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Analysis of Front-End Processes

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The aim of the thesis was to map out and analyse the Front-End Processes within the development processes of companies to identify areas of improvement. Another goal was to reveal significant similarities, which could serve as a basis for future studies.

The study was conducted in the form of in-depth guided interviews with responsible managers at Finnish companies in 2009. The theoretical background, supporting the qualitative research, tackles respective areas in the field of quality, process and operations management. As a part of the analysis, the development processes of the companies were remodelled, and separately examined. In total three companies were analysed.

The results show that these small and medium sized companies see development as the main activity of survival. Their core activity is to develop products for immature, niche markets, thus their development processes are strongly technology pushed. Their processes, fitting to their size, are relatively simple since the management have a strong grip over the development process.

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PREFACE

For my dear parents and my beloved friends, who have always been there for me.

Thank you.

CONTENTS

1 INTRODUCTION

In today's economy numerous products are competing against each other on the markets, to satisfy the needs of the customers. The success of the companies behind the products depends greatly on the success of the products themselves. Those products which have competitive advantages over the others, sell better, gain a higher market share, and eventually produce higher profit for the company. According to Vonderembse A.M. & White G.P. (1996, 37) "A competitive advantage is a capability that customers value, …, and that gives an organization an edge on its competition". For each competing player it is vital to develop such advantages. To do so, they use their competitive capabilities to satisfy the requirements of their customers, better than the competitors.

Different structures, market approaches, and strategies have been developed, in order to utilize these capabilities as much as possible. At the same time huge amount of efforts have been made to support and facilitate the sales of these products.

A winning product, however, needs not only good marketing communication, but besides it has to fulfil the needs of the customers; have an outstanding quality with a robust design; developed at the right costs and at the right time; produced with the right technology, in the right amount, without distribution issues… etc.

Nevertheless, most markets are saturated; there are many products and services present. For that reason the characteristic, value, and quality of a product are important decision making factors for the buyers.

1.1 Product Development Process

To meet all the above mentioned criteria, a product has to have a clear vision, a promise to the customer, and a versatile design. This requires a co-ordinated interplay between nearly every function within a firm. Thus developing a new product is a complex and risky undertaking for every company. In order to minimize the involved risk, and to allocate the resources suitably, modern companies have established various processes to manage the product development.

To quote from Eppinger D. S. & Ulrich T. K (2003, 12), "A product development process is the sequence of steps or activities which an enterprise employs to conceive, design, and commercialize a product".

The goal of this practice is to create products, based on synergies, among marketing, design, and manufacturing. Such a product is more likely to have competitive edges, through the synergies inbuilt in it.

1.2 Aim of Thesis

Eppinger D. S. & Ulrich T. K (2003, 12) reveals that while some organizations follow a well defined development process, others might not even beware of them. Thus the small and medium sized companies, which are involved in the thesis, are generally known to compete successfully in niche market segments, where the market is too small or too rapidly changing for big companies point out Scarborough M. N. & Zimmerer W. T. (1996, 4). This fact suggests that there can be many viable practises, which are equally suitable.

The main goal of the thesis is to map out those operations at the interviewed companies. By drawing the product development flows, a broad understanding of the development practice should emerge. A comparative analysis should reveal probable inconsistencies and indicate areas of improvement, which could serve as a foundation for the examined businesses in enhancing their own procedures.

The thesis focuses mainly on the Front-End Process (FEP) that is an important part of the Development Process. Eppinger D. S. & Ulrich T. K (2003, 16) refers to the concept development procedure as the FEP, since all important steps in a new product development is done there.

This paper tackles merely superficially other respective areas, such as strategic planning, quality, and operations management. There is neither intention nor possibility of conducting complete analysis on every aspects of the subject.

The notion of 'product' is a very wide one. The development of manufactured products differs from the development of services. In this thesis services are omitted, in order to keep the focus, however service providers can benefit from the findings of the thesis as well, if they are able to abstract from the specific research.

1.3 Thesis Structure

After the first chapter, the theoretical framework gives a brief introduction to the most important theories. This part deals with business processes, quality and integration. The main focus is kept on the generic product development procedure, particularly on the Front-End Process.

The methodology is described in chapter 3. In there the qualitative research and its route is explained, through the justification of validity and reliability factors. The link between the theory and the practise is established by electing a sample process, and an interview guide. The structure of the analysis is explained, as a preamble for chapter 4.

In the results and discussion part the findings of the analysis are revealed, following the structure of the interpretation. I.e. after a brief introduction to the companies, their process will be described and the separate steps will be identified and a remodelled process flow is drawn. At the end of each analysis conclusions are drawn and suggestions are made.

After the discussions the conclusion briefly summarises the common characteristics of the examined companies and general suggestions are made.

2 THEORETICAL FRAMEWORK

The theoretical framework gives a brief summary to the applied theory, in order to clarify and justify the research methods, used during the research. In this way a linkage should be established between the reality and the theory that provides validity to the study. To quote from Flick U. (1998, 225), " A basic problem in assessing the validity of qualitative research is how to specify the link between the relations that are studied and the version of them provided by the researcher".

2.1 Business Processes

In order to fulfil the needs of their customers, organizations have moved away from the traditional "function" based structure to an operations/process oriented one. By defining their activity as a set of processes, rather than loosely connected functions, they can gain a greater focus on their outputs, which eventually the consumers conceive (Vonderembse A. M. & White G.P., 1996, 23).

The operations approach enables integration within the company, as it defines its processes horizontally, involving many different (vertical) functions. As Vonderembse A. M. & White G.P. (1996, 3) define: "Operations are the processes within organizations that acquire inputs (people, capital, and material) and transform these inputs into outputs (services and goods) consumed by the public".

Vonderembse A. M. & White G.P. (1996, 24) conclude that a company, which is organized purely after functions, is inefficient. In other words: customers are not concerned about the function-related issues, but how the outputs satisfy their needs. Customer needs can be satisfied by competitive capabilities, which are the results of the business processes.

Thus it is vital for every company to continuously develop their processes. The PDP (Product Development Process) is one of the most important processes, as its output is the competing product (good or service) itself.

Hill W.L. C. & McShane L. S. (2008, 198) claim that organizations, especially rapid changing and high-technology firms have shifted towards the so called 'matrix' organization structure; to integrate processes into their structure, and to distribute the strategic responsibilities.

Within the matrix structure the functional managers and project leaders coexist and they share responsibilities. Project leaders manage small cross functional teams, the project groups, in which each member regardless its vertical position, works together under the leadership of the project manager (Eppinger D. S. & Ulrich T. K., 1996, 25-28).

2.2 Generic Product Development Process

Andreasen M. M. & Hein L., 2000,117-122 identified the phases in the integrated product development, whereas Eppinger D. S. & Ulrich T. K (2003, 12-16) use the term 'Generic PDP process' to describe the same process, which is a generalized model that is suitable for most companies, involved in product development. This process has six phases, i.e. (0)Planning, (1)Concept Development, (2)System-level design, (3)Detail design, (4)Testing and refinement, and (5)Production ramp up.

This process defines the individual stages, deploys the tasks, and sets the responsibilities at the different functions.

Planning, aka phase 0: The Product Planning phase is the first step in the process. At this stage the opportunities have to be identified and prioritized, resources allocated, the timing set. The complete pre-project planning is concluded in the mission statement, which specifies the aims and key assumptions and constraints.

Concept Development, aka phase 1: Through this phase competing concepts are developed, then compared to each other, and the most suitable is finally selected. An agreement on the trade-offs is reached, and the final specifications are set.

System-level design aka phase 2: The product architecture, and the subsystems as well as the components of the product are fixed. The final assembly scheme for the production system is defined.

Detail design aka phase 3: All sub-parts now possess complete specifications, the control documentation for the product is complete. The issues of costs and robust design are addressed.

Testing and refinement aka phase 4: Alpha and Beta prototypes are built to test and to refine the production process and to evaluate the products both internally and externally. Marketing prepares for launch.

Production ramp-up aka phase 5: The product is made by the intended production method. The workforce is trained and the remaining, minor issues at production are solved. The product is now launched on the market and available for distribution.

Yet the generic model is not a universal one, the individual drives and needs requires tailored, more specific processes to fit the needs of the company better. In each case, the facilitator is unique, which results in various process flows (Eppinger D. S. & Ulrich T. K., 2003, 12-17)

2.3 Integrated Product Development

The term 'Integrated Product Development' refers to cross-functional integration that occur due to implementation of the process based approach (Andreasen M. M. & Hein L., 2000,16-24). It enables companies to utilize the already existing competences at the company, in a way that they create synergies and lead to a better performance.

The PDP, such as the other processes, renders tasks for different business functions through its execution. For example while marketing is collecting customer needs, or examining competitive products, the designers are already developing early concepts, as manufacturing is looking for feasible production alternatives (Eppinger D. S. & Ulrich T. K., 2003, 22-25).

Andreasen M. M. & Hein L. (2000,23) concluded in 1985 that marketing, design, and production business disciplines have a common business goal, thus they have to work together during the development process. This concept is nowadays widely accepted. Figure 1 depicts how these functions work together during the PDP.
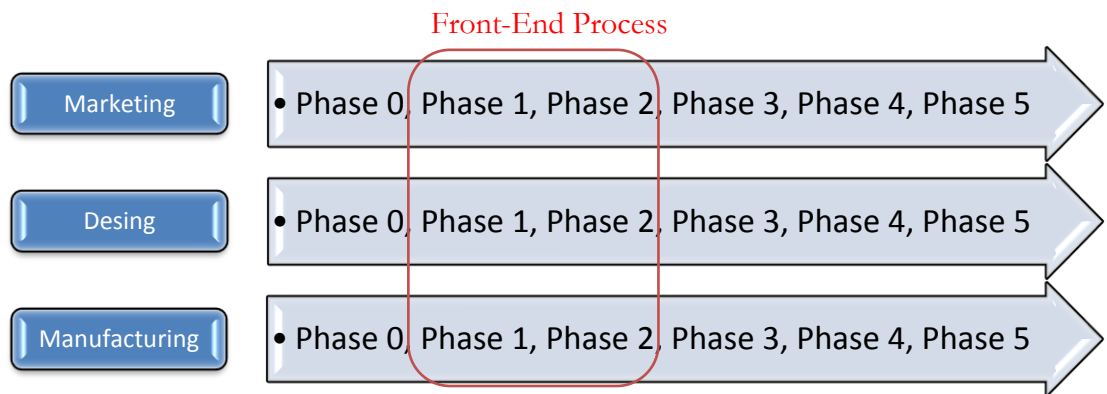
Figure 1 Interplay between the business functions during the development process. In reference to Andreasen M. M. & Hein L. (1996, 23).

Other business functions such as: finance, legal, research, and general management might be also involved, and they support the project in their own means (Eppinger D. S. & Ulrich T. K., 2003, 5).

2.3.1 Product Development Team

Projects integrate into the company by project groups. In the case of PDP there is no difference. A PDT (Product Development Team) has to be formed, with a leader, who is responsible for co-ordination and reports the status of the project.

Eppinger D. S. & Ulrich T. K (2003, 25) claim that this leader might be drawn from any of the functional areas. However, Aumayr J. K. (2006, 11-21,) disagrees with that and he suggests that this role is a part of the job of the Product Managers. He implies (2006, 11-21, 125-128) that companies should consider using a product management approach.

Aumayr J. K. (2006, 15) defines the 'Product Manager' as a person who is responsible for a collection of projects related to the product portfolio including the PDP as well. This expert shall develop a broad understanding of the market, the customer needs, the organizational possibilities, the competitors etc.

Aumayr J. K. (2006,81-84) concludes that a well implemented Product Management System is advantageous for the company, as it provides a better understanding of its external and internal environment, and eventually it could lead to an even higher degree of integration.

2.3.2 Forming the PDT groups

It is a very important question process wise, when and how the PDT groups are formed to ensure that the group had the chance to agree on major issues. Otherwise there is a good chance that poor interplay happen (Andreasen M. M. & Hein L., 1996, 15).

To minimize risks and improve quality the PDT should be formed, possibly right after the capacity filter but before the QFD process begins at the latest. Before the group is formed, the project leader manages the tasks in the early process using the resources at his disposal.

Andreasen M. M. & Hein L. (1996, 78-83) argues that while selecting the team members identical personalities should be avoided. An appropriate mix of personality types should be chosen. They suggest (1996, 79-80) the following personality types should be considered when selecting team members:

- Creative product developer: a creative and rational personality. Without other member he or she functions inefficient.
- Entrepreneur: an extrovert, persuasive person, who is more emotional than the creative developer.
- Project leader: a structured mind, who is good at organising things and pays attention of the others.
- Sponsor: an experienced developer, who has the role of the link to the management.
- Information handler: a communicator and analyser. A person, who follows the latest trends and news within the industry and on the market.
- Environment creator: he is the model for the group, the representative of the corporate culture. This person motivates the group for a good performance.

Thus Andreasen M. M. & Hein L. (1996, 82-83) points out that group intelligence should be measured and considered during the assembly of the project team.

2.4 Quality

Quality is a widely used term, which has developed throughout history. Vonderembse A. M. & White P. G. (1996, 44-45; 77-78) suggest that it has become so important; regardless the positioning of the product, today every company strives for better quality.

There are many definitions for quality. Some look at it with an internally oriented focus, saying that quality denotes conformity of the end-products to previously set specifications, while others prefer to explain quality externally; they consider customer satisfaction as a foundation of quality (Vonderembse A. M. & White P. G., 1996, 79).

Regarding the PDP process the fitting definition from Vonderembse A.M. & White G.P. (1996, 79) state: "...quality begins with an external process that identifies customer's needs and expectations. Then those (...) are translated into an internal process to guarantee they are met or exceeded". By having said that, it is clear that 'Quality' is achieved by processes. Eventually it leads to the conclusion that the quality of the process leads to Quality. Thus a process, which has quality already in built, through integration and well defined activities, leads to success on the market.

2.4.1 Total Quality Management

The Total Quality Management (TQM) is a management concept. It has evolved during the last century into a philosophy of ever continuing improvement of processes and products. TQM has many contributors, most importantly: Deming W. Edwards, Juran M. Joseph, Corsby Philip and Taguchi Genichi. In their work Vonderembse A. M. & White P. G. (1996, 86) classified the most important components of the TQM as follows:

- **Focus on customer:** Customers' needs and wants must be examined and understood and then translated into specifications. For that TQM uses the VOC (Voice of the Customer) and the QFD (Quality Function Deployment) techniques.
- **Everyone is responsible for quality:** Quality is not done at the QC (Quality Control) departments, but quality what is perceived by the customers depends on each person at the company. Integration is the key to solve the problems as a team and to share the responsibility.

- **Employee training:** TQM emphasizes team based problem solving.
- **Fact based Management:** Competitive benchmarking on competing companies or even on different industries can help the company greatly to see itself and its processes objectively.

2.4.2 Six Sigma

The six sigma method is based on the TQM, aiming for 99.99966 percent accuracy in producing products without any defects. Even though it is seemingly impossible, it encourages the company to endlessly engage in quality improvement programs according to Vonderembse A. M. & White P. G. (1996, 93).

A philosophy of continuous improvement: Organizations should always look for improvement, since there is always place for that. It suggests that organizations should remain in a state of flux in order to pursue higher and higher standards of quality (Vonderembse A. M. & White P. G, 1996, 94-95). The elements of the Continuous Improvement as follows:

- Standardize and document procedures
- Assign teams to identify areas for improvement
- Use method analysis and problem solving tools
- Use the Plan-Do-Check-Act cycle
- Document improved procedures

Hill W.L. C. & McShane L. S. (2008, 168) claim that today TQM philosophy is superseded by the six sigma, and the DMAIC methodology (define, measure, analyze, improve and control) has become the core of the six sigma.

In reference to Evans R. J. & Lindsay M. W. (1996, 259), quality is achieved through processes. Thus in orders to achieve excellence in quality, TQM and Six sigma techniques have to be integrated into the process itself. Trott P. (2008, 110) and Vonderembse A. M. & White P. G. (1996, 21-44) suggest that trough operations management, it is possible to create outputs with quality in a proactive way according to, rather than checking for quality subsequently.

2.5 Product Strategy

When the management decides upon the business-level strategy, the desired competitive edges are chosen, based on the core-competencies present within the company suggest Ireland R. D., Hitt A. M. & Hoskisson E. R. (1999, 127-130). In other words: the strategy of the company determines the processes and the structures, which will eventually reflect on the products.

Hill W.L. C. & McShane L. S.(2008, 137-138) argue that business-level strategies can be described as a mixture of the two 'generic strategies' identified by Michael Porter. Hill and McShane emphasise that these strategies are always combined, they summarise Porter's strategies as follows:

- A low cost strategy is focusing on giving the customers value for money, by pursuing a policy that keeps the costs of the operations low at the company.
- A differentiation strategy is based on the value that a product has to offer for the customers. It is achieved by the competitive capabilities, which lead to competitive advantages.

In his work Cooper G. R. (1998,236-242) argues that strategies are build upon each other in a logical sequence. The business-level strategy is followed by the product strategy. Trough the product strategy the company translates the vision of the company to the market and plans new product strategies. Cooper G.R (1998, 237) concludes that each product in the product portfolio has a unique role, and business goal that is set in its 'new product strategy'.

Cooper G.R. (1998, 246-247) refers to Miles R. E. & Snow C. C. following their categorization, as follows:

- Prospectors: Industry innovators who value being firs in adopting new technologies. They respond quickly, however they might suffer losses due to the risky undertakings.
- Analyzers: They are the quick followers. By analyzing the competitors they react quickly and often bring superior products to the market.

- Defenders: Businesses, which try to find a niche segment in a stable market. They develop superb competitive-capabilities to protect their sales. They react to changes slowly.

- Reactors: These companies reach only, when strong external and market pressure appear.

It is evidently visible that the business-level strategy certainly affects the product strategy and the development process. To bring as an example, a company might decide to purse a technological leadership within the industry to defend its leading position – based on a strong development competency. This company most likely has a very separate structure and core competencies than a company that is aiming for cost leadership to gain market share – based on a strong purchasing competency. On a sundry basis each company built different processes to focus on their own outputs.

The nature of the product and the industry play a big role in adjusting the development processes. To bring as an example: the aviation or automobile industry, where many components and subsystems are designed at the same time, require distinct business processes than the consumer electronics industry (Eppinger D. S. & Ulrich T. K., 2003, 20-22).

2.6 Drives for Development

By taking into consideration both industry and the strategy, it is clear that there are great amount of companies on the markets, with different processes. However there are common traits, which are more common at a certain companies, can be categorised. Eppinger D. S. & Ulrich T. K (2003, 19) categorised and discussed the product types in detail. The following main types were identified:

- Generic (Market-Pull) Products
- Technology-Push Products
- Platform Products
- Process-Intensive Products
- Customized Products
- High-Risk Products
- Quick-Build Products
- Complex Systems and manufacturing.

The Generic Product Development Process is based on a common market-pull situation . Eppinger D. S. & Ulrich T. K (2003, 12-16), i.e. the development process is initiated by a recognised and unsatisfied need on the market. The market opportunity is the drive for the development.

According to Trott P. (2008, 22-29), the linear models of innovation – he considers the above mentioned models linear – have become superseded. He claims that during the last two decades research companies have managed to establish a linkage between the technology push and market pull by the 'interactive' model.

With the rapid development in telecommunication and the transition to the knowledge based economy, new models, namely the network models have raised in which innovation is a continuous management process that occurs due to the cyclic interactions (Trott P.. 2008,22-29).

2.7 Product Planning

The Product Planning Process is a part of the Product Strategy. It is a set of activities by which companies manage their current portfolio, the Product Life Cycle (PLC) of its current products, and schedule development. This enables the company to develop a successful product portfolio for the future, (Trott P., 2008, 357).

According to Trott P. (2008, 361) product planning is the process through the 'new product strategy' is developed. It is based on the business-level strategy and aims to achieve the competitive advantages. He suggests that by analysing different factors and electing the results into portfolios a multi-dimensional portfolio shall emerge, which could be interpreted as an investment portfolio. That could give a realistic insight for the new product strategy.

Market portfolio

The share-grow Matrix or Boston Matrix is used to map out the competitors on the market, to identify 'competing products' of rival companies in every price segments. Trough this process, the company can identify the products that can become 'Stars' and 'Cash Cows'. Using the same analogy, it is possible to position the future products that enables to future prediction and of the market (Aumayr J. K., 2006, 53-58).

Technology Portfolio

According to Trott P. (2008, 60-61) technology S-curves and trajectories helps to predict the emergence of future technologies, already at the product planning stage. As a result of the nature of the S-curves it could indicate, when it is time for a company to adopt a new technology. Based on the technology S-curves and other methods of prediction such as: Moore's law, technological magazines, reports of research institutions... etc, a technology roadmap is elected (Eppinger D. S. & Ulrich T. K., 2003, 40). This indicates every single forthcoming technologies (the competing ones as well), which should be considered in the product planning. Managing technology development makes the planning of future platform developments realistic.

Platform Planning

The platform planning is a list of projects and their timing, so that the management can have a good understanding of current and future developments of future product platforms and their derivates. In comparison with the market segmentation, here the main focus is on the timing and coordination of the development projects, so the company can plan the resources in advance (Eppinger D. S. & Ulrich T. K., 2003, 40-43).

Developing a new product platform is very expensive, thus it is vital to oversee and manage the platform developments and the related derivates. Trott P. (2008, 357-361) categorised the following types of development:

New product platforms: develop all new technologies into a common platform, what serve then as a base for the upcoming derivates

Derivates of existing product platforms: Products with minor differences in their specifications, built on the same technology and subparts, allow further and more precise positioning at lower development costs.

Incremental improvements to existing products: Minor changes or updates of products, to keep them competitive on the market.

Fundamentally new products: These products involve the most amounts of uncertainty and risks. The unfamiliar market and the untested new technologies makes these project with a full of ambiguity, but the long term success of a company based on these 'original' products.

The PLC of a product platform could be prolonged by incremental improvements to existing products. Fundamentally new products are developed, when e.g. experimenting new technologies or entering to new markets (Eppinger D. S. & Ulrich T. K., 2003, 35-36).

2.7.1 Managing Innovation

Eventually good ideas are the foundations of the products on the market. A good idea along with a good concept, could give a whole new meaning to a product (Trott P., 2008, 12-15). He continues concluding (2008, 15) that innovation occurs when a novel theoretical conception meets a technical invention that is commercially exploited. There are various examples for that such as: the ball-pen, the safety belt, or the Tetra Pak's packaging.

Thus it is vital for every player on the market to come out with new ideas, innovations in their products. There are many ideas in the environment of the company; they might come from an internal function e.g. sales department, a sales person who knows the customer the most, might spot become aware of an unsatisfied need of a current customers, manufacturing function, or from current developing teams. They might come outside of the company, from third parties, from research and development organizations, or might even directly from the customers (Eppinger D. S. & Ulrich T. K., 2003, 36-38).

There are many ways to facilitate the idea generation through e.g. employee programs, customer surveys, benchmarking. Trott P. says (2008, 15), " Innovation is the management of all activities involved in the process of idea generation, technology development, manufacturing and marketing of new (or improved) product or manufacturing process or equipment".

Opportunity Funnel

Nevertheless collecting and managing ideas is very important, but selecting the proper one has the at least the same, if not even higher importance. Ideas must meet the opportunities in order to have a real use of them. For that reason the opportunity funnel is established. It functions as a risk management tool (Eppinger D. S. & Ulrich T. K., 2003, 37).

On the top of the opportunity funnel the ideas are collected. And they are processed through the funnel, by testing and examinations (Andreasen M. M. & Hein L. 1996, 72). As a result an idea, or ideas; will be selected to become pre-project(s). The funnel employs several filters to achieve this result. Companies, might employ different filters, or choose another way for sorting the ideas out (Eppinger D. S. & Ulrich T. K., 2003, 37).

In here, the three commonly used filters are summarised: the strategy filter, the market filter, the capacity filter in reference to Cooper G.R. (1998, 113) and Trott P. (2008, 527) as follows:

The Strategy Filter: The main purpose of the strategic filter is to double check, whether the idea fits the direction of the management's strategy. If the new product could fit into the product portfolio and there are no timing issues.

The Market Filter: Whether the market is ready for the innovation. Is there an already established product with a mature PLC on the market? Is it a growing market? How big the potential revenue could be? Would it be able to produce an acceptable ROI factor?

The Capacity Filter: it is important for every organization to monitor its own resources, and activities, (running projects, and the labour assigned to them, costs). Monitoring resources makes it possible to assign assets in the future, eventually to plan and optimize capacity. As a part of the resource management, the capacity filter helps to allocate free resources for the project. If there are no currently available assets at hand, timing has to be revised, or the project has to be re-prioritized, in some cases even dropped.

Cooper G.R. (1998, 113) names filters as screens and emphasise their importance as Go/Kill points, whereas Trott P. (2008, 527) separates the market filter into two separate entity. He suggests that market information and demand should be assessed independently.

Various filters could be established in order to screen ideas and collect opportunities, if they are suitable for the organisation's activity (Eppinger D. S. & Ulrich T. K, 2003, 34-50 and Trott P. (2008, 527-528). Legal or technology filters could be handful at certain companies.

Rejected ideas, which seemed promising, but they e.g. failed one of the filters in the opportunity funnel, remain in the idea pool and will be marked for follow up (Eppinger D. S. & Ulrich T. K, 2003, 38). To bring as an example for such a case: an upcoming new technology can fail the market filter, due inadequate market readiness, but keeping in mind the characteristic of the technological S curves, it makes sense to get back to this technology after some time. So the idea will be marked for revision in the near future.

2.7.2 Pre-Project Planning

When an idea is selected at the end of the funnel, it enters the pre-project planning phase. It is a special phase, where the project will be built up and prepared for integration to the currently running projects. The project will be then prioritized according to the importance for the company (Eppinger D. S. & Ulrich T. K. 2003, 45-47).

Mission Statement

Based on the core team's report on the pre-project planning, the management reaches a decision, whether the project worth to put into implementation, or there are too many remaining uncertainties in it. Rejected projects can be iterated until the unsolved issues are addressed properly, and the risks are lowered to a tolerable level. They can be revised then later again, or simply documented in the archives as a lesson for the future, so the work of the core team is not lost (Eppinger D. S. & Ulrich T. K., 2003, 48)

Upon the acceptance of the project, the mission statement is put in force, which is the brief summary of the project planning, concluding the aims of the project, and the most important details: such as target costs and the timing of the milestones. As Eppinger D. S. & Ulrich T. K (2003, 48) summarise, the mission statement helps the team in identifying constraints (e.g. certain manufacturing facilities) in the early stage, and in addition to that it calls the attention on product needs that might not derived from the customers, but has to be considered (e.g. environmental issues).

In practice, apart from the obvious functions of the mission statement, it has a less visible, but still a very important function corresponding to the TQM principles. Namely: the distribution of the responsibility. It articulates the commitment from the side of the management; furthermore the leaders from the relevant function and the core team can meet face to face and sign together a commitment towards this project. This should help in preventing disputes in the future concerning responsibilities and questions of capacity.

With the mission statement accepted the project takes off, and proceeds to the Front-End Process.

2.8 Front-End Process

The Front-End Process (FEP) is a standardised framework to manage the integration process-wise. It functions as a tool to achieve integration easily and repetitively. During the FEP all the aspects of the future products are set, the alternatives are over thought and the fittest is chosen. At the end of the FEP the PDP process has reached a high degree of maturity, and the results are documented in the 'Development Plan' (Eppinger D. S. & Ulrich T. K., 2003, 16-17).

During the FEP a set of activities are executed in a linear sequence. After each phase an economic analysis, benchmarking of competitive products, and the building of continuous test models and prototypes must be conducted (Eppinger D. S. & Ulrich T. K, 2003, 54).
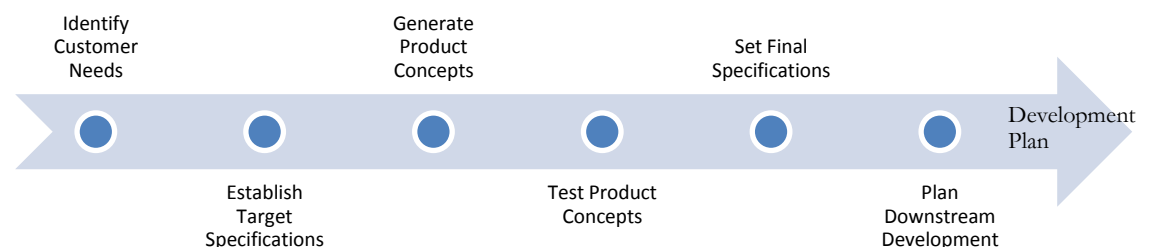
Figure 2 Elements of the FEP according to Eppinger D. S. & Ulrich T. K (2003, 16)

Identify Customer needs

As it was mentioned earlier, in order to build quality into the products, the process itself has to identify the customer needs. According to the TQM terminology, this means listening to the 'Voice of the Customer' (VOC). To quote from Vonderembse A.M. & White G.P. (1996, 87): "The more a company understands its customers, the better it will be at the meeting or exceeding the their needs and expectations" Thus it is clear that identifying customer needs, establishing specifications, concept generation and testing are greatly connected to each other.

Identifying customer needs is a complete process according to Eppinger D. S. & Ulrich T. K (2003, 55). Based on their suggestions and on the TQM principles, the following main steps are described:

- Gather raw data from customers (the Voice of the Customer events)

- Interpret, organize, prioritize needs and translate them into specifications (Quality Function Deployment)

This process ends with the set of intended specifications, which functions as the point of origin for the concept development.

Voice of the Customer

As Evans R. J. & Lindsay M. W. (1996, 161) states: "Customer requirements, as expressed in the customers' own terms, are called the voice of customer. There are three widely used methods to gather Raw data from the customers (Eppinger D. S. & Ulrich T. K., 2003, 56).

- **Interviews:** Members of the development team interview a customer, to gather a deep insight.

- **Focus groups:** A moderated discussion within a small group (around 10 participants), which is observed and analysed.

- **Observing the product in use**: This is probably the most useful tool. By observing the customers, while they use the product, can deliver essential information about how customers use the product in real life, and what are the properties of the product what they really value. It is very important that the observers remain utterly passive, in order to let the customers undisturbed.

Evans R. J. & Lindsay M. W. (1996, 161) argues that there are many different persons involved in selling and supporting a product. This 'Field Intelligence' should be considered. Besides Study complaints could also serve as a voice of the customer, and can deliver vital information.

As a result of the VOC event, the gathered data has to be translated into needs. These then have to be prioritized, to gain a good overview of the needs of the customers. Following the process, the next step is to assign those interpreted needs to features, specifications.

Figure 3 Brief overview, how the voice of the customer should be interpreted.

Quality Function Deployment

To accommodate the customer's needs and the expectations with the realities, the Quality function Deployment (QFD) tool can be used (Evans R. J. & Lindsay M. W., 1996, 248). It is often called as a 'House of Quality' method, after its shape.

This is a matrix, where the needs (WHAT) dimension is melted with the HOW (design specifications) dimension. This tool is a great help in creating a realistic specification, which helps by identifying the areas for rational trade-offs (Evans R. J. & Lindsay M. W., 1996, 248-259).

According to Vonderembse A.M. & White G.P. (1996, 87-90), there are more "houses", not only one. After the characteristics are set, further transformations are needed to identify the further aspects of the products. This method could give a very precise description for the engineers to come up with suitable concepts.

The initial set of specifications

By setting the initial set of specification, the direction of the whole development process will be assigned. To give a characteristics to a product, which has to please the customers' needs and fulfil the expectations of the company, is a long process with plenty of tradeoffs Eppinger D. S. & Ulrich T. K. (2003.73-83). Thus it is vital that during this procedure many aspects of the development are over thought.

The multi functional nature of the development team is vital at this point, in order to make the right tradeoffs. Some aspects, the development team should think of:

Cost analysis: It can be very helpful, in the means of remaining below the target costs. By creating a bill of materials with cost estimates, corresponding to the results of the QFD, a simple cost model could help eliminating unnecessary costly features (Eppinger D. S. & Ulrich T. K., 2003, 94-95).

Built for Manufacture/Production: Manufacturing and purchasing experts can help, avoiding making expensive decisions, which could cause problems later in the development process. As Hill W.L. C. & McShane L. S.(2008, 175) states, "Design for manufacturing is a philosophy that tries to increase productivity by designing products that are easy to manufacture".

Robust Design: To quote from Evans R. J. & Lindsay M. W. (1996, 239), " Products that are insensitive to external sources of variation are called robust". The term 'robust design' tied to the name Taguchi Genichi. He used statistical tools to identify variations points in the design, and examined them how they tolerate variations. By identifying design elements that are less sensitive to variations, can lead to further cost reducing, or standard sing elements, longer life time and better quality.

There are many aspects, upon which the team has to decide. Process wise it is important to make these considerations before the concept development begins, to give the engineers a realistic brief to work with.

2.8.1 Concept Development

To quote from Eppinger D. S. & Ulrich T. K (2003, 98): "A product concept is an approximate description of the technology, working principles and form of the product". In other words, the concept of the product is the shape of the idea. This is the stage where the function meets the purpose. A good idea, itself is not enough for a successful product, but yet an innovative solution, which pleases the needs of the customers, can bring the product into a new level (Trott P., 2008, 20-27).

To illustrate the difference between new ideas and a radically new concept, the example of Apple's iPhone is brought, based on the case study in the work of Trott P. (2008.23-55). The idea of the modern mobile phones is not a revolutionary one; on the contrary they are already an important part of our lives, representing a mature industry. The touch screen, has also been available for quite a time, the technology is not anymore immature.

Still what the industry didn't have, was a firm belief in, the segment of the touch-screen phones. Basically the idea, of a mobile phone, was fitting the plans of Apple in order to break into the market of the handheld devices. They knew that they can only repeat the success of the Ipod, if they are able to bring the same amount of innovation, what they managed before. Otherwise the Apple mobile, could not reach other users, expect from the fans of Apple.

What they needed is a fresh approach, a new concept for the existing product. Therefore an entirely re-thought user interface, an utterly new approach to the concept of the touch screen enabled devices, with a great focus on users, brought success to the company.

When the specifications are set, the engineers develop several concepts on the same theme. Process wise it is possible, to support the engineers and coordinate the other functions. Eppinger D. S. & Ulrich T. K (2003, 99) suggest the following steps to be taken:

- **Clarify the problem:** Understanding the problem, which is decomposed into sub problems.
- **Search externally:** interview lead users and experts. Search for relevant solutions in patents and literature. Benchmark the industry.
- **Search internally:** Different concurrent or previous projects could have already came up with new ideas. Individuals can also generate new ideas.
- **Explore systematically:** Using the classification tree and the combination tree to find the best possible technology, fitting the product.
- **Reflect on the solutions and the process:** Revise the process, select the most promising concepts.

2.8.2 Concept Selection

By this stage the development team has already came up with several interesting concepts. To cite from Eppinger D. S. & Ulrich T. K (2003, 125): "… concept selection is the process of narrowing the set of concept alternatives under consideration". There are methods to choose the right concept, which helps to retain customer focus, and reduce risk. Eppinger D. S. & Ulrich T. K (2003, 125-139) suggests using decision matrixes, such as: the concept screening and the scoring matrixes. The main idea behind those tools is to support the decision making, by giving a relative objective picture of the possibilities represented by the different concepts.

Through screening, the concepts are compared to a reference model by considering numerous factors. The concepts, gained highest scores, will be ranked. And at the end, one (or very few) will be chosen for testing Eppinger D. S. & Ulrich T. K (2003, 107-118)

The concept selection is a very important moment, where a mixture of significant aspects should be taken into consideration, thus it is important that apart from the 'artificial' analysis the development team can reach a commonly accepted agreement. Combining and melting ideas can lead to a mutually accepted solution. (Eppinger D. S. & Ulrich T. K., 2003, 125-139)

The selected concept is put into test. Concept testing can be time consuming and also expensive, thus it is vital that the best model(s) was/were selected. It is a key moment in the PDP, where the acceptance of the product can be measured (Cooper G.R., 1998, 118).

Eppinger D. S. & Ulrich T. K (2003, 146-159) explain the major steps in conducting such a test. There are many forms for conducting these tests, but the team has to come up with a solution, how to ask future customers and how to present their ideas to them. The main goal is to gather information from relevant customers, with decision making power.

Based on the results of the test, the team can improve the original forecasts. If the numbers are promising, and the testers' attitudes, opinions and suggestions are discussed, the team continues by establishing the final set of specifications (Cooper G.R., 1998, 118).

2.8.3 Downstream Development

According to the FEP methodology (Eppinger D. S. & Ulrich T. K., 2003, 158-159 , after this point the marketing function begins the preparations for launching the new product. However still working together with the design and manufacture functions on various tasks, such as: early demonstration of the beta products for partners, preparing marketing material for the packaging... etc.

3 METHODOLOGY

Product development is a complex procedure that develops together with the company during the years. Innovative organisations learnt the way of accommodating emerging expertise to their processes through organizational learning.

With new competences appearing within the company, structures and processes must be redesigned to cope with the new situation. Thus in their endeavours for innovation, better quality, cost efficiency, and answering the challenges of the ever-changing business environment, companies realised that revision and actualisation of their current processes must be a regular activity.

As it can be clearly seen, business processes reflect on the entire practise within the organisation, thus studying those processes requires a much deeper insight than a quantitative research could deliver.

Flick U. (1998, 5) defines qualitative research as follows: "... to design methods so open that they do justice to the complexity of the object under study. Objects are not reduced to single variables but are studied in their complexity and entirely in their everyday context. Therefore, the fields of study are not artificial situations in the laboratory but the practices and interactions of the subjects in everyday life..."

Focus interviews allow the interviewee to express themselves more openly than a standardised interview or a questionnaire (Flick U., 1998, 76). In consequence a qualitative research method is chosen, in the form of focussed in-depth expert interviews

3.1 Reliability

An interview guide was developed, to ensure that the interviews keep their focus and the research is reliable. According to Flick U. (1998, 224) a reliability has two important aspects in a quantitative research, firstly a detailed description of the data genesis needs to be explained. Secondly, the procedures of the field interview have to be explicit. However in general reliability does not play such an important factor as it has in a quantitative research.

The interviews were conducted at the firms' head quarters in a prearranged appointment. A summary of each dialogue can be found in the appendices, besides the results were double checked during the confidentiality check that followed the consolations.

3.2 Validity

As Flick U. (1998, 225) states, " A basic problem in assessing the validity of qualitative research is how to specify the link between the relations that are studied and the version of them provided by the researcher". The research is based on the following three pillars:

- Theoretical part in terms of Quality, Integration and Operations
- Sample Process (see page 29)
- Organizational Realities

3.2.1 Sample Process Flow

A process flow is the visualisation of the practice, what the company follows in performing the process. As a summary of the theoretical framework and as an introduction to the analysis, a sample development process flow is drawn including all the aforementioned steps in the Generic PDP. It leads step-by-step through the whole process according to the theoretical framework. The process is depicted in figure 4 and also in the appendices.
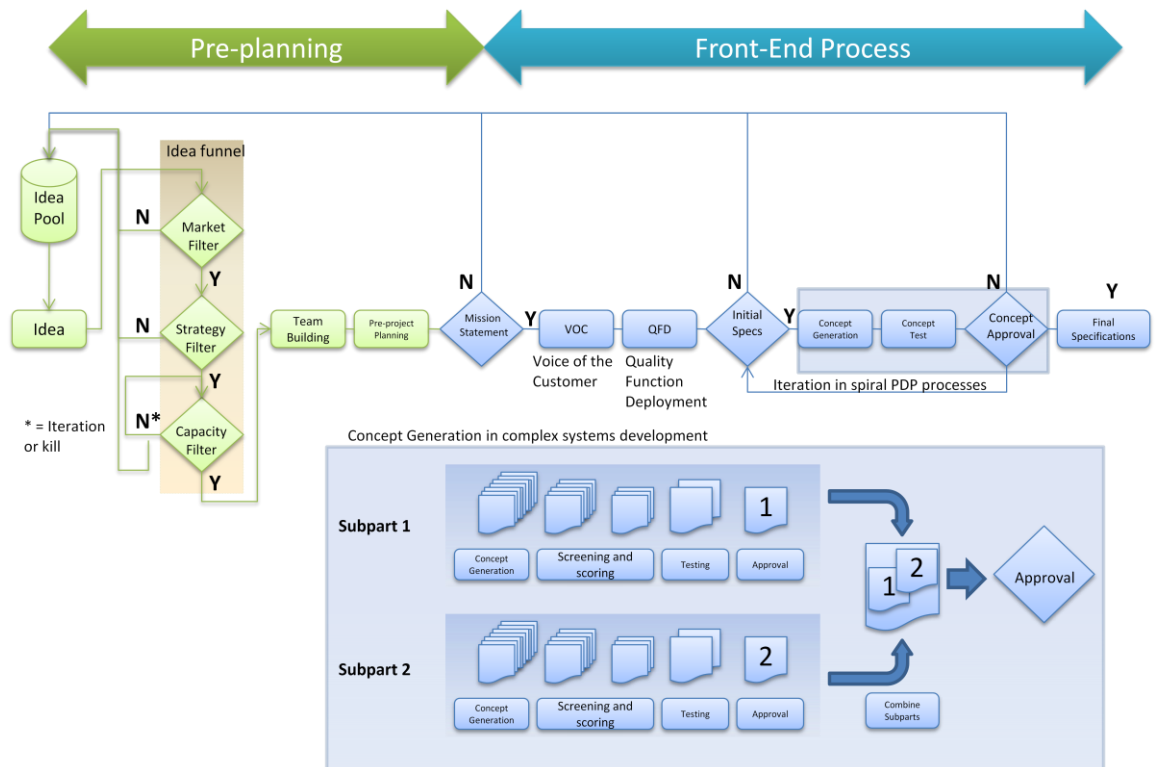
Figure 4 Sample Development Process Flow

The picture above illustrates the whole process from the collection of ideas to the final specifications. Each rhomboid represents a Go/Kill decision point. According to Cooper G. R. (1998,49) it is very common that companies neglect kill decision points, that leads to failures.

A distinct light green colour is used to mark the steps belonging to the pre-planning phase and a light blue colour to indicate the steps that are part of the FEP.

The iteration at the capacity filter refers to the short term iteration cycles. It could occur when the company finds a promising idea and resources are expected to be freed in a short term. If the management re-evaluate the project it falls back to the idea pool (Eppinger D. S. & Ulrich T. K, 2003, 38).

The Iteration between the initial specifications and the concept approval refers to the spiral product development processes, which is the characteristic of the quick-built products (Eppinger D. S. & Ulrich T. K, 2003, 22).

The light blue box beneath the process demonstrates how concepts for complex systems are developed. The procedure is iterated or simultaneously done for each separate components, which will be then integrated for approval (Eppinger D. S. & Ulrich T. K, 2003, 22).

Yet electing a sample process has multiple functions. In the analysis, the real processes will be remodelled, by identifying the steps in reference with the theoretical framework. A connection between the theory and the practice is achieved by creating corresponding processes, which can be matched with each other.

This process is based on the theory, which presumes ideal (artificial) conditions at the company (Andreasen M. M. & Hein L., 2000, 22-29). It focuses on the activities of the development team, rather than the specific functional tasks.

Nevertheless in reality, many companies fall into the pitfalls of departmentalisation that can be seen on the strongly fragmented processes. Integration, however, requires a team that works together during the whole process, rather than delegated tasks from one department to another (Andreasen M. M. & Hein L., 2000, 22-29).

3.2.2 Organizational Realities

To gather more realistic data from the companies, the generally addressed trouble areas are taken into consideration, during the development of the interview questions.

Hill W.L. C. & McShane L. S. (2008, 198) suggest that integration of the project managers can be problematic. Clashes between the functional managers and the project leaders can endanger the performance of the operations.

Eppinger D. S. & Ulrich T. K (2003, 7-8) has similar findings to Andreasen M. M. and Hein L. (2000,13-19) in identifying common problems concerning development at companies. They suggest that general issues are:

- In company structures, what lead to clashes between the functional managers and the project managers
- Inadequate cross functional representation on development teams

- Inadequate resources, as a result of the neglected resource planning
- There is a chance for that some delegates from the functions might influence the development process to gain better positions at the company

To establish a starting point for the analysis that refers to the theory, introduced in the previous chapter, and at the same time it answers the questions of the organizational realities, the following factors depicted on figure 5:
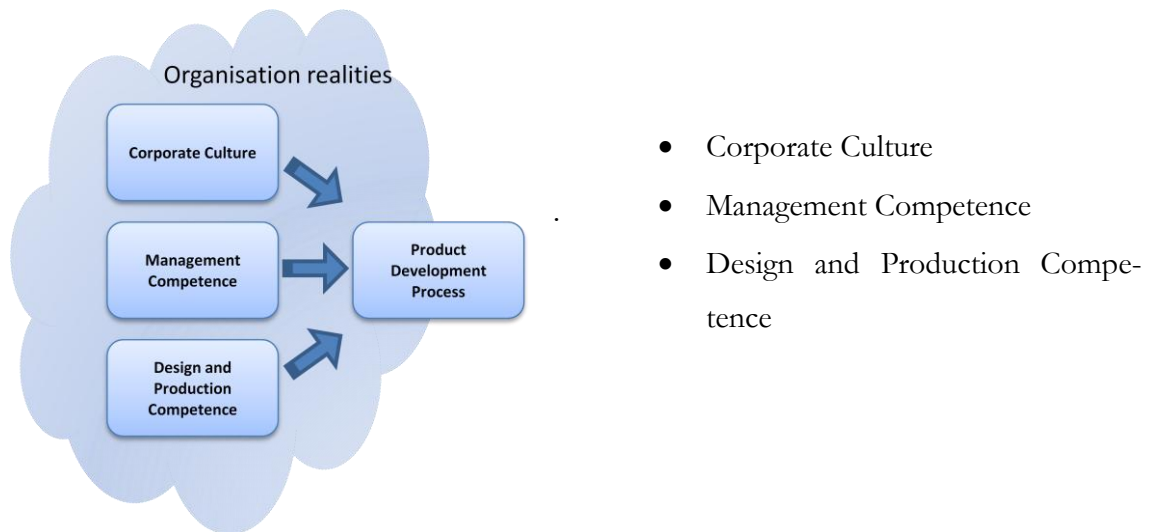

- Corporate Culture
- Management Competence
- Design and Production Competence

Figure 5 Affecting factors on the PDP

3.3 Interview Guide

The interview guide, can be found in the appendices, are structured into four significant parts: general questions I, core questions, general questions II, free questions.

The core questions were meant to be sent in advance, so that the companies could prepare for the interview. The rest of the questions were hold back to minimize the distortion in the questions concerning attitudes and corporate culture.

General questions I: The main purpose of the first part is to give a straight kick off to the topic, involving the interviewee in a simple ranking task, and then giving some freedom to let them explain their own ideas about quality, and to have them justify their own company structure. The reason behind it is to measure corporate culture by letting them speaking about it. The managers carries the values and attitudes of their organisation in themselves,

therefore it is possible to make implications, whether the company is a 'developer company'? What is the degree of interplay within the company, the flexibility and organisation?

Core questions: The core questions focus on the process itself. It tries to identify: methods of product planning, the main drive behind the development, how does the product portfolio look like, and what is the general timing for launching new products? In other words, if the company has implemented a product management approach or not?

Then the questions move forward on issues in innovation management. How does the company handle new ideas? What sorts of filters are established? By what means do the development teams form? How is capacity measured? How does the company conduct the FEP? Which tools do the use for identify customer needs, and how do they transform them into specifications, later on to concepts. How do they sort out and finally select the concepts? How do the test them?

Eventually the purpose of the core question is to lead the interviewee through the development process until the final project approval, from where the downstream development begins. By adding question of costing to this section, my intention is to investigate, whether pre-planning takes place and to identify control points in their processes.

General questions II: After the main questions concerning the FEP process are answered, more abstract questions are asked. Taken the organisational realities into consideration, questions of improvement are raised. Companies experience problems, but they are not necessarily see the reasons behind it. Thus in this part has a double check function, which helps in supporting or disapproving suggestions for improvement concerning the process during the analysis.

Free questions: These in-depth interviews take plenty of time, furthermore the questions were designed to identify the most common problems, but since each case is unique it has to be handled flexibly. It is very likely that miscellaneous and even off topic matters will be tackled, during the interviews, which still can contain worthy information. Therefore there is space left for those questions.

3.4 Interpretation

The analysis is primarily based on the conducted interviews (see appendices for details) , in addition to that on (confidential) company materials, which can be found in the appendices, and on publicly accessible corporate information from the websites of the companies.

The structure of the interpretation follows as it is discussed in the 4th chapter.

The analyses structured as follows:

- A brief introduction to the company and its product portfolio. Product strategy and product planning is considered. To identify strategies, the classification of Michael Porter (Hill W.L. C. & McShane L. S., 2008, 137-138) is used, who defined two major competitive strategies: cost leadership and differentiation.

- Analysis of the product development process. In this part the companies own processes are remodelled, by using the terminology of the general PDP and the steps of the previously elected sample process. Besides the visual explanation, the most specific characteristics are discussed descriptively as well.

- Separate conclusions are made for every case, in where the findings of the analysis are discussed in general, focusing on the current state at the organisation.

- After each conclusion, suggestions are made, focusing mainly on the possible improvement areas process wise. Other areas such as: opportunities in product planning are might tackled cursorily.

In hopes of exchange of useful information and search for improvement the following companies co-operated:

- Raute Corporation Mecano business : Jyrki Pesonen, Technology Chief

- Ebsolut Oy : Esko Suomalainen, Senior Consultant

- Sensinode Ltd : Veli Matti Enkenberg, Director, operations

4 RESULTS AND DISCUSSION

The results of the interpretation are discussed in this chapter. The structure of the analyses follow the order as it was previously discussed in chapter 3.

4.1 Mecano

Mecano is a small sized business, employing nearly thirty employees. The company's core activity is in the wood processing industry, specializing in production, and selling and developing of vision, moisture, and integrated analyzers. It was founded in 1992 and today, as a part of the Raute group since 2005, the company has activities all around the world.

The company operates in the B2B sector, its products meant for industrial production. During the years a strong and diverse product portfolio has been developed in which, apart from the different machines, smart devices, software, and support services are now also included. Today the third generation of the product line is currently available and the next generation is currently under development.

The extensive product portfolio is centred on the integrated analyser that is clearly the 'flagship' of the product line. The VDA/VRA/DMA is able to perform all the three major application areas: visual clipping analysis, visual defect analysis, and moisture measuring.

To facilitate sales and to make the 'flagship' more appealing for the customers, the VDA/VRA/DMA is available at various prices. The customers can customize the product, to fit their needs utterly. This means manageable capacity and less risk for the customers, which are viable sales arguments for the extra costs of the machine.

In order to keep its leading position in the industry, a best in class strategy is applied that is based on the assumption that customers are willing to pay extra for best products. It generates extra profit for the manufacturer, in this case for Mecano. To explain the price difference the company has to maintain its technological upper hand over the competitors.

4.1.1 Development Process

Accordingly product development at Mecano is a clearly technology driven. They are continually looking for new technologies and their possible use in their new products. The structure of the company reflects on the strong research capability. The sub-functions in the R&D are organised after the relevant technological areas (as it can be seen in appendicies), which enables the company to engage in multiple research projects generating useful know how for the company.

Research integrates well into the development process. The technology department is the initiator of various research projects in hopes to discover new feasible technologies, which could serve as an idea for a new product.

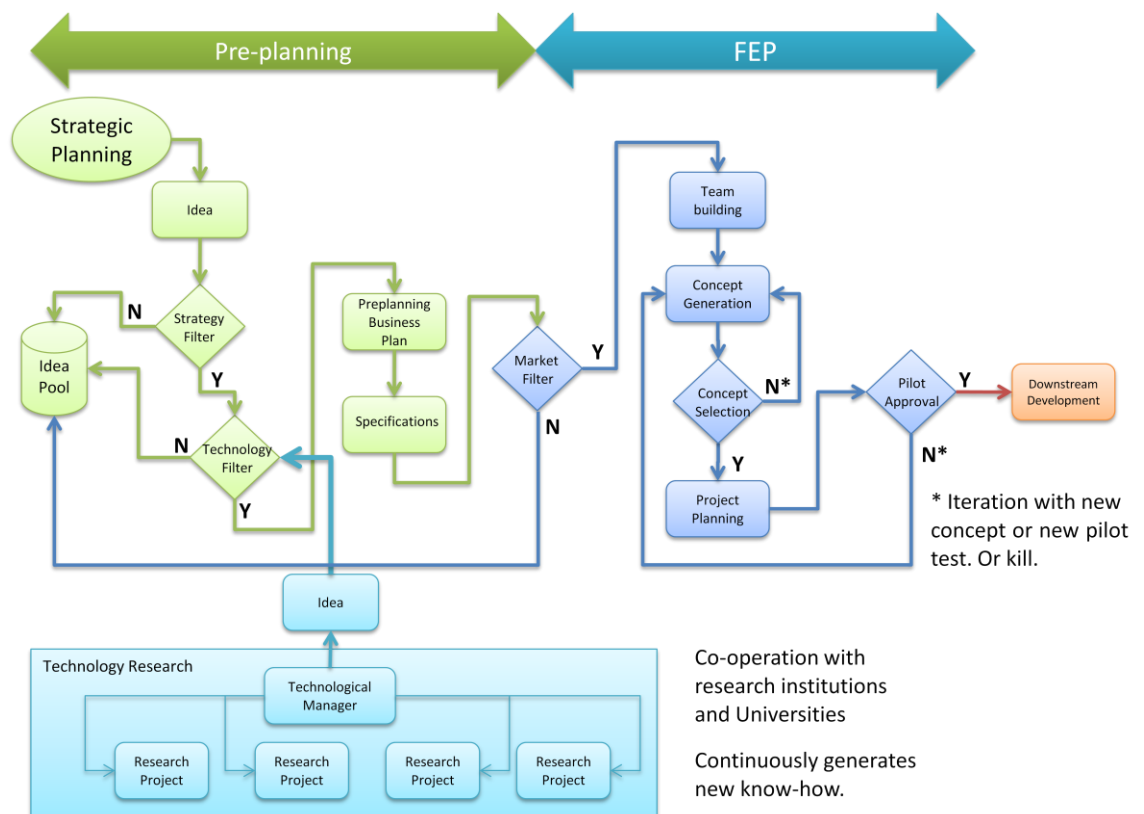Figure 6 Remodelled development process of Mecano

At the active technology research level the company co-operates with different institutions such as: Oulu University, Joensuu University, and with local technology labs. To decide upon the technology the first filter the technology manager has to approve the project. In case the project receives a green light, the business planning step is commencing.

There are two main ways to initiate product development in this system as you can see it in the remodelled map above (or at the company material in appendices). There is either a new emerging technological know-how that drags the attention of the technological manager, or it is a scheduled development in correspondence with the product planning. During the planning process the company uses the technological S-curves and other tools such as the Moore law to foresee possible advancements in forthcoming products.

The business plan is kept on the product development managers' level, where the market size, benefits for the customer, and ROI are calculated. Basically it functions as the market filter. Shortly after the market filter, the planning and research functions make suggestions for the technology and materials, to establish the specifications.

After the specifications the development team is formed to develop a concept and then present it to the product development manager in the form a brief realization presentation. In here the concept generation and the concept selection are done.

If the management approves the concept, the team engage in building the project plan. If necessary the design functions begin to work on an early prototype for the pilot testing. The test of the concept will be then evaluated. If it is successful, then the downstream development takes off.

If not then it is up to the management whether they iterate the process, and retry with a new concept, or simply kill the project before it becomes too costly.

4.1.2 Conclusion

Mecano has one of the most specific and well developed processes in this analysis. The company is in business for seventeen years now, with the third (and soon with the fourth) generation of products. Its well established product portfolio and strong know-how skills indicate that the company has overcame the problems of the small start up companies regarding their business processes long ago.

The main characteristic of the development process at Mecano is the strong technology research capability. The structure of the company and its processes imply a development friendly attitude, a good development enabled corporate culture. The research manager is

responsible for managing the research projects within the company, who has the right to initiate projects on investigating promising new technologies. Employees are encouraged to communicate their ideas to him that strengthens commitment and generates new ideas.

Capacity is managed loosely; there is no specific filter in the process either. In order to plan capacity first monitoring tools have to be installed. The company is aware of its currently insufficient activities in monitoring capacity, and already developing on a solution. So far the small size of the company made it possible to overcome the capacity issues by flexibility.

The company has a great deal of experience in financing and tracking projects, thanks to the previously underwent research and developments projects over the years. The technology manager has his own budget, allowing smaller projects to take off easily. The company set target costs for each project, which are dependent on the importance of the project or as it was set in the market filter. In case of strategically vital development, such as a new generation platform development, target costs may be handled with more flexibly.

4.1.3 Suggestions

The company is rather function oriented; hence integration in projects can be problematic. Although there is a great engineering capacity at the company there is no real integration between the functions during the development process.

The development team is formed rather late, at the concept creation phase. This means that the team, which eventually has to work on the development project, might have had nothing to do with the project during the earlier phases. By this practise they need more time to get acquainted to the project, and their know-how and practical ideas could not be heard at the specification setting phase.

If the team formation would happen before the specifications setting is done, the synergies in the team could be used more efficiently. In addition to that a wider acceptance of the decisions, a consensus could be reached. This would enable the team to understand other point of views and facilitate more creative solutions.

A higher level of interplay could be achieved if the development team would integrate other functions as well. Some other business competence e.g.: purchasing, marketing and manufacturing specialists could help to provide better forecasts, realistic cost analysis and by eliminating expensive decisions regarding production.

At the moment only one concept development is used to develop a concept. There is no standardised way that would indicate a conscious concept generation and then elimination. A link could be established with the research projects to develop multiple concepts competing with each other. In case there would be no clear winner, both (or all) advantageous solutions could be used in one final concept.

As the company grows personal supervision will become less and less sufficient; in consequence the need of more specific processes is increasing. To cope with this challenge the company has to focus in employees who are capable of planning and executing different projects within the company. The current process and structure gives the management a strong grip over the ongoing projects. To introduce self-determination to the corporate culture there should be a plan for empowering employees, more responsibility delegation.

4.2 Ebsolut Oy

Ebsolut Oy is a small sized software developer company, founded in 2000 in Kajaani. Today it employs around fifty employees and mainly active on the Finnish market. Originally the main profile of the company is outsourcing programmers and executing small software development projects. In 2002 the company spotted a business opportunity in developing its own product, which was introduced to the market in 2003.

The product portfolio of the company is based on the 'Emobile CS' platform. This platform enables programmes running on a computer in vehicles such as: lorries, loaders, and excavators to communicate with the back office systems real time (depending on the connection).

Based on that platform, a logistic and a taximeter software were developed. The development was initiated by a partner, whose main products are onboard computers. Since the partner was committed, Ebsolut carried out the development, as it seen a safe investment. Later on, to broaden the distribution channels and increase sales, another version was developed. That is not dependent from the partner's onboard computer, and can be installed on any MS Handheld device.

In the beginning of 2008 KPO (Kainuun Puhelinosuuskunta) has purchased the company in order to develop further its own IT competence and integrate the outsourcing and IT project business into its own activities. An acquisition takes time and brings changes to both companies. Currently a new leaders has been chosen to lead the ex-Ebsolut business, thus the situation is currently in a state of flux including the structure of the company as well as the processes within the company.

Product planning is done for the own product, since external projects have their own management teams. The company considers it 'Emobile CS' platform as it is still in its growing, immature stage, thus there is not yet a fix schedule for a future version. Although a new derivate is planned to reinforce the product portfolio. The company uses the strategy of software versioning to keep their products update and manage the product's PLC.

4.2.1 Development Process

The company has many years of experience in working on small projects. In order to reduce risks and to meet the all the criteria of an own development process the generally used process is modified. The currently used project processes can be seen in appendices.
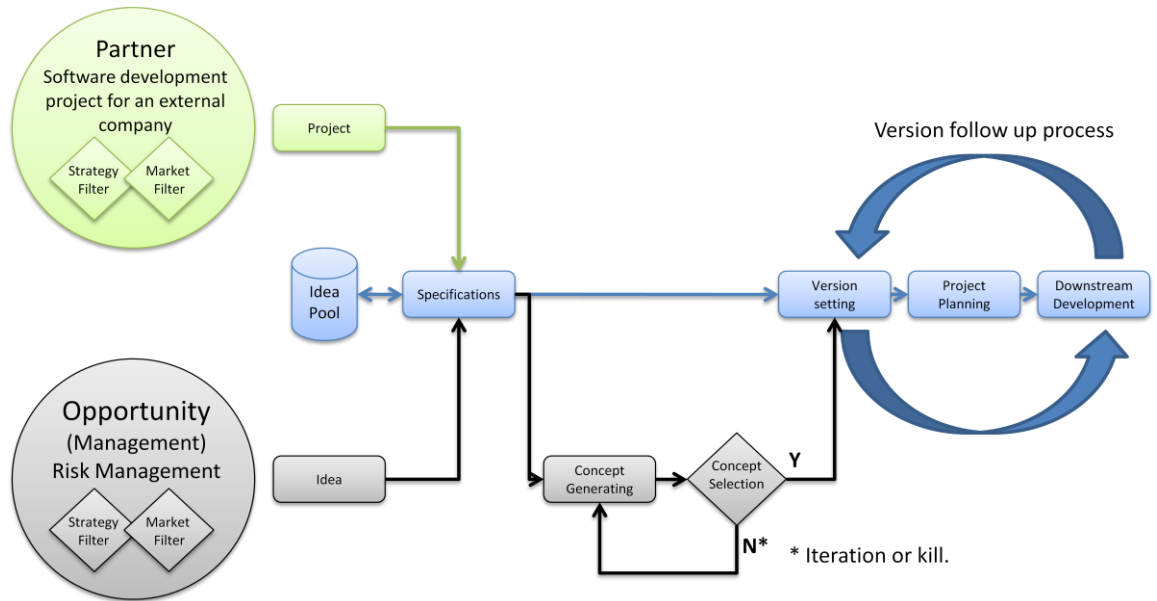

Figure 7 Remodelled development process of Ebsolut Oy

Virtually every function of the company contributes to the idea generation process. The Ideas are stored in an idea pool, so there is no idea is lost.

The modified process consist extra steps between the specifications setting and version planning. A product concept is developed basically focusing on the layout of the program and imitating some of its features. During this stage a 'pre-prototype' program is written in UML (Unified Modelling Language) and then the actual program is simulated for the testers evaluating the product.

Both processes lack of conscious market and capacity filters. Most likely the reason behind is that the small projects usually have their business competence at their office and the development was initiated by a real or thought-to-be-real market opportunity in trust of a partner. In a consequence the management itself made the decisions in evaluating possible market size and opportunities.

The lack of capacity filter can cause severe problems in planning resources and small haphazard projects can drain team members from the teams working on long term projects.

As it is usual in the Software industry downstream development and FEP activities overleap. The loop in the development process starts at the detail system design following the feature list made at the during the version decision stage.

4.2.2 Conclusion

The Ebsolut focuses clearly on the small projects, which reflects on its PDP. It seems to cause ambiguity within the company, as if there might have not been a clear commitment next to a project apart from the fact that development in general is needed. For this reasons it there is no clear product strategy identified. That can cause a negative effect on the corporate culture as well.

The company successfully recognised that they need to develop a concept, what is more concrete than the specifications. This process has to be however refined, perhaps due to the old reflexes, the company focused on the layout and testing with machine operators, whereas they should have tested the decision maker group (the business owners) and focusing on their gains. It does not mean that intuitiveness and convenience should not be considered, but an importance hierarchy should be considered.

The lack of pre-business planning makes it difficult to realistically estimate possible market size, competition (primary and secondary, current and future) and costing. In addition the haphazard capacity planning generates unwanted risks. To eliminate the high risks the company used founding from Tekes for its platform development.

4.2.3 Suggestions

Process wise it would make sense to integrate an active and profound market research, especially when developing software for the 'future'. Niche and immature markets involve the highest amount of risk, thus a well understanding of the market is a must in advance.

The company develops rather complex products, which could be decomposed into many sub parts. In this case, the user interface could be handled as a separate sub-part and tested and developed along the core product. In that way both parts could be tested before integrating.

The company ought to expand its sales distribution to an international level. A company of this size could easily make this step. Opening up could bring new competences and a better knowledge from the market.

Newly born markets are usually unregulated with a lack of standardisation. To help the industry grow and secure the future of the company, a patenting and open-standard creation strategy could be considered.

The acquisition by KPO gives the chance for reshaping the company in a more empowering structure, and perhaps a clearer vision for the future. Identifying competencies which are missing at Ebsolut but present at KPO could lead to synergies. It could lead emerging business competence that could result in new synergies.

When the new business competence emerges, the company could focus on establishing on creating involving different functions to the development team, who could support the work of the project leader until the very end of the project. By that better integration could be reached.

4.3 Sensinode Ltd

Sensinode is a young company, founded in 2005, as a spin off from the well known Centre of Wireless Communications, Oulu. Its main vision is to become a decisive player on the developing market of 'internet of things'. This niche market segment is expected to develop rapidly as companies begin to recognise the possibilities (and the present know-how) in the technology.

Sensinode sells basically solutions for its customers in areas such as: enterprise building automation, asset management and advanced metering. To meet customer demands in the field, the company has developed a portfolio of products, which are based on a programmable chip (CPU) that compiles to the standards of 6LoWPAN. The 6LoWPAN technology is the core of the business, what enables to develop smart utilities with a long battery life (years) and with a great reliability.

The core asset of the company is the practical knowledge that it posses in this particular field, on which the company has built a diverse strategy of price and technology leadership (cost leadership and differentiation). The competitive edge over its competitors is the smallest program code possible, what brings price advantage and reliability.

The business operates on a currently pre-mature market that is developing fast, thus the technology leadership is vital for the company. In order to secure the future of the business an extensive patent creation process is undergoing, along with the development of free standards, which are helpful in broadening the market.

4.3.1 Development Process

Since the beginning the management is formed by experienced professionals, whom brought practical know-how and industry competence. The company's size is relative small, thus business processes can be handled in an adaptable manner, with no need for strict standardised processes.

The process is relatively simple; it starts with an idea, followed by market filter, specifications, project planning, and finally the downstream development phase.

The Software development is more flexible than the traditional development. The product can be reshaped or redesigned at much lower costs, meaning that the Front-End Process can be handled with more flexibility. The company can reshape its product to every customer and thus the product development quickly that resembles to the repeated nature of the fast-built products.
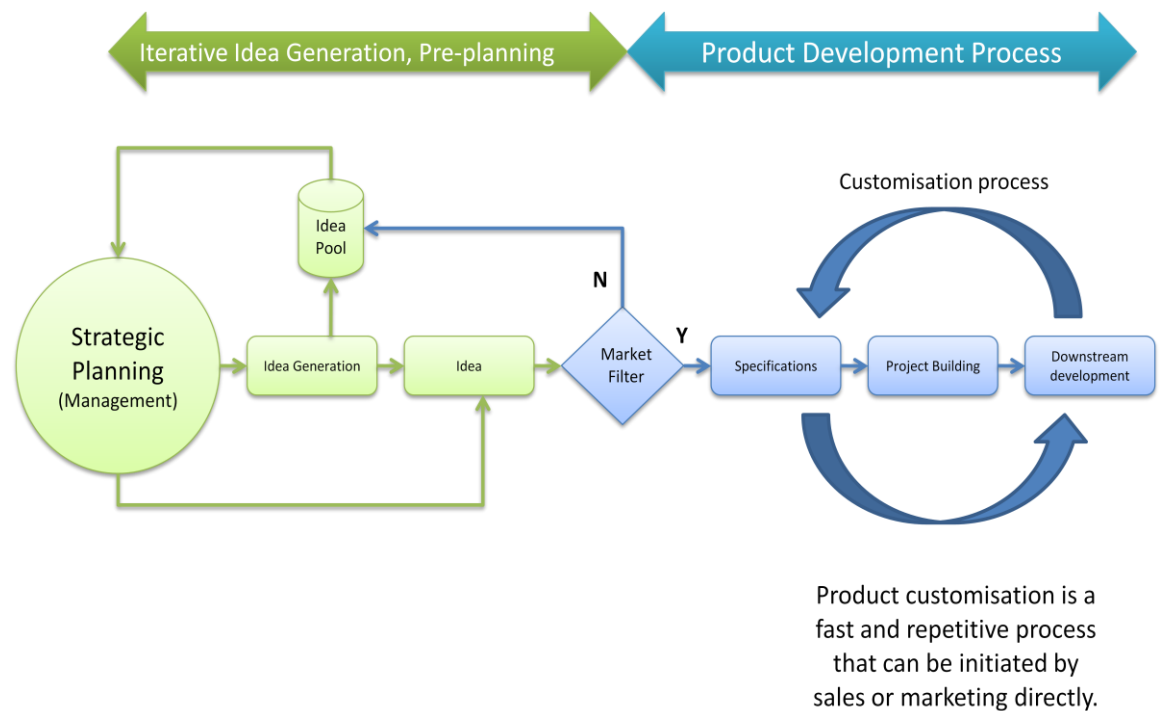

Figure 8 Remodelled development process of Sensinode Ltd

The Idea generation process is very democratic, which encourages a friendly corporate culture. Each week the employees gather together with the management for two hours to discuss new ideas. This gives a great opportunity to give a direct and quick feed-back, which strengthens the corporate culture and motivates the workforce.

As it can be seen there are many elements missing from the process such as technology and capacity filters. In fact the company does monitor its capacity and available assets, but in a much broader level. Since development is seen as the key strategy of survival, these decisions are already made in the product planning phase in the strategic plan. For that reason, costing is done flexibly. There are no fix target costs for each project, since 'the company is the project'.

For the same reasons, there is no specific development team. Once a project is accepted the management acts as the supervisor of the project and every employee is the member of the development team.

Concept development and concept testing is missing. The company engages in development, when there is a pronounced need on the market, meaning a committed buyer. It is then the customer, who is involved in the specifications setting.

Developing a new platform of course takes more time and consideration, but standards allow the industry to develop platforms easily, thus a new standard in the industry will definitely mean a new platform for the products.

4.3.2 Conclusion

The small size of the company ensures the interplay within the company that would be otherwise difficult to attain by such a process at a bigger company. The low degree of standardisation gives more freedom to the employees to come up with creative solutions, and in addition to that it ensures a quick reaction time to specific demands.

The complexity of the process is suitable for the company. Flexibility and quick reaction time are key characteristics of SME companies. Furthermore the company has developed a strong development friendly corporate culture that is a good foundation to build on.

On the other hand, attention must be paid on the matter of integration. Due to the practise that each employee works on the same project, could lead to a too strong 'engineering' influence in product planning that could harm the business by other means.

4.3.3 Suggestions

The company is developing products on a pre-mature market that involves much risk. Thus eliminating risk is essential, what is done currently by flexibility. However as the market grows mature the risk of the customers will decrease. By that time it is important to come up with a product portfolio that can offers a good balance between customisation and specific solutions to cope with the possibly appearing new competitors. A clear product strategy e.g. differentiation could help the positioning of the product.

Process wise it is important that the new competences appear in the development process as well. There is no current need to establish a separate strategy and technology filter, as the management team has a direct control over the employees but with the growing number of employees, the company structure will become more complex and it will require new processes.

In order to develop a broader but still focused new portfolio in the future, the company has to make efforts in studying their customers' needs and come up with general solutions for more specific sales areas. For that in the near future possible customer reviews and the introduction of piloting could be useful.

5 CONCLUSIONS

The main aim of the thesis was to map out the Front-End Processes at the interviewed companies and to search for improvement areas, has been achieved. The other goal was to identify common characteristics of the organisations.

All three companies develop products for niche and emerging markets. The flexible market gives a chance to the companies to establish themselves before their entrance barriers are lowered and the bigger counterparts decide to venture on the market.

The immature markets are liquid, sensitive for changes meaning a risk for the companies. A good understanding of the market is always important; especially in case of small and new markets it is an absolute necessity. Companies ought to investigate the market carefully in advance, before they commit themselves to development. Mecano and Sensinode had a clear comprehension of the market and the aptitude to develop a product for that.

For that reason all development processes are technology-pushed, which reflects on the present competence at the companies. Development is undoubtedly seen in every company as the strategy for survival, thus resources are allocated generously when it comes to development.

Pre-planning is somewhat neglected in the companies, principally the reason for that is the fact that the management has a strong daily control function, so they can oversee their own plans swiftly. In most cases the final initiator of the development project is the board itself, thus there is no need to convince the management about the necessity of the undertaking.

Development teams are perceived as units of downstream development, rather than active participants of the pre-planning and FEP. Consequently there is little synergy achieved through the interplay within the business functions.

Recommendations

An in-depth market research, prior to the development of the product, could be helpful in providing realistic knowledge of the market in advance. It is advisable to research on an international scale for primary and secondary competitors, as niche markets might not necessary grow over a certain extent. Thus identifying the right segment and the right competitive strategy is the first step to reduce risks in product development.

The needs of the customers are complex that requires a systematic approach to discover. SMEs operating with a relative little amount of employees also need such process to abstract from their own prejudices about the market and the customers.

The word of concept caused confusion during the interviews. It is important that companies understand that developing and combining various concepts lead to better quality. Based on the given specifications, and all identified constraints put into consideration, can still lead to different solutions which worth of examining and combining.

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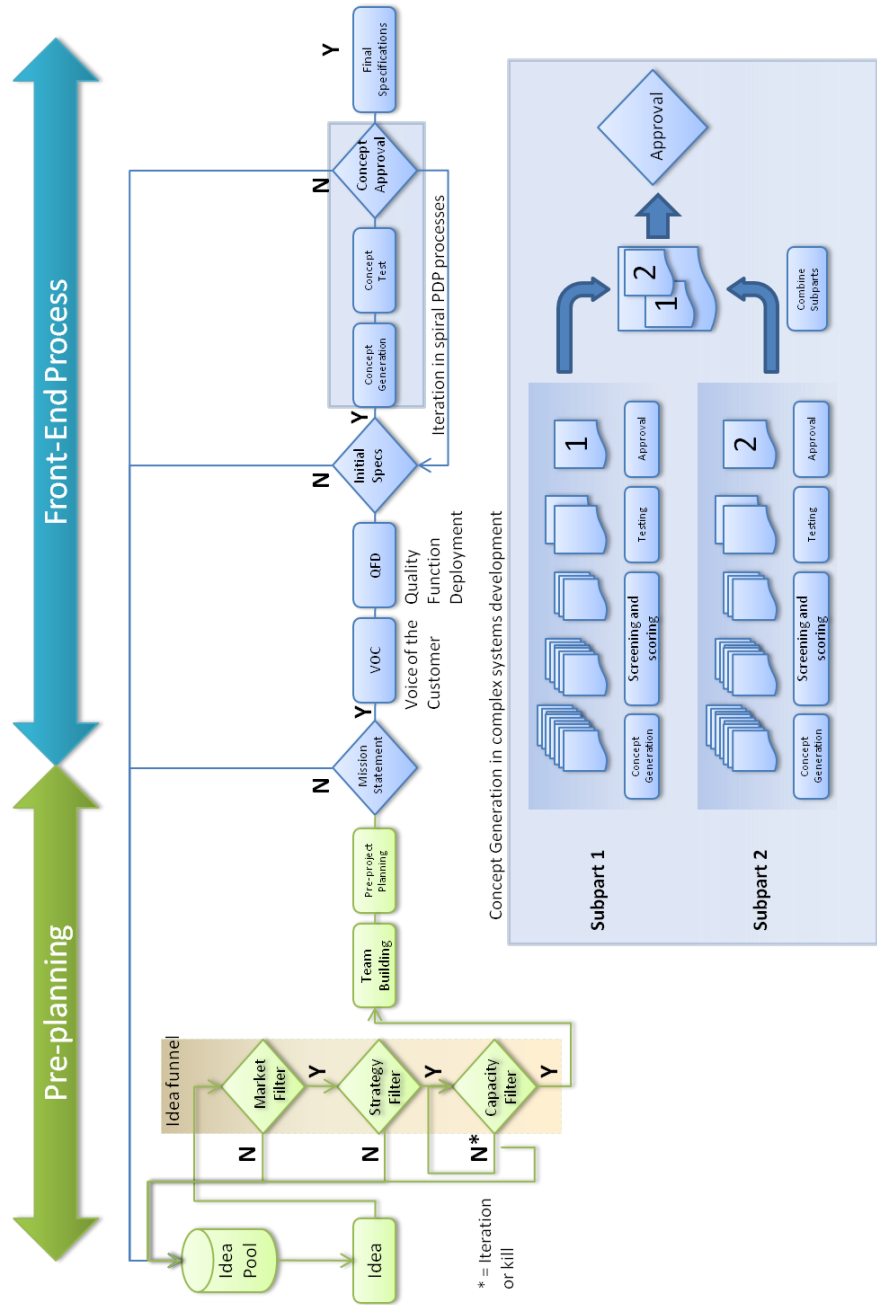
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LIST OF APPENDICES

APPENDIX 1   Sample Process

Front-End Process

Pre-planning

Idea funnel

Market Filter
Strategy Filter
Capacity Filter

Idea Pool
Idea

* = Iteration or kill

Team Building
Pre-project Planning

Mission Statement

VOC
QFD

Voice of the Customer
Quality Function Deployment

Initial Specs

Concept Generation
Concept Test
Concept Approval

Iteration in spiral PDP processes

Final Specifications

Concept Generation in complex systems development

Subpart 1
Subpart 2

Concept Generation
Screening and scoring
Testing
Approval

Combine Subparts

Approval

APPENDIX 2   Interview Guide

General Questions I

Q: Please arrange the following phases in a sequence, in which you feel it describes your current development process the most. You might wish to add or remove any stages. If you have any question regarding the task please feel free to ask.

A, Concept generation

B, Plan for downstream development, Launch preparations

C, Team building

D, Product planning

E, Idea generation

F, Product concept selection, final specifications

G, Establish target specifications

Your answers:

1	2	3	4	5	6	7	8	9	10

Q: How would you define the notion of Quality? Do you plan quality into your products? If yes, by which means do you do that?

Q: How do you feel, which of the following statement describe your company better?

 a, The company is structured according to functions

 b, The company is structured according to processes

Core questions

Product Planning

Q: Who is responsible for the product planning at the company? (Where is this responsibility positioned within the company? How does it integrate into the strategic planning?) How does the company manage the PLC (Product Life Cycle).

Q: If there is a product platform and derivates plan developed? If yes, then for how long? In case no, then what practice do they use to plan resources for future development?

Q: How is the timing of new products (or platforms) considered? Are technological S-curves, market readiness, competition considered?

Idea Generation

Q: How does the company look for new ideas, opportunities? Actively or passively? Is there an established idea generation and collection process?

Q: Where do these ideas usually come from? Do they come from inside or outside of the company, if inside from which function?

Q: How does the company filter those ideas? Is there an opportunity funnel established? (Strategic, Market, Technological, Capacity filters)

Q: What happen to the rejected ideas?

Grouping questions

Q: How are the development-teams created? Is there a clear project leader for each group?

Q: From which function is the project leader usually delegated? How big are the core-teams, which functions are directly involved to the projects?

Q: To whom does the project manager report? How is the project team assembled? How is capacity considered? How do the functional managers respect the tasks given to their direct subordinates?

Process and quality questions

Q: Could you describe the current process which is in use at the moment, until the downstream development phase?

Q: How do you identify the customer needs (by which practice)? After the voice of customer is gathered, how do you translate them into specifications? Is there a clear process for that? Is Quality Function Deployment in use?

Q: How do you create concepts? Are derivates considered? How do you test concepts (internal, external, and financial)? What are the survival factors? What happen to the rejected concepts?

Costing questions

Q: Do you use Target based costing for your development projects? Does each project have its own budget? How is the responsibility shared between the management and the project leader concerning the project budget (extra expenses)?

Q: What do you think, when is the most of the used, in the beginning or at the end of the project?

APPENDIX 3   A brief summary of Mecano interview

The interview took place on the 18th of February 2009 in Kajaani. The interviewee was Jyrki Pesonen and the interviewer Daniel Fraknoy.

To begin with Mr. Pesonen briefly explained about major milestones of the company, then swiftly moved forward to the product portfolio. The third generation of products are currently on the sales meaning that the company has learned from the past and developed an extensive portfolio.

Before taking the next step to the development process stage, the structure of the company was clarified. He pointed out that there are many concurrent research projects takes place at the research department. The main function of the research department is to look for new technologies and test them, whether they could be usable for development.

Product planning is done very consciously, by considering technological curves and product lifecycles. He stressed that emerging technologies can initiate new product development in that sense planning is done flexible. By this practise they can keep their flexibility and technological leadership on the market.

He pointed out that small projects have strict cost limits, but those projects considered to be worthy and trigger a development project will have a greater flexibility. Still the company keeps a track of each project including the development projects in order to meet the targets.

He continues with explaining about the business planning process that is the part where the idea is put into a test in terms of business. Possible market size, ROI and customer value are calculated to minimise as much ambiguity concerning the market as possible.

If a product seems to be profitable then the specifications will be established at which point the technological manager plays a key role. When the specifications are set, a project manager will be drawn from the technology side to manage the development process.

At which point a concept is developed and if necessary a prototype is built for the pilot testing. The pilot testing, means test purchases, and in case they are successful the downstream development begins. He adds that in planning capacity they had some issues in the past, due

to the inadequate monitoring. But efforts have been made to overcome those issues in the near future.

Issues of growing and international sales are mentioned in the sense of customisation. Different countries have different regulations in their industry, which can involve costly changes in design.

In closing he adds that he considers the corporate culture is development friendly, however it is inevitable to have changes, when the company is growing.

APPENDIX 5   Brief summary of the Ebsolut interview

The interview took place on the 25th of February 2009 in Kajaani. The interviewee was Esko Suomalainen and the interviewer Daniel Fraknoy.

The interview started with the introduction of both parties. After a brief introduction to the topic Mr. Esko Suomalainen continued with telling about the history of the company until the point of the recent acquisition with KPO.

The company has three distinct fields of operations. Outsourcing of programmers for third parties and subcontracting of small software projects are the main activities of the company. Besides the company has developed its own logistics (and a taximeter) software, based on its 'Emoblie' platform.

He concludes, that at the moment outsourcing and subcontracting are the main income centres at the company, but for the future they expect their own products to gain a bigger share in generating income.

The idea of developing the logistics software came from a partner, with whom the company had been working together in the past. Basically both of the development projects (the idea of the platform and the logistics software) came from a project, which were then further thought.

Since the developments happened unexpected, product planning had not played a strong role. The company trusted its partner regarding the size of the market and they engaged in development. Afterwards the sales results weren't that promising, thus the company decided upon launching a derivate for another hardware platform to broaden sales channels.

For the questions regarding the process itself, he explained that the company has a well-tired development process for small software projects, and in this case they expanded that process with further risk assessing activities. After they collected the ideas into the pool, they established the specifications and then a pilot version was created in UML language to demonstrate the user interface for the end users.

Mr Suomalainen added that there were problems of capacity before, meaning that different parts of the company had to compete for internal resources. Short-term projects took away

resources from the long-term projects. Costing of small projects is strict, yet there are no strict targets in (own) product development, in order to have the project done.

He concludes the lack of capability in monitoring and planning resources as the major issue that he would like to see changed. Then continued on the recent acquisition and the restructuring programmes at the Ebsolut business, which are already taking place in order to fix that problem (among others as well).

According to him the other major issue is that the company has a limited capacity in creating new ideas. Motivating people and getting new ideas have to improve. In closing he expressed his hopes for the better during the ongoing restructuring.

APPENDIX 7   A brief summary of the Sensinode interview

The interview took place on the 10th of April 2009 in Oulu. The interviewee was Veli Matti Enkenberg and the interviewer Daniel Fraknoy.

After the mutual introductions the previously sent question were discussed. There was some ambiguity concerning the term of concepts and product platforms, which had to be explained. Then Mr. Veli Matti has showed and explained the current product portfolio. He pointed out, that company is basically a software company, and their main product is a control program of a programmable intelligent chip. Based on this chip (and the control program), the company has developed hardware elements, which are using the same chip and software, and a system management program for pc as well.

Mr Enkenberg stressed that their competitive edge is the price advantage over the other competitors. They achieve that through development, since their program code is much smaller than the other companies; their hardware requirements are lower that lead to lower prices for the customers.

For the questions regarding product planning, he explains that the market is newly born, and underwent a quick standardisation, in which their company played a major role. Sensinode had been active in establishing standards in the industry that is now more solid. The life cycle of product platforms are planned for two years, the company expects that with the appearance of new intelligent chips the industry changes quickly. In his answer for benchmarking, the frequent competitor watch is mentioned.

Because of the rapid changes on the market, the company is in constant developing. Furthermore many customers demand high customisation, meaning that development of derivates must be done very quickly.

He explains that their process is very simple and the management keeps a close look on the process. They can alter or kill the development at any point.

While discussing about the development process the importance of marketing and the idea collection is mentioned. Marketing is responsible of risk assessment. They have to find a committed buyer before the development process begins or assess risks regarding market size and estimate ROI ... etc to minimise market risks.

He underlines that every employee has the right to share their ideas, more than that they are encouraged to present their ideas on the weekly idea collecting sessions.

For the question of listening to the customers' voice, he explained that currently there is no specific process established for that. They operate in the B2B sector, and their customers' (such as: Universities and Measuring Laboratories) demands are usually clearly articulated before the development process begins.

There is a conscious monitoring of capacity and the company planes it in advance to schedule major development projects. In case of platform development the whole company is working on the main project, while normally up to eight smaller projects can run simultaneously.

Costing is done flexibly; the development activity is clearly the survival technique to come up with new and more efficient products. Thus there is not much emphasis put on target based in a platform development. Smaller projects are openly under the control of the management, who can decide upon the costs of the project.

In managing corporate culture selection plays a decisive part, what is a part of the company's competence planning in growing expertise.

For the question of what would he like to change within the company, Mr. Enkenberg stressed the importance of further documentation of processes.