

# **Handbook in Innovation Management**

**- Dynamic Business & Product  
Development**

By

Stig Ottosson

*“He who ponders too long over the next step will be  
left standing on one leg for the rest of his life”*

Chinese proverb

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# **Handbook in Innovation Management - Dynamic Business & Product Development**

This handbook does not contain examples. Separately, however, the author can be engaged for speeches, seminars, and coaching missions at which he will share his more than 30 years of practical experiences of 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.

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# 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, and still for some 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 complicates life. However, if *innovation* is seen as a noun it becomes easy to handle the term as the act of developing an idea to be a new business then can be called an *innovation process* done as an *innovation project*. In this book we therefore with an innovation 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, the result will be a stationary state. The hero of his story was the *entrepreneur*, who disturbs the equilibrium and thereby causes economic development. Today it is commonly accepted that without innovative activities the development in individual companies and the whole of the society will stop. Therefore it is important that many 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 our practical experiences the author is convinced that “the most efficient way” is using

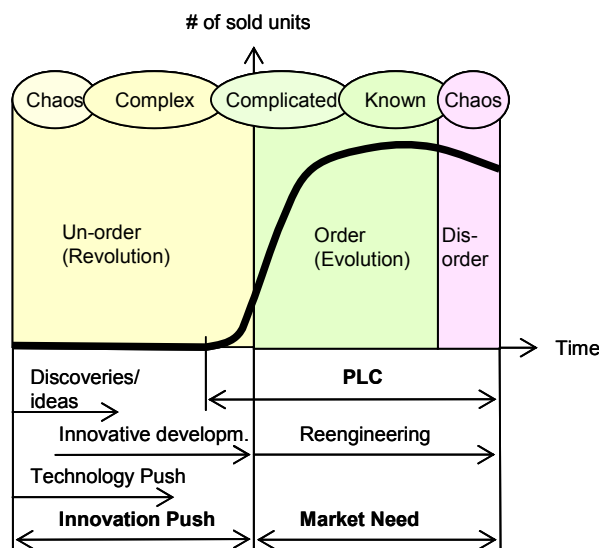
dynamic principles why the dynamic view is the guiding principle in the book.

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

The scientific origin of the dynamic theory dates back to 1995 although entrepreneurs all time have been dynamic to manage to be successful. The dynamic theory in turn is based both on dynamic industrial innovation experiences since the 1980<sup>th</sup> in as well large companies as 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 successively can be transformed in standard products sold on one or many 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 it has been accepted by the market one is initially in a positive chaotic situation followed by a complex situation meaning 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 to a known situation. When the sales of the product starts to slow down one can get into the “disordered domain” when different opinions exist on what to do meaning an increased negative chaotic situation. This negative chaotic situation will also arrive in the recovery period, which we will come back to, as well as every time when sales drops radically. To avoid the negative chaos to be too deep it is important to early have started up new businesses that successively can 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 the



selling of it

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

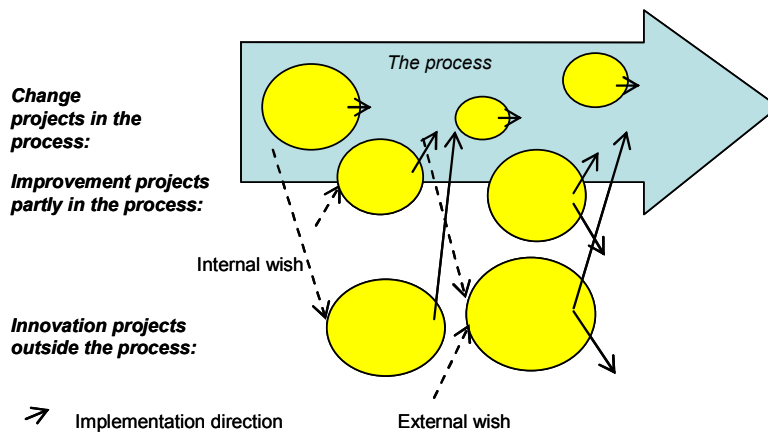
	Innovation project		Standard business process		
	Un-order (emergent order)		Order		Dis-order
Reality	Positive chaos	Complex	Complicated	Known	Negative chaos
Cause & effect (C&E)	No C&E relationships perceivable	C&E are only coherent in retrospect	C&E separated over time and space	C&E relations repeatable, 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 *technology push*. The origin of a new product can also be 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 secure that the market need for the products is cultivated as long as the products are not regarded old-fashioned by the market. Reengineering is in general easy to plan and can return on investments be calculated, which often is opposite to the situation when innovative development is done. The PLC varies from about 6 months for games to 20 or more years for some mechanical products (Ottosson 1998).

When the *innovation push* has resulted in that the sales takes off and a *market need* has been established, it is important in the production process to develop and follow strict rules, 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 - as new product development, production development, and new business development - the project organization is feasible “drawing up the map”. For repetitive work as mass production, the process organization is feasible for “following the map”. The tricky thing, is how and when to integrate an innovation into the process of a company while it is natural how to integrate the result of a change project into the process. For innovations sometimes the business will be better off in an own company instead of trying to get it 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?

Common for the conventional methods is that they deal with the known domain in figure 1-2 meaning 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<sup>th</sup> 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).

<b>Development Project Type</b>	<b>1990</b>	<b>2004</b>	<b>% Change from 1990</b>
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
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>	

**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 also that the product development impact and profitability are decreasing the more they use the conventional methods. According to a large study (Adams & Boike 2005) 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 thus seems as it is high time to turn to dynamic principles if more new successful innovations shall 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 than 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 still is not 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).

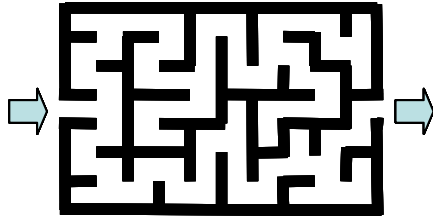
When a want situation arises one in general has some time to develop a solution, which also is needed as the possibility to copy already existing solutions or parts of solutions is much lesser for want situations than for need situations. Instead of re-engineering as the most common situation a want situation means 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 for the project.

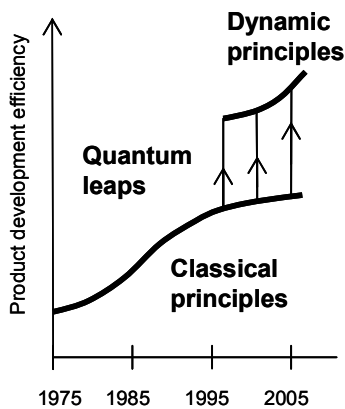
## **1.6 Walking through the labyrinth**

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 again and try another path 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 (see Appendix) 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.

## 2. TERMS USED IN THE BOOK

As there are no standards for terms used in product and innovation development, some 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 here 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 here called an *innovation process*.

For a new product to be an *innovation* it must have been sold at least to one customer (Ottoosson 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* (Ottoosson 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 (Ottoosson 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) (Ottoosson 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

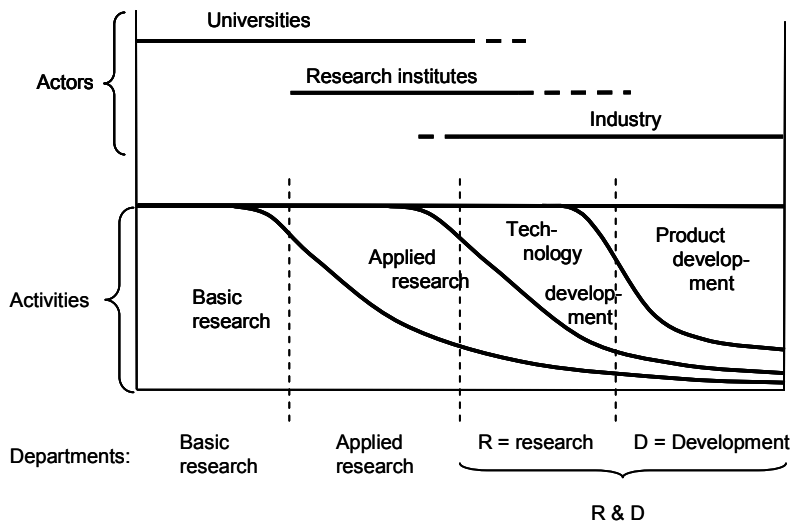
**Table 2-1:** Levels of novelty in investigated patents during the 1970<sup>th</sup> and 1980<sup>th</sup> (Altshuller 1988)

Level one	Routine design problems solved by methods well known within the specialty. No invention needed. About 32% of the solutions fell into this level.
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 level.
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 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.

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 in general 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 technology 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. Technology 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 technology 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 aim to make products that can be sold while technology development does not have that aim. Research and development is often abbreviated



R&D.

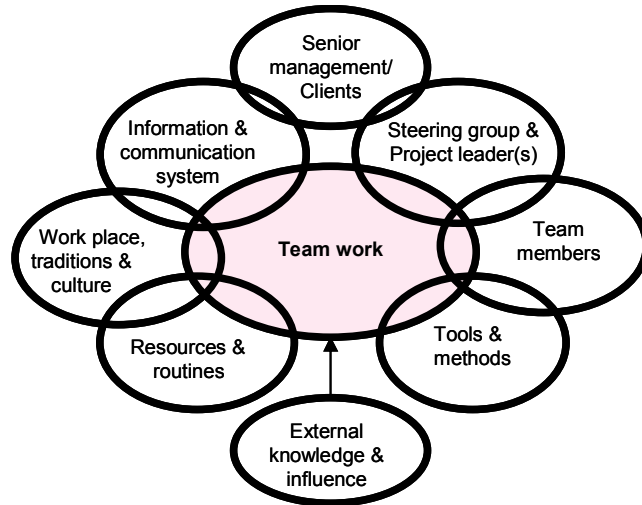
**Figure 2-1:** Actors and activities in product development related fields



### 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.

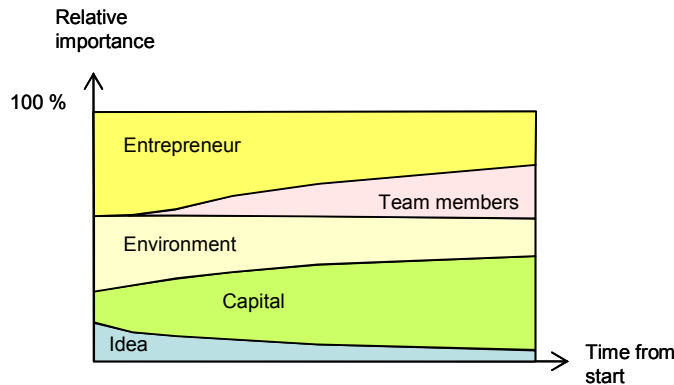


**Figure 3-1:** All projects are dependent on many factors that in turn are time dependent, making them truly complex (Ottosson 2005)

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 right products, the success will come. 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 build up IKEA to the enormous success it today is giving him a private richness that is enormous. The same counts for Bill Gates and Microsoft. Surely the business plans they started with are not the business plans that came to be the success stories.

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 little and decreasing from when the innovation project has started. Often it only is 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 look for that the business will be 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 for the 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. If no formal leader is appointed self organization will occur and can e.g. the leadership be “jumping” between team members depending on situation and time.

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

- *Laissezfaire (free) leadership:* This type of leadership means that the team members have to organize themselves to be able to make the work. After some time in general an informal leader will 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 Laissezfaire leadership if the managers on each level have more than about ten subordinates. That 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 go well together and no one takes a 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 in general without first hearing the views of the subordinates. As orders

are going downwards and information going upwards in one direction 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 contacts with each other. The ultimate situation for the authoritarian leader is to exchange people with robots that will not cause emotional problems and that will not do things in other ways than what the leader has ordered. The security of the team members is dependent of 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 the leader can try to increase the respect for her/him by making one (or more) of the team members to be a scapegoat or a butt. An introvert “*I-feeling*” becomes dominant in the hierarchic structure formed by this type of leadership.

- *Group oriented leadership*: The leader has in that 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 from the position as leader but has chosen another way to get things done as she/he is convinced that the result will be faster reached and better with less energy consuming conflicts if the subordinates can influence the work and are demanded to take own responsibility for their contributions. Therefore the leader starts dialogues about how to solve principal problems and to find out which directions to take in a crossing. The decisions are in general taken in consensus in a rather democratic way. Doing so the team members will understand why a certain decision is taken and will they thereby be positively motivated. Team members being encouraged to have cross contacts with each others supports the group oriented leadership and will a “*we-feeling*” develop in the team.

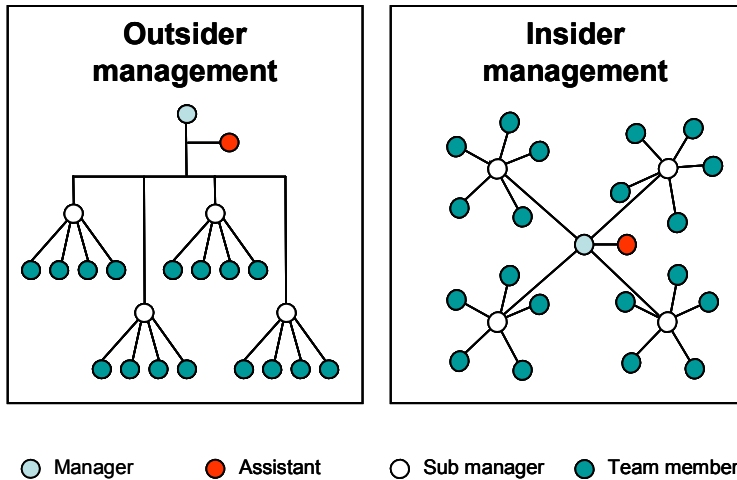
The three types of leadership executed by a leader are symbolized by:

- 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 do. Thus in this case the leader has no interest in looking into the box influencing the work being done there. When she/he makes controls in the box at “gates” or “tollgates” or “milestones” in advance set, 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 giving feed-back on what the leader experiences means a situation when she/he knows what is going on and better can guide the project to a happy end.

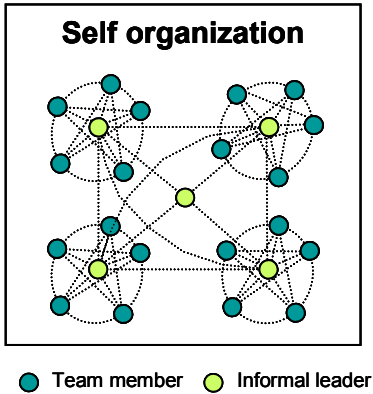
The true commonly used line organization has as base an authoritarian leadership. The softest management – an outsider management - is used when the manager only

occasionally meets with her/his subordinates and they thereby only get the hard pressure on them at these moments. When the manager is in the middle of the activities (insider management) most of the time that means a hard pressure if the manager is dictatorial. This approach is tough as the subordinates in that case can not escape the manager. Figure 3-3 shows the two management situations.



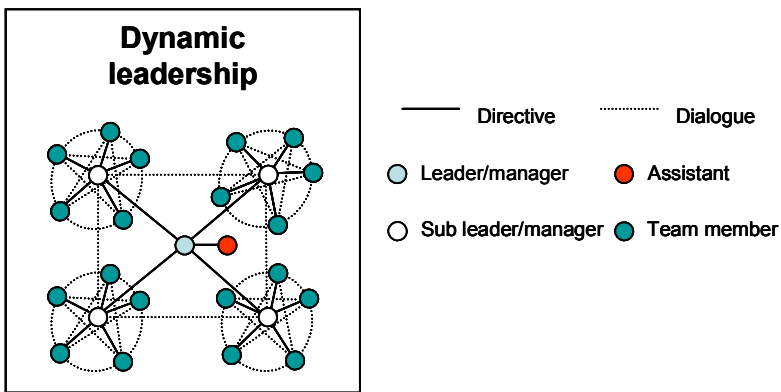
**Figure 3-3:** The traditional line organization means a softer management than insider management shown in the right figure

The Laissezfaire 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 Laissezfaire leadership will be. That as the leader will have few possibilities to maintain a 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 turn to an authoritarian leadership. At the same time the possibilities increase that someone(s) in the group will step forward to become informal leader(s) to fill out the emptiness that will occur when the formally appointed leader or manager only can maintain sporadic contacts with her/his subordinates. The informal leaders can in bad cases be very dictatorial as their mental power over the group will be larger than what a formal leader normally can build up if she/he does not start to use punishment as a method to build up fear and un-security among the team members.



**Figure 3-4:** When no formal manager is appointed self organization will occur meaning dialogues between the team members to solve the problems in an efficient way

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 of obvious reasons. However, in critical situations – when a negative chaos situation has occurred or is emerging - an occasional authoritarian leadership can be needed to avoid chaos or to soon 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 in the figure mentioned “Dialogue” 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:** Performing a 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:

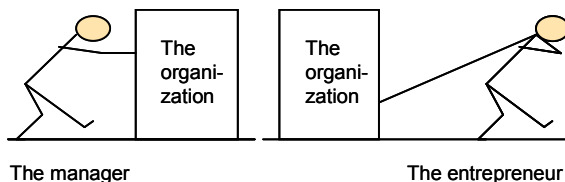
- communicate a clear vision of the goal with the project,
- engage suitable sub-project leaders and to let them engage their people,
- draw up strategies and targets as well as to give guidelines for the work,

- break down the work and distribute work packages to groups and individuals,
- look for that the team members work toward close and distant goals,
- notice and reward good work both on an emotional and a 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 early notice when things are not going well and when dangerous attitudes start to emerge. She/he can in such cases immediately or soon initiate changes for the work in a desirable direction and can through dialogues gradually change attitudes in the group. Such changes demand pedagogical skills, patience and persistence. The deeper an unwanted attitude has spread, the more time the leader has to spend with the team members to secure that a sustainable change will take place.

When the work runs satisfactory, the leader must spend time to secure that the project is up-to-date. Therefore, project leaders must always strive to be a few steps ahead of the work being done in the projects. As a consequence, the project leaders – and especially entrepreneurs - must be very mobile to be able to be in frequent contacts also with the customers, society, researchers, experts and other important external people without losing the contact with the people working in the project. By using MBWA, project leaders will know the real status of the projects long before written or oral reports will reach them. Thus, dynamic project leaders are moving back and forth between being in the middle of the project work to be on 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 that is 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. Important is also 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 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 on, has shown to be a good complement as not everybody is reading Internet or Intranet information.



**Figure 3-6:** A bureaucratic/administrative project manager pushes the organization mostly in

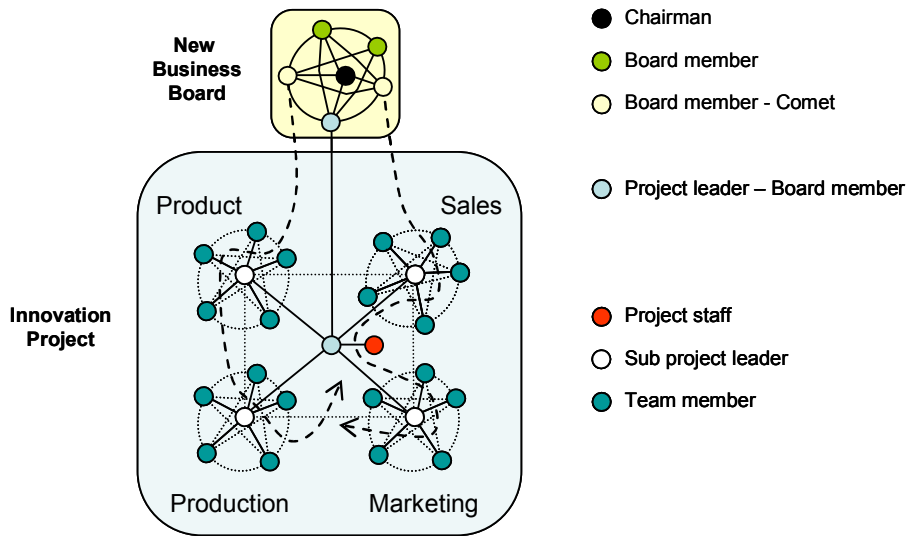
a reactive way. A dynamic (entrepreneurial) project leader pulls the organization in an active way

Research on leadership since the 1980<sup>th</sup> has dealt much with change and 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 leaders 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 leaders as project leaders. That is surely one reason why so many projects are not successful. Also it is common that planning projects are not being transformed in performance projects, when that was the aim of the total project.

### **3.3 Innovation project organizations**

Except for when an individual starts a project on her/his own a *Steering Group* is normally set up which will be responsible for appointing the project leader, for financing the project and for the outcome of the project.

When a dynamic view is used the responsible Steering group can be called *New Business Board* as that name clearly tells what the aim is – not just to make a successful innovation but to form a new business with a life also 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 of the project. To secure direct and undisturbed 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 experiences from commercialization of new products and one board member with experiences of new product development will act as “*Comets*” in the project (see figure 3-7) to support the project leader and to secure that the Board members have the right information to make critical decisions on when that is needed. An important mission for the comets is also to give suggestions built on their experiences and to, in a narrative way, improve knowledge of the team members. In addition the comets will help to find out when “enough” good levels have been reached in the development, which is a problem for un-experienced team members and team members with low self confidence.



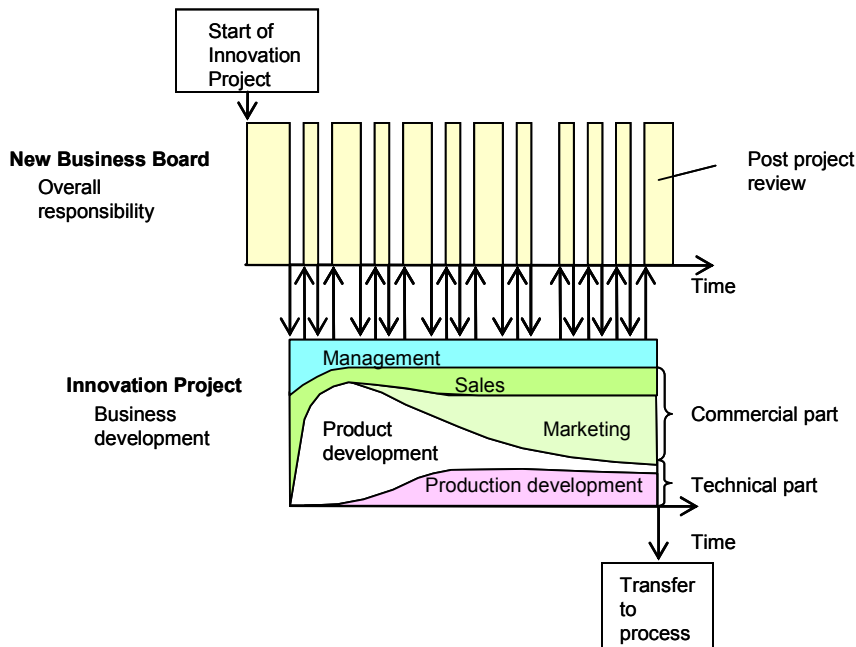
**Figure 3-7:** The New Business Board is an insider board of the Innovation Project (c.f. fig. 3-5)

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 needs to have the information instead of only going upwards 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 largely is 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 for a long time in a wrong direction when problems occur or when other competing better solutions have been experienced. This as 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 company ordinary activities as a business group or when it is being established as an own company (c.f. figure 1-2) the activities in the New Business Board and the Innovation Project following the dynamic approach in principle are 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 represents on the vertical axes 100 % work hours for each week.)



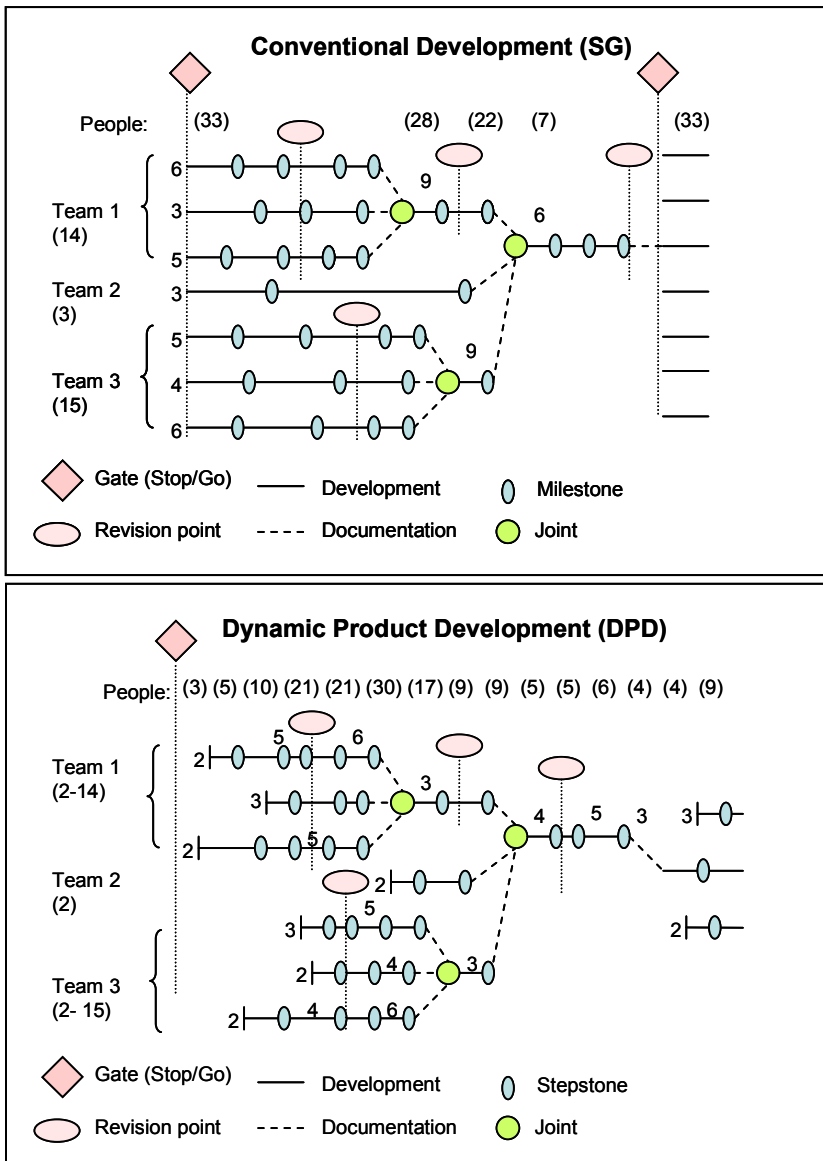


**Figure 3-8:** Between the New Business Board and the Innovation Project there must be a close connection to reduce failure risks

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 (see Appendix). 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 done.

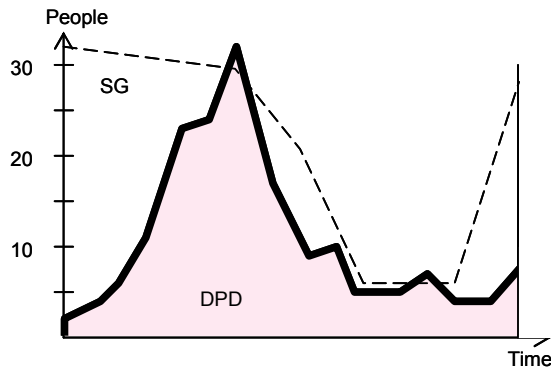
Figure 3-8 also indicates that a minimum staff for each activity shall be used – which at the start of each activity means only the sub-project leaders. When the product development (PD) needs more manpower the PD team is expanded with more people. When less people are needed the team is reduced always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

A simultaneous start – a kick off - with all people needed for the next development step means a slow and costly start. This as it will take time to bring all the team members to the same understanding level before they can start to work in an efficient way. Instead adding people when that is needed and starting every new work sequence with few highly 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 is seen.



**Figure 3-9:** For Conventional Development more team members are needed than from Dynamic Product Development (see also figure 3-10)

[Stepstones in DPD are like stones in turbulent water in a creak that can be used to jumped 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 stepstones.]



**Figure 3-10:** The two different ways of performing product development in figure 3-9 means different use of manpower for reaching the same goal

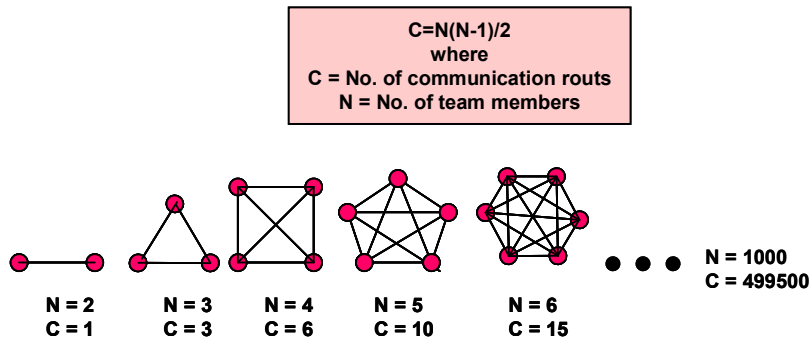
### 3.4 Project sizes

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. Big organizations and large numbers are also fascinating for researchers and management consultants as such organizations stands for much 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 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 that small changes are the origin of early exponential development until a critical mass has been reached when it is difficult or impossible to calm down the situation.

However, findings from large and gigantic projects are that sub-projects of no more than 6-10 team members are the most efficient teams (e.g. Cusamo 1997). That is also in accordance with our experiences. To have in mind therefore is that the efficiency seems to decrease rapidly when more members are added above 5 – 10 team members for each sub-project. That as the communication becomes difficult when the number of communication routs between the team members increase when new team members are added to a team.

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.



**Figure 3-11:** The number of communication routs depending on the number of team members

Thus, the number of communication routs grow with the square of the number of team members. Due to this formula and due to practical experiences, it therefore is important to break down projects and sub-projects with many team members in 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. Responsible for the break down work must be the project leader and the sub-project leaders respectively.

It is clear that the efficiency factor between people can be quite large although they have the same education. At Microsoft one has e.g. estimated the difference in productivity between the “best” software programmers and averaged 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 averaged team members as the number of communication routs grow so fast.

Thus it is defendable to use one highly 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. This as ten not so productive programmers have to communicate more to be able to fulfill the task according to the communication formula. More needed communication means that it will take longer time 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 a 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 that has a suitable personality profile for the mission both when things are running well and when unforeseen problems will show up – which they tend to do in development projects. The view of life, and the competence (knowledge and experience) are other important factors to take in consideration.

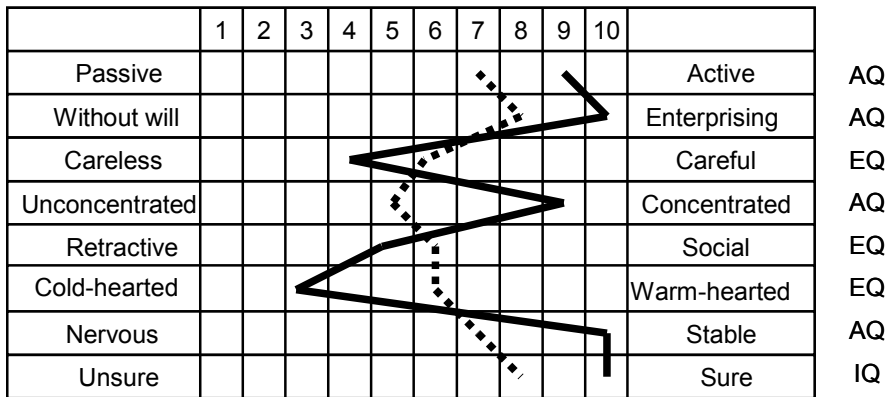
Very important is that the project leader is allowed to choose her/his closest subordinates her/himself. The same principle should be the rule for their recruiting of people. Having that recruiting principle means that the personal “chemistry” will work well from the start of the project as none will choose someone who is difficult to work with or have a low efficiency in the work. The successively coming people to the project will be planned for so that they soon can start to work.

Unfortunately, it is often common that the human relations (HR) staff in an organization appoint project members and supply the project leader with them. In severe cases the project leader is even appointed after the project team has been appointed. An extremely inefficient start will be the result of such a manning principle and will a difficult psychological situation be the case when all the people have to find out how the other team members act, think, and behave. Territory will be marked and will the efficient work be low for a long time. To reach full efficiency of a simultaneously starting team can take months even if they are localized together and have no other work to do then the project work.

When a team is to be set up, the different personalities that each team member have 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 wanted 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 for her/his work it does not help much to have the best soft values in the world. Knowledge will therefore be discussed in next section.

How well two or more people will interact is dependent of 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 that exist in the world, or forming a soccer team with the best players, doesn’t mean that a success will be the result. Also it is important to match people with different profiles instead of matching people with similar personalities and knowledge.

A complication is that the personality is not constant over time but will change depending on situation and the people the individual is in contact with. Thus in an unpressed situation everyone has one type of behaviour while we being stressed or threatened, will behave in another way. Figure 3-12 shows an example of one player from two tests on soccer players that we have performed during 2002. In that case the coach decided on which profiles that were more important.



**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 is centers of gravity what regards 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 the own knowledge. Discussions about the term *knowledge* have been a philosophical topic for the last 25 centuries. Already Greek philosophers (e.g. Aristotle/Socrates and Platon) discussed knowledge as:

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

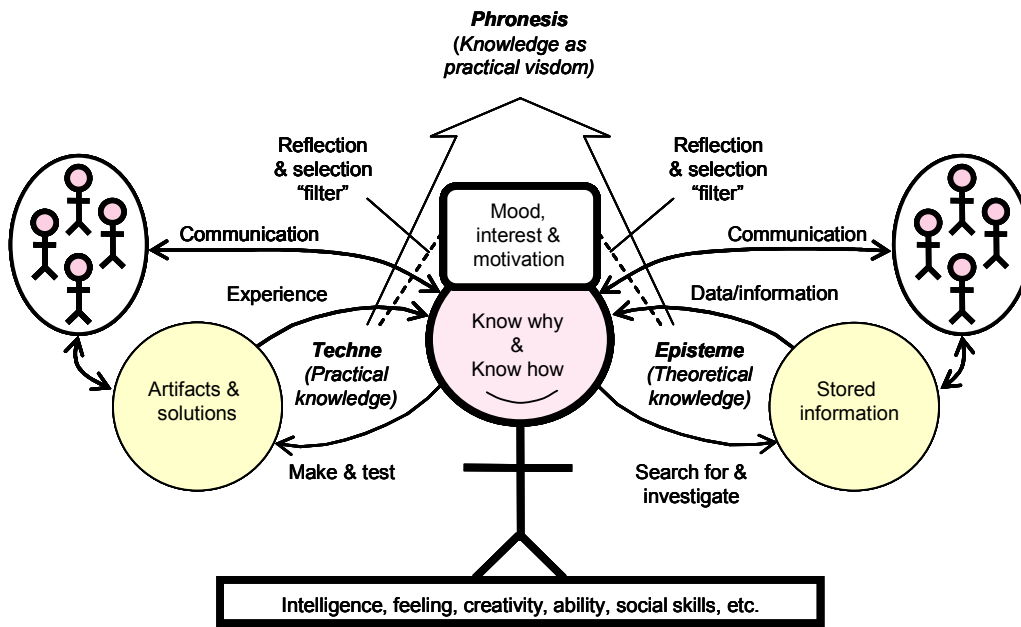
The meaning of Techne and Episteme is rather obvious to us as e.g. that is how we have separated the university system from the practical world. When people speak about *Competence* they usually mean a combination of Techne and Episteme.

Fronesis is a more difficult term as it grows when both 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 is 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 our earlier in our brains stored pictures

(Wheatley & Kellner-Rogers 1999).

The personal ability to increase the individual knowledge is dependent of many factors as e.g. the own intelligence, creativity, ability and feelings in general. The ability to take in information and signals and to combine them with the own so far accumulated know-why and know-how to new knowledge, is dependent e.g. of the mood, interest and motivation in each moment. This can be called a filtering effect. Being in good mood, having a large interest and being motivated means that the own filters are open to take in most information and a maximum of all incoming signals. Not being in good mood, being uninterested and being unmotivated means that no or very little information and few signals will be able to add to the own existing knowledge and know-how. Figure 3-13 shows the complex reality in a simplified



way.

**Figure 3-13:** The individual know-why 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 the own knowledge is to collect and process information from other people through the 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 be rapidly decreasing (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 - of good or bad reasons - wants it to be. Also reality is constructed from our thoughts of reality and that there is no reality until that reality is perceived. Further 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. Not to forget 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 manipulation 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 for “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 so far have failed.

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 deeps 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 Brainstorming 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 somewhat 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 commitment of providing 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 narrow definition of the term:

*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."*

Not 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 manager who has the responsibility for major operations rather than the initially small business that the entrepreneur may manage.

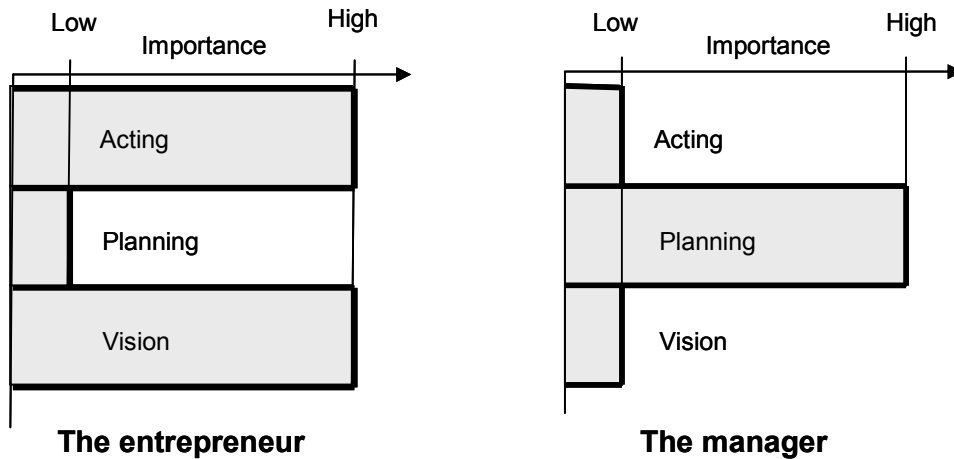
A comparison between a traditional project leader/manager and an entrepreneur is that the *project manager/leader*, does not generally have any real business role. An *innovative project*, also differs from other projects through the project not having a defined end, and that it instead transforms into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

<b>The compass of the entrepreneur</b>	<b>The compass of the manager</b>
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)

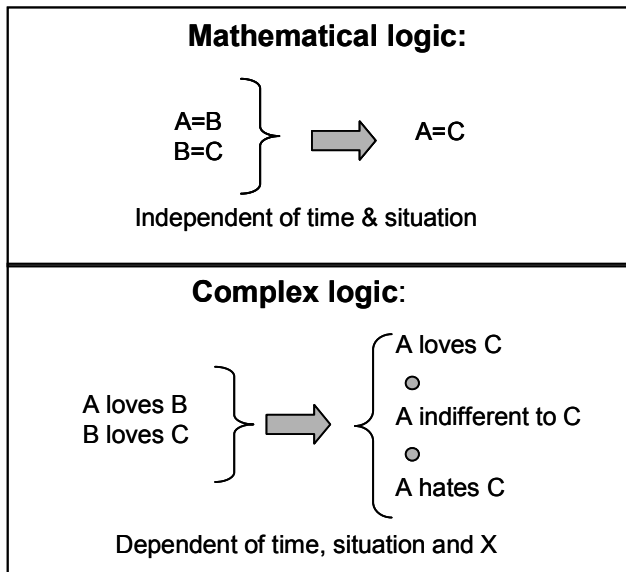
The entrepreneur's and the manager's respective focusing on concrete action, planning and vision can schematically be expressed as in figure 3-14.



**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).

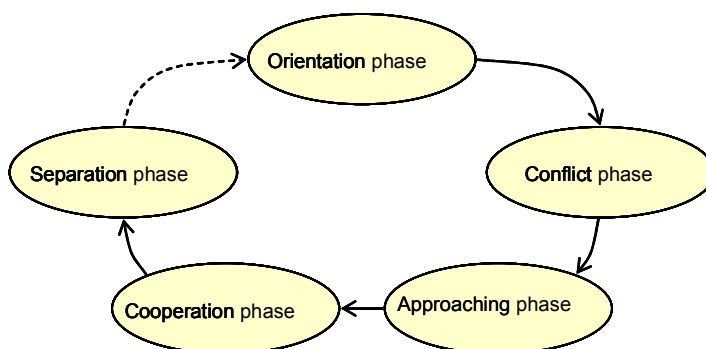
Note that in this context, the focus of education at university colleges and universities has in principle traditionally adopted the profile of the manager, which stimulates the *left cerebral hemisphere* - the analytical cerebral hemisphere of the human brain. Only in artistic educational disciplines 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 demands a different focus in the education than the pure mathematically 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)].



**Figure 3-15:** Mathematical logic is seldom applicable on complex situations (Björk 2003)

### 3.8 Group dynamics

As pointed out, to reach full efficiency of a simultaneously starting team can take 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 well together from the first meeting, In other cases they will feel as: “I simply cannot work with that person! If a formal manager has not been appointed one or more group members will take 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 to be made 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 each other.

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 and unique selling points (USP).

When the team members 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-less 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.

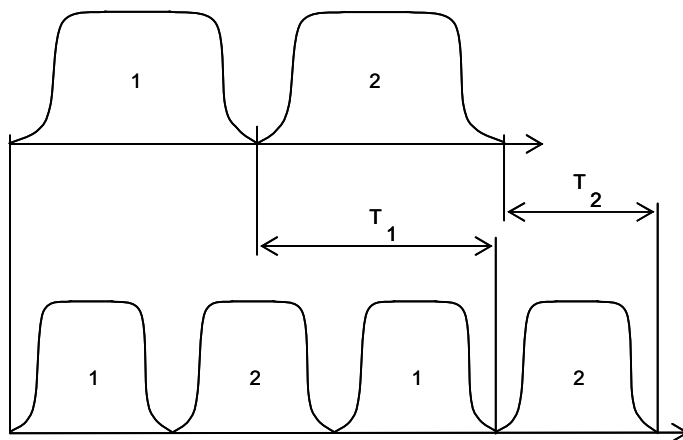
When the group has completed the task or when it is clear that a new project needs to be set up, it is time to close down the initial project. The *separation phase* has now been reached. The separation phase can be like divorcing the other team members. For the team members to be able to go further in a healthy way a lot of energy should be spent to integrate memories, to work through separation agony, and to plan 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).

To note is 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 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 that 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 even can lead to burn-out.



**Figure 3-17:** If a team has to work simultaneously with two projects it loses 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 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. That 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 mis-understandings 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 if the 'climate' is good or not. The Planetary organization (see figure 3-5) is also in that respect better than 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 demands that the project leader intuitively understands 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 to later solve 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.
- Exercise how to relax.

### **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 lose memory and concentration difficulties become more noticeable. She/he can swing between crying and being angry and will lose 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***

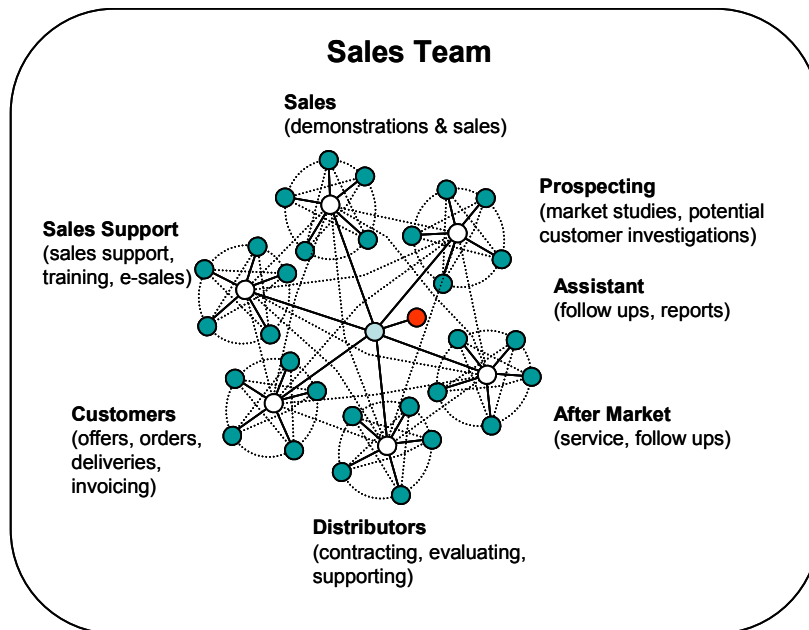
Without sales all other activities to develop a new product is wasted money. Therefore sales can be said to be the most important activity in an innovation project. If the product cannot be sold before it is developed it in many cases should be questioned if the development shall start at all. For radical new products this statement may be too far reaching but at least a strong interest must be able to create with one or some customers that can be called pioneers. This is very different view from the common view that the customer – which means majority buyers – shall tell what they need and will buy before the development can start. Having found a large interest from the customers should signal that many already probably are working on finding a solution to sell and that hardly an innovation is needed to satisfy the need but at the most a reengineered product.

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

The price of the first order can be low as it will anyhow in general not be able to cover the expensive production costs of the first new product. An agreement that the customer will pay if the product works well and if she/he is satisfied after some test period is also OK for the first sales. The commitment of a customer is the crucial thing for starting up the development of a new product and a speculation that it will be possible to sell the product build on a business idea/plan shall 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 way of working has brought profitable products which in one case – Flexlink Systems – brought extremely much profit 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 the selling a marketing message is gradually build up. When the innovation has become established on the first market, there is generally a need for both specialized 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 that 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 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 have 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. To bear in mind is also 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 tell 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 is meaningful to print nice brochures. Not to be too turned down in the early

selling process, it is good to practice your stories on a friend or relative before you test 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 the 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 would be able to 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 goals 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 do 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 up 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 upon the sale, the higher the expectations in 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.

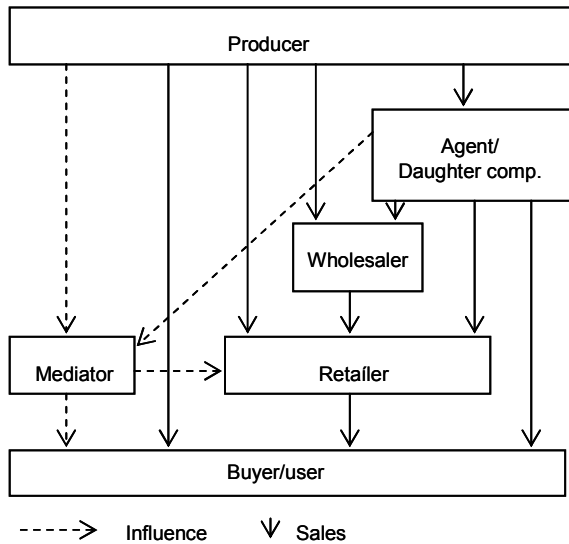
The basic properties are often referred to as *expected requirements*. When a product meets such tacit demands, it does not mean that the customer/user becomes more satisfied with the product or company. However, there will be great disappointment if the product does not have the basic properties. Therefore 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 be 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.

### 4.3 Ways to reach the market

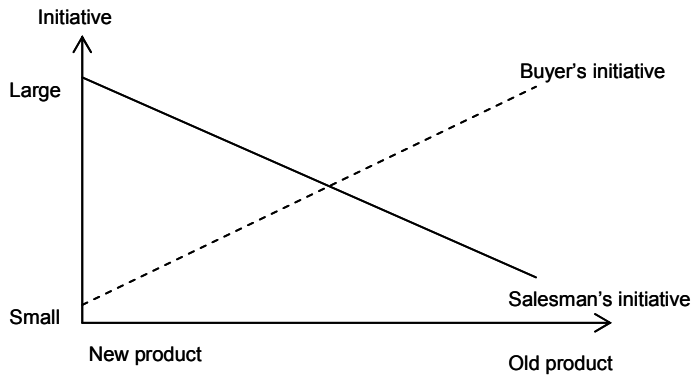
There are many ways for a producer to reach the market with a product. The producer can sell the product direct to the customer or via one or many levels (*middlemen*) between the producer and the customer (see figure 4-2). On the export market, sales can be wholly or partly done via the customer's sales 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 4-2:** Examples of different options for manufacturers to reach the market

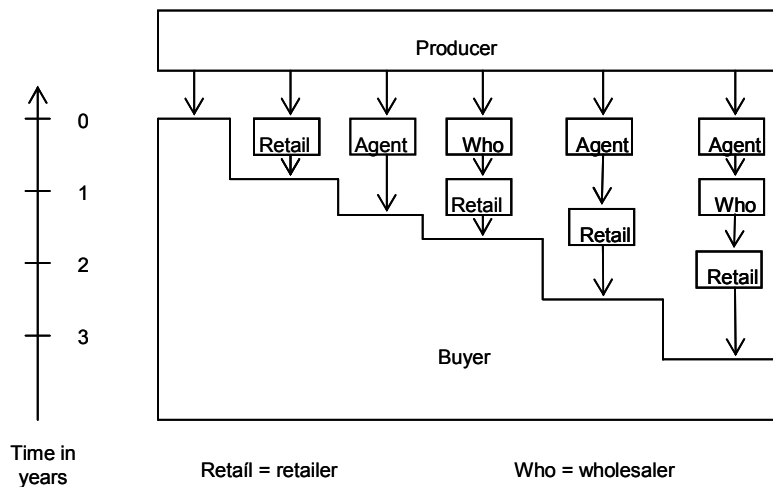
The more *middlemen* there are between the customers and the producer, the lower the profit margin for the producer, for the simple reason that there are more who will share the total product margin. At the same time, volumes in general will be greater the more middlemen there are, when each middleman 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 4-3.



**Figure 4-3:** 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 4-4.



**Figure 4-4:** 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

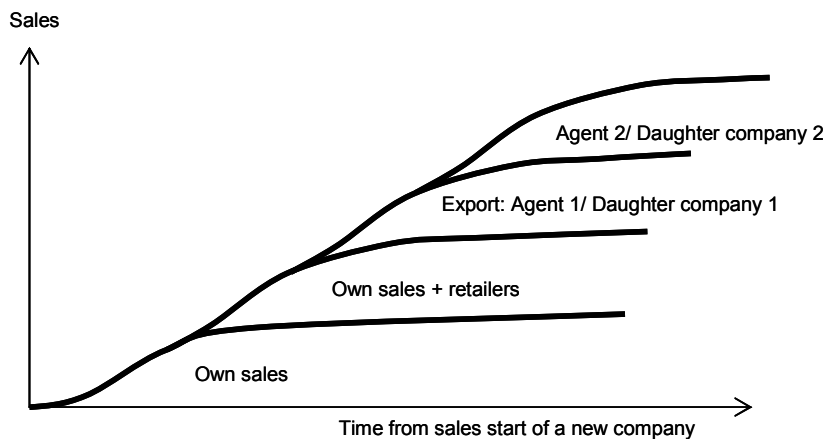
Some producers strive to reduce the number of middlemen between themselves and the market, regardless of whether they produce mature products or new products. The extreme case of this striving is completely to rely on own sales completed with Internet sales or on TV-shops – and combinations of them. One important reason for this striving 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 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, of 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 are going down the sharing of the decreasing margins with many surely will 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 other really good way to start sales than by starting as 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 4-5.



**Figure 4-5:** For increased income there is an eventual requirement for new geographical markets to be reached, either direct or via other channels

#### **4.4 Expansion through distributors**

From when the company has got some experiences of the selling of the products on the close geographical market where the company is situated, expansion can be done through distributors. *Distributors* are individuals who act as representatives of the company but who through 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 it has stipulated. The most well-known distributorship is “franchising”, which e.g. is the main form MacDonalds has chosen for their expansion of their global fast food business.

Another distributor form that spreads 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 done. If each new level distributor has to buy a minimum quantity of the products which they sell further at fixed prices, that in most countries is regarded to be an illegal pyramid game. The products are not sold through other market channels than through the distributors thus giving them exclusivity to the products.

For the company MLM means that it does not need to set up a sales force for the 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 for 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 of friendship reasons. If the family members and friends also are recruited to be own distributors and are not successful in their work, a good friendship can abruptly be broken eventually leading to social problems, which is not a wanted situation for the 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](http://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](http://www.mlmstartup.com)).

#### **4.5 Recovery period**

As a rule, sales are initially slow when introducing a new product on the market and until a certain number of customers – the critical mass - have been reached and they

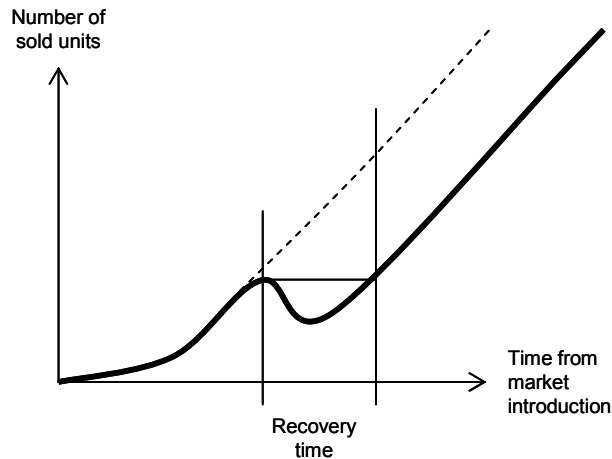


start to generate new customers based on their information of the product they have bought. This applies above all to groundbreaking new products, since customers most rarely queue up to be first to buy a new product. In order to start sales therefore, one needs to be highly active in making market contacts - 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 4-6. 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 4-6:** 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). The IT business did it also in the early 2000<sup>th</sup>.

#### **4.6 The seller's role**

Everyone who buys a product must feel security 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 quickly to 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.

#### **4.7 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 tell a good story about the product and its

background, who can and utilize *market rhetoric* in a good way by focusing on customer benefits, and who can sell 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 after the fair actively contact and influence potential customers and follow up contacts made. 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 then 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 thus 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 small chances 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 particularly many sales calls per day although very disciplined making 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.

#### ***4.8 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 as they are the most important door-openers to prospects to contact.

Textbooks often tell 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!

## 4.9 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 aeroplane 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.

#### **4.10 Sales techniques**

There is abundant literature on sales techniques, sales psychology, body language etc. We will not here go into these subjects at length, 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-practised 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 the product. 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 unnoticed 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 a meeting by someone who knows the individual is considerably more favorable than oneself contacting a completely unknown person. 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", 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 who fit into the environment. For example, there is a big difference between selling motorbikes, pharmaceuticals and office equipment.

A sales meeting should be pedagogically planned 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 often 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”.

#### **4.11 Easily done mistakes**

To build a returning/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 that one knows will bring no 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.

#### **4.12 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 persons 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.

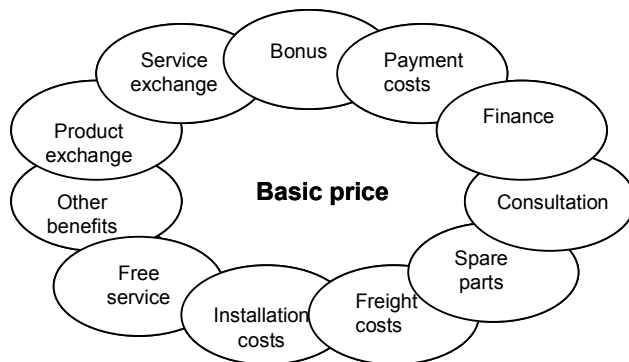
Finally, something should be said about the problems of operating in a large organization. To refuse to accept parts of the mother company's sales organization for selling a new product is easier said than done, but even so, one should put forward this view if one feels that this organization will not 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 the mother company. In addition, competition is always valuable also to the sales organization of the mother company if one chooses another sales channel.

## 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. However, 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* why branding is an important marketing activity.

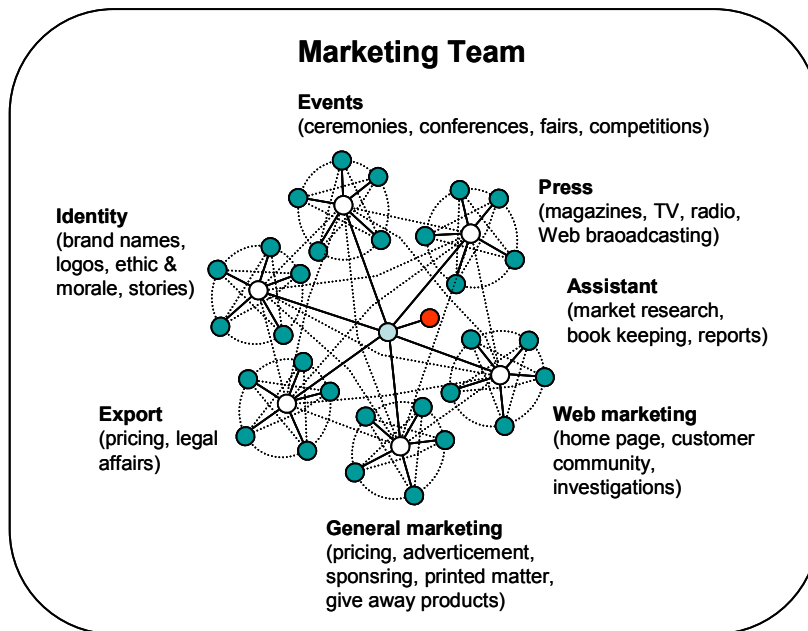
Marketing is done principally by marketers and sales personnel, but all employees in the company contribute to the marketing of the company and its products. The switchboard operator for example influences in a positive way the potential buyer's attitude towards the company when the caller is received in a swift, pleasant and efficient way. The automatic more and more used telephone answers asking the caller to press buttons step by step to sometimes 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). Experiences however tell 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 more and more is 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

### 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 for 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 to display the product, to create interest, to persuade, and to set prices to ensure that the company with as good a profit as possible was able to exchange its products for money. 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, political parties 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 and when disposing 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 shows also 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.
2. Potential customer: is aware of the supplier and the supplier's offers, and perceives a need of 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.

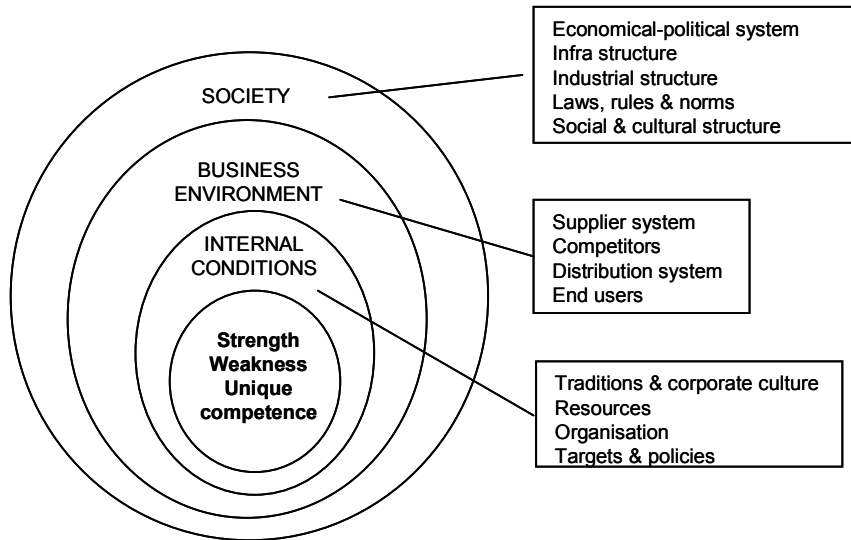
A customer may be a consumer and/or *user*. To be a *consumer* means to consume the product, which in turn means that the time during which the consumer utilizes the product is often short (e.g. one day for a tablet with a depot effect). If the term 'use up' is used, then the utilization time is longer (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 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. 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. 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.



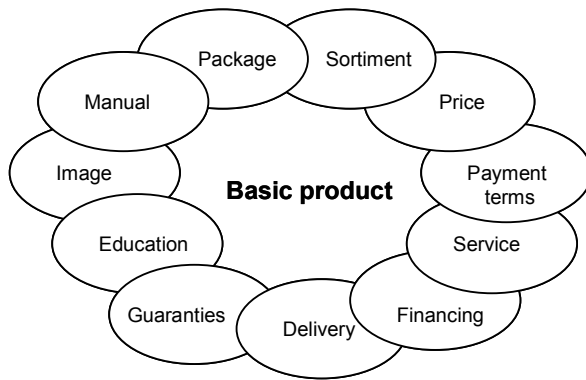
Product developers need also to consider that users can be divided into *primary users* (i.e. principal users) and *secondary users* (i.e. temporary users).

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), 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.

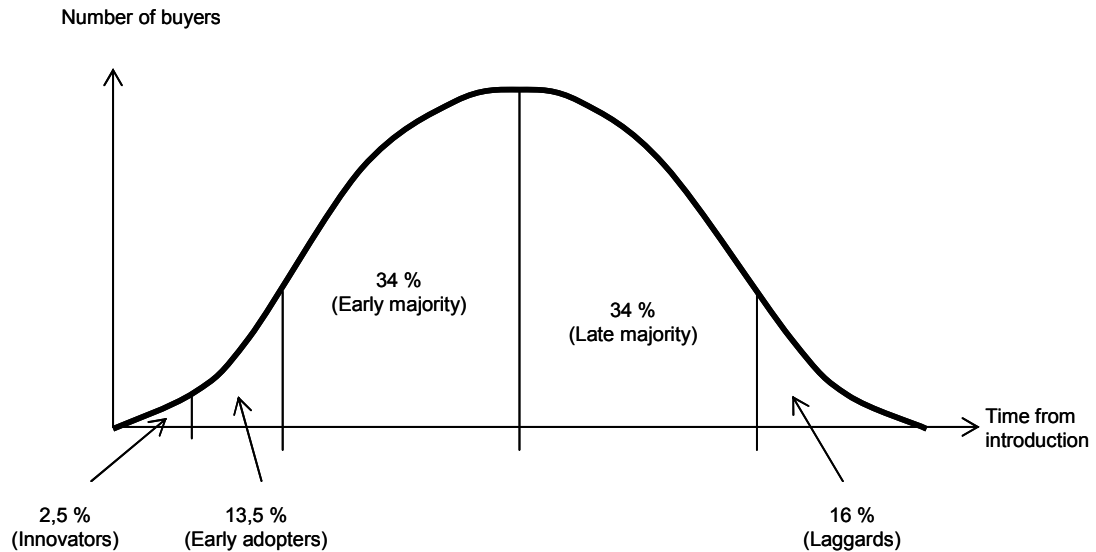


**Figure 5-4:** When the customer is placed at the centre of marketing activities, the product becomes merely a part of the total offer

#### **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 others have previously bought and used the product.

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. In selecting the target group furthermore, 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).



**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. Innovators and Early adopters form the group Pioneer buyers

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. Constructors, 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 never are companies, but one or more individuals in the company.

Even if it is wishful quickly to reach the early majority group of first-time buyers, it is thus 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, which

further will 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. Successfully to establish a new product means putting the focus on finding and linking as many pioneers as possible, among buyers, users and other influential persons.

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 using 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, that when first selling the business/product idea this analytical way of working often is without success and that 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 method to better take 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 obtain many suggestions to

choose between, it is important to be creative and to list as many different alternatives as possible and to soon start to approach the felt most interesting ones, which 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 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 done.

When the different market segments have been valued, it is time to decide which of them is/are to be targeted first by the sales people and what to communicate. 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. Customers/users, which purely make demands without making suggestions for solutions, are of course of less value than customers/users which also make demands and 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 mean 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 under a 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 mainly will discuss the pricing of primary products in the classical view as the new view means no pricing at all for the primary products. For industrial products and many consumer products still the traditional pricing is

relevant and will so be even in the future.

Price-setting new products is difficult to carry out at the same time as a price-setting strategy is strongly affecting the company's profit margins. Some reasons for this are that 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, until a few new products have been sold.

When price-setting a groundbreaking new product the first thing to do 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:**

**Costs + margin = price**

**Market-oriented price-setting:**

**Price – costs = margin**

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. This 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.

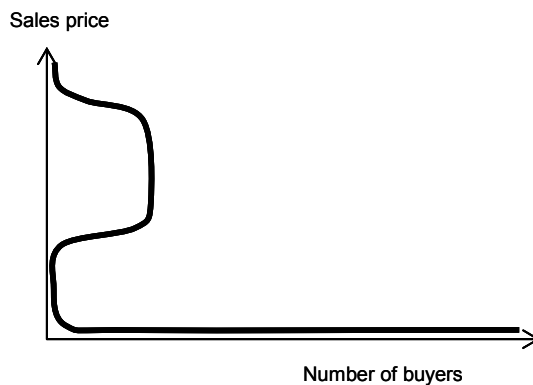
If a number of units have been sold at a high price and the company nevertheless wants to reduce the price, for example owing to the appearance of a competitor with lower prices, it is important not to irritate or disappoint the first buyers by suddenly offering the same product at a lower price. The 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

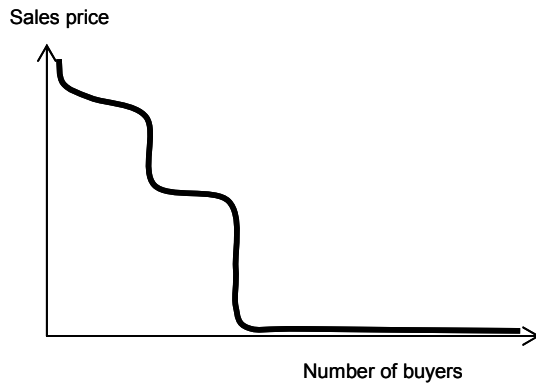
the unconscious and conscious formation of an action plan to be used when the real market game starts, i.e. when the product is launched on the market.

Personal experience of the introduction of *groundbreaking new products* shows that the remarkable situation often arises where pioneer buyers are not interested to buy 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 the point of view of coverage. The principles of this situation can be illustrated as in figure 5-6.

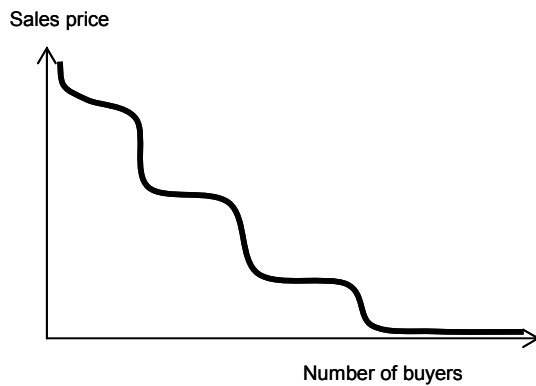


**Figure 5-6:** Number of buyers as a function of the price-setting upon introduction of a groundbreaking new product

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 in an unfavorable way.



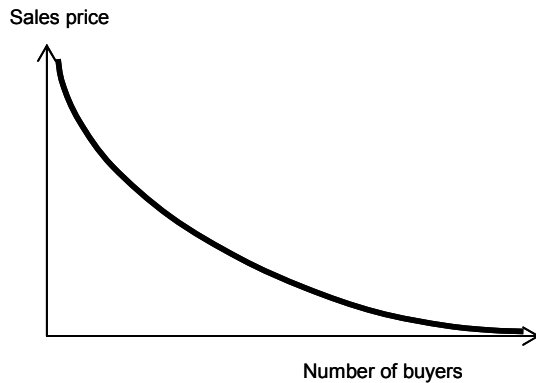
**Figure 5-7:** Number of buyers as a function of the price-setting when the so-called early majority group is to be reached



**Figure 5-8:** Number of buyers as a function of price-setting when the so-called 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.

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 why one talks about *Moore's law*. These experiences are important to bear in mind, and emphasizes the importance that initial price-setting should be at a sufficiently high level to allow establishing 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 *hysteresis* (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 of products. 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 development has been made 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 persons 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 not slavishly to 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 them.

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 no or little 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 learned 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 of printed marketing material is very low as the Web has taken over as 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 marketing channel for the early sales. In addition information can be provided through advertisement in different media. Far better than paying for advertisement is to get newspaper articles published as such information is perceived to be objective, unlike the company's own production of marketing material.

Participation at *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 at fairs also means big costs for exhibition stands, exhibition material and payroll costs. There are often high expectations of sales after participation at 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 often repeated and the broadcasts are long and exhaustive, which also means a very expensive means of marketing. Radio advertising can be effective if one can explain the product in simple terms and/or put across a message. Radio advertising also is 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 any 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 thereby becomes dependent on indirect and filtered information. It is therefore important carefully to 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 done in a planned way. 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 on 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, 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 on 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**

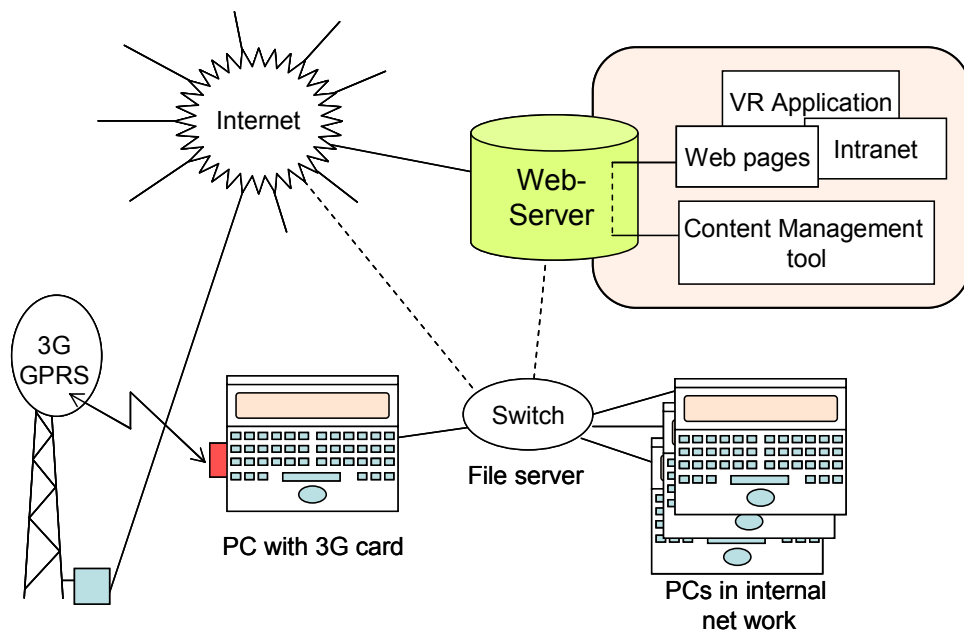
Since the mid-1990s, the *Internet* has constituted an important option for marketing a company and its products via the company's *website* or *web pages*, as they are also called. One is on the *World Wide Web (WWW)* when "surfing the net" (a web is literally a kind of network). The great advantage 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 (CMS) and look at it only on his/her 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 on 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 her/his computer she/he can buy only one standard motorcycle, which the potential customers can ride to get the right feeling of the vehicle. Then she/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 she/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 in a more efficient way 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 – due 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.
- 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 company operating internationally it is important to have several domain names. [www.volvo.se](http://www.volvo.se), [www.volvo.com](http://www.volvo.com), [www.volvo.de](http://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 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 own 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](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 [astroturfing](#) 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 in 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 standardised 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 cost must be prepared for which differ depending on e.g. maturity of the business, branch, etc. The principles of financing are the same regardless of whether a company, public body, organization or household is to be financed.

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 later return 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 later return also 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 then has developed to the extent that there is strong belief that it is possible to create a successful, i.e. profitable business of the innovation project, 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 the demands of other business set-ups.



### 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. Note that by using a web based Intranet the people reporting and using the data are independent of place and time!

#### Current result-based budget

	Month 1	Month 2	Month 3	Months 4 -6	Months 7 -12
Total income					
Total spendings					
Result					

#### Current liquidity plan

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

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

A possibility with budgeting and then in practice reducing the load on liquidity 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 capital. One way to improve liquidity is with one or more customers to agree on advance payment for work and/or services to be supplied later.

If the customer is wary, the customer 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 bank 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 term and the long term, it is therefore crucial continuously to 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 says also 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 bankruptcy estate from these sales, deductions are made for administration of the bankruptcy and the bankruptcy 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. 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 its assets in a bankruptcy 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 payable. From the community's point of view it is important that a bankrupt innovative operation may continue under new and better conditions with the minimum of delay after a bankruptcy. 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 continuously to ensure that liquidity in the operation is acceptable to avoid stoppage of payments, composition 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 to another company. The expectation that shareholders often express by their venture capital investment, is that value growth will be so good that the shares eventually can 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 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 valuer.

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 doing business, the application must often 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 mark greater commitment than if only the minimum required equity had 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 operational in a meaningful way. (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 annotated 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 shares each shareholder owns and which type of shares the shareholders own, 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. In the EU rules the term "nominal value" has even been removed.

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 on 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 rumours 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's shares. Thus the "true" value of the company, represented by the company's business operations, leads one life, while the share price lives a separate life.

### **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 persons 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 what the company intends to use the new capital for.

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 secure that not 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 is advantageous for the company through the added publicity and it indicates that additional new issues will have good prospects to achieve full subscription if not unwanted 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 additionally 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 if the capital should be used up quickly, for example through lost customers, unexpected depreciation, accidents etc. Under European law, *compulsory liquidation* is often ordered when 50 % of 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 shareholders' 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 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 agreement 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 is the option to receive 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 finance institute. 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, then 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 that still have not reached break-even – when incoming money from sales exceeds the money paid per month – and when venture capital is not available as equity, and when additional shareholders' equity and/or convertible debentures can not be used only shareholders' contribution remains to use. *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 any tax has been paid.

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-downs 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 for e.g. 25,000 EUR to most people means a significant commitment if the guarantee commitment needs to be realized. Firstly, the guarantee 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 continually to enter all developments 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 on development has always proven to be difficult otherwise. Accountants least of all are willing 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. 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 if the company risks an impure auditors' report due to its

carrying out development which is entered as a depreciable asset and not as a cost as soon as the development takes place and there is still no or only little income generated by the development. During the development phase the company has sufficient resistance to overcome 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 different cultures shall be mixed to give a good result. 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 done. The auditor annually makes an 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, thereby to be 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.

To end this short overview of financial questions, 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.

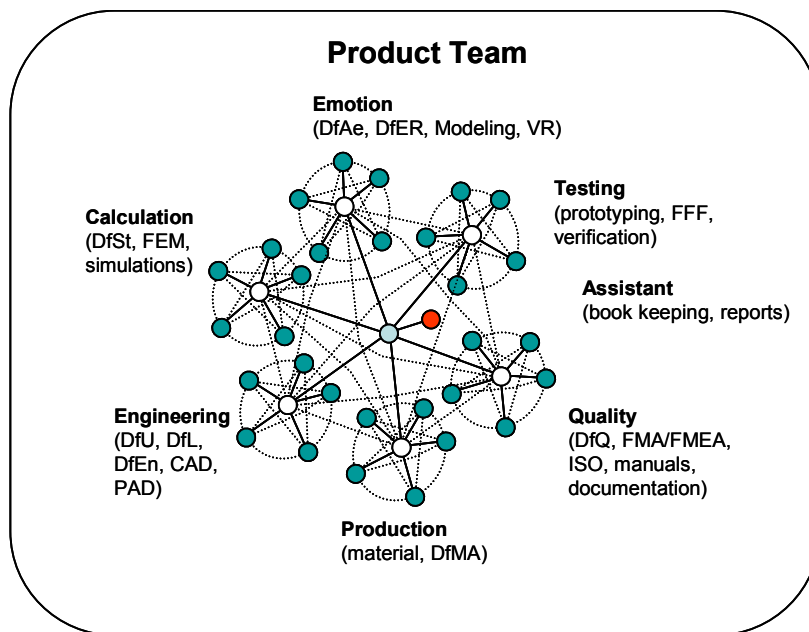
## 7. PRODUCT DEVELOPMENT

### 7-1 General topics

#### *The project team*

Today when innovative product development - as well as reengineering - is to be done, this in general is 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. 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 shall be utilized.

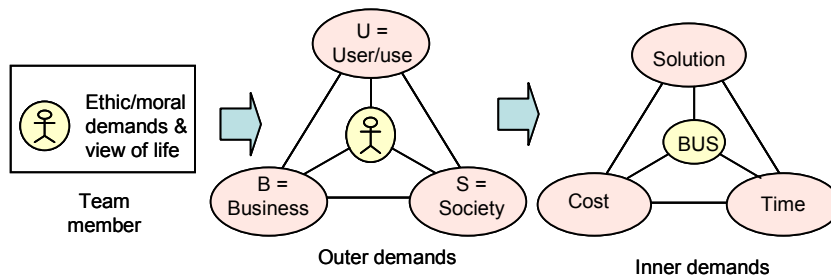


**Figure 7-1:** Different topics to cover when a complicated product is developed

#### *The product developer*

The individual team members in the product development team - as well as the project leader – always has her/his 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

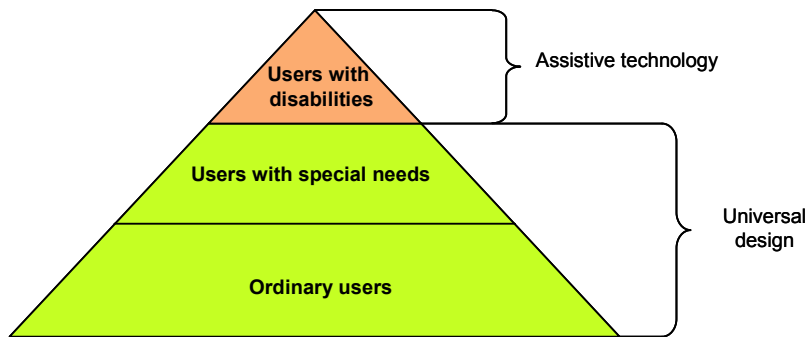
When developing according to the principles of Dynamic Product Development (DPD), technically devoted product developers have to concentrate on the user/use, while the entrepreneur of an innovation project and the sales & marketing people have to focus on the customers (*customers* are the ones that 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 drink just as they do from watching a movie.)

### **User categories**

Contrary to other methods that emphasize customers or have a mindset that product development should be done for a number of stakeholders where the customer is one, 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 emphatic abilities of the product developers the result will not be good. DPD therefore can be said to be an *emphatic 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 7-3). 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 7-3:** 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 individuals who have high individual demands. Some of the disabled users belong to the lead user category.

*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 belongs to this group of which some are lead users, as explained in chapter 1.

*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 rather easily can be used 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 creating a growing market to take care of. The number of older adults with disabilities is also increasing which adds to the demand of 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 perform coming from the design of ordinary users or design for users with 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 7-3 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.

The 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 the 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 defeats 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 usability in products. Four central components have been described as essential for good usability in a product (Jordan 1998, Nielsen 1993, Baber & Stanton 1996):

- 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.

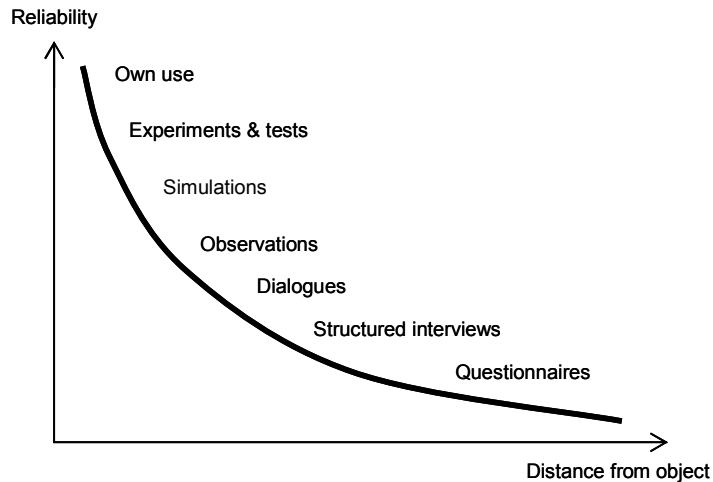
What a product communicates to a user is a kind of message of how it should be handled and used. If this message is falsely interpreted, the risk of misuse increases (Wikström 2002). Monö (1997) has described semantic functions aimed at analysing the communication aspects of products and defining a clear 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 7-4. [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 on 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, which implies that industrial competence should be seen as a valuable asset in industrial research.]



**Figure 7-4:** The reliability of different data collection methods is dependent on the distance from the object

### **Primary and secondary products**

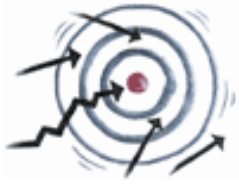
In the same way as there are primary and secondary users there are also primary and secondary products. In this book the main product is the *primary product*. *Secondary products* are parts and systems that is needed for the function of the primary product. Examples of secondary products are supports,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

[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.

The more visionary the product is the more the target will move. The more the target will move 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 7-5 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.



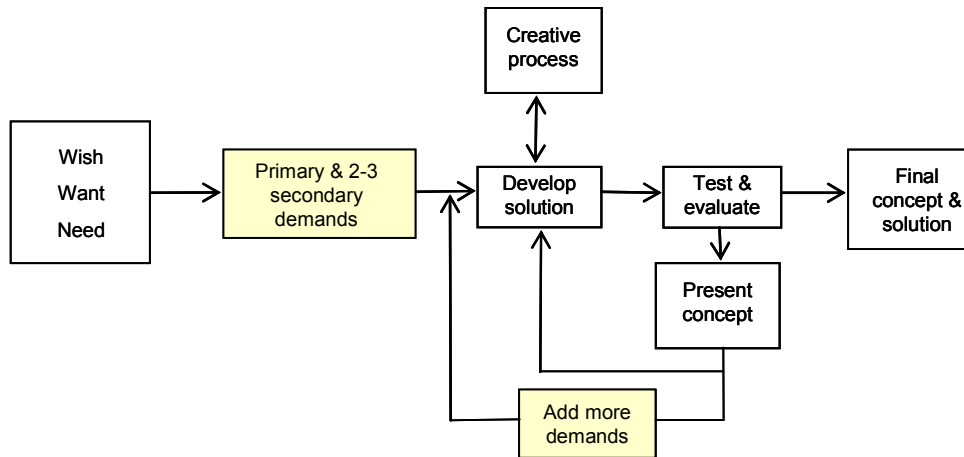
**Figure 7-5:** The target for the technical development will move with time why it is important to carefully plan only for the short next coming period

As the target for the technical development will move all the time from the project start 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 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.

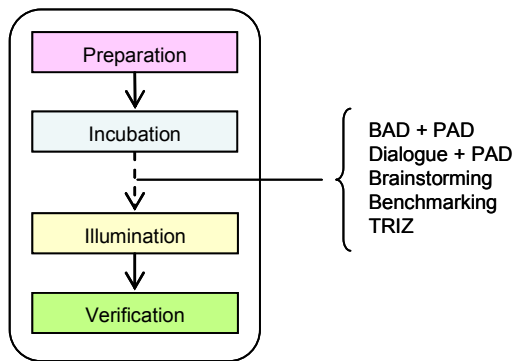
Contradictory to what is taught in general – that all demands must be set before the creation of a concept starts – we have found that one shall start only with one primary demand and 2-3 secondary demands and then start to create solutions for them. When one or some solutions have been found, more demands 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 7-6, a high speed can be held in the work 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 7-6:** 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 7-4 shows some common 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 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. 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 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 to base the concept on. 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 7-7). 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, 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 7-7:** The creative process (Knellner 1975) and some methods to find solutions

The first method (BAD + PAD) in figure 7-7 means individual work starting with Brain Aided Design (BAD) and then to make sketches (PAD = Pencil Aided Design). BAD is 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 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 7-7 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 to take care of 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 that the eyes register a sketch they register a word when making 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.

With *Benchmarking* is meant 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 a 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 seldom will occur – only level 1 -3 solutions in table 2-1.

Using *TRIZ* - which is a translation for the Russian “Theory of Inventive Problem Solving” - one first identifies *contradictions* after which one in general makes benchmarking for 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 calls 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).

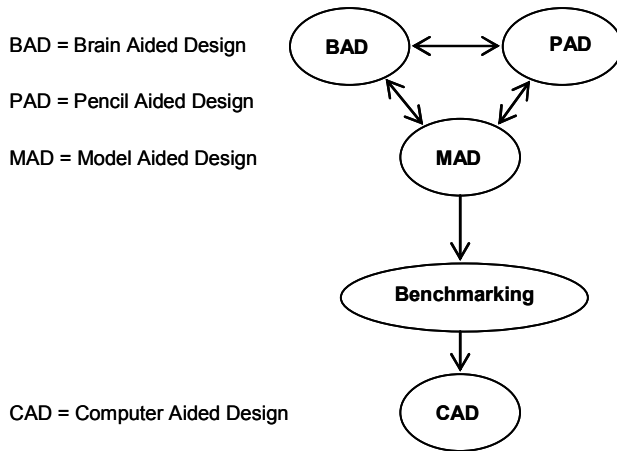
[The one who started the work with TRIZ was the Soviet/Russian engineer Genrich Saulowitsch Altshuller who indeed had a very interesting life story that can be found e.g. on <http://www.aitriz.org/altshuller.htm>. Altshuller was born 1927 and died 1998.]

### **7-3 Design philosophy**

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 – which means operating from level 3 to level 1 in table 2-1. 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. This 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

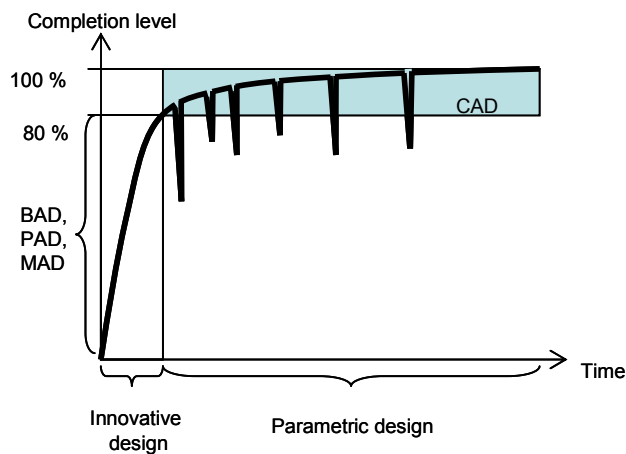


other solutions before it is time to make Computer Aided Design (CAD). Figure 7-8 shows the dynamic principle.



**Figure 7-8:** Initially when a concept is developed and later when problems occur, the ways of working shown in the figure has shown to be efficient to use

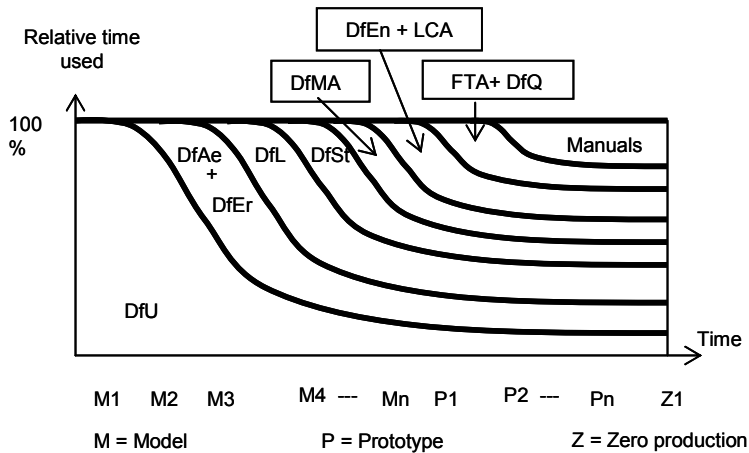
For need-based development – levels 1-3 in table 2-1 - one strives to only make benchmarking and CAD, which sometimes bring solutions that are not functional as the critical thinking seems to disappear only looking at the product on the computer screen – using only one sense. If the development continues too long only of a solution for which simple models have not been done and tested, the costs can be large to make a functional solution. Worst is that time is lost when the product is developed only in the computer environment. The ideal situation to develop a new



product from scratch to a finished product is seen in figure 7-9.

**Figure 7-9:** When problems occur in the development of a new product BAD, PAD, and MAD helps to find solutions to continue the CAD work

The recommended order in which to develop a “hardware” product is seen in figure 7-10. In the figure different 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 ergonomomy, L for Logistics, St for stress, MA for manufacture and assembly, En for environment, and Q for quality.



**Figure 7-10:** The order in which a new mechanical product preferably is developed

As figure 7-10 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 ergonomomy 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 7-10 shows, the next step when the functional, aesthetic and ergonomic solutions have been found is to look for that the primary product can be transported in an economic way to the users. This demand will often cause new solutions to be found on 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 7-10 shows that it 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 to

make a Failure Tree Analyzes (FTA). When all these steps have been completed it is time to make manuals for the product.

### ***7-4 DPD rules of thumb***

Figure 7-10 has more dimensions than the two shown which will influence the outcome of the work. Therefore some rules of thumb will be given.

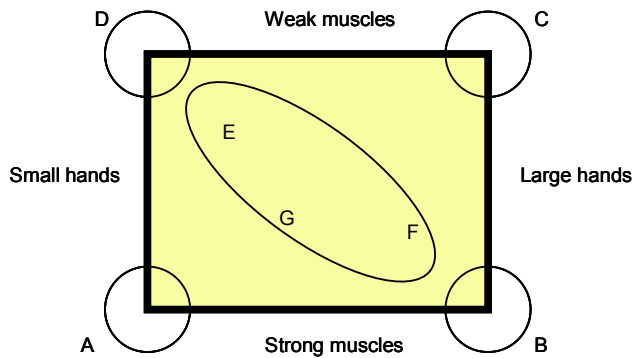
#### ***Make useful scenarios***

When developing a new product it is common to describe the demands in technical terms. However, it has shown to be better to make useful scenarios for the product developers that makes it obvious for them what to do. Thus, if a mobile telephone maker first gives the scenario that the phone shall be used on 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 tree environments and with the imaginable treatments it will get in the three cases – which also calls for empathy by the product developers.

#### ***The framing principle***

Especially when a new product for many users is to be developed there are two principles how to do the work. Either one starts to develop it for what can be found being a normalized 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 done two solutions for the extreme users one can make use of these two 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 7-11 shows an example when only two 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 product will be needed in that case.



**Figure 7-11:** 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 the importance of being creative first, before looking at what others have done (c.f. figure 7-8). This as if one does not do it in that order one will be so influenced by what one sees that for a long time the own creative ability will be seriously hampered. Reinventing the wheel is in general quickly done but gives 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 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 (Norrestrand 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 happen to have solutions to that problem.

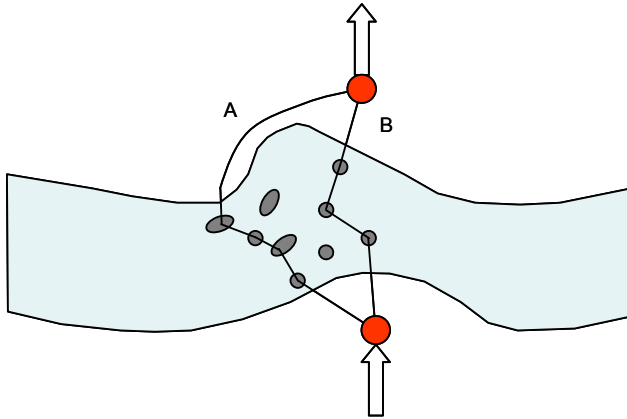
When co-locating the team, the product, or a model, mock up, etc, of the product to be developed should – if possible - be placed in the center of the group. This has many advantages:

1. It reminds the team members of what they are there for, helping them to focus attention to the product.
2. It serves as a good visualization 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.

### ***Step-stones***

In DPD step-stones are used not to lose momentum in the work. This is like passing a creek or small river stepping on stones (see figure 7-12). When one stone has been reached the next step shall be taken immediately not to lose the balance and to 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 close to be finished the planning starts for the next step, and so on.



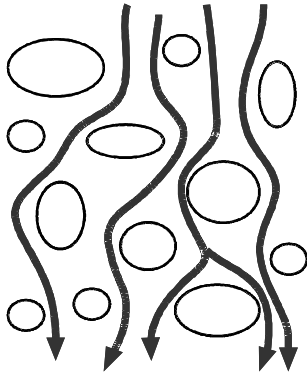
**Figure 7-12:** When crossing a creek or river one eventually can use step-stones to make a fast crossing without being wet. Often different choices of stones to use will lead to the same result – marked with the traces A and B - but with different efforts and skills of the jumper

If one does not manage to reach the goal one has to step back and try another path or to build a bridge between the too far separated stones (compare the labyrinth in chapter 1). If this situation appears, it is important to inform about the situation to the project leader and the other team members in the group.

### ***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 with how water flows around smaller obstacles (see figure 7-13). 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.



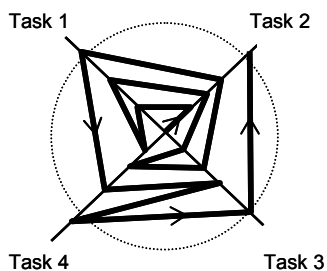
**Figure 7-13:** The metaphor of flowing water is used to solve problems without losing momentum (Holmdahl 2006)

### ***Switch between activities!***

The principle of switching between activities is connected to the principles of step-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 7-14.

**Figure 7-14:** Shift between tasks when good-enough solutions have been reached

### ***The Pareto Principle***

There is a proverb: “Don’t let perfect be the enemy of good”. This guiding principle can be called the ‘Pareto Principle’ (e.g. Koch 1998). It tells that when making 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 part. After three such cycles an almost 100 % solution has been reached

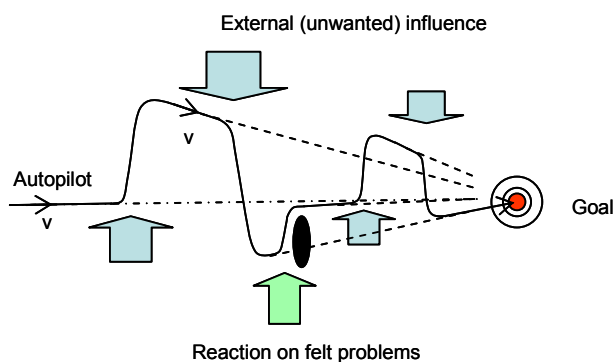
in a very short time. If one instead tries to reach 100 % direct it in reality shows that the time it will take to reach that level will be much longer.

[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 inaccurately 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 also is 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.]

### ***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 sensible e.g. for swiftly-flowing water or strong winds (see figure 7-15). To reach a goal a new direction must be set every time an external (unwanted) influence occur 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.

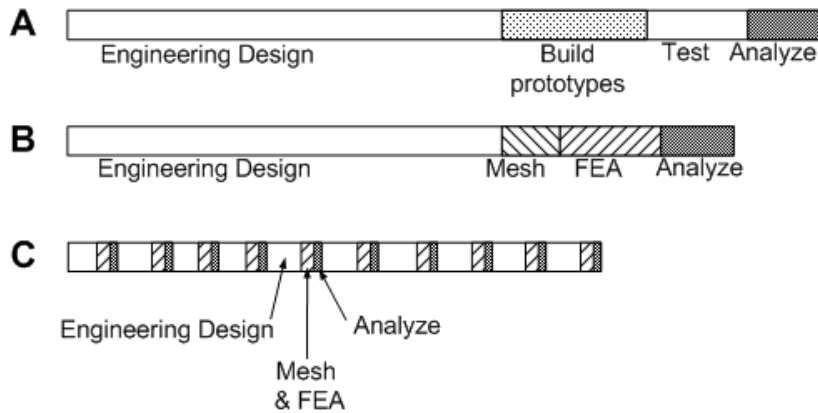


**Figure 7-15:** A skipper of a small boat must often change direction to reach a goal

### ***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 test, 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 7-16.





**Figure 7-16:** Comparison between different development strategies in foremost 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 7-16. (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 7-16 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 7-16. By using modern software such as DesignSpace® from ANSYS, 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, 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 continues concept development – which also figure 3-8 shows.

### ***Writing on the wall***

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. There are numerous of such smart solutions to project work. The own fantasy really is the limit in this case.

### ***Highlight important information***

As we have turned being sitting working with computers most of the time, we sometimes have difficulties focusing on important issues in the excess of information we get via the Internet and Intranet. 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.
3. Plot out drawings such as assemblies, sections, and mating 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 will fall on the wall meaning that the brain is filled with visual information that feeds the creative process of the subconscious mind.

### ***Weekly reports***

At the end of every week, each team member briefly should reports 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.

### **Notebooks**

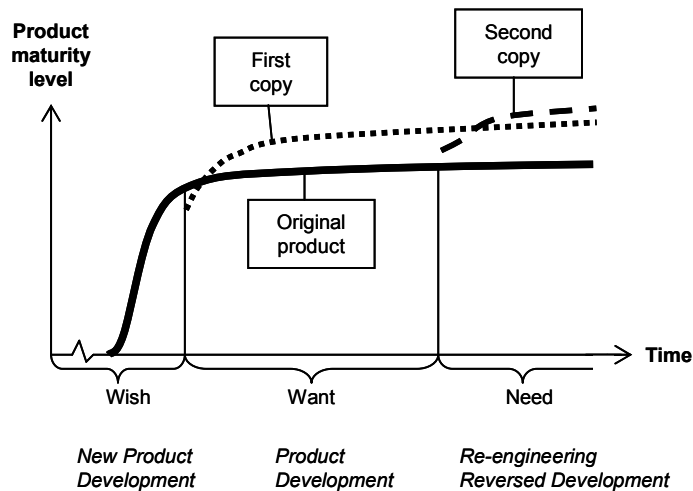
Every team member – and the project leader(s) - shall make notes in her/his own notebook from meetings, when great ideas or problems have occurred, etc. Looking back in the notebook now and then gives possibilities to reflect on the work done and why certain decisions were taken.

The notebooks also have a legal implication in case patentable inventions have been done 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 as information then easily can be changed afterwards.

If accidents happen with the products in their use eventually the notebooks can be valuable information in court trials. Going back to the notebooks can in such cases give evidences that the solutions have been discussed informing why a certain solution was chosen.

### **7-5 The S-curve**

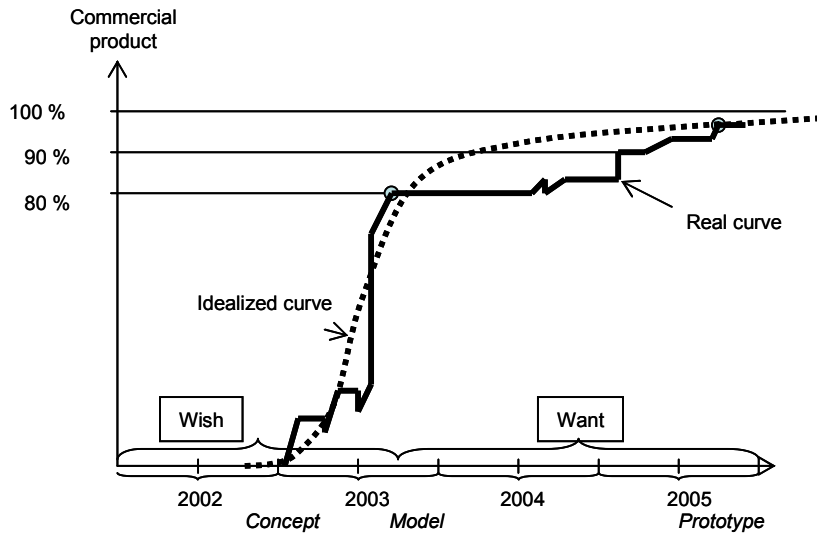
It can take a long time from when a *wish* is expressed until a functional principal solution has been created by someone wanting to make a new product that satisfies the wish. When at least one principal solution exists, the innovative development can result in a fast growth of the maturity level (see figure 7-17). 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 has been reached, when a *market need* exists, many companies may be interested in making developed copies of the product.



**Figure 7-17:** A principal situation from a wish to a need

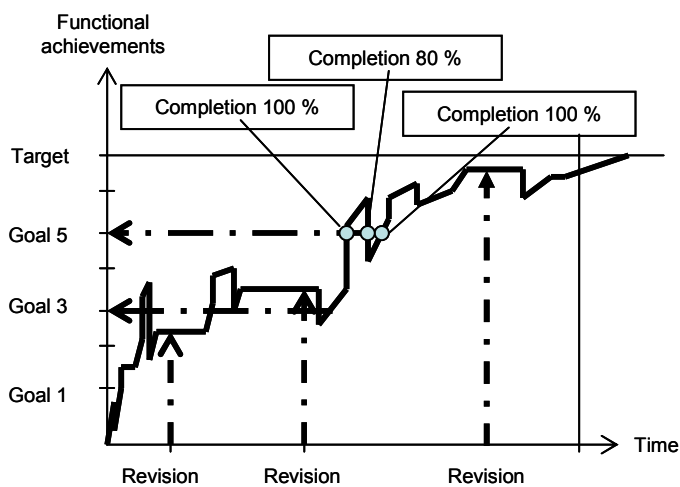
In reality the S-shaped curve in figure 7-17 is not as smooth as pictured and can it only be drawn in retrospect.

One real case (Careva Crossit) is shown in figure 7-18. 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 7-18:** 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 3 in figure 7-19 and compare going back in the labyrinth in figure 1-4) the New Business Board shall be informed for 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 New Business Board can also at any time revise the project. When major problems occur, the members of the New Business 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 causes on the speed and efficiency (Ottosson 2004-C, Minderhoud & Fraser 2005).



**Figure 7-19:** In DPD goals reached and lost shall be made known by the project leader or the comets to the other members of the New Business Board. They can also at any time make revisions if they feel unsure of the situation

## **7-6 Verification**

To be able to quickly develop a functional prototype that pioneer buyers and users will like, it is important in innovative product development to produce many rough sketches, models and prototypes and also to immediately test them on buyers and users to obtain their feed-back. Thus, it is extremely important to perform tests & simulations often in the development process. Note that verification with only one human sense is less reliable than using many senses why it is better to have a model to touch – even a very simple one – than just to have a sketch, a drawing, a picture or an animation to look at. This since the eye often deceives our judgement 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 upon. 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**

The earlier in the development process, the softer the material that should be used, 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 does also the thinking.” (Schrage 2000, p 79). The strength of rough 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 (sometimes called *mock-ups*) and later the physical prototypes. For design studies – especially of large objects – *digital mock-ups* (DMU) 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 fast 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 especially 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, which DPD is an example of, as we cannot foresee everything in a theoretical way. According to our observations, it is not unusual that companies can even spend thousands of hours developing detailed specifications that are invalidated by the initial prototype. ‘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 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, or materials 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 in manufacturing. They are used by engineers to better understand and communicate their product designs as well as to make rapid tooling to manufacture those products. Surgeons, architects, artists and individuals from many other disciplines also routinely use the technology.

The names of specific processes themselves 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 copies, 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 or by having a needle that touches the surfaces of the object.

However, although it may seem simple 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 of 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 done. Going direct from a drawing to a CAD file is of course an other possibility, but that can only be done having the drawing at hand. Also it is easier to forget something when there is a distance between the drawing and the screen where the new image is to be done. Raster file can also be exported via Internet to someone who is specialized on transforming drawings meaning that the valuable source 2D drawing must not leave the files.

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.

Two types of imaging technology are used for 3D scanning; CCD and direct contact array. The most widely used scanning technology is the CCD. In an effort to reduce the cost of scanners, however some manufacturers have adopted the direct contact array. Especially for large objects that is a feasible way of scanning the object. When the objects to measure are soft or partly liquid only CCD can be used. As for 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 effect 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 of as well energy reasons and useability.]

### ***Virtual reality***

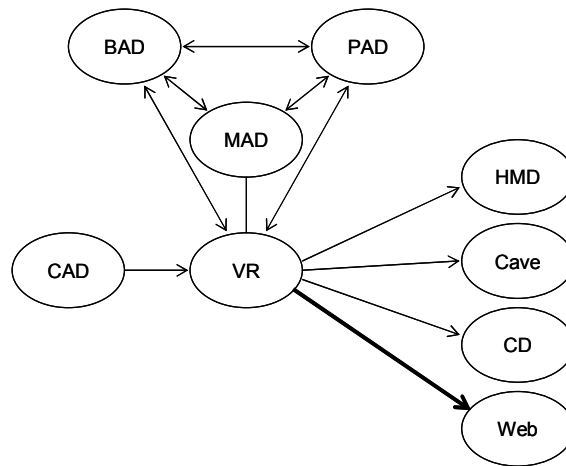
VR means that an individual encounters 'synthesized' experiences created by computers and performed in such a way that the experiences to some degree are experienced as real experiences by the user. The individual will through uncontrolled and controlled reactions in real time influence the computer 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 per 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, needed is some work to go from CAD files to VR files, 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 7-20) 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 7-20:** Input for a VR presentation is BAD (Brain Aided Design), PAD (Pencil Aided Design), MAD (Model Aided Design) and CAD (Computer Aided Design) (Otto 1998-B). The user of the VR files can use different presentation forms as HMD (Head Mounted Displays), Cave, CD and Web as well as combinations of them.

By combining a content management system 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 done instead of the heavy to use and costly method of Quality Function Deployment (QFD) and other methods for collecting and analysing 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 CM system with a web module
3. Publish the VR file on a web page

## **7-7 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 manufacturer*), 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

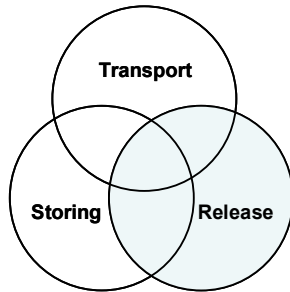
### **Function of packages**

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 7-9 is valid also for the development of packages. However, the package is also an important message carrier from the producer to the user/consumer/customer.

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 7-21 the short duration release activity is colored. In the development process it is dealt with after the two other activities have got their solutions.



**Figure 7-21:** 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 always will 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 careless by the transport or store staff. For some packages there are norms and rules to follow in the development work but often own imagination is needed to make good package solutions, which is done e.g. with demands found in brainstorming sessions.

Due to the vibrations and shakings during transport wearing will occur on the package. It will also be exposed to different temperatures and humidities during longer transport cycles. Combinations of these impacts on the package have to be taken in consideration of 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 in a disastrous way.

Also at 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 strives for tight packing of the goods. The package therefore must be designed not to collapse when other packages and other objects are piled on top of the package. By using module thinking and 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 reality in this case.

A special situation is at hand when long time storing takes place as attacks of animals, insects, and microbes/micro organisms including fungus (e.g. mold) can occur. If the primary product shall not be damaged the package must in such cases be developed with special care what regards the material selection. Also preventing rust if the storing will be in cold stores for a long time 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 shall the package material be taken care of – which calls for correct material labels on each piece of the package. Wanted is often that special tools shall not be needed for the release, which does not count for theft attractive products that shall be difficult to get hold of other than for the right user.

### ***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 checks 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, preventing actions can be done. Registering packages will only register information about the package and the product so that it afterwards can be investigated what has happen – like for the “Black box” information in crashed air plains and cars. Passive packages have no sensors.

Active packages can send an alarm signal over the mobile phone net to a guard if e.g. a thief tries to steal the product. At the same time the build in micro computers can start contra actions as starting a high sound alarm or starting a gas evaporating system. If the thief anyhow 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 the product but will it be easy to repair it for the manufacturer. If the good is money bills or clothes ink can be used to destroy the goods telling other thieves that they get nothing out of trying to steal from similar packages – or containers. The goods is anyhow lost so it does not matter in that case if they get 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 the parcel to sink, which is another example of unintelligent but active system. A third example is the use of bi-metals to react on temperature changes causing activities to happen for certain changes from the normal situation.

### ***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, possibilities to give information in many languages often are at hand. The cost is low for using the parcels as publicity creating objects!

## **8. PROJECT PREMISES**

### ***8-1 The mission of a room***

When we enter a room we immediately get some relation to 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 more are 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 as it is.

Before localities are sought for, it is first of all important to try to find out the function of them 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 must it 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 often is difficult to make tests e.g. on prototypes in exclusive room settings. Exclusive localities with exclusive furniture also demands a special dressing of the team members that maybe is not perfect for performing project work.

A room where people are close to each other - a social room – is limited in size by fixed walls. It can as well 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 by the players regarded as walls around the playground 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, and the better the result of a team work will be. Also the shorter the time will be to reach good solutions. 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 the smell in a room also effect the mental distance as people will be distracted by other things then the 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, the 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 distinguished which however are they 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 ways 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 it be. In the listening zone “overhearing” will take place when one team member asks someone in the conversation zone of some information. The third person can due to that 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 of taking part in a dialogue will be reduced and will the dialogue groups be split up in dialogue groups with not more then six persons. (More dinner guests then six at a dinner table will e.g. of the same reason be spit up in smaller groups having dialogues, which can be an interesting experience to make 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 from each other, the we-feeling decreases radically as that means that the distance in principle equals to be in the listening zone. Stairways increase the distance 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 also is the case when the team members are using MP3-players. If doors of 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**

If the team members have been chosen carefully - to secure that they can work together without big problems - the mental distance will be short. For them it is advantageous if they can work together without distance cutting obstacles as walls, book shelves, stairways, etc. For maximal well being, their individual work places they shall be able to form as well as their closest environment.

If it is possible the models and prototypes shall be placed in such a way in the project localities so 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.)

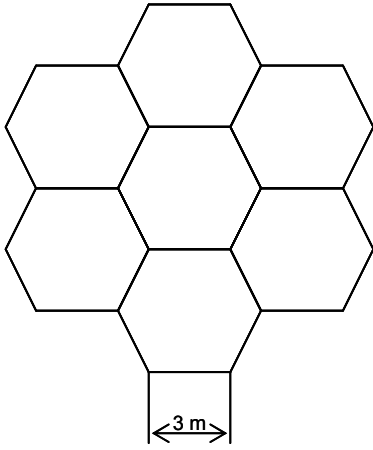
During a project work it now and then is important to be able to withdraw from the community to study, reflect and think undisturbed in a silent room. The project leader(s) shall also be able to have access to a closed room without insight from others e.g. when having personal dialogues with team members, the board chairman, the project owner, etc.

At meeting points as coffee corners, and relaxing points, there shall preferably be whiteboards and/or paper to sketch. 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.

The creativity seems to be reinforced if the work is done in rooms which are not too well organized and perfectly structured. Chaos situations are the mother of creativity and the most creative researchers, inventors, artists, and product developers often for other people seem 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 general one has few chances to choose project localities why one has to make the best out of the localities offered. However, if new efficient localities are to be projected new ways of thinking can contribute to a good outcome of the projects. As so often Nature has some solutions to offer. In this case by looking at how a beehive is build up some ideas can be gained. Thus rooms with walls arranged as regular hexagons (see figure 8-1) with the length of each wall of 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.



**Figure 8-1:** Optimal project rooms are maybe hexagonal rooms with the sides 3 meter

## **9. Research on innovative activities**

### **9-1 Introduction**

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

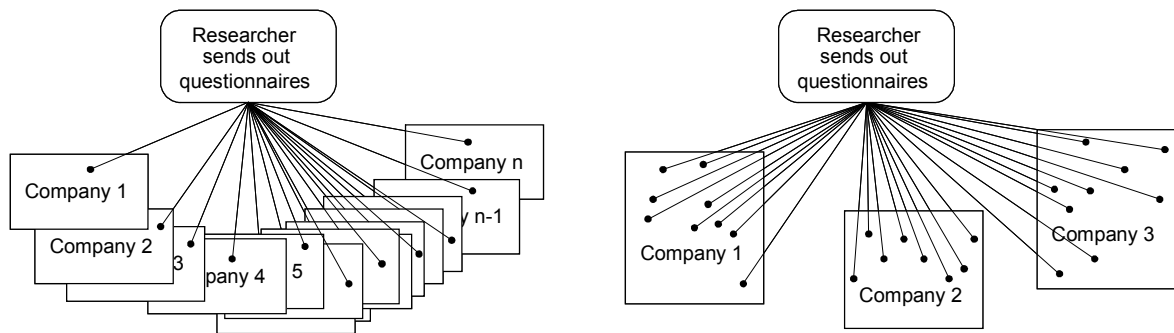
Basically there are two main purposes for making research on business/product development processes: a scientific and a practical purpose. The scientific part is either to make testable propositions followed by generalizing from empirical investigations or to study the reality and generalize from the 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 user 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. To understand the complex process of development studies of ongoing projects, the researcher who makes 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 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 (Otto 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 has been 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 quickly done and cheap to do (Jönsson 2004). In turn 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 measures 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. Extremely important in that case is to look for that the response rate is high.

Although well known, the lower the response rate 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). 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.

The result of the questionnaires is dependent on many things. Often mentioned as shortcomings are the difficulty in formulating questions and the low responding rates achieved. 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 have effect on 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 to 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 as 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 for that readers of research papers should benefit from knowledge of the researcher's background and loyalty situation.

A common 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 commonly used outsider research perspective simply 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 was - “state of the art”. 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 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 mostly is driven by commercial enterprises leaving to the researchers to test the different options.

### ***9-4 Holistic research***

The most unpredictable factor 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 traditional research problematic to be applied on ongoing processes. This as the researcher not being present over a longer period of time can get an impression of a person that is not representative for a more normal situation.

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 to a total system.

A conclusion of this might be that researchers having focus on business/product development today do not manage to grasp what really happens on a daily basis in a development project if and when they have an outsider position for their investigations. 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 studied in a qualitative way. Thus, for the researcher to be able to in a holistic way understand 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 the researchers mainly to make 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 on 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 mainly is 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 on 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 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. 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 observed 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 by narrative theorists (e.g. Riessman 1993) regarded 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 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.

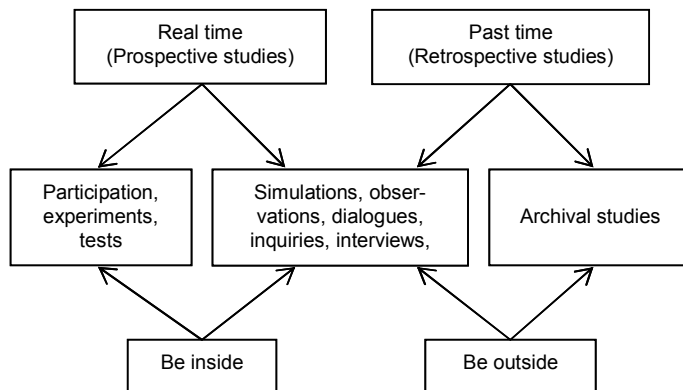


Using a narrative approach necessitates a somewhat different way of presenting the findings than the traditional research does. In that case the quality requirements for public presentation are that the knowledge is communicable, relevant, and trustworthy in terms of validity, credibility, and reliability.

### 9-6 Qualitative research aspects

Research can be made as prospective studies in real time or as retrospective studies in past time as two opposing possibilities. For studies of ongoing processes as innovation processes often the two methods are used together e.g. so that 80 % of the studies are prospective and 20 % are retrospective.

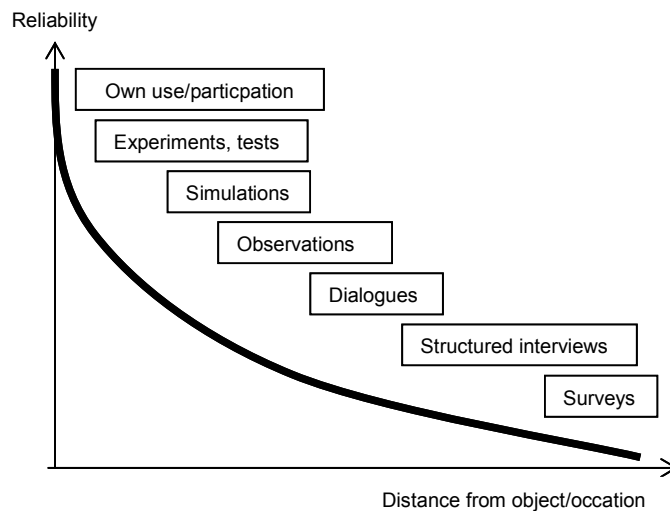
When performing *prospective studies*, three unique methods can be distinguished. They are to participate in a process, to make experiments and to make tests. Experiments and tests are often the same thing. When performing *retrospective studies*, one unique method can be distinguished and that is to 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 make dialogues, to make inquiries and to make interviews. The different possibilities are shown in figure 9-2. The figure also shows that the researcher can choose to mainly be inside the object studied or mainly be outside the object.



**Figure 9-2:** 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, own use and own participation means that the reliability gets higher than if the researcher chooses other methods shown in the two right boxes on the middle row of figure 9-2. This as the information is first hand information without interpretation errors. How in principle reliability is dependent of method used is shown in figure 9-3. 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



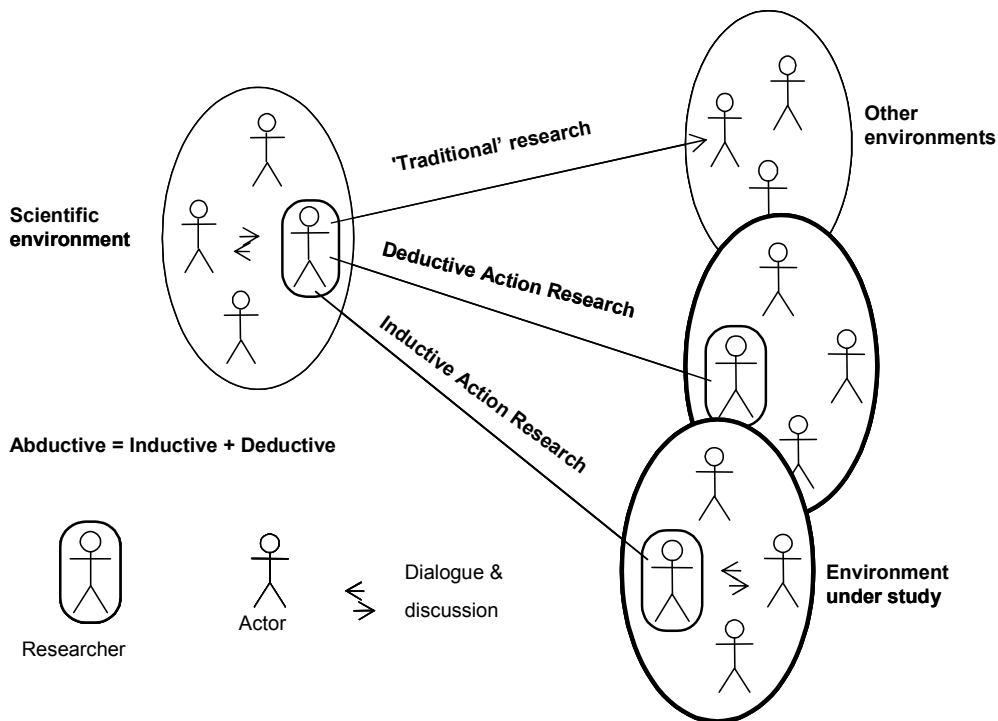
situation exists e.g. for inquiries.

**Figure 9-3:** The distance from the studied object depending on probing method used influences the reliability of the information acknowledged (Ottosson1999-B). To the left in the figure qualitative treatment is used while quantitative treatment is used more and more on the behalf of qualitative treatment when methods to the right in the figure are used.

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

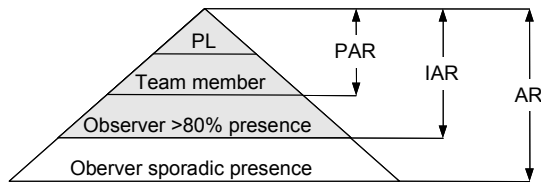
We must also bear in mind that quantum physics has taught us that we – the observers of reality - are, at the same time, the participants of reality. In other words, ‘observation’ is not a passive noun and ‘to observe’ is not a passive verb. However, our classical Western upbringing has preconditioned 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 (inductive approach), has taken part in a process (deductive approach) or has been in a process and still is part of it of it (abductive approach) (see figure 9-4). When the researchers use the inductive approach they need to ‘step out of’ the studied project now and then for reflections. Having a scientific environment to share the experiences in is of great help for reflection.



**Figure 9-4:** Illustration on relations involved in an action research approach, which can be done with an inductive, deductive and abductive approach

Performing Action Research (AR) means to be inside the studied process (see figure 9-5). 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. (Of natural reasons, also team members and project leaders perform observations. In addition, they perform traditional studies when studying other processes or competitors, etc.).



**Figure 9-5:** 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)

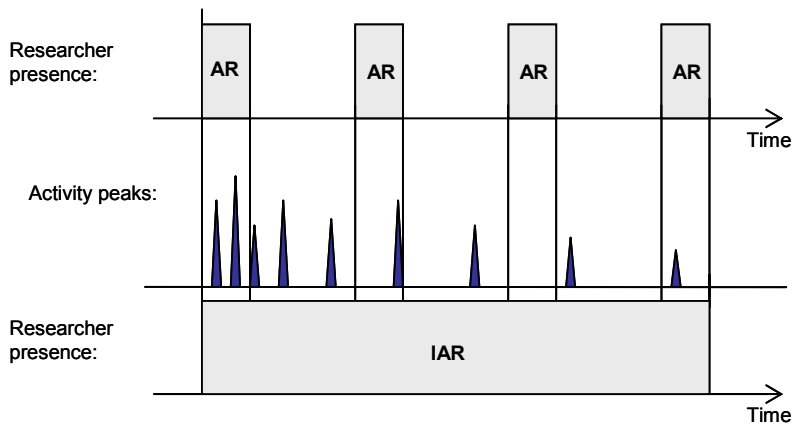
The following advantages can be achieved performing IAR over being outside of the process of interest:

- 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 out 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 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 9-6).



**Figure 9-6:** 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 done 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 it in practice was not regarded with such a magnitude (Bragd 2002). When mass media found out that, 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. In most countries researchers are not allowed to get into a company on totally free conditions. Sweden, Norway, Denmark and Finland seems to be a rather unique exception from that rule.

Performing PAR means a loyalty problem for the researcher, 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 much 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 strengthens the 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/is is within an excess of data flow difficult to handle.

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## **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:

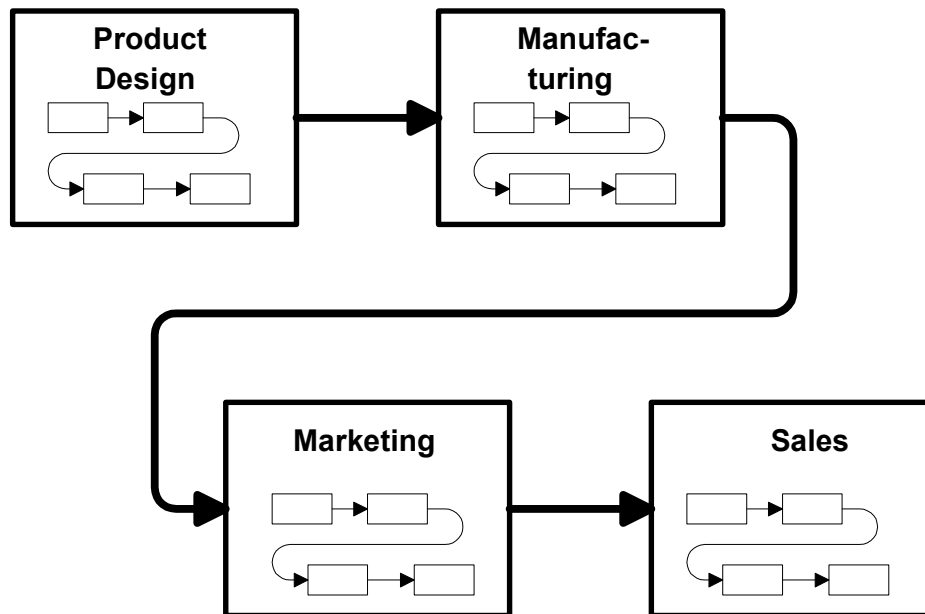
- increasing commercial pressures which demand continuous improvements in quality, shorter lead times and reduced costs
- the trend towards globalization and the reliance on IT
- increasing complexity of both products and processes
- problems of retaining and retrieving knowledge and experience
- the 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***

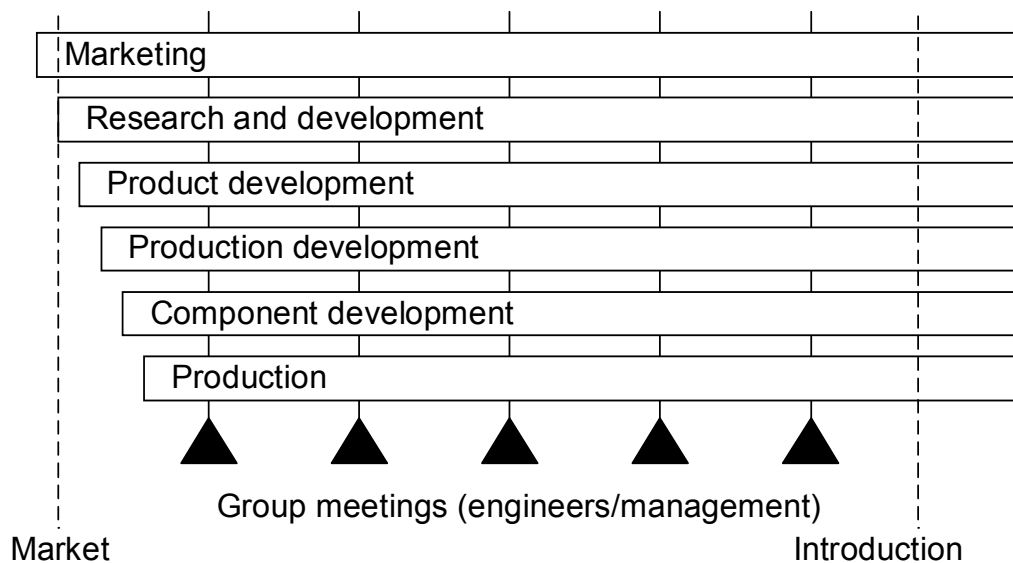
Parallel product development methods are called parallel because there is a more or less simultaneous start of activities in all involved functional departments of the company. The work within each department, however, is not performed in parallel, which would have required e.g. concept development performed 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).

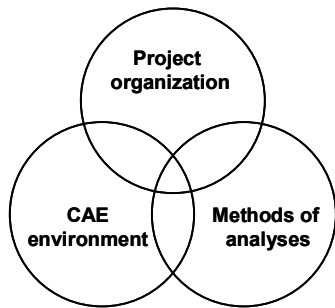


**Figure X-2** Nissan’s development strategy in the 1980’s (Graves 1987)

### **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.

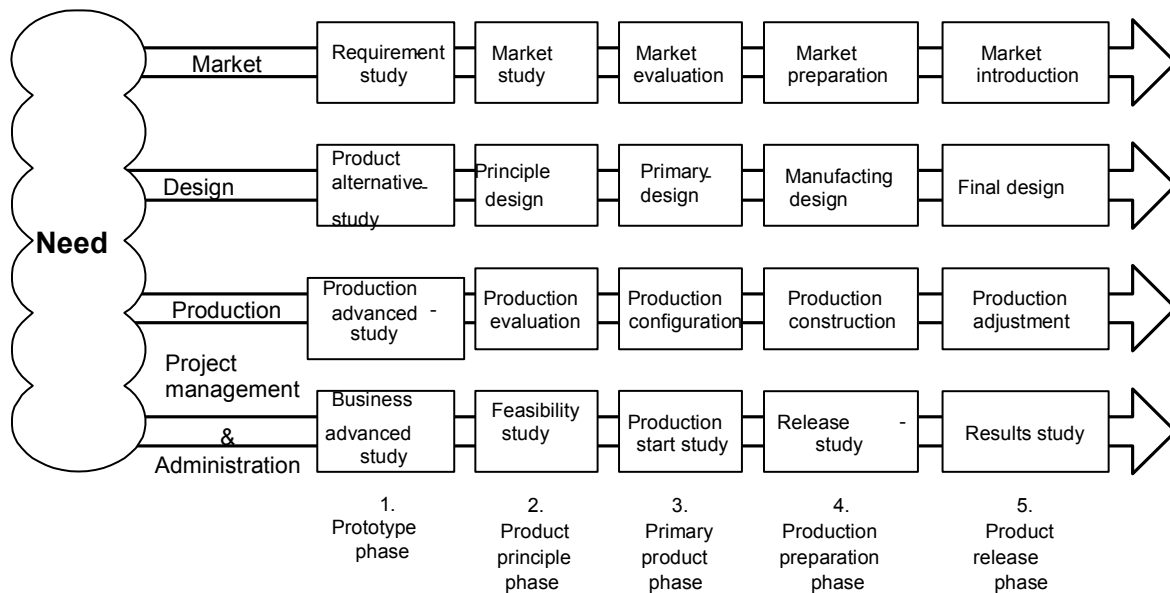
With CAE (Computer Aided Engineering) environment was meant that one shall use the possibilities the computers provide leaving the manual environment that was dominant at that time. A popular saying was that “Throw out the drawing boards.”

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 Fredy 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.

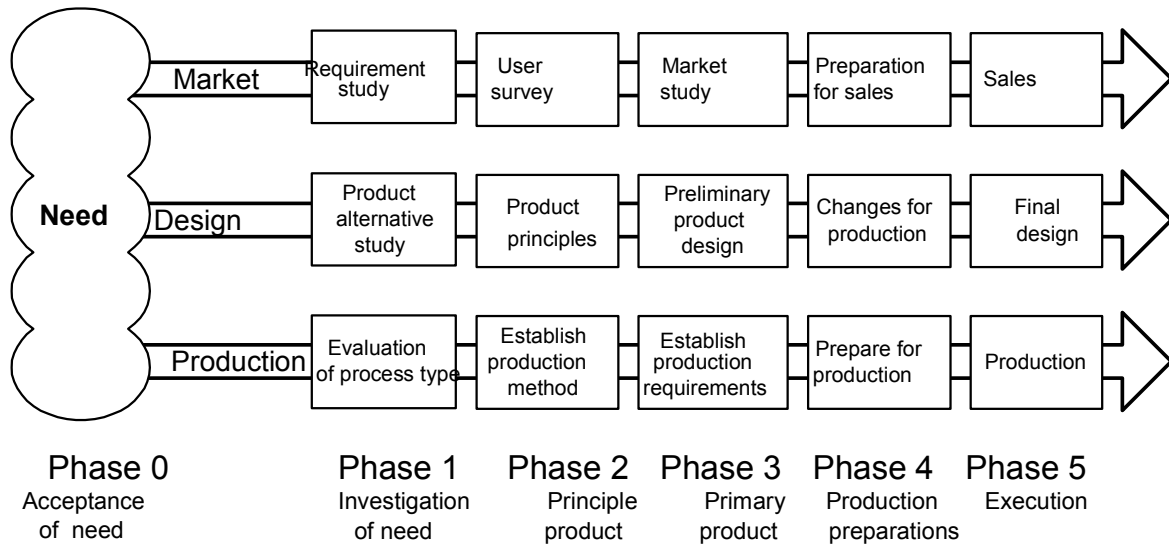


**Figure X-4:** Fredy Olsson’s IPD model (1985)

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 1995).

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 the 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.

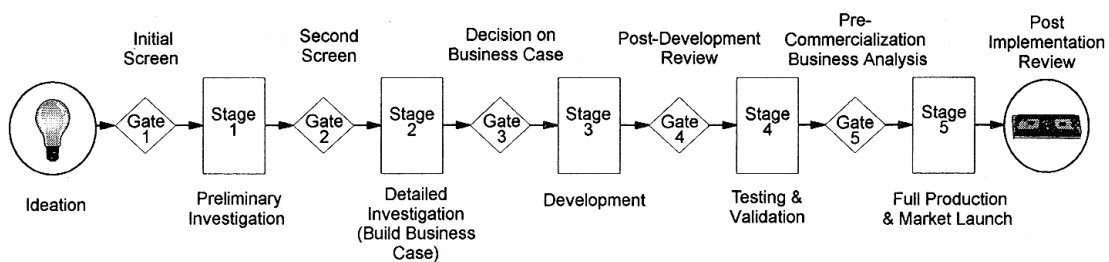


**Figure X-5:** Andreasen & Hein’s IPD model (1987)

QFD (Quality Function Deployment) is usually recommended for the identification of the ‘need’ in figure X-5, if project requirements are not already stated. Ulrich & Eppinger (2000), however, prefer interviews for collecting customer data and they also stress the importance of observations. Active customer collaboration in combination with acquiring an enhanced understanding and awareness of customer needs and demands leads to a better grasp of overall product requirements. This can reduce expensive and unnecessary component selection.

**Stage-Gate® methods**

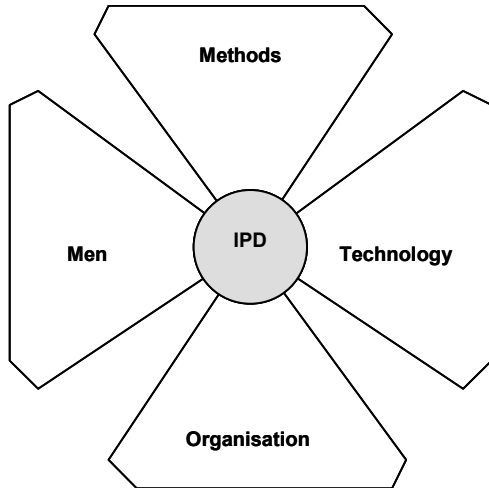
Based on quantitative studies that started in the 1970’s and now having accumulated a sample of more than 500 North American companies, Dr. Cooper and his colleges have designed a simple stage-and-gate process known as Stage-Gate® (see figure X-6). This process, it is claimed, had been adopted by more 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/>. This is the official website of the Product Development Institute Inc, which was founded by Dr. Cooper and Dr. Edgett.



**Figure X-5:** The generic 5-stage Stage-Gate™ model by Cooper (1998).

### **Dynamic Integrated Product Development (D-IPD)**

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<sup>th</sup> 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 brain of the developer as well as DfX in his view was the heart of Methods in the figure.



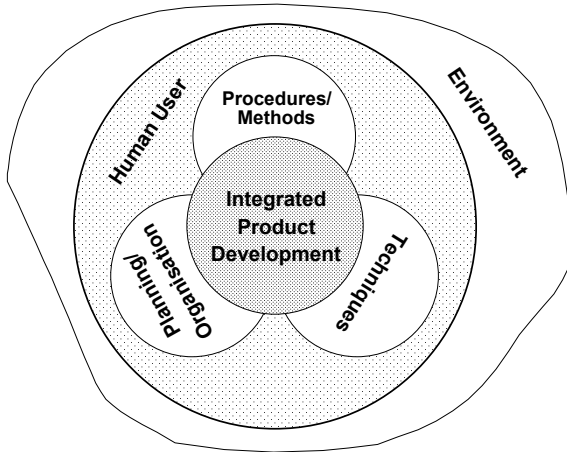
**Figure X-6:** The IPD model of prof Harald Meerkamm from 1996

Professor Sándor Vajna however felt that importance of men should be strengthen even more and proposed a model of IPD 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.*

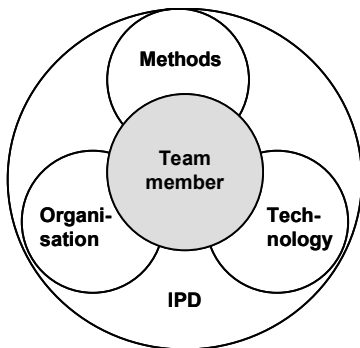
*IPD describes the integrated application of holistic and multidisciplinary methods, organization forms, and both manual and computer-supported tools with minimized and sustainable use of production factors and resources*





**Figure X-7:** The early IPD model of professor Sándor Vajna (Vajna & Burchardt 1998)

Later Vajna and his research team in Magdeburg have placed the team members in the centre of the product development. Figure X-8 shows a picture from a PhD thesis 2006 from the chair of professor Vajna. As they underline the importance of a dynamic behavior, sometimes they call their philosophy of product development for Dynamic Integrated Product Development (D-IPD).



**Figure X-8:** The D-IPD model as per 2005 (Naumann 2005)

#### ***X-4 Collaborative Product Development (CPD)***

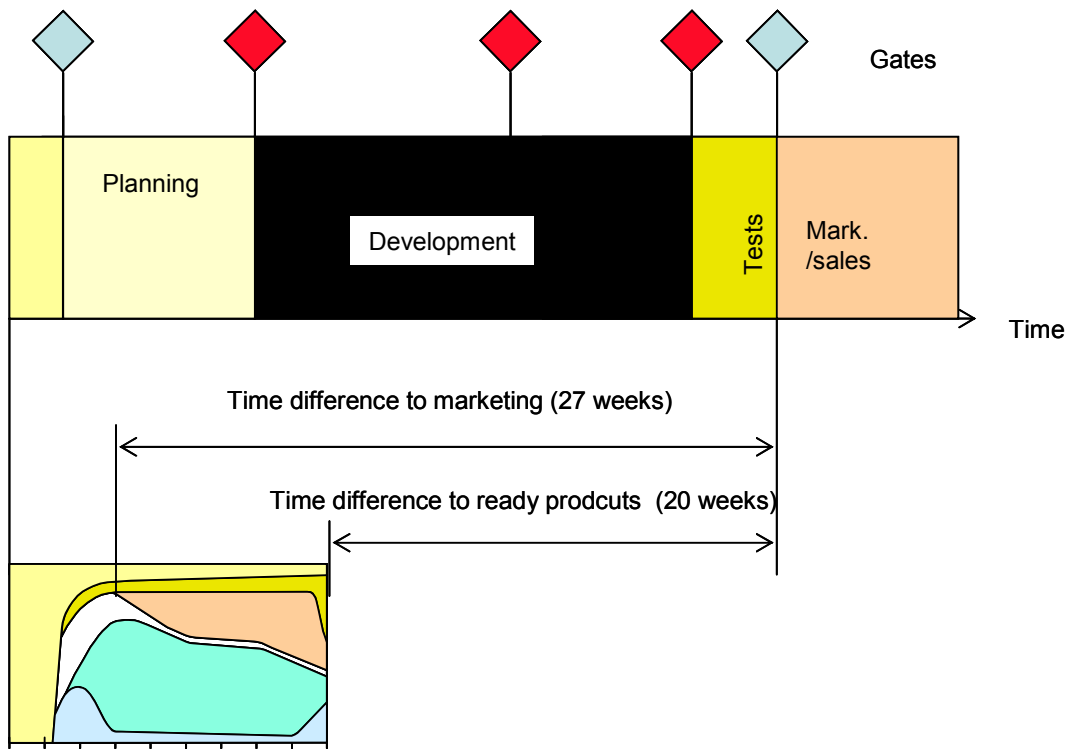
Since the end of 1990s, particularly in the automotive industry, much effort has been focused on connecting geographically separated computers in the development area with the help of ICT - Information and Communication Technology. As a result, the term Collaborative Product Development – CPD – was created, 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 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. Research has shown that more than 50 % of collaborative efforts are unsuccessful (Littler et al. 1995, Wognum et al 2002).

### ***X-5 Improvement of existing models***

Although rather big changes have been seen in the product development methods the research community has realized that the development methods and philosophies need to be changed. This as time and cost overdrafts frequently occur 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 by using a new mind setting and by doing things radically different from the opinions about how IPD should be done. The initial 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 was called Dynamic Product Development (DPD). Since then much testing and research has been done, which the reference list may indicate. Although it in general is difficult to compare development principles, figure X-9 shows a comparing study between Stage-Gate® and DPD for the development of a web portal.



**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)