interesting to steal but will be easy to repair for the manufacturer. If the merchandise is paper money or clothes ink can be used to destroy it telling other thieves that they get nothing out of trying to steal from similar packages – or containers. In either case the merchandise is lost so it does not matter if it gets destroyed.

A form of an unintelligent but active system is sprinkler systems that will start a water shower if fire or smoke reaches a sensor. If the package with content falls into water it can have float bodies that prevent it from sinking, which is another example of an unintelligent but active system. A third example is the use of bi-metals to react to temperature changes causing abnormal activities to occur.

Information carriers

Packages are often excellent carriers of information. On the packages therefore important and selling information should be attached. As the space is bigger on the packages than for the product inside, information in many languages is often possible. The cost is low for using the parcels as publicity creating objects!

Design for Packaging Logistics - DfPL

Logistics and packages are often intimately connected hence the combined term 'Design for Packaging Logistics' sometimes is used in much the same way as Design for Manufacturing and Assembly is used when they are intimately connected and not treated separately as Design for Manufacturing and Design for Assembly.

As the aim of logistics, in the context of supply chain management, is to move and locate inventory, internally as well as externally, to achieve preferred time, place, and possession benefits at the lowest cost, the product and packaging design can have a great impact on logistics efficiency (Klevås 2006).

In addition to marketing, protection and containment, the packaging also enables more efficient distribution and storage of products, which means that the packaging can help to reduce costs and cut lead-times in the supply chain. Tailor-made packaging and product design can also contribute to a reduction of packaging waste (Bjärnemo et al. 2000; Klooster 2002).

8. PROJECT PREMISES

8.1 The mission of a room

When we enter a room we immediately form some relation with it depending on what we see of the disposition of the area, the furniture and other objects in it, etc. (Nordin-Hultman 1998). The feeling is also influenced by how our other senses are influenced by the smell we notice, heat, humidity, sound, etc. In addition the total feeling is influenced by who else is in the room and the physical and mental distance to them. Thus it is a very complex interplay that exists between the room, the things (the artifacts) in the room, and the individuals in it. As a further complication the total feeling is time dependent e.g. as the mood will vary for the individuals in the room. The special feeling towards a room deepens or matures when we move around in it. After some time we get used to it and do not reflect much on it.

Before localities are sought for, it is first of all important to try to find out what function they will fulfill and what image they shall give its visitors – which is one way of strengthening the image value of the company. Shall the localities e.g. be used as exhibition areas to impress external people or shall they be an area for the performance of a project to which no external visitors will be allowed? In the first case the outer environment is important to investigate as well. However there must not be a contradiction between these two extremes as a nice area with nice interior environments will influence the project work in a positive way. Unfortunately it is often difficult to make tests e.g. on prototypes in exclusive room settings. Exclusive localities with exclusive furniture also requires an exclusive dress code on behalf of the team members which may not be optimum for the performance of project work.

A room where people are close to each other - a social room – is limited in size by fixed walls. It can also be limited by moveable walls, draperies and furniture. Other space limiting effects are sound, light and climate zones. A light cone in a big hall lighting up an area will e.g. be felt as a limited room in the big space. The lines on a sports arena are regarded by the players as walls around the play area forming a virtual room, etc. Thus the mental room does not need to be limited by visual signs. In addition, if someone belongs to a special social group she/he will feel uncomfortable entering a space where people from other social groups are present.

8.2 Metrical influences

If people accept each other, the shorter the physical distance gets between them, the result of team work will be better and good solutions will be reached more quickly. However, the physical distance is not only dependent on the metric distance but also on the area of sight and the audibility an individual experiences. Humidity and smell in a room also affect the mental distance as people will be distracted by things other than communication with other people in the room. If the area of sight is reduced by different obstacles and/or smoke and if the smell is not nice or if the sound level is high, communication will also be reduced between the individuals. To make work premises where people can hear each other but cannot see each other will cause negative psychological effects to grow.

Different metric zones have been identified which however are dependent on personalities (age, hearing, sex, etc.) and cultures. In the Western culture we have the following zones (Branzell 1995):

- Touch zone or intimate zone (0 – 1,8 meters) – communication through all senses
- Conversation zone (1,8 – 5 meters) – two way communication possible
- Listening zone (5-11 meters) – one way communication possible
- Mimic zone (11 – 25 meters) – information through study of body movements
- Shout zone (25 – 70 meters) – information through shouting
- Transformation zone (70 – 135 meters) –larger movements can be noticed

The more people who are within the conversation zone in which they can see each other without disturbances of sound, light, weather and smell, the better the idea generation and problem solving will be. In the listening zone "overhearing" will take place when one team member asks someone in the conversation zone for some information. A third person can fill in with information if she/he has the missing information. Faster reaching solutions can thereby be achieved then if the third person had not been within the listening zone. However if more then six persons are within the conversation zone the interest in taking part in a dialogue will be reduced and the group will split up in dialogue groups with not more then six persons. (More dinner guests then six at a dinner table will e.g. for the same reason spit up in smaller conversation groups, which can be an interesting experience when participating in a dinner.)

If high book shelves and other big obstacles in a room without inner walls are placed so that people in it can not see each other although they are not more than e.g. 2 meters apart, the we-feeling decreases radically as that means that the distance in principle equals that of the listening zone. Stairways increase the distance as radically as walls do between the people working in e.g. a normal office with corridors and cabinets. If the doors are closed that means that the physical distance is equal to infinity – which unfortunately is also the case when the team members are using MP3-players. If doors for any reason must be closed a somewhat better situation is accomplished for the we-feeling if the doors and walls against the corridor have windows. Thus the "open door principle" is important for the we-feeling in a group.

As a general finding the wellbeing in a group is increased if the team members can influence how the localities are set up and furniture and other artifacts are arranged. For early product development projects the choice of localities is especially important as a free flow of creative ideas will increase improving the efficiency/speed of the project. Especially that is the case if the models and prototypes can be placed so that the team members can see them when being in the project room.

8.3 Demands on project localities

To ensure that the team members can work together without major problems they should be chosen carefully so that there is a short mental distance between them. For them it is also advantageous if they can work together without physical distance from obstacles such as walls, book shelves, stairways, etc. For maximum well being, they shall also be able to form their individual work places as well as being able to influence their closest environment.

If it is possible the models and prototypes shall be placed in such a way in the project localities that the team members can see them when they are in the room. On the surrounding walls sketches, drawings, plans and messages are hung. (Already PM Winston Churchill had "war rooms" with maps on the walls on which his generals could make creative plans.)

During a project work it now and then is important to be able to withdraw from the community to study, reflect and think undisturbed in a silent room. The project leader(s) shall also be able to have access to a closed room out of sight from others e.g. when having personal dialogues with team members, the board chairman, the project owner, etc.

At meeting points such as coffee corners, and relaxing points, there shall preferably be whiteboards and/or paper to use for sketching. Good ideas and solutions that suddenly appear in a dialogue can then be noted down before they disappear. Through the use of whiteboards and large paper stands the creative dialogues will be strengthened after which the useful ideas have to be noted in the personal notebooks.

Creativity seems to be reinforced if the work is done in rooms which are not too well organized and perfectly structured. Chaos situations, it seems, are the mother of creativity and the most creative researchers, inventors, artists, and product developers often appear to other people to work in a total mess. To note is that many of the biggest companies seem to have been started in simple garages (e.g. Hewlett-Packard and Ford) that were as far as possible from well organized localities.

8.4 Optimal project localities?

In practice one has few chances to choose project localities, which is why one has to make the best out of the localities offered. However, if new efficient localities can create new ways of thinking, they can contribute to a good project outcome, which should be taken in account when new project localities are planned. As so often happens, nature has some solutions to offer. In this case by looking at how a beehive is built some ideas can e.g. be gained. Thus rooms with walls arranged as regular hexagons (see figure 8-1) with the length of each wall about 3 meters should allow a team of six people to always be within the conversation zone if they have their work stations in the corners of the room. By having the sides 4 - 5 meters in the center hexagon corridors and storing areas can be arranged between each project room. To allow light to enter the rooms as much as possible – to get a good atmosphere - large windows should be installed in the peripheral walls and the roofs.
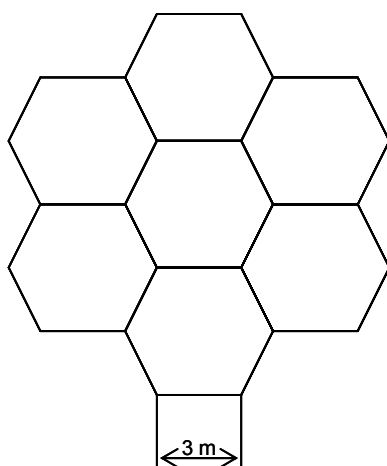
Figure 8-1: Optimal project rooms are maybe hexagonal rooms with the sides 3 meters

9. Research on innovative activities

9.1 Introduction

For a practitioner to evaluate the theories and make useful recommendations on the work the researchers provide, it is important to understand how research is done - or ought to be done. This chapter therefore has as its aim to give some insight into the world of research on innovative activities. The chapter builds on a paper presented at the conference Design 2006 in Dubrovnik, Croatia by Ottosson et al (2006).

Basically there are two main purposes for doing research on business/product development processes: a scientific and a practical purpose. The scientific part is either to make testable propositions followed by generalizing from empirical investigations or to study the reality and generalize from the findings. A combination of these two extremes is also possible. The practical part is to improve the usability in methods and tools for the product developers. Being more effective and more efficient in business/product design activities and gaining satisfaction from the users usually means commercial benefits for the company.

As was shown in figure 3-1 every development project contains many interacting factors. As they and the boundaries between them change with time and often in an unplanned or unforeseen manner development processes/projects are complex in their nature. Complex structures change with time while complicated structures are relatively stable over time. To understand the complex process of development, the researcher who do research on ongoing processes/projects will benefit having former experience from the actual field she/he investigates. The more experiences the better possibilities she/he will have to understand and contribute to the science and the art of business/product development.

Research on development processes/projects in general is conducted either from a management point of view or from a technical engineering point of view (Ottosson 2005). However, a combination of the two perspectives is what gives a holistic view.

9.2 Research from a management point of view

So far an outsider perspective using a quantitative research approach is dominant for researchers studying the management perspective on development processes. The main data collecting method used is making surveys – sending out questionnaires by mail or e-mail – as such studies are relatively quick and cheap to do (Jönsson 2004). Also one's own experience of management is not needed, which is why this type of research can be done by almost anyone.

Questionnaires can be used in two principally different ways (see figure 9-1); sending out questionnaires to many companies targeting one person per company, or sending questionnaires to a few companies targeting several persons per company. The important difference between the two alternatives is that in the first case the researcher obtains one measurement of many different objects, and in the second case she/he obtains many measurements of few objects.
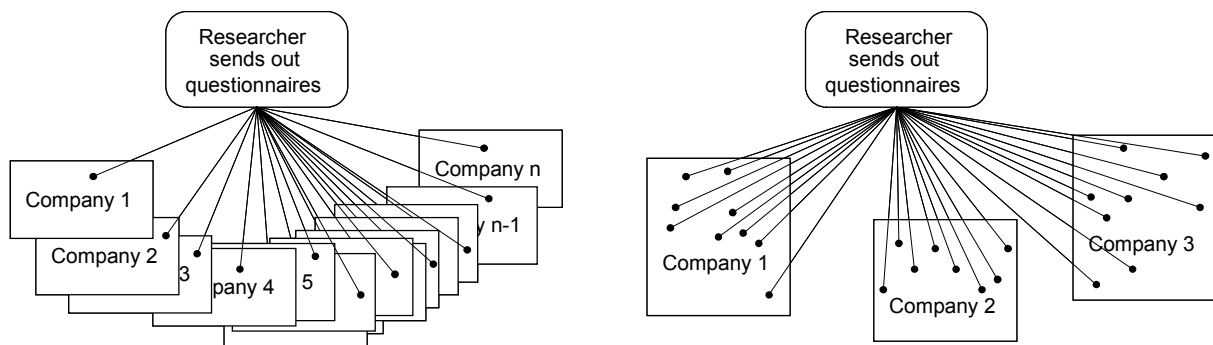
Figure 9-1: There is a quality difference between sending questionnaires to one person per company compared to sending to many persons per company (Holmdahl 2006).

As every development project is unique the left alternative in figure 9-1 is highly questionable to use. Asking only one individual from each project then mixing the answers is like measuring the resistivity of many different metals and then giving an average value for the resistivity of all metals, which is of no practical value. The right alternative in figure 9-1 however can give useful insights. It is extremely important to try and ensure that the response rate is high.

Although well known, the lower the response rate is the higher the probability of non-response error (Eaden et al 1999). Poor response rates will lead to bias because some groups are less likely to fill in a questionnaire than others (Williams 2003), and a response rate lower than 90% will bias the results (Marshall 2005). At response rates of less than 60% it is very difficult to interpret the results at all (Huston 1996). Despite this, lower response rates, unfortunately, are quite common in scientific journals. Therefore it is extremely important to check up the response rate before conclusions from a research report are accepted.

The result of the questionnaires is dependent on many things. What is often mentioned as a shortcoming is the difficulty in formulating unequivocal questions. However, the mood, the interest, and the motivation of the respondents are seldom discussed even if these factors might have a considerable effect on the result. The understanding of terms used and how much time respondents have had to set off for answering the questions are other factors that might effect the result. In addition, there might be political reasons for answering the questions in a tactical way.

Interviews can be conducted in several ways; first as structured which is an approach much like the survey except for the presence of the researcher. Second, semi-structured interviews give opportunities for free comments from the respondent. The third alternative is the free interview that is more like an open dialogue between the researcher and the respondent. Interviews instead of surveys might improve the situation as misunderstandings can be reduced when the researcher is present personally or by phone. This is because the researcher will normalize the subjective answers of each respondent giving a more reliable result (Ottosson 1999-B). To note however is that the researcher's understanding and experience of the context will influence the reliability of the interviews. Björk (2003) therefore argued that readers of research papers should benefit from knowledge of the researcher's background and loyalty situation.

A commonly heard opinion of product developers and managers in industry is that the scientific results are often of low usability and/or already known to them (Björk & Ottosson 2005). The outsider research perspective - which quantitative research builds on - points to the fact that the research findings provided have already been experienced in industry when results are presented. In some cases, the result does not correspond to common praxis and experience. Thus, the application of the outsider perspective unfortunately means that researchers are one step or more behind the development in industry, and could only present results which are – or were - "state of the art". Therefore, to be close and to be present is crucial for researchers who want to be at least one step ahead of industry, which in turn requires a qualitative and more action oriented research.

9.3 Research from a technical point of view

Research on product development processes done by researchers with a technical or natural science background is often limited to pieces of the development process and mostly is of the type describing effects of using different tools – thus a narrative approach. The practical value of the narrative approach can be considerable. However, noticed in the academic society of product development processes is that the transfer of research findings to industry has shown to be slow and that the development of tools is mostly driven by commercial enterprises leaving the researchers to test the different options.

9.4 Holistic research

The most unpredictable factor in business/product development is humans being involved in the development process. As was shown in figure 3-13 the complexity of a person mainly comes from his/her mood, interest & motivation. These three factors will work as reflection & selection filters letting more or less new information add to the knowledge and experience the person already has. The mood, interest & motivation can change considerably with time – and in an unpredictable way - which makes quantitative research too problematic to be applied on ongoing processes. This as the researcher is not present over a longer period of time and cannot get an impression of a person that is representative under normal circumstances.

In addition, every development process is unique, which means that theories cannot be proved to be true or false in a traditional fashion (Andreasen 2003), and only when they are eventually used as methods can their productivity be evaluated. These two characteristics of product development processes make research on them special (see e.g. Blessing et al 1998, Blessing 2003, Cantamessa 2003, Bender 2003, Holmdahl 2006) and gradually the awareness is growing in the technical research society that traditional research methods are not designed to be used on complex, non-repeatable processes. Thus, in contradiction to research on complicated systems as machines - for which the interfaces between their different parts do not change over time - complex systems can not be broken down in small stable pieces that separately can be studied and assembled as a total system.

A conclusion of this might be that researchers, having an outsider position of business/product development, do not manage to grasp what really happens on a daily basis in a development project. The quantitative view is also limiting as theory on how to best develop new businesses and innovations is improved only by comparing findings from one project with findings from other projects having been

151

studied in a qualitative way (c.f. figure 9-1). Thus, for the researcher to be able to understand in a holistic way what happens in a development project and its complex nature, to get the opportunity to reflect upon it, to be able to contribute to the knowledge of business/product development, and to be able to give sound recommendations on how to better develop innovations, we have found it necessary for her/him to make mainly qualitative studies having an insider position in ongoing project/activities.

9.5 Research Considerations

Research on complex systems can be divided in the three parts basic; applied, and clinical (e.g. Friedman 2000, p18) with overlapping interfaces between the three types of research activities. *Basic research* means to search for general principles. *Applied research* means adapting general findings to classes of problems. *Clinical research* is related to specific cases but is not a well found term for product development. Romme's (2004) term "design" is maybe better as it points to a creative side of reality – taking steps forward into the unknown. Thus, research on product development includes development, testing and evaluation to discover or to contribute to a body of general knowledge and to set the findings in relation to earlier published findings and theories.

Ideally, research on complex social systems is mainly a process of interaction between practice and theory. However, when researchers become excluded from the practical use of theories, they will just get fragmented information on how well the theories work and what needs to be changed in the theories to be better adapted for the practitioners. In learning from our research activities and reflecting on outcomes in an effort to find explanations that agree with the relevant theory, we can ultimately contribute new knowledge to existing theories, thereby strengthening them. Occasionally we can also find that existing theories are quite counter productive in their intended area of application – which was partly the reason why the development of DPD started out of the aim to improve the IPD theories (IPD = Integrated Product Development) (see also the Appendix).

Theory in general can be regarded as "a set of well-developed concepts related through statements of relationship, which together constitute an integrated framework that can be used to explain or predict phenomena." (Strauss & Corbin 1998, p 15). To develop a "good" theory on how to develop new products and innovations – to develop a development method – will not work as such processes are complex meaning that they are situation dependent, time dependent, and dependent on the individuals involved, etc. However, a "good" product/business development method can be developed based on studies of reality from an insider position in many projects/activities.

Acting from inside an organization means performing qualitative research which is contextual and often unsystematic as in reality things happen in an unplanned way. Its counterpart - quantitative research - is systematic but often un-contextual (Scheff & Starrin 1996). In principle, qualitative research does not accept the traditional positivistic view of separating reality into subjects and objects. Instead the importance of access to the subjective reality of everyday life – or reality as experienced by the individual - is emphasized (Scheff & Starrin 1996). As knowledge of development processes build on contextual knowledge, a qualitative research approach is important as a main research method for the analysis of empirical studies. This implies also the use of different research methods including quantitative studies. In

principle quantitative research can be used to screen areas while qualitative research is needed to get a deeper knowledge of studied phenomena. During and after the development quantitative studies are often used to focus on some topics, e.g. the perception of a design in a chosen group of people.

The quantitative research approach often starts with a hypothesis on some theory or a previous statement. Qualitative research, in general starts out with a more open research question or no specific question at all. The initial broad/vague research question then gradually develops and can with time be broken up into more specific questions. The benefit of such an approach is that the research questions, the experiences and the results are compatible with each other. The research questions become increasingly relevant as the researcher attains a deeper knowledge of the research field during the process. She/he can thereby gradually formulate more relevant questions.

When a qualitative approach is used the researcher will get a mass of information that she/he has to deal with. To pick out what to tell others from all information gained is difficult. The recorded material alone from an insider action research as observer at Volvo Cars during one year performed by Bragd (2002) amounted e.g. to over 400 hours. Also the use of fragmented citations, which is accepted and commonly used by action researchers, is regarded by narrative theorists (e.g. Riessman 1993) as problematic in that it destroys the narrative that is of paramount importance for understanding all the small pieces that build up reality in a holistic way. Björk (2003) gave two detailed examples of how limited the information is that such a technique brings to the total information and understanding of a development project. The narrative approach simply showed to give a much better total understanding of the total process and pieces of it. Thus a narrative description of research done from an insider position over a longer period of time is of paramount interest when product development methods are investigated.

Using a narrative approach necessitates a somewhat different way of presenting the findings than traditional research does. In that case the quality requirements for public presentation are that the knowledge is communicable, relevant, and trustworthy in terms of validity, credibility, and reliability.

9.6 Qualitative research aspects

Research can also be done as prospective studies in real time or as retrospective studies in past time as two opposing possibilities. For studies of ongoing processes such as innovation processes, the two methods are often used together e.g. so that 80 % of the studies are prospective and 20 % are retrospective. Figure 9-2 shows this principle which can be compared with iceberg situation of which the bulk is under the surface.
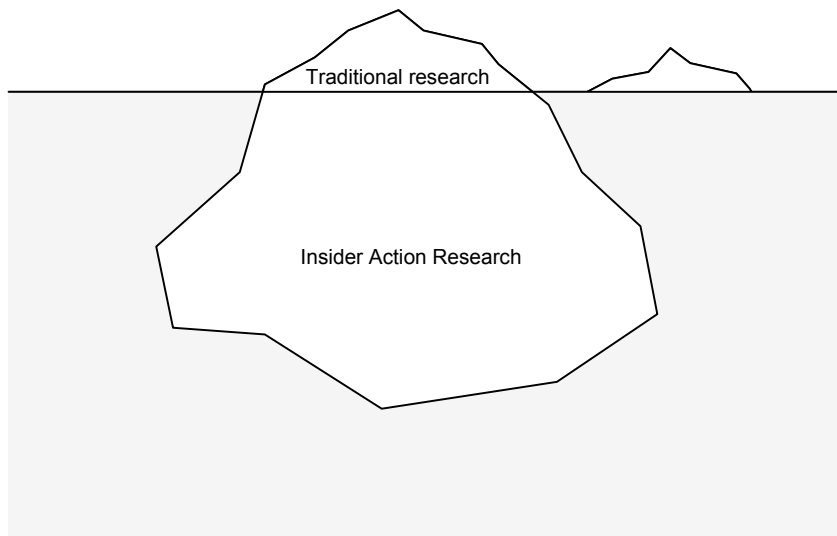
Figure 9-2: With quantitative research methods (traditional methods) some overall information can be gained while qualitative Insider Action Research is needed to get a detailed knowledge of development

When performing *prospective studies*, three unique methods can be distinguished. They are to participate in a process, to make experiments and to make tests. Experiments and tests are often the same thing. When performing *retrospective studies*, one unique method can be distinguished and that is to make archival studies, i.e. to make studies in/on historical material (artifacts, written material, photos, sketches, etc.). For both prospective and retrospective studies common methods are to make simulations, to observe, to engage in dialogues, to make inquires and to hold interviews. The different possibilities are shown in figure 9-3. The figure also shows that the researcher can choose to be mainly inside the object studied or mainly outside the object.
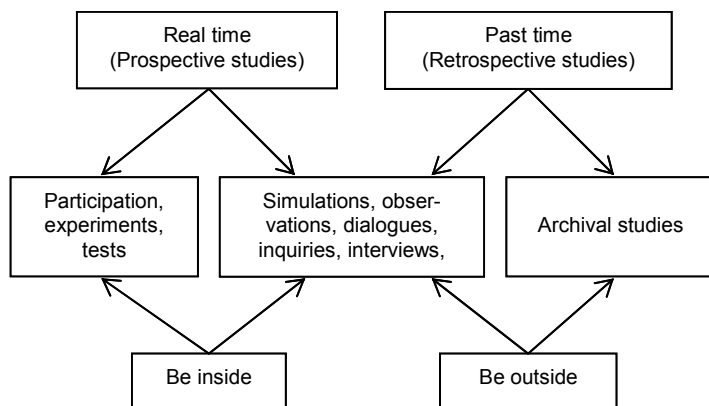
Figure 9-3: Research can be done as prospective studies and retrospective studies. Dependent on which track the researcher chooses to use different research methods can be used as is shown (Ottosson & Björk 2004)

According to our experiences, ones own use and participation means that the reliability factor gets higher than if the researcher chooses other methods shown in the two right boxes on the middle row of figure 9-3. This as the information is first hand information without interpretation errors. How in principle reliability is dependent on method used is shown in figure 9-4. A qualitative treatment is used to the left in the figure while quantitative treatment is dominant to the right in the figure. This as statistical methods cannot be used on single qualitative studies while the reversed situation exists e.g. for inquiries.
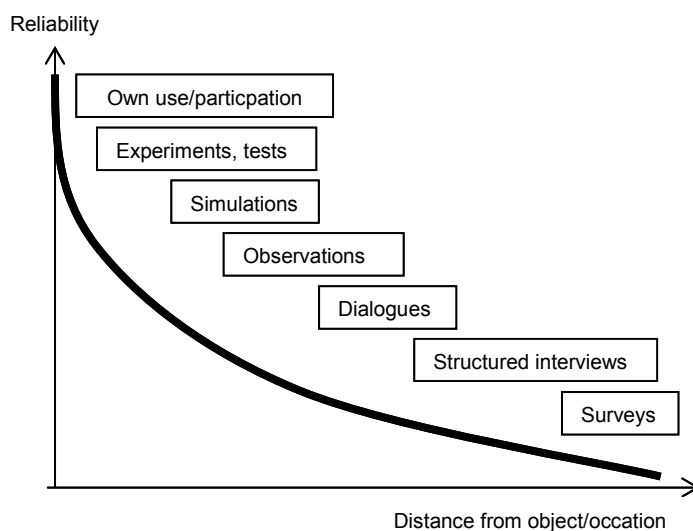

Figure 9-4: The distance from the studied object, depending on the probing method used, influences the reliability of the information acknowledged (Ottosson1999-B)

According to classical theories, scientific knowledge should highlight the causes of events in our world. However, events in complex systems are difficult to find as the origin of changes initially is more or less invisible/noticeable (see e.g. Collins 2001 p 169). In addition, the methods used to obtain this knowledge

155

are dependent on the formulation of the researcher's questions and perception of reality (Svensson & Starrin 1996) and methods/tools used. Further, the researcher's perception of reality has a decisive effect on her or his perception of human behavior. This in turn strongly influences the scientific perception that is developed and the methods used to obtain scientific knowledge in a field like product development.

We must also bear in mind that quantum physics has taught us that we – the observers of reality - are, at the same time, the participants of reality. In other words, 'observation' is not a passive noun and 'to observe' is not a passive verb. However, our classical Western upbringing has preconditioned us to think objectively; to see the world as pre-existent (Wolf 1989, p146). According to modern physics, reality is constructed from your thoughts of reality, which means that reality is relative and not absolute, as everybody will have their own view of reality. According to this approach, objectivity does not exist in reality although a majority can have an equal picture of the same matter. Thus, giving up the limitation of the strong positivist view of objectivity in research opens up for performing Action Research, which means that the researcher is inside the ongoing process she/he is studying (see figure 9-5). Ideally the researchers 'step out of' the studied project now and then for reflection. Having a scientific environment to share the experiences in is of great help for reflection.
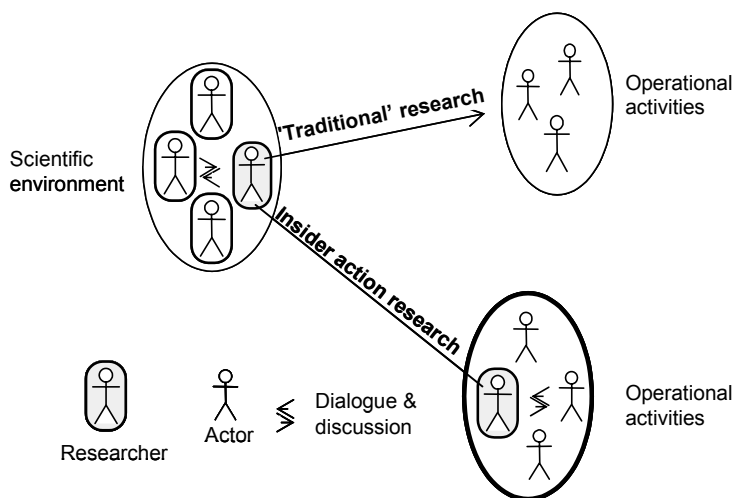
Figure 9-5: Illustration on a holistic research view where the researchers perform most of the research as Insider Action Research.

Performing Action Research (AR) means to be inside the studied process (see figure 9-6). However, AR can be performed in three ways. One can be an observer, a team member or the project leader/manager. Anyone can in principle be an observer while few researchers can in principle be team members in industrial processes as they lack industrial experiences or cannot be absent from their university duties enough to take part on a daily basis in an ongoing industrial project. Fewer can be project leaders or managers as the industrial demands are higher for this alternative than being a team member. (For natural reasons, team members and project leaders also perform observations. In addition, they perform traditional studies when studying other processes or competitors, etc.).
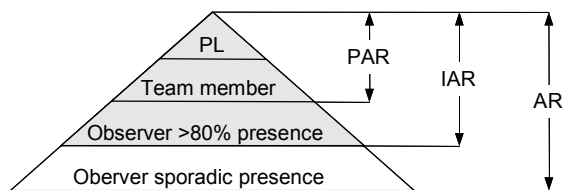
Figure 9-6: The figure illustrates the relations between Action Research - AR, Insider Action Research - IAR and Participation Action Research - PAR. It is the time spent in the system that qualifies an observer as action researcher or insider action researcher. Taking part in the work means that the researcher will be a participation action researcher. (PL = Project Leader)

The following advantages can be achieved performing IAR over being outside of the process of interest:

- A minimum risk of loss of valuable information/data due to forgetfulness or incorrect reconstruction. When reconstruction of past events is made, there are risks of misunderstandings. The researcher has no opportunity to consider the circumstances outside or inside the studied process that may have influenced the result.
- First hand information eliminates the influence from other people's understanding of the situation and their ways of expressing it.
- Opportunities exist to rapidly make corrections in interview manuals or to clear up misunderstandings between the questioners and the respondents.

To be able to get most information from an ongoing project the researcher has to act as project leader. Three big advantages being project leader/manager instead of being a team member are:

- The experience and knowledge gained from participating in the studied process gives the researcher unique possibilities to lead a later implementation of the research findings. The organization feels familiar and confident with the ongoing process and the person leading it.
- The result can be useful for practitioners; this is sadly lacking in current research findings when classical research methodology is used.
- The user satisfaction of the products can increase when a holistic view is accepted as a mediating tool in research and in product development in practice.

Conducting IAR means that the information flow is massive and that it is difficult to select important pieces. Also the big steps show in general – due to chaos theory – to have started with small invisible changes which grow exponentially, suddenly becoming visible as a big change after some time. Being present most of the time in a development process means also that the small changes, which appear unevenly distributed in time, can be grasped (see figure 9-7).
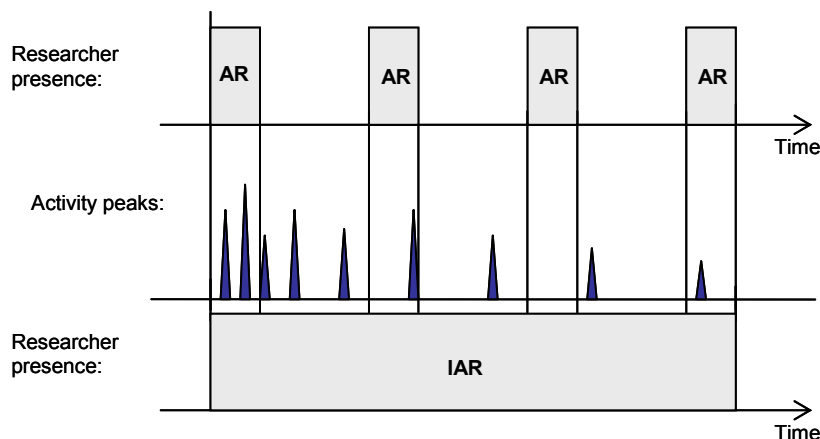
Figure 9-7: Activity peaks of different magnitudes occur unevenly distributed. To catch them it is not enough to be present now and then, as is common for Action Research (AR). The researcher needs to be present most of the time - doing IAR - to get a good understanding of the development process (Björk 2003)

From a traditional reliability aspect, in order to be reliable the comparison between two methods should be carried out by the same developers using the same method and developing the same product twice. However, when developing the first edition of a business or a product, the developers will learn what to do, which will have effects on the development of edition two. As "de-programming" is impossible the same developers simply can not compare two methods with trustworthy conclusions as a lot of uncontrollable aspects may influence the outcome. Neither would using different developers give a comparative situation as the individuals have different backgrounds, competence, capacity, etc.

To overcome that problem, comparing performance has been used and discussed in several research studies (e.g. Wallace & Ahmed 2003, Tversky et.al. 2003, Ahmed & Wallace 2004). In these studies comparisons have been made between novices and experts as well as comparing studies of novices (e.g. Badke-Schraub & Stempfle 2003). Comparing studies of experts has also been done (e.g. Badke-Schraub & Frankenberger 1999). To give most reliable results for comparing tests of different performances and tools we argue for using novice students of roughly the same age and roughly the same grades before entering the university, although this approach is not problem-free (see e.g. Klein 1999). If such studies are performed at the same time, the differences can be more observable than if the studies are made separated in time. That method was used to compare the effects of IPD and DPD early in the development of DPD 1994-1995 at Halmstad University in Sweden.

9.7 Participation Action Research

As pointed out, principally there is a difference between conducting IAR as researcher/observer and being part of the development as manager/leader or team member – being researcher/practitioner. We therefore have chosen to call being researcher/practitioner making IAR for doing Participation Action Research (PAR) (Ottosson 2003). Doing PAR means in addition to IAR to take part in the development activities and to perform experiments on development activities.

Making PAR the duality issues, pre-understanding and political role are different from making IAR as observer for which these three parts of the daily work do not influence the outcome of the research work.

In principle the observer does not need to be accepted by the people in the studied process although practitioners can be frustrated over having someone present who does not take part in the everyday work (Bragd 2002). Thus, duality issues should not be a big problem for observers being present most of the time in a development project while it can be a problem being part of a team or being project leader of a team. The project leader, but also the team members, will have a political role during the work done, while an observer will not have a political role while making the observations. However observers can play a large political role when the report is being made public.

This political role of a researcher when publishing the findings was demonstrated when the observer Bragd revealed that the official position of Volvo was to put environmental questions as very important in the development work while in practice it was not regarded with such magnitude (Bragd 2002). When the mass media found that out, Volvo representatives had to explain that there was a misinterpretation based e.g. on that the researcher did not have enough pre-understanding of how things were done at Volvo Cars. (In turn that situation pointed on a problem giving the researcher the total right to publish whatever findings as they can be disadvantageous for the company studied if it has no veto right). In most countries researchers are not allowed to get into a company on totally free conditions. Sweden, Norway, Denmark and Finland seem to be a rather unique exception to that rule.

Performing PAR means a loyalty problem for the researcher, which is why it is extremely important that the researcher carefully explains her/his loyalty situation in the reports given (Björk & Ottosson 2006). Pre-understanding makes the work easier but within a few weeks normally anyone with relevant knowledge and social skills will have accumulated enough information to be an accepted member in a team. The political dimension is very important in every development project and again that will bring loyalty problems to the researcher. Revealing the game behind the scenes can cause big problems to the people taking part in the game and as people are more vulnerable than organizations the researcher with a lot of inside information has to judge carefully how and what to present in public.

9.8 Conclusions

The simple view of science - when a common belief was that only one best method or solution was possible to find, when mathematical logics ruled the world, and when everything in principle could be simulated and planned to give wanted results - is gradually being broken down. Unplanned situations, large and small, occur more quickly. Society in general and industry in particular, therefore, will put pressure on the researchers to produce useful findings and conclusions worthy of trust that strengthen industrial competitiveness and which contributes to increased quality of life. For the findings to be accepted, understood and used the method of communication used, the pragmatic writing, and the actuality of the findings is crucial. The outsider approach means that the researchers will be one step behind the development in industry.

To increase usability, to facilitate research conclusions and to increase the trustworthiness of the findings we have found it important that the researchers conduct Insider Action Research and especially Participation Action Research and that a lot of attention is paid to validity, reliability, credibility and usability. Especially the loyalty of the researcher must be treated in the reports, which also needs to be treated in all types of scientific reports as the researcher always has the right to choose what to present and how to present it.

The political dimension is very important in every development project which can bring loyalty problems to the researcher. Revealing the game behind the scenes can cause big problems to the people taking part in the game and as people are more vulnerable than organizations the researcher with much inside information has to judge carefully how and what to present in public.

One problem for the researcher that has to be worked further on is that when she/he is doing IAR studies she/he is within an excess of data flow difficult to handle.

References

Adams, M. & Boike, D. (2005): *Your NPD portfolio may be harmful to your business's health,* Visions, XXVIII: 3, July 2004, pages 26-29

Ahmed, S. & Wallace, K.M. (2004): *Identifying and supporting the knowledge needs of novice designers within the aerospace industry,* Journal of Engineering Design, Vol 15, No 5, pages 475-492

Alströmer, C (1998-07-28): Private communication about the writing of manuals at Ericsson Corp, where Claes Alströmer had been project manager

Altshuller, G.S. (1980): *Creativity is an Exact Science*, Gordon and Breach Science Publishers, New York

Andreassen, M.M. (2003): *Improving Design Methods´ Usability by a Mindset Approach,* in Lindemann, U. (ed.), *Human Behaviour in Design,* Springer Verlag (ISBN 3-540-40632-8), Germany, pages 209-218

Andreasen, M. M. (2002): *Discussions at the Integrated Product Development* Workshop, Magdeburg, September

Andreasen, M.M. & Hein, L. (1987): *Integrated Product Development,* Springer Verlag, Berlin

APQP, (1994): *Advanced Product Quality Planning and Control Plan*, Chrysler, Ford and GM

Arbetsterapeuten (2003): Förbundet Sveriges Arbetsterapeuten, No 02, pages 5-7

Aurisicchio, M., Bracewell, R. & Wallace, K. (2006): *Characterising the Information Requests of Engineering Designers,* Design 2006, Dubrovnik, Croatia, pages 1057 -1064

Axelsson, B. (1996): *Professionell marknadsföring (in Swedish),* Studentlitteratur, Lund, Sweden

Baber, C. & Stanton, N. (1996): *Observation as a technique for usability evaluation* (from Jordan, P.W. Thomas, B. Werdmeester, B.A. McClelland, I. L. 1996: *Usability Evaluation in Industry)* Taylor & Francis, Padstow Books Ltd, Padstow

Badke-Schraub, P. & Stempfle, J. (2003): *Analysis of solution finding processes in design teams,* in Lindemann, U. (ed.), *Human Behaviour in Design Human Behaviour in Design*, Springer Verlag (ISBN 3-540-40632-8), Germany, pages 121 - 131

Badke-Schraub, P. & Frankenberger, E. (1999): *Analyses of design projects,* Design Studies 20, pages 465 – 480

Bender, B. (2003): *Task design and task analysis for empirical studies into design activity,* Journal of Engineering Design, Vol. 14, No 1, pages 1-15

Benktsson, M. (1993): *Designing for our future selves*: *the Swedish experience*, Applied Ergonomics, Vol 24, pages 19-27

Billgert, L. (1998): *Hur tar du ett Nej? (on Swedish):* Sälj & Marknadsstrategi No 5, ICA Förlaget AB, Västerås, Sweden

Bjärnemo, R., Jönsson, G. & Johansson, M. (2000): *Packaging Logistics in Product Development,* 5th International Conference: Integrated Manufacturing Technologies for New Millennium Manufacturing, Singapore pages 135-146

Björk, E. & Ottosson, S. (2006): Aspects of Consideration in Product Development Research, Journal of Engineering Design, Vol 17, No 4

Björk, E. (2003): *A contribution to Insider Action Research Applied on Development of Assistive Products,* PhD Thesis, Otto-von-Guericke-Universität, Magdeburg, Germany

Björk, E. & Ottosson, S. (2006): *Aspects of Consideration in Product Development Research,* Journal of Engineering Design, Vol. 17, No. 4

Bhote, K. R. (1996): *Beyond Customer Satisfaction to Customer Loyalty,* AMA Management Briefing, American Management Association, NewYork

Blessing, L. (2003): *Future Issues in Design Research,* in Lindemann, U. (ed.), *Human Behaviour in Design,* Springer Verlag (ISBN 3-540-40632-8), Germany, pages298-303

Blessing, L., Chakrabarti, A. & Wallace, K.M. (1998): *An Overview of Descriptive Studies in Relation to a General Design Research Methodology*, in Frankenberger, E., Badke-Schraub, P. & Birkhofer, H. (eds), *Designers – The Key to Successful Product Development*, Springer Verlag, Germany

Bragd, A. (2002): *Knowing Management – An Ethnographic Study of Tinkering with a New Car,* PhD thesis at School of Economics and Commercial Law at Göteborg University, Sweden

Branzell, A. (1995): *Något om rummet (in Swedish):* Architecture, Chalmers University of Technology, Göteborg, Sweden

Brooks, F. (1975): *Mythical Man-Month*, Addison-Wesley, ISBN 0-201-00650-2

Cantamessa, M. (2003): *An emprical perspective upon design research,* Journal of Engineering Design, Vol 14, No 1, pages 1-15

Carlsson, M. (1996): *State-of-the-art and State-of-the-science as a Framework of Development of Conceptual Models, Key Factors and Future Research Areas in Integrated Product Development*, TMCE'96, Budapest, Hungary

Collins, J. (2001): Good to Great: Why Some Companies Make the Leap... and Others Don't, HarperCollins Publishers, New York, ISBN 0-06-662099-6

Cooper, R, G. (2005): *Product Leadership Pathways to Profitable Innovation,* Second Edition, Basic Books, Jan 2, 2005, ISBN 046501433X

Cooper, R.G. (2004): *PDMA foundation CPAS study reveals new trends,* Visions, XXIX: 2, April 2004, pages 22-26

Cooper, R.G. (2002): *Winning at New Products – Accelerating the Process from Idea to Launch,* Perseus Publishing, Cambridge, Massachusetts, 2002

Cooper, R. G. (1998): *Product Leadership, Creating and Launching Superior New Products*, Persus Books, Cambridge Massachusetts, ISBN 0-7382-0010-7

Cooper, R. G. (1994): *Perspective Third generation New Product Processes*, Journal of Marketing Management, Vol.11, pages 14-43

Cunha, M. P. & da Cunha, J. V. (2002): *To plan and not to plan: Toward a synthesis between planning and learning,* International Journal of Organization Theory and Behavior. Boca Raton: 2002. Vol. 5, Iss. 3/4; page 299

Cusamo, M. & Selby, R (1995): *Microsoft Secrets,* The Free Press

Davis, K. (1998): Could *qualitative research become the "rule" instead of the "exception"?* Journal of Physical Education, Recreation & Dance. Reston: Feb 1998. Vol. 69, Iss. 2; p. 5 (1 page)

Downes-Le Guin, T., Janowitz, P., Stone, R. and Khorram, S. (2002): *Use of Pre-incentives in an Internet Survey,* Journal of On-line Research, www.ijor.org/ijor_archives/articles/ use_of_pre-incentives_in_an_internet_survey.pdf

Eaden, J., Mayberry, M. K. and Mayberry, J. F. (1999): *Research methods: Questionnaires: the use and abuse of social survey methods in medical research*, Postgrad. Medical Journal;Vol. 75; pp. 397-400

Edwards, P., Roberts, I., Sandercock, P. and Frost, C. (2004): *Follow-up by mail in clinical trials: does questionnaire length matter?,* Controlled Clinical Trials, Vol. 25, Issue 1, February, pp. 31-52

Engle, T. J. and Hunton, J. E. (2004): *The effects of small monetary incentives on response quality and rates,* Auditing; Mar 2001; Vol. 20, No. 1; ABI/INFORM Global p. 157

Ehrlenspiel, K. (2003): *Integrierte Produktentwicklung (in German),* Carl Hanser Verlag, München Wien (ISBN 3-446-22119-0)

Evans, B. (1988): Simultaneous Engineering, Mechanical Engineering. New York: Feb 1988. Vol.110, Iss. 2; page 8

Flodhammar, Å., Bäckman, B., Lundgren, S. och Nielsen, T. (1991): *Industriell marknadsföring (in Swedish),* Liber Ekonomi, Malmö, Sweden

Friedman, K. (2000): *Creating design knowledge, From research into practise*. IDATER 2000, Loughborough Univeristy, UK

Gilbreth, F. & Gilbreth, L. (1920): *Fatigue Study*, NY, The McMillan Co.: London, George Rothledge & Sons Ltd. (republished Easton, PA, Hiving Publishing Co. 1973)

Glascoff, D. W. (2001): *Physician Repsonse to Surveys: A Review of the Literature / Reported Respons,* Marketing Health Services; Summer; Vol. 21, No. 2; p. 39

Godin, S. (2005): *All Marketers are Liars*, Portfolio, NY

Gourville, J. T. (2006): *Eager Sellers and Stony Buyers,* Harvard Business Review, June

Granér, R. (1994): *Personalgruppens psykologi (in Swedish):* Studentlitteratur, Lund, Sweden

Graves, A. (1987): *Competitive Trends in Automotive Research and Development*, DRC Discussion Paper No. 54, SPRU, University of Sussex, Brithton

Gummesson, E. (2002): *Total Relationship Marketing: Rethinking Marketing Management,* Butterworth-Heinemann Ltd, (ISBN: 0750654074)

Hansen, C.S. (1991): *How are you treated*. Master Thesis from Inst. For Engineering Design, Denmark Technical University, Lyngby, Denmark

Hedlund, S. & Johannesson, K. (1993): *Marknadsretorik (in Swedish),* SIFU, Borås, Sweden

Haynes, B. & Price, I. (2004): *Quantifying the complex adaptive workplace*, Facilities; Vol. 22, page 8

Highsmith, J. (2004): *Agile Project Management: Creating Innovative Products*, Addison Wesley, 2004, ISBN: 0321219775

von Hippel, E. (2005): *Democratizing Innovation,* The MIT Press, Cambridge, Massachusetts (ISBN 0-262-00274-4)

Holmdahl, L. (2006): *Enhancement of Insider Action Research on Product Development,* PhD Thesis, Otto-von-Guericke-Universität, Magdeburg, Germany

Hsu, C.-W. (2005): *Formation of industrial innovation mechanisms through the research institute,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol 25, No. 11 November 2005, pages 1317 - 1329

Huston, P. (1996): *Reporting on surveys: information for authors and peer reviewers,* Canadian Medical Association Journal 1996; 154: pages 1695-1698

Johannisson, B. (1992): *Entreprenörskap på svenska (on Swedish),* Almqvist & Wiksell, Malmö, Sweden

Jordan, P.N. (1998): *Human factors for pleasure in product use,* Applied Ergonomics, Vol. 29, No. 18, pages 25 – 33

Jönsson, S. (2004): *Product Development – Work for Premium Values,* Liber/CBS Press, Kristianstad, ISBN 91-47-07511-2 & ISBN 87-630-0134-9

Kaku, M. (1998): *Visions – How Science will Revolutionize the 21st Century,* Anchor Books, New York

Kano, N., Seraku, N., Takahashi, F. and Tsuji, S. (1996) *Attractive quality and must-be quality.* In *The best on quality,* edited by John D. Hromi. Volume 7 of the BookSeries of the International Academy for Quality. Milwaukee:ASQC Quality Press.

Kellerman, S. E. and Herold, J. (2001): *Physician Response to Surveys: A Review of the Literature,* American Journal of Preventive Medicine, Vol. 20, No. 1, pp 61-67

Kim, W. C. & Mauborgne, R. (2005): Blue Ocean Strategy, Harvard Business School Press, Boston

Klein, G. (1999): *Sources of Power: How People Make decisions*, Second MIT paperback edition, ISBN 0-262-61146-5

Klevås, J. (2006): *Design for Packaging Logistics,* Design 2006, Dubrovnik, Croatia, pp 269-276

Knellner, G.F. (1975): *The Art of Science of Creativity,* Holt, Rinhart and Winston, NY

Koch, R. (1998): *The 80/20 Principle,* Currency Doubleday, New York

Kotler, P. & Keith, C. (1972): *Readings in Marketing Management,* Prentice Hall, Englewood Cliffs, New Jersey

Koudal, P. (2005): *Mastering Innovation*, Deloitte Research, www.deloitte.com/research

Krigel, R.J. & Patler, L. (1991): *If it ain't broke ..... BREAK IT!,* Warner Books, New York

Kurtz; C. F. and Snowden, D. J. (2003): The new dynamics of strategy: Sense-making in a complex and complicated world, IBM Systems Journal; 2003; Vol. 42, No.3; page 462

Lekval, P. och Wahlbin, C. (1993): *Information för marknadsföringsbeslut (on Swedish),* IHM Förlag, Göteborg, Sweden

Linn, C. E. (1985): *Metaprodukten och Marknaden (in Swedish),* Liber Förlag, Malmö, Sweden

Linn, C.E. (1990): *Metaprodukten och der skapande företaget (in Swedish):* Liber, Malmö, Sweden

Littler, D., Leverick, F., & Bruce, M. (1995): *Factors affecting the process of collaborative product development: a study of UK manufacturers of information and communications technology products,* Journal of Product Innovation Management, Vol. 12, No. 1. pages 16 – 32

Lorentzon, P. & Dahlberg, K (1995): http://www.geocities.com/survivorsickness/symptomsmain.html

McAlpine, H.C., Hicks, B.J. & Culley, S.J. (2006): *A Review of State-of-the-Art Technologies for Supporting a Designer's Electronic Logbook,* Design 2006, Dubrovnik, Croatia, pp 565-572

McCarthy, E. J. (1968): *Basic Marketing: A Managerial Approach,* Homewood, Illinois, USA

Magnusson, C. (2001): *Introduktion till designmetodik, rehabiliteringsteknik och design (in Swedish),* Certec, Lund Technical University, Sweden (www.certec.LTH.com)

Malhotra, A. & Majchrzak, A. (2004): *Enabling knowledge creation in far-flung teams: best practices for IT support,* Journal of Knowledge Management; Vol. 8, No 4; page 75

Markides, C. C. (2000): *All the Right Moves,* Harvard Business School Press, ISBN 0-87584-833-8.

Marshall, G. (2005): *The purpose, design and administration of a questionnaire for data collection,* Radiography, Vol. 11, Issue 2, May, pp 131-136

Mehri, D. (2005): *Notes from Toyota-Land,* Cornell University Press, Ithaka, USA

Minderhoud, S. and Fraser, P. (2005): *Shifting paradigms of product development in fast and dynamic markets,* Reliability Engineering & System Safety, Volume 88, Issue 2, May 2005, pages 127-135

Monö, R. (1997): *Design for Product Understanding*, Liber AB, Stockholm, Sweden

Naumann, T. (2005): *Adaptives Systemmanagement, Ein Ansatz für die Planung ind Steuerung von Produktentwicklungsprozessen (in German),* PhD thesis, Otto-von-Guericke-Universität Magdeburg, ISBN 3-9807688-4-8

Nielsen, J. (1993): *Usability Engineering,* Academic Press Inc., Boston

Norman, D.A. (1988): *The Psychology of Everyday Things,* New York: Basic Books

Nordin-Hultman, E. (1998): *Det pedagogiska rummet speglar vår syn på barn (in Swedish),* Pedagogiskt magasin No 3, pages 22-27

Norrestranders, T. (1999): *The User Illusion: Cutting Consciousness Down to Size,* Penguin Books Ltd, ISBN: 0140230122

Olsson, F. (1992): *The story of the invention of the Product Development Education in Halmstad,* First International symposium on Engineering Education Integrating Machine Design, Electronics, Management and Marketing, Halmstad, Sweden

Olsson, F. (1985): *Integrerad Produktutveckling (in Swedish)*, Mekanförbundet, Stockholm, Sweden

Olson, J. (2002): *Research about office workplace activities important to US businesses – and how to support them,* Journal of Facilities Management, Vol. 1 No.1, pages 31 - 47.

Ottosson, S., Schabacker, M., von Specht, E. & Vajna, S. (2006): *From IPD to D-IPD,* IPD Conference 2006, Magdeburg

Ottosson, S. & Holmdahl, L. (2006): *Web Based Virtual Reality,* Journal of Engineering Design, Vol. 17, No. 5

Ottosson, S., Björk, E., Holmdahl, L. and Vajna, S. (2006): *Research approaches on Product Development Processes,* Proceedings from Design 2006, Dubrovnik, Slovenia

Ottosson, S. (2005): *Background and state-of-the-art for DPD,* EIASM Conference, Copenhagen, Denmark June 12-14

Ottosson, S. (2004): *Dealing with Innovation Push and Market Need,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol 24. pages 279-285

Ottosson, S. (2004-B): *The Development and Research of DPD – A Historical Review*, EDIProD Symposium, Poland, October

Ottosson, S. (2004-C): *Dynamic Product Development - DPD,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol 24, pages 179-186

Ottosson, S. (2004-D): *Stage-Gate™ vs. DPD in Software Development*, IPD Symposium in Magdeburg, Germany September

Ottosson, S. and Björk, E. (2004): *Research on Dynamic Systems – Some Considerations*, Technovation - the International Journal of Technological Innovation and Entrepreneurship, Volume 24, Issue 11, pages 863-869

Ottosson, S. (2003): *Participation Action Research – A Key to Improved Knowledge of Management,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol 23, pages 87 – 94

Ottosson, S. (2003-B): *Collaborative Product Development Considerations*, in Lindeman, U. (ed.): Human Behaviour in Design, Springer Verlag, Berlin, pages 164-173

Ottosson, S. (2001): *Dynamic Concept Development – A Key for Future Profitable Innovations and New Product Variants,* ICED 01, Glasgow, August 21-23, pages 331-338

Ottosson, S. (2002): *A New Mindset on Product Development,* Tools & Methods in Competitive Engineering (TMCE002), in Wuhan, China, April

Ottosson, S. (2002): *Virtual Reality in the Product Development Process,* Journal of Engineering Design Vol 13 No 2, pages 159 -172

Ottosson, S. (1999): *Dynamisk Innovationsverksamhet (on Swedish),* Tervix Förlag, Floda, Sweden

Ottosson, S. (1999-B): *Dynamisk Produktutveckling* (in Swedish), Tervix, Floda, Sweden

Ottosson, S. (1999-C): *Planetary Organization,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol.19, pages 81-86

Ottosson, S. (1999-D): *Dynamisk Projektverksamhet* (in Swedish), Tervix, Floda, Sweden

Ottosson, S. (1998): *Strategic Considerations of the Interplay between R&D and M&S,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol. 18 No. 4, pages 235 – 244

Ottosson, S. (1998-B): *Qualified Product Concept Design needs a Proper Combination of PAD-MAD before PDM,* Journal of Engineering Design, Vol. 9, No.2, pages 107-119

Ottosson, S. (1997): *Pilot Your Organization using Cash-Flow Planning with Frequent Feedback,* Technovation - the International Journal of Technological Innovation and Entrepreneurship, Vol 17, No 9, pages 513 – 520

Ottosson, S. (1996): *Dynamic Product Development - Findings from Participating Action Research in a Fast New Product Development Process,* Journal of Engineering Design, Vol 7, No 2, pages 151 - 169

Ottosson, S. (1983): *Guided Product Idea Generation,* Omega - The International Journal of Management Science Vol. 11, No 6, pages 547-557

Pahl, G., Beitz, W. and Wallace, K. (Eds) (1996): *Engineering Design: A Systematic Approach,* Springer-Verlag, New York

Reissman Kohler, C. (1993): *Narrative Analysis,* Qualitative Research Methods, Vol. 30, Newbury Park, Sage Publications

Romme, G. (2004): *Action research, emancipation and design thinking* , Journal of Community & Applied Social Psychology. Nov/Dec 2004. Vol. 14, Iss. 6; page 495

Rowland, G. (2004): *Designing with: a homeopoietic ethic for organizational change,* Systems Research and Behavioral Science; May/Jun 2004; 21, 3; page 219

Rowley, J. (2004): *Researching people and organizations,* Library Management, Vol.25, Iss. 4/5; p. 208

Rylander, L. (1995): *Tillväxtföretag i startfas (in Swedish):* PhD thesis, Stockholm University, Sweden

Scheff, T.J., & Starrin, B. (1996): *Om delar, helheter och sociomorfologisk metod*, (in Svensson, P.-G. & Starrin, B. :*Kvalitativa studier i teori och praktik*) *(in Swedish)*, Studentlitteratur, Sweden

Schneider, B. (2000): *Managers as evaluators: Invoking objectivity to achieve objectives,* The Journal of Applied Behavioral Science. Arlington: Jun 2000. Vol. 36, Iss. 2; pp. 159 – 174

Schrage, M. (2000): Serious Play – How the world's best companies simulate to innovate, Harvard Business School Press, Boston, USA

Schumpeter, J. (1934): *The theory of Economical Development,* Harvard University Press, Cambridge, MA'

Simon, H. (1997): *Hysteresis in Marketing - A New Phenomenon ?,* Sloan Management Review, Spring, pages 39-49

Sjöstrand, S.-E. (1992): *Företagsledandets Janusansikte (on Swedish),* in Sjöstrand, S.-E. & Holmber, I. (red.): *Företagsledning bortom etablerad teori,* Studentlitteratur, Lund, Sweden

Smedberg, M. (1994): Om stridens grunder, (in Swedish), Page One Publishing, ISBN 91-7125-028-X.

Smith, P. G. & Reinertsen, D. G. (1995): *Developing Products in Half the Time,* 2nd ed., John Wiley & Sons Inc, ISBN 0-471-29252-4

Strauss, A. & Corbin, J. (1998): *Basics of Qualitative Research*, Sage Publications, California

Stucker, C. (2002): *The Mystery Shopper's Manual (5th Edition),* Special Interest Publishing, Sugar Land (ISBN 1-888983-24-8)

Svensson, P.-G. (1996): *Förståelse, trovärdighet eller validitet?,* in Svensson, P-G. Starrin, B. (eds.) *Kvalitativa studier i teori och praktik* (in Swedish), Studentlitteratur, Lund, Sweden

Taylor, F. (1911): *Principles of Scientific Management*, Harper and Row, New York

Taxén, L. (2003): *A Framework for Coordination of Complex Systems′Development,* PhD Thesis at Linköpnig University, Dep. of Computer and Information Science, Linköping, Sweden

Ten Klooster, R. (2002): *Packaging Design: a methodological development and simulation of the design process,* PhD thesis, Delft Technical University, the Netherlands

Tversky, B., Suva, M., Agrawala, M., Heiser, J., Stolte, C., Hanrahan, P., Phan, D., Klingner, J., Marie-Paul, M, Lee, P., Haymaker, J. (2003): *Sketches for Design and Design of Sketches*, in Lindemann, U. (ed.), *Human Behaviour in Design,* Springer Verlag (ISBN 3-540-40632-8), Germany, pages 79 – 86

Ulrich, K. & Eppinger, S. (2003): *Product Design and Development,* McGrax-Hill/Irwin; 3 edition (July 30), ISBN 0072471468

Upitis, R. (2004): *School architecture and complexity,* Complexity and Education, Dec 2004, Vol. 1, No 1

Utterback, J. M. (1994): *Mastering the Dynamics of Innovation,* Harvard Business School Press, Boston

Vajna, S. & Burchardt, C. (1998): *Dynamic Development Structures of Integrated Product Development,* Journal of Engineering Design, Nr 9, pages 3-15

Wallace, K. & Ahmed, S. (2003): *How Engineering designers Obtain Information,* in Lindemann, U. (ed.), *Human Behaviour in Design,* Springer Verlag (ISBN 3-540-40632-8), Germany, pages 184-194

Wheatley, M.J. (2006): *Leadership and the New Science – Discovering Order in a Chaotic World,* Berrett-Koehler Publishers, San Francisco (ISBN 1-57675-344-1)

Wheatly, M. & Kellner-Rogers, M. (1999): *A Simpler Way,* Berrett-Koehler, San Fransico, (ISBN: 1-57675-050-7)

Wikström, L. (2002): *Produkters Budskap, Metoder för värdering av produkters semantiska funktioner ur att användarperspektiv (in Swedish),* PhD thesis at Department of Product and Production Development at Chalmers University of Technology, Gothenburg, Sweden

Williams, A. (2003): *How to ... Write and analyze a questionnaire,* Journal of Orthodontics; Sept; Vol. 30, No. 3; Academic Research Library, pg. 245

Wognum, P.M., Fischer, O.A.M, & Weenink, S.A.J. (2002): *Balanced relationships: management of client – supplier relationships in product development,* Technovation Vol. 22, No. 6, pages 341 – 351

Wolf, F.A. (1989): *Taking the Quantum Leap – The New Physics for Non-scientists,* Harper & Row Publ., New York

Zohar, D. (1997): *Rewiring the Corporate Brain – Using the New Science to Rethink How We Structure and Lead Organizations*, Berrett-Koehler Publishers, San Francisco (ISBN 1-57675-022-1)

Appendix

X.1 Product development from a historical perspective

People have always manufactured equipment and products for their own immediate needs, where the user/use has influenced the design. The technological developments connected to the Industrial Revolution of the 1700s resulted in the mass production of products for sale to many users. Consequently, the user focus began to shift. During the Second Industrial Revolution, from 1850 to 1900, engineering developed rapidly, and serial product development methods were identified. As production runs increased and technological development progressed, competition also increased, and work routines were broken down into shorter subroutines that could be performed by relatively unskilled labor (Taylor 1911). Distances increased, and the user and manufacturer were no longer mentally and geographically close to each other. In time, this led to serious side effects such as reduced product quality and repetitive stress injuries among production workers. The serial product development methods paid homage to the art of engineering and technology at the cost of user focus and humane working conditions.

Although Gilbreth & Gilbreth (1920) pointed out the importance of developing and manufacturing products in a human-oriented way, it was not until the mid-1970s that industry began to take an interest in human-machine interaction and fields, such as ergonomics and work environments. A new paradigm that entailed a shift from the "hardware age" to the "software age" came into being. During the 1980s, people began to speak of the "people ware age" (Evans 1985).

The development from the traditional serial methods towards dynamic and flexible methods has been accelerated by, among other things, rapid growth and fierce competition in branches where development time is continually and dramatically reduced. Wallace & Ahmed (2003) gave the following reasons for the change in product development strategies:

- increasing commercial pressures which demand continuous improvements in quality, shorter lead times and reduced costs
- the trend towards globalization and the reliance on IT
- increasing complexity of both products and processes
- problems of retaining and retrieving knowledge and experience
- the need to move towards sustainable development

The importance of empathetic capabilities of the product developers to companies involved in product development projects has also increased, as more and more attention is devoted to soft product values and usability issues.

X.2 Serial product development

Serial product development is one of the oldest of the product development methods. It is also called the relay race method because the baton is first carried by one department, then another department, and so on. Points of decisions are defined between each phase of development (see figure X-1). At the decision points - or gates - between the phases, it is determined whether development will continue or be

terminated (Cooper 1994). At each gate it can also be decided to repeat the previous process (e.g. Pahl & Beitz 1996).
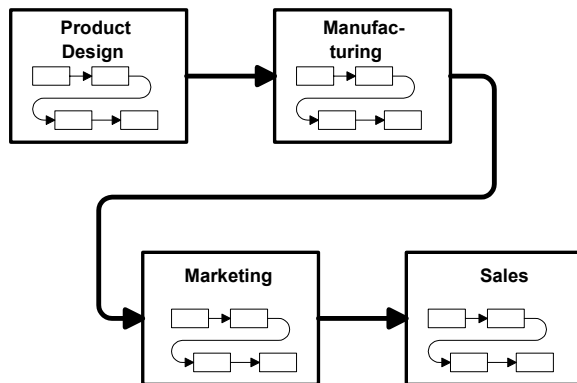
Figure X-1: Serial product development involves successive development (Ottosson 1999-B).

Initially, the serial development was mainly motivated by the need to take advantage of technological progress. Technological development came first, followed by production and market development. The method involves waiting times between the active phases of the process. Furthermore, as it does not facilitate collaboration between various departments, it can lead to delays and expensive product modifications at the end of the development chain when communication is poor.

The serial method has a long history, and many companies have based their operational structure on the system, which can make it difficult to implement new product development strategies when circumstances change. Many small and medium sized enterprises – SMEs - still adhere to the serial product development principles.

X.3 Parallel Product Development

Parallel product development methods are called parallel because there is a more or less simultaneous start of activities in all involved functional departments of the company. The work within each department, however, is not performed in parallel, which would have required e.g. concept development performed in parallel with design, but is still performed in a serial fashion and separated by few decision points often called gates, tollgates, and milestones.

Simultaneous Engineering (SE)

In an effort to increase the speed of product development during the 1970s and 1980s, the industry began to question the long development time inherent in the serial development approach. To overcome that problem, the automotive industry developed a new methodology called Simultaneous Engineering – SE (e.g. Carlsson 1996). Simultaneous in this context means that engineering design and process development are performed in parallel with separate starts for each activity, forming a waterfall pattern.

The principles and protocols of SE are adequately described in the Advanced Product Quality Planning and Control Planning (APQP 1994) manual, which was adopted in 1994 by the automotive giants Ford, Chrysler and General Motors. The Japanese automotive industry developed a similar model usually known as "lean product development" (see figure X-2). As can be seen, different activities are introduced on a step-by-step basis, producing a "waterfall" start, in contrast to CE, where all activities start at the same time (see next section).
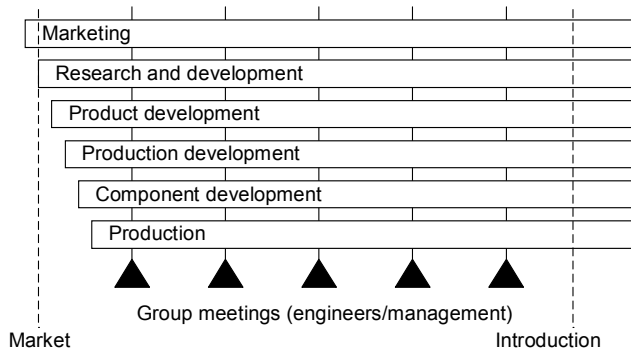
Figure X-2 Nissan's development strategy in the 1980's (Graves 1987)

Concurrent Engineering (CE)

The term Concurrent Engineering was coined 1988 by the US Institute for Defence Analysis (see figure X-3). Their definition was: "Concurrent Engineering as a market-oriented and systematic method for integrated and simultaneous development of products and their accompanying processes, including sub-contracting, manufacture, maintenance and customer support. This method is intended to motivate designers and other team members to optimise all elements in the product lifecycle - from delivery to scrapping - including user requirements, quality, time aspects and costs". Since 1990s, the term Concurrent Engineering - CE has been more commonly used to describe simultaneous product development carried out by integrated teams.
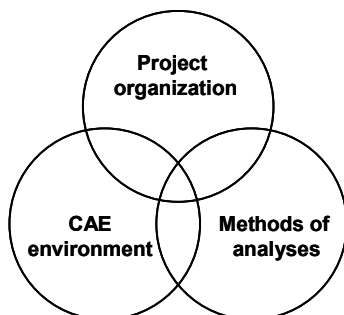
Figure X-3: The original three parts of CE

With project organization (team) was meant that one puts together team members from different departments to form integrated teams.

With CAE (Computer Aided Engineering) environment was meant that one shall use the possibilities the computers provide leaving the manual environment that was dominant at that time. A popular saying was that "Throw out the drawing boards."

With Methods of Analysis was meant to use methods such as QFD (Quality Function Deployment), FMEA (Failure mode Analyses), JIT (Just in Time), TQM (Total Quality Management), and DFMA (Design for Manufacturing and Assembly).

Integrated Product Development (IPD)

When SE/CE is combined with marketing development, the term Integrated Product Development – IPD - is applied (Andreasen 2002). Unfortunately, the definition and the understanding of IPD differ between countries and between researchers, a fact that the IPD workshops held in Magdeburg in Germany every second year have revealed.

The inventor of the term IPD appears to have been Professor Freddy Olsson at Lund University in Sweden. For the public he presented 1985 a model of parallel development, as shown in figure X-4. His model has a 'need' as the starting point of the development process.
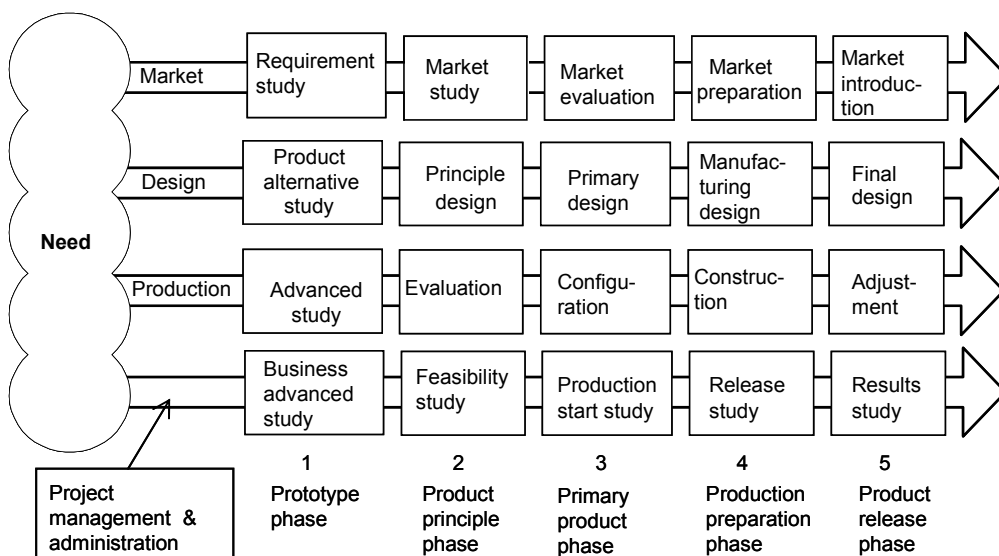

Figure X-4: Freddy Olsson's IPD model (1985)

The reason Olsson selected the name "Integrated Product Development" was that "Integrated teams" should be made up of people from all the four "branches" shown in figure X-4. Today this may seem quite natural but in 1985 such ideas were somewhat radical. The use of "Integrated teams" is however long established in the military world. The first to use "Integrated Army Corps" is said to have been Napoleon, who formed teams of infantry and cavalry (Smedberg 1994).

175

The model shown in figure X-4 was introduced by Olsson for Halmstad University as the basis for a possible new program when the university campus of Lund University was founded in 1985. At Lund University, the principles were considered too radical to be implemented at that time. The response in Halmstad was, however, positive and the Innovation Management Program began using this model as a concept for education (Olsson 1992).

A modified IPD model described by Andreasen & Hein (1987), shown in figure X-5, has become better known internationally than Olsson's model. As for the original, this IPD model is also based on "needs". The model is designed to describe an effective work method in which various activities are carried out simultaneously preferably in big and middle sized enterprises.
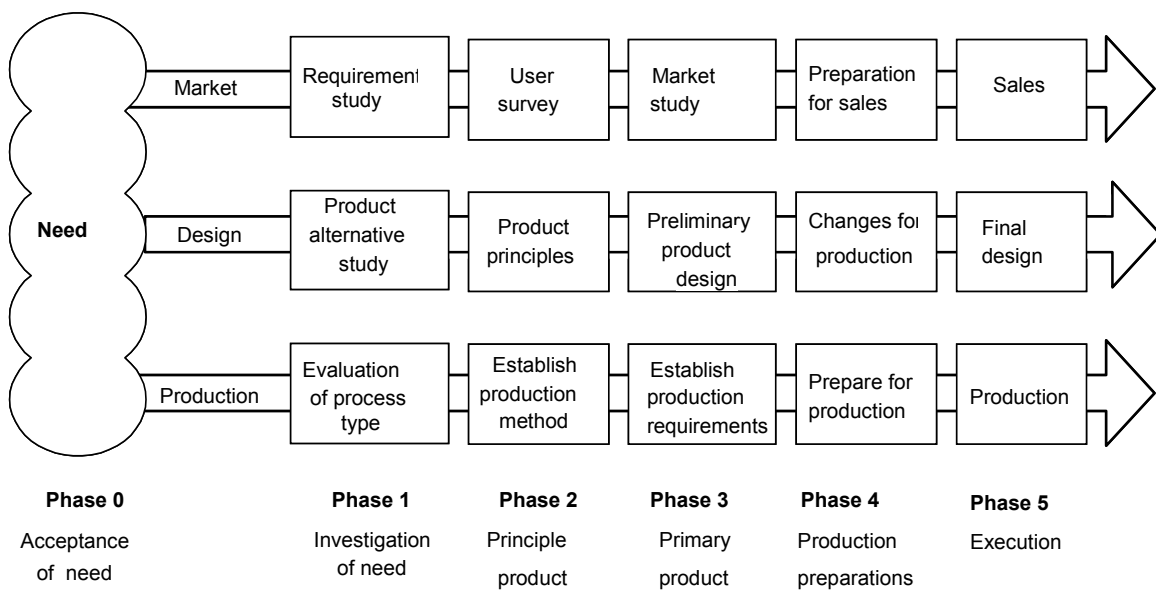
Figure X-5: Andreasen & Hein's IPD model (1987)

Between the phases in figure X-4 and X-5 there are decision points although not explicitly outspoken. Some people regard these decision points as gates in the Stage-Gate® method shortly described below.

When CAE developed rapidly from the 1980th Design and Production in figure X-5 in reality became equal to CE/SE and at the IPD conference in Magdeburg in Germany 2002 professor Andreasen gave his view that IPD is equal to CE/SE plus market development. To note is that IPD including CE/SE has a customer need as starting point. To find out this 'need' usually QFD (Quality Function Deployment) is recommended.

The euphoria about the possibilities with computer based systems that seems to have been the base for CE/SE gradually weakened in the early 1990's and 1996 professor Harald Meerkamm at the IPD Workshop in Magdeburg in Germany presented a model that more highlighted the importance of the product developers (figure X-6). He also connected different DfX tools to the mental process of the developers as well as DfX in his view was the heart of Methods.
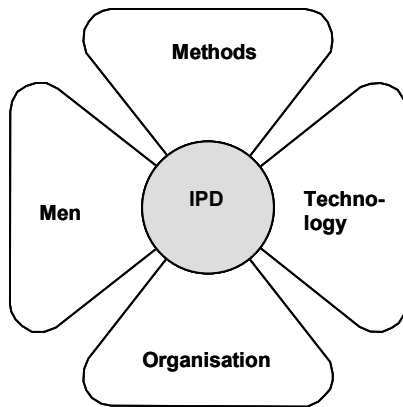
Figure X-6: The IPD model of professor Harald Meerkamm from 1996

Professor Sándor Vajna however felt that importance of men should be strengthen even more and proposed a model of IPD as is shown in figure X-7. The definition of IPD he proposed also shows that not only CAE methods but also manual methods are needed to develop products that fulfill different demands (Vajna & Burchardt 1998):

> *The Integrated Product Development (IPD) is a human-centered procedure of developing competitive products or services of high quality, within a reasonable amount of time, and with an excellent price-performance ratio.*

> *IPD describes the integrated application of holistic and multidisciplinary methods, organization forms, and both manual and computer-supported tools with minimized and sustainable use of production factors and resources*
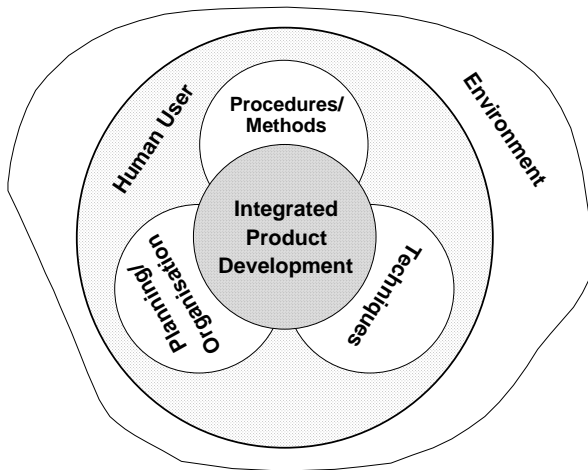
Figure X-7: The dynamic IPD model (Vajna & Burchardt 1998)

Stage-Gate® methods

Based on quantitative studies that started in the 1970's Cooper and his colleges have designed a simple stage-and-gate process known as Stage-Gate® (see figure X-8). This process, it is claimed, had been adopted by more than 73% of North American companies in 2006, making Stage-Gate® the dominant product development method, according to information found at http://www.prod-dev.com/.
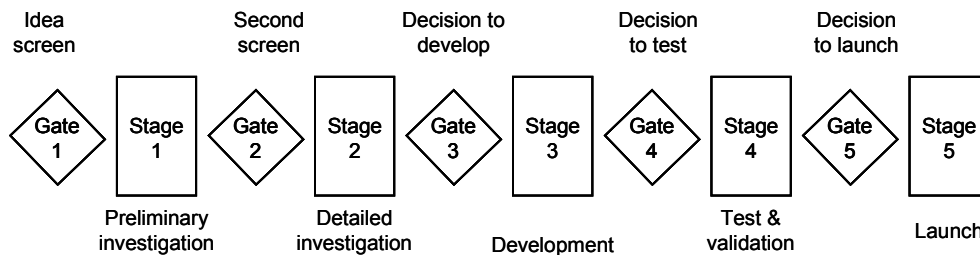

Figure X-8: The generic 5-stage Stage-Gate® model by Cooper (1994).

The method does not tell what to do in the stages and at the gates means that the development process is slowed down. Worst of all is that the model encourages the 'killing' of new product development instead of enhancing it. A citation of the words of Frederick D. Buggie (2002) nicely points at this:

> "The measure of the value of a Stage-Gate process is how early it can kill a new product candidate. The worst case occurs when the new product gets all the way through and is introduced but then flops, for one reason or other. The biggest savings result from killing the product prior to the latest stages. It would be nice to avoid wasting the investment in the mid-stages (that's real money); best of all, abort the new product concept in the beginning and save all that money!

> The Stage-Gate cross-functional review committee is typically well-staffed to do the job of killing any proposed new product, from the standpoint of production, marketing, finance and technology"

To understand the problems with the Stage-Gate® model a simple example is needed. In this example first a thought development curve to reach a certain quality or performance is drawn. Next control gates are distributed over the thought development time. Also a similar accumulated cost curve is drawn (see figure X-9). However – as was shown in figure 7-11, in real development work the smooth curves are not possible to reach. Therefore 'Kill' decisions based on slower development and/or higher accumulated costs will stop even good projects, as the figure shows. In this case the overdrawn time and costs for a completed development process are in the region of 20 %, which is a figure normally seen as a good result.
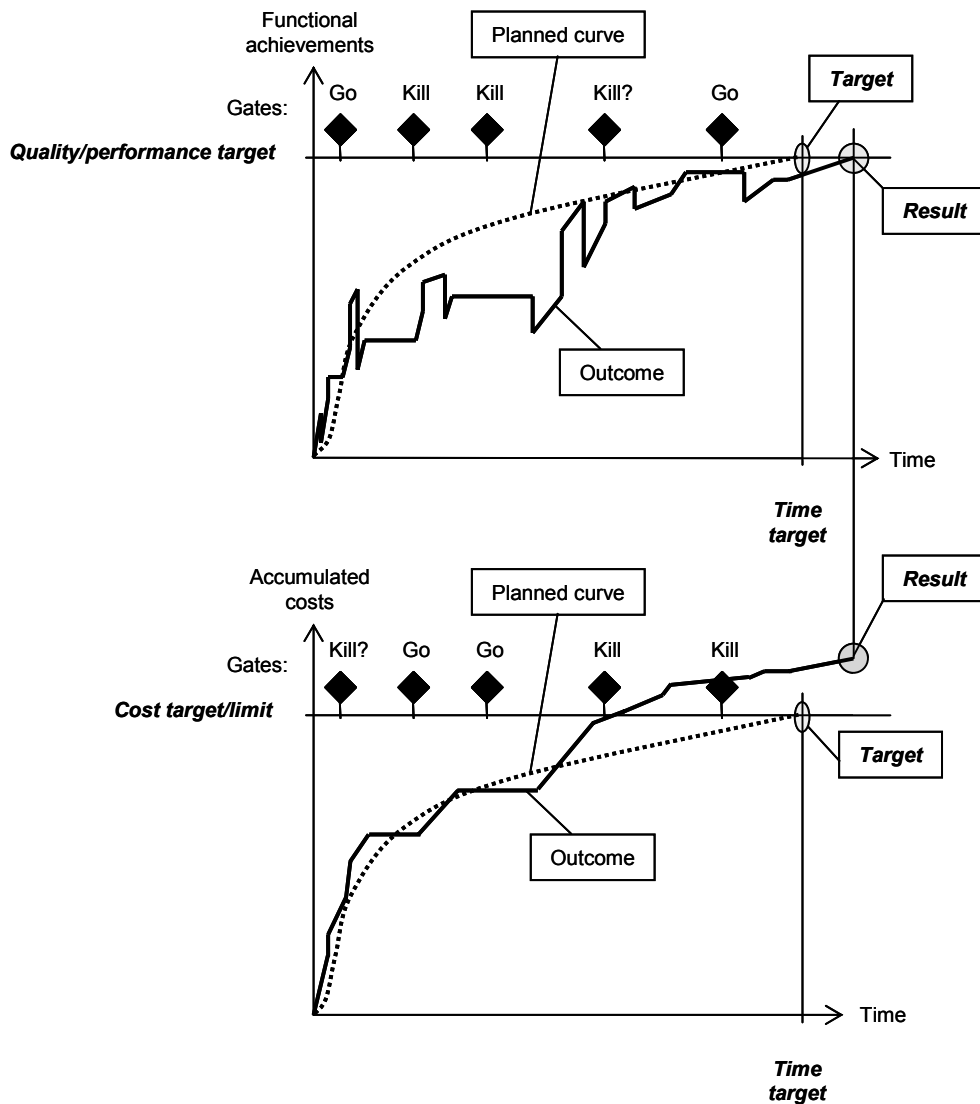
Figure X-9: En example of when a good project with the Stage-Gate® method should have been stopped at all gates except possibly for the first gate

## *Dynamic Integrated Product Development (D-IPD)*

In the student project works done at University of Magdeburg in Germany using the IPD models, gradually a more dynamic execution developed in much the same way as DPD developed from the experiences at Halmstad University in Sweden (see next section). The Dynamic IPD model looks as is shown in figure X-10. This model is useful for need-based product development and should be a natural alternative to investigate for larger companies having problems with their Stage-Gate® models.
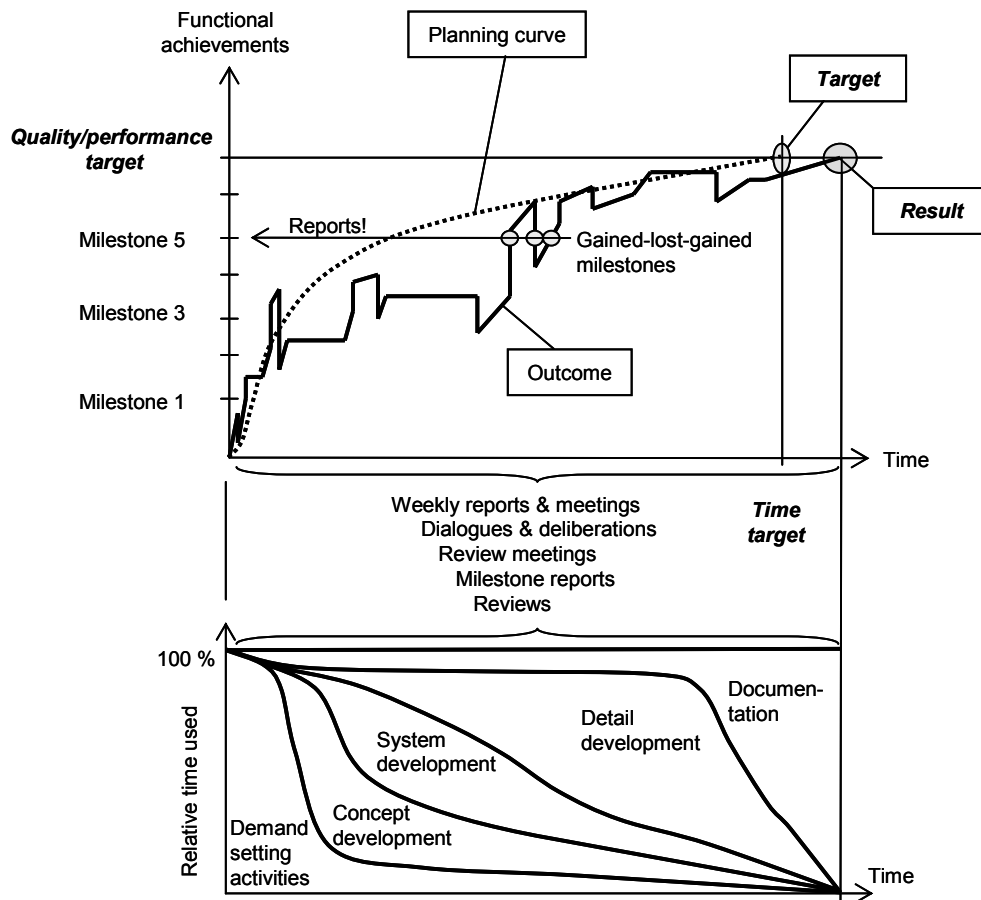
Figure X-10: The Dynamic IPD model developed at University of Magdeburg for the technical development of products (Ottosson et al 2006)

Note that reports are to be given from the project when defined 'Milestones' are gained as well as when they are lost and re-gained again. No static gates are used. Instead different methods are used for management to be well informed at all times and to be able to influence the development. As is seen the concept as well as the other activities can be changed all the way until the development project is finished which means a dynamic way of working as for DPD.

The whole chain from the original IPD model by Freddy Olsson 1985 to the Dynamic IPD model is shown in figure X-11.
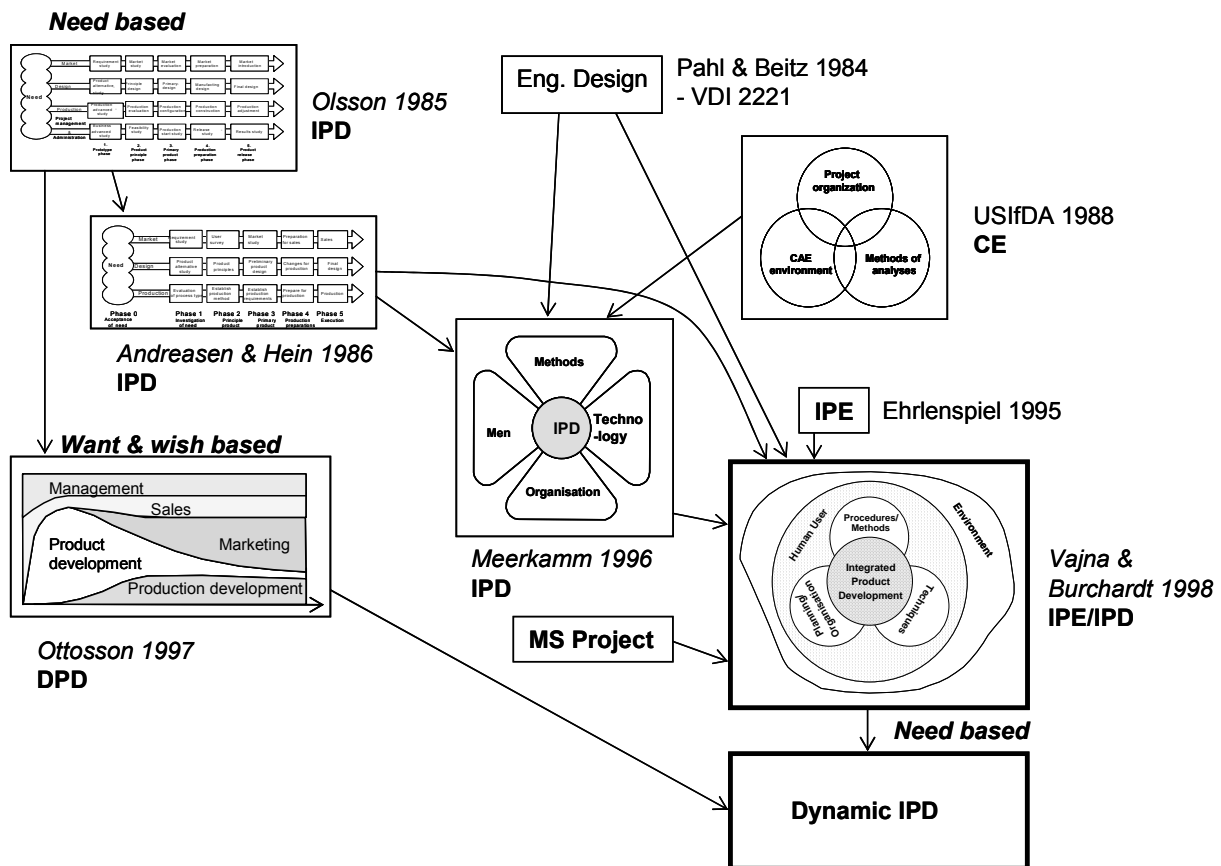
Figure X-11: A study of how the development of the IPD model from a serial to a dynamic model has largely taken part from 1985 to 2006 (Ottosson et al 2006)

X.4 Collaborative Product Development (CPD)

Since the end of 1990s, particularly in the automotive industry, a lot of effort has been focused on connecting geographically separated computers in the development area with the help of ICT - Information and Communication Technology. As a result, the term Collaborative Product Development – CPD – was created, which can be seen as an extension of CE. However, as computers are still incapable of abstract or concrete reasoning and as their creativity, if any, is inferior to that of human beings, computer based development is useful for parametric design providing the innovative design that has been performed in advance.

On the other hand, much has been written about the perceived advantages of collaboration. In addition, a great deal of attention has been devoted to the benefits that information and communication technology (ICT) can offer collaborative product development between geographically dispersed locations. However, collaboration management is highly complex, and so far little is known about the problems encountered by those managing the collaboration between client and suppliers in the product development area (Wognum et al 2002). Companies have realized that ICT cannot replace personal meetings (face-to-face communication). It merely offers increased possibilities for fast exchange of information. So far research

has shown that more than 50 % of collaborative efforts are unsuccessful (Littler et al. 1995, Wognum et al 2002).

X.5 The development of DPD

It has been noted in the scientific field that the common product development methods can not handle the problems of frequent time and cost overdrafts in industrial development projects. It has also been revealed that existing and recommended product development models are rarely used in practice (Bragd 2002, Andreasen 2003, Jönsson 2004).

In 1995, after several years of industrial experience the author, at that time professor at Halmstad University, started to improve the Olsson IPD model. The intention was to shorten the development time in industrial product development projects carried out by students using a new mind set and by doing things differently from the opinions on how IPD should be done. The initial student tests were promising and the development of the model continued, resulting in a shift from the basic IPD principles used to the new way of working. The new method from 1996 was given the name Dynamic Product Development (DPD). Since then much testing and research has been done, which the reference list may indicate. Although in general it is difficult to compare development principles, figure X-9 shows a comparison study between Stage-Gate® and DPD for the development of a web portal. As seen the Time to Sales was 3 week instead of 30 week for DPD compared to Stage-Gate® (or 10 %). Time to Market was 10 weeks instead of 30 weeks (33 %) for DPD compared to Stage-Gate®. Customer and user satisfaction was also felt to be much higher for DPD although that is difficult to measure. However, the customer decided to use the solution developed with the DPD method instead of the solution developed with the Stage-Gate® method. For the development of an elevator (a mechatronic product) we have seen even larger differences (Ottosson 1996).
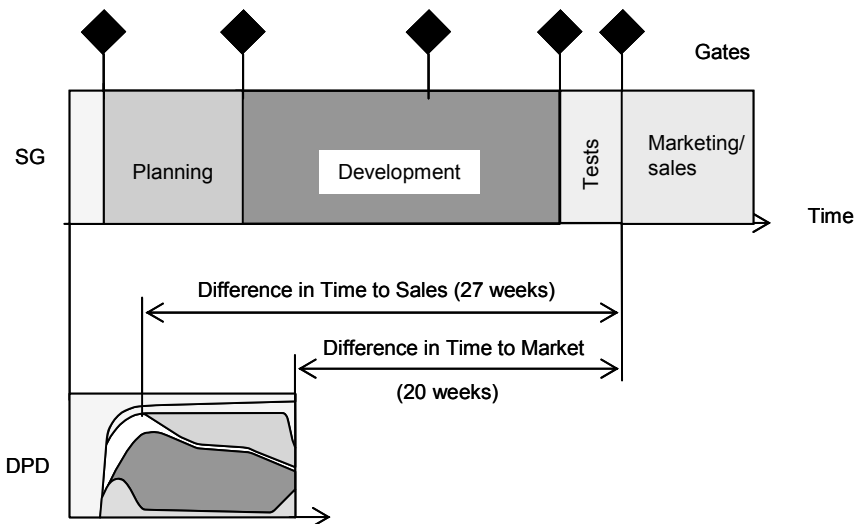
Figure X-9: A comparing study between Stage-Gate® (the upper process) and DPD (the lower process) on a soft-ware development project (Ottosson 2004-D)