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Outsourcing mechanical design in Finland with S&M companies

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Abstract

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Title: Outsourcing mechanical design in Finland with S&M companies

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Supervisor: Elina Karttunen

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Aim of this thesis is to examine attitudes and methods how S&M companies manage their mechanical design and their outsourcing needs in mechanical design. This thesis is done because there is very little research made from this topic in Finland. I will go through theoretical overview on the topic of the outsourcing mechanical design and I will create base for my thesis. Then I will interview managers from companies that fit to this thesis. After the interviews I will report my findings to results section of my thesis.

This thesis uses qualitive research methods. I conduct interviews with managers in companies that I choose for this thesis.

In the theorical overview this thesis focuses to explain disadvantages like weaker quality of the end product with outsourced designs and advantages like extra resources. In results section I interview managers about these topics and conclude answers from these interviews. There can be seen strong correlation between my research and current theorical research.

Tiivistelmä

Kirjoittaja: Joel Länsisalmi

Tutkielman nimi: Outsourcing mechanical design in Finland with S&M companies

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Ohjaaja: Elina Karttunen

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Tämän tutkimuksen tavoite on tutkia asenteita ja käytäntöjä joita pk-yritykset Suomessa kokevat mekaanisen suunnittelun ulkoistamisessa. Tämä tutkimus on tehty, koska tämän kaltaista tutkimusta ei Suomessa ole aikasemmin tehty tästä rajatusta aihepiiristä. Teoreettisessa katsauksessa käyn läpi ajankohtaiset teoreettiset tutkimukset mekaanisen suunnittelun ulkoistamisesta. Teoreettisen katsauksen tarkoitus on luoda pohja työn empiiriseen osuuteen. Tämän jälkeen loin kysymyspohjat yrityksille teoriasta, josta lopulta tulososio on rakennettu.

Tässä tutkimuksessa käytetään laadullisia tukimusmetodeja. Haastattelut ovat iso osa tätä tukimusta. Haastattelut on järjestetty yritysten kanssa, jotka näin sopiviksi tähän aiheeseen.

Tulokset -osioissa yhdistän löytöni teoreettisestä katsauksesta ja haastatteluista. Teoreettisessa katsauksessa keskitytään selittämään mekaanisen ulkostamisen huonoja puolia, kuten lopputuotteen laadun heikentyminen mekaanisen suunnittelun ulkoistamisen johdosta ja hyviin puoliin, kuten lisäresurssien tuomat edut. Tutkimuksessa on nähtävillä vahva korrelaatio teoreettisen löytöjen ja haastattelujen välillä.

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1. INTRODUCTION

World is changing, behaviour of consumers is changing, whole global economy is changing (Milecova, Grznar et al. 2010). Needs of the consumers are growing and new products are needed to fulfil these needs. We need to find ways to keep up with the changing world. In this thesis I will examine reasons why S&M companies from Finland outsource their R and D department and how can they keep up with the changing world. I will also scope these reasons of outsourcing how they correlate between each other. Two main reasons for this topic are; First is that outsourcing mechanical design haven't been researched so much in Finland earlier. Second is that outsourcing is all the time more current topic and more relevant for companies to understand that they can succeed in this current climate(Mol 2007). In this thesis I will research how outsourcing effects companies that outsource their mechanical design. My goal is to find out real reasons why companies outsource their mechanical design to outside company and how these reasons correlate between each other.

One of the biggest questions these days for companies is that should they outsource their need to other firms or should they make it in their own company and use their own resources to fulfil the current need (Zirpoli, Becker 2011). In this thesis we will try to answer this question and observe how outsourcing effects companies that want to outsource mechanical design.

Outsourcing mechanical design is difficult question for companies, because companies that outsource mechanical design, also outsource knowledge which comes within the project. Companies are in middle of important strategic question, should they outsource mechanical design to have better profit in the short run, even that they are eating their competitive power when losing knowledge or not trying to obtain more knowledge in the long run.

In this thesis keywords will be outsourcing, mechanical design and modules. With outsourcing I mean specifics outsourcing in mechanical design, not procurement or make and buy decision. In this thesis Mechanical design prefers to actions that are taken to tackle manufacturing problems with some type of products. Modules are specific design where different components have similar interfaces and are easily adjustable.

1.1 QUESTION TO BE SOLVED AND SCOPE OF THE THESIS

In this thesis we will determine reasons why S&M companies from Finland outsource their mechanical design to outside consultant firms. I have made scope for the purpose, of the thesis, that it will conclude companies that have revenue between 1-15 million and are mainly on production field. Main research question to be answered is:

“What are the reasons why S&M companies will outsource their mechanical design for consultant firms?”

Thesis will answer sub-questions that will conclude answer for the main question. Sub-questions are:

“What are biggest disadvantages for the company when outsourcing project?”

“What are the key benefits when outsourcing project?”

“Will outsourcing decrease knowledge in company and will company lose competitive edge against competitors in the future?”

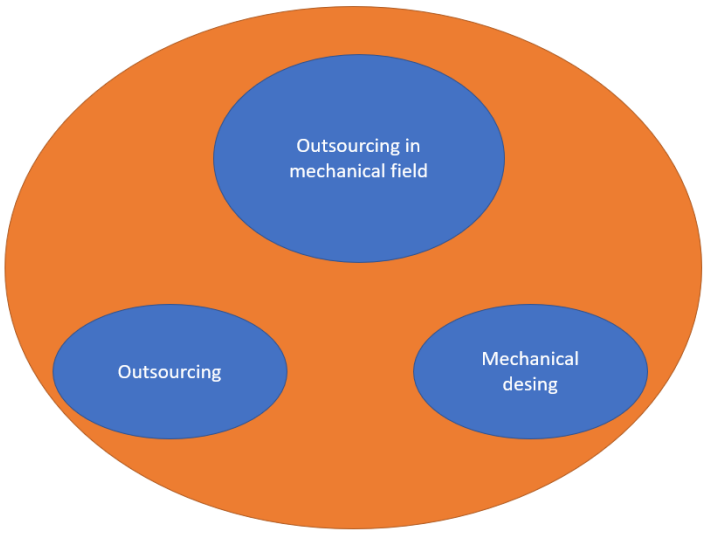
“How to choose right supplier between different suppliers?”

Idea is that sub-questions are the base where I can create my answer for the main question. Questions are created to be wide as possible to conclude most important aspects why companies outsource their mechanical design.

2. THEORY AND BACKGROUND OF THE THESIS

2.1 OUTSOURCING

Outsourcing is important part in my bachelor's thesis. In this chapter I will tell basic definition of outsourcing and little history of outsourcing. After that I will explain theory of outsourcing in mechanical design which is essential to know when reading my thesis. I will also go bit deeper in the knowledge of learning and learning by doing in one chapter. Modularity is bit more precisely explained in this thesis.



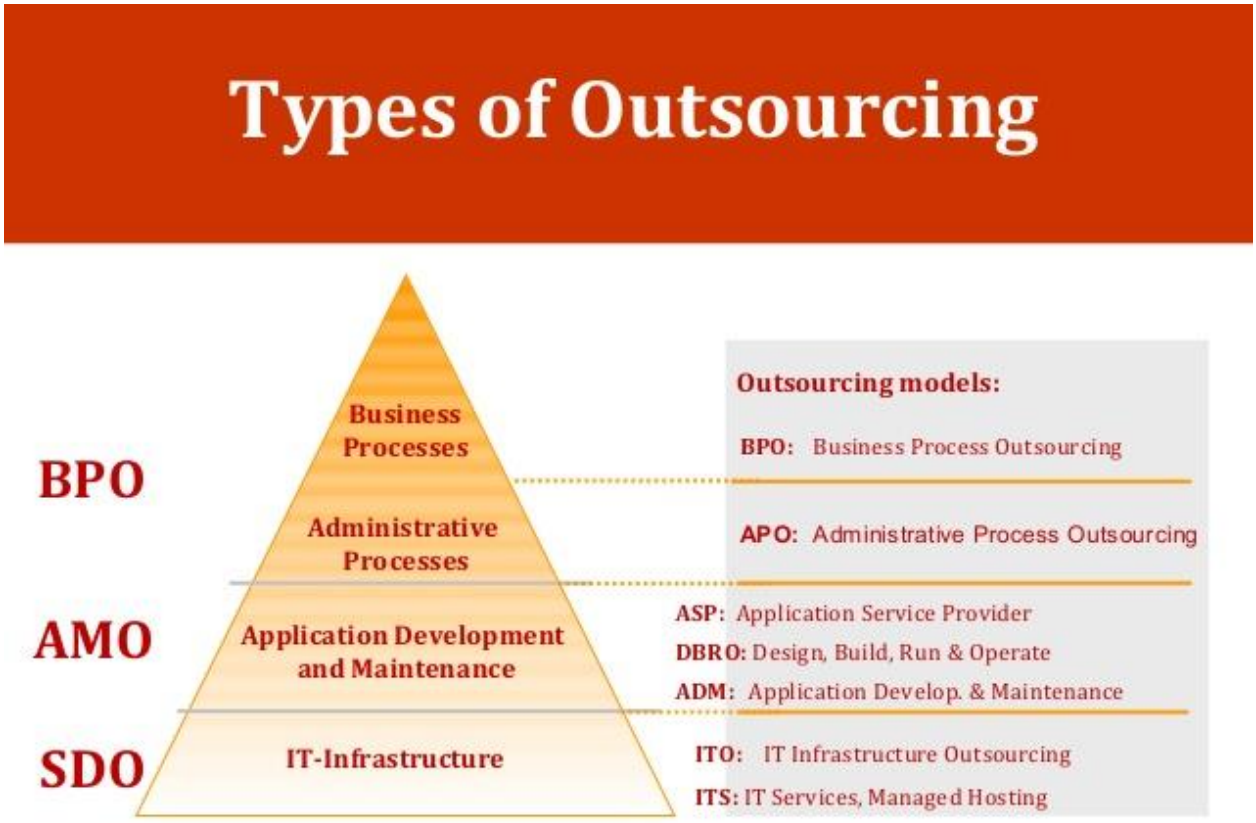
Picture 1. Theoretical framework for my thesis

2.1.1 DEFENITION OF OUTSOURSING

There is endless number of theories and ways to inspect outsourcing that whole thesis could just be about that. In this section we will examine the basic principles and theories of outsourcing to keep this thesis in it's given restrictions. Idea is to give you the basic capabilities and understanding of outsourcing, that you can read and understand this thesis.

There are many different kind of theories that explain outsourcing here are few: Transaction cost theory, Agency theory: relationships risks and goals, Contracting theory,

Resource based view, Recourse dependency theory, Firm strategy, Game theory, Auction theory, Social exchange theory, Social capital theory, Innovation diffusion, Social cognition, General system theory and Resource-based theory (Lacity, Willcocks 2008). Those are some theories that explain how outsourcing works and is seen through eyes of scholars. We can see how these theories create complex networks of theories of outsourcing. One reason for this is that outsourcing is really in every business and another one is that outsourcing is widely researched.



Picture 2. Outsourcing types.

The definition of outsourcing can't be easily defined. One way to look at it, is that company does not waste money on activities that are not so profitable but focus on the key activities and so they end up outsourcing everything else which is not key functions in the company.

I will start this with basic definitions of outsourcing. Michael. J. Mol divided basic principles in three sections (Mol 2007):

1. Outsourcing refers to those activities that are undertaken by outside suppliers
2. Outsourcing refers to the transfer of activities and possibly assets from a firm to an outside supplier
3. Outsourcing refers to those activities that are undertaken by outside suppliers but could also be undertaken by the firm

These three definitions define basics of outsourcing activity. But there are some limitations to this definition also. First on is straight forward and creates good base for this definition, but it does not define what type of activities are being outsourced. In the second definition, it doesn't editorialise scope how long does this activity take. When definition doesn't define the scope, it's harder to define is it outsourcing or just ordinary procurement. Third definition have some limitations also, because it doesn't define reasons, how it could be undertaken by own firm, are the reasons mechanical or economical. You could always hire more work force if it's lack of mechanical skills what are necessary to achieve some goal (Mol 2007). Then economical restrictions would be the problem. Key is to optimize the structure for your companies needs and skills. As we see it is hard to define outsourcing with no limitations.

Outsourcing is hard to define precisely and without any limitations. One obvious separations are between procurement and outsourcing. Another separation is between outsourcing and make or buy. Both separations need to be clear from outsourcing, these to other activities are single purchases, outsourcing is more complex activity (Milecova et al. 2010). In this thesis we will focus on outsourcing mechanical design and uniqueness of this field. When outsourcing mechanical design, it's important to understand mechanical components and compatibility of these components. Outsourcing shouldn't be mixed with offshoring which refers to relocating R&D activities to other country (Kuemmerle, 1998; Lewin et al., 2009).

2.1.2 BRIEF HISTORY OF OUTSOURCING

History for the term outsourcing isn't that old, but the whole concept of hiring external work force to complete some task is and have been done through history. First documented outsourcing happened in Ancient Rome, where process of tax-collection was outsourced (Milecova et al. 2010). Outsourcing have been used also in mechanical designs, in 1886 there was consultant firm called Arthur D. which had job where they were to investigate possibilities to improve process to perfect the product (Kahn, 1986). Opinion for use of the term history varies to one author to another. Bacher says that term outsourcing was first used in article that was written in 1984 and it was about American car industry, how American car producers outsource some procurement of car parts to Japanese companies that take over the industry with subcontracts (Bacher 2000). There is disagreement when term is used the first time, but many scholars agree that term was first commonly used in 1970 manufacturing executives and from there become more general in every field (Corbet 2004).

In the 1990 companies started to outsource activities more commonly that are not their key functions. Companies outsourced activities that didn't make profit and focused on the activities that were their core business (Siepmann 2013). These days some companies outsource everything that isn't their key functions or part of the core business. In another hand other companies have made full circle and are bringing everything back in house (Siepmann 2013). In the 1990 companies also started outsourcing engineer and design tasks in product development (Zirpoli, Becker 2011).

2.1.3 OUTSOURCING MECHANICAL DESIGN

Outsourcing mechanical design haven't been researched as much as outsourcing commonly, at least mechanical design outsourcing risk management is area which have been researched very little (Zirpoli, Becker 2011). Risk when outsourcing mechanical design vary from risks commonly in outsourcing. Biggest risks are that performance of the product is reduced and knowledge of the key functions of the product is outsourced (Zirpoli, Becker 2011). Second risk is great, because it may follow that ability to innovate can be outsourced in the same time and company loses competitive edge.

As in many fields also in mechanical design outsourcing have become more popular because of the external market forces and accelerating competition in innovations (Sturgeon 2002). Evolution of the markets for mechanical development services have forced companies to outsource innovations (Arora 2001).

2.1.3.1 RISKS AND BENEFITS

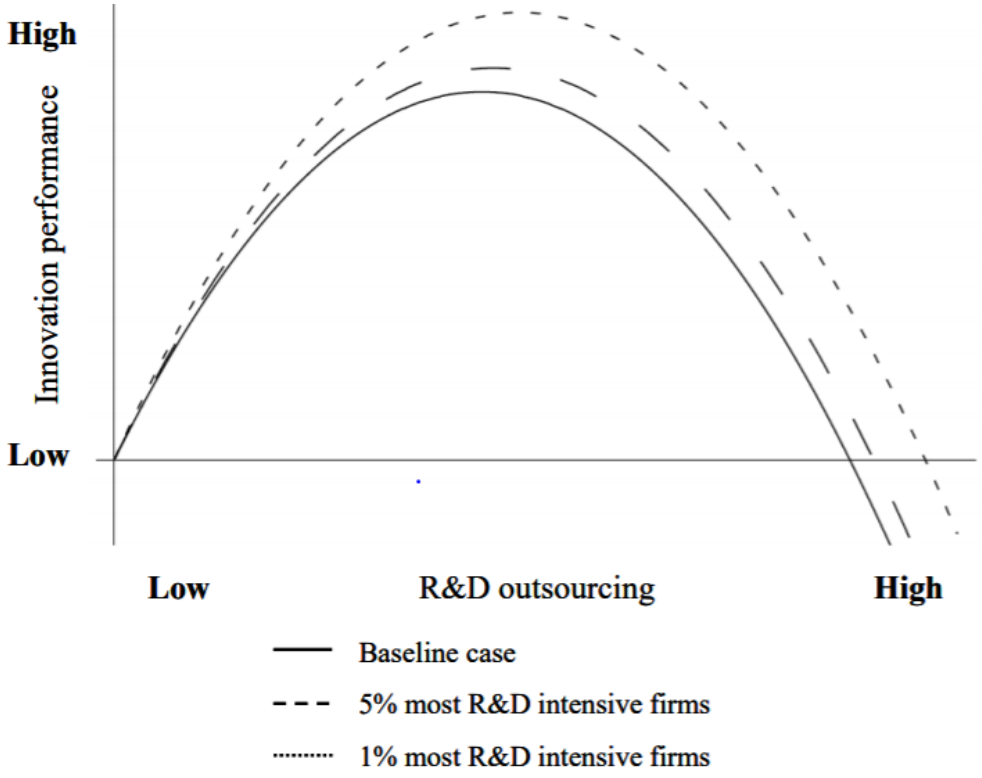
Outsourcing mechanical design is very complex process. To succeed in outsourcing, company needs knowledge base to be big enough about the outsourced project, in the way that company is able to control all the pieces of the puzzle. Company need to understand component compatibility and how other projects can align with others. Leading knowledge and sharing information seems to be one of the biggest difficulties when outsourcing mechanical design. Difficulties grow along with mechanical complexity of the project (Zirpoli, Becker 2011). Risk to fail in outsourcing is even greater when project require different kind of technologies as electricity and IT. Failed outsourcing will raise expenditure and unique in mechanical design outsourcing, failing outsourcing will degrade quality of the project dramatically.

Key benefits to outsourcing mechanical design is that company is able to require knowledge that it wouldn’t be able to acquire without external associate (Grimpe, Kaiser 2010). Companies can take bigger projects with joint assets and focus on their key functions. Knowledge can be key these days to achieve competitive advantage and sharing knowledge can create networks where learning is faster. Joint projects can also reduce costs, when expenses are shared (Tapon and Thong, 1999). Working with external company may also be seen as higher creativity internally because of the new research methods that are learned externally (Grimpe, Kaiser 2010). Time may also be reduced due to collaboration.

One important thing when outsourcing mechanical design is to estimate the right proportion to be outsourced of mechanical design. If company decides to have light engineering team, it may have negative effects on the product. Risk is greater when company outsource knowledge from key functions and areas of expertise that are essential for the performance of the product. Zirpoli also saw this problem in his research

and said; “In particular, the managers we interviewed confirmed that it is difficult (if not outright impossible) to integrate systems without mastering the technology underlying each system in depth”(Zirpoli, Becker 2011).

Other scholars say, that there is U-shaped relationship between degree of outsourcing mechanical design and innovative performance. Research says that there is tipping point where additional outsourcing mechanical design has positive but decreasing effect up to the tipping point from which extra spending on outsourcing mechanical design have negative effects on the innovative performance. (Grimpe, Kaiser 2010)



Picture 3. U-shaped curve, how extra outsourcing effects on innovation performance. (Grimpe, Kaiser 2010)

Best practices in outsourcing have been that outsourcing focuses on the functions that are not that important for the company. Functions that are older mechanically or/and easier to grasp and master than companies core competence. If company outsource that kind of functions and tasks it can focus more on the core competence of the company

and truly understand all the requirements and needs of the key functions in the design. (Zirpoli, Becker 2011)

In the mechanical design outsourcing literature there have been highlighted that problems with designs should be tackled mostly already in the pre-design stage. If problems occur later in the design, it will be much more expensive to fix (Thomke and Fujimoto, 2000). Literature also underlines that good co-operation with outsourced company and sharing the knowledge with outsourced company will give best results (Zirpoli, Becker 2011).

When outsourcing mechanical design and some parts of mechanical design there may occur some problems with Intellectual Property Rights (IPR) (Howells, 2006). Companies should define precisely IPR before starting the project. Whom will control the design, whom will fund it and whom will own the product after design is finished.

Outsourcing mechanical design successfully is big challenge to management. Managers need to manage external relationship with sub-contractors. Selecting the best sub-contractors is challenge itself but sub-contractors needs to be also monitored and guided. Deploying knowledge resources between own and sub-contractor company might be the biggest task. Grimbe says it: “Further, management attention is required for redeploying internal and external knowledge resources. Management needs to recognize and implement promising combinations of internal and external knowledge resources. A failure to appropriately integrate acquired external knowledge may again increase the likelihood that the resource base of the firm suffers from dilution, making it less unique and easier for competitors to imitate”(Grimpe, Kaiser 2010, p. 9). Grimbe also noticed that when knowledge is well deployed externally and internally, solution is best possible and if they don’t share the knowledge it will reduce products uniqueness compared to competitors and it is easier to mimic.

With mostly outsourced mechanical design team, management costs in the companies will rise. It may lead to situation that rising costs from management are so great that benefits from outsourcing are loosed, this is the tipping point that I already mentioned earlier.

As I have already said that knowledge is the main driver when outsourcing mechanical design. One risk when outsourcing mechanical design is that knowledge produced externally isn’t unique and firm specific resource, so competitors may benefit equally from

external expertise and competitive advantage is missed (Jaffe, 1986). Outsourcing knowledge will also be risk because companies won't have knowledge in the future to succeed in projects that are even harder, they don't have the knowledge from older projects and learning by doing (Nelson and Winter, 1982).

I can conclude that when mechanical design outsourcing is managed correctly can result be very benefactor to the company that is outsourcing. Benefits can be in decreased cost, increased knowledge and better solutions. But if outsourcing isn't managed well or all the key knowledge is outsourced, can outsourcing have very negative effect on the company that is outsourcing mechanical design. I still want to conclude learning by doing in this thesis, because it's one of the biggest thing company misses if outsources mechanical design.

2.1.3.2 LEARNING BY DOING

Learning by doing is one sidestep what we need to take, that we are able to proceed in this thesis. It is important to understand how learning by doing affects the decision of outsourcing and how it affects future of the companies that are outsourcing their mechanical design.

We will think about how learning by doing, effects future of the company, because it will effect on the decision making. Learning by doing is complex theory, but the basic idea is that learning happens in the same process as projects advance, you learn by what you do. What is learned earlier in process can be used again in later parts of the project or in completely new project. This all is very important for the knowledge base of the company.

When outsourcing mechanical design knowledge base, learning and co-operations are big part. Well made planned outsourcing in theory give advantages to company in learning, because company can use external knowledge and ways in a project, learning is enhanced.

2.1.3.3 ABOUT MODULES

For this thesis it is important to learn little about modules. Modules offer solution for many problems that outsourcing mechanical design provide, but it also has downsides that I will discuss later on this chapter. It's current topic and offer different kind of views on the topic of outsourcing mechanical design.

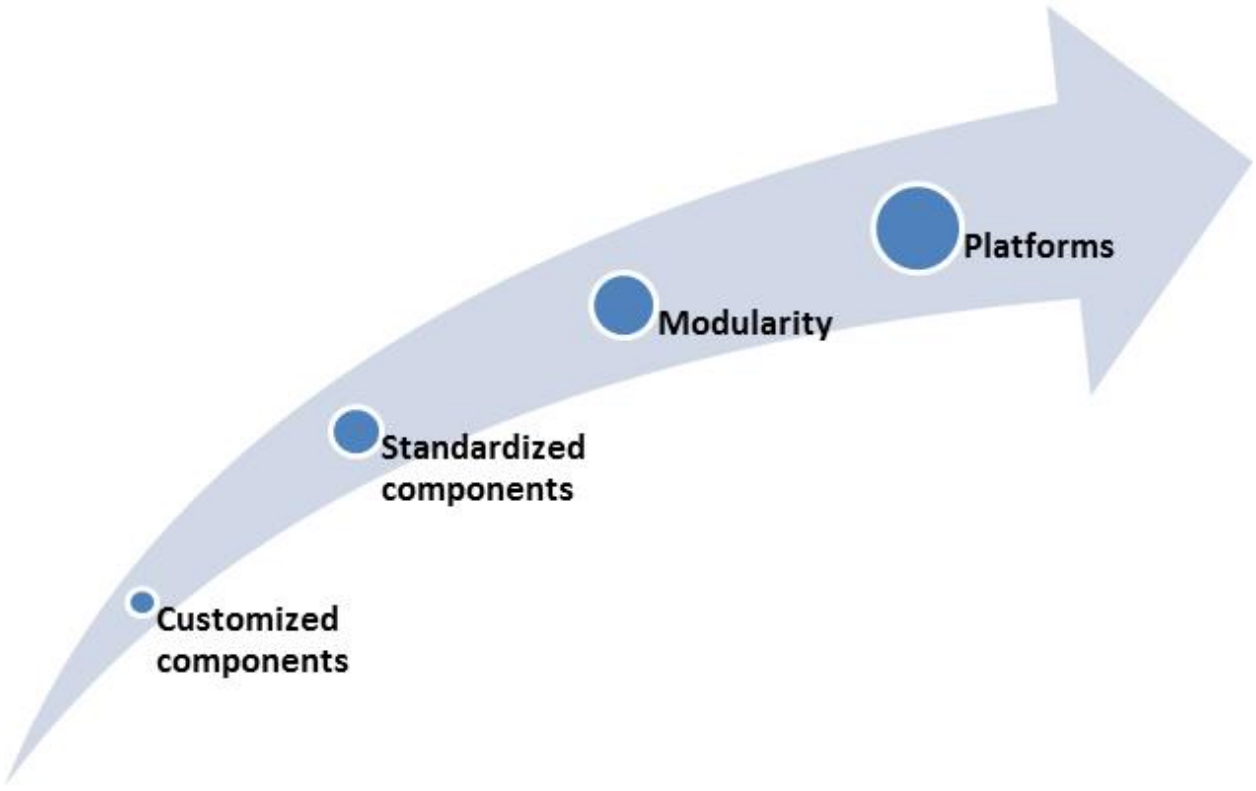
For the complex product designs outsourcing have created solution that helps companies to succeed in outsourcing process. As I told earlier some projects are so complex that possibility to fail in outsourcing is increasing. One biggest reasons is that companies aren't able to understand all the requirements of the project, because they have outsourced knowledge from that area (Zirpoli, Becker 2011). Different kind of modules can be answer for this problem. With modules there is idea to have best basic models what you can easily and fast modify to the current project, those models are called modules.

Management theorists have explored that if work can be organized into modular units, interdependencies between units can be reduced greatly. As Blair says: "a "module" is a component or a step in production that can be carried out separately from other steps or components, but is linked to those other steps through a common interface that allows it to link in multiple ways to more than one other type of component or step." (Blair 2011) Blair makes clear how it helps designs if modularity is well used. Companies can focus to combine these modules and their interfaces. This is very time and money saving method. Problem is that modules don't work in all situations. There is also different quantity of steps in designs and some take more modules than others. Expenses and time are dependent on the quantity of steps (Blair 2011).

Modules have lots of benefits as lower costs and faster production time, but modules have downsides also. Modules are impossible to use with completely new problems. They work better with old problems and basic designs. Basic idea for using modules is that modules are compatible with other modules, so they can be easily attached with other modules. The problem is that modules should be compatible with other modules which is not the case all ways. Most of the time basic models are designed by some big company that has the biggest market share. The big company can manipulate the need in the markets in the way that their modules are most commonly used and so every new module

needs to fit with that module. Interfaces just can't be combined and in result the whole product won't work. This creates stiffness in the new designs and don't give the best outcome for the designs. Government can also affect on the modules. If government invest a lot in some new project, it is possible that around that field there comes lots of different modules (Blair 2011).

Modularity has its benefits and risks, but I don't research it more now because best benefits with modularity can be seen with large companies, that are able to create wide base of modules and take biggest market cut in one field (Blair 2011). I'm focusing in this thesis more on small and medium sized companies, so more research on this field is not needed. Mass customization isn't my topic in this thesis.



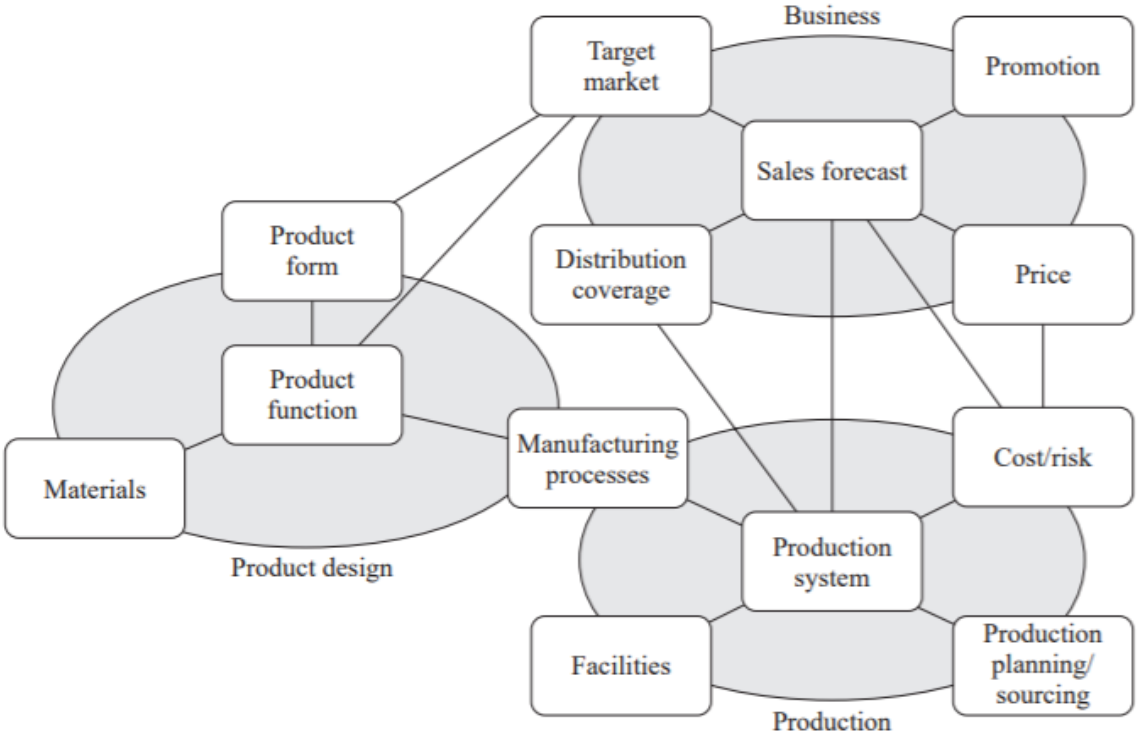
Picture 4. From customized to standardized. (roboticstomorrow)

2.2 MECHANICAL DESIGN

“Humans have been designing mechanical objects for nearly five thousand years (Ullman 2015).” Different kind of objects have been created to fulfil functions. There is continuous need for new cost effective, high quality products on the markets to fulfil needs of the consumers (Ullman 2015). Most products are so hard to create that it takes complex skills and diverse expertise to create high functioning products these days (Ullman 2015). Outsourcing may be one answer to obtain these skills. More complex product, more people it needs to create it, more people needed, more communication between team members is needed and this all leads to need for more management. First in this short chapter I will open little bit of mechanical difficulties and properties mechanical designing have and after that I will talk about controllable variables in mechanical design.

Performance of engineering task is limited by the properties of the material which it is made, by the shapes which this material can be formed and technique which the material is shaped (Ashby, Cebon 1993). Different techniques can be performed to achieve totally new product, enchantment of the product or some update on the production lines. My thesis will research mostly companies that outsource mechanical design when updating their production lines but will conclude companies with new product designs. Two important design risks are that design delivers wrong product (wrong design problem has been solved) and risk of delivering product in wrong time.

Product functions describe what the object does, product form contains product’s architecture, it’s shape, it’s colour, it’s texture and other factors relating to it’s structure. Materials and manufacturing process is also important part when thinking about mechanical design process. All of the areas are related to other areas like business and product design. Product form and product functions are connected to target market, customers in the target market judge the product by what it does and what are the key functions of the product. Target market gives predictions of the sales forecast and it defines how company can arrange other business functions. Business functions are also connected on the production and how it has been organized. Production is also connected to product design. Basic idea is that all the areas are connected and decision on one of the functions will affect on the other functions and decisions. (Ullman 2015)



Picture 4. Controllable variables in product development. (Ullman 2015)

2.3 METHODOLOGY

First in this thesis I will make comprehensive theory overview of outsourcing and mechanical design. Where I will make conclusions of newest theories that are essential to my thesis. My primary use of methodology is focused interview. Method concludes all practices and operations that we are going to use (Alasuutari 1995). In this qualitive research I will use case study of 3 companies that have already outsourced some of their mechanical design. My research method has little bit from half structured research method, because I will have structured questions for my companies, but I'm also going to ask questions on the spot, if I have idea of some extra question which works for that situation. In half structured interview, interview structure haven't been locked in all aspects (Hirsijärvi ja Hurme 2001, 47).

Idea is to create good base of knowledge with comprehensive theory overview, where from I will create suitable question structure for the companies. In the end I will conclude answers. Companies that I choose needs to have some experience of outsourcing

mechanical design and have revenue between 1-15 million. Companies are small and medium sized companies from Finland that are in field of manufacturing.

Interviews were conducted with phone and skype, interview lasted approximately 0,5-1 hour. All of the interviews were anonymous, I had a permit to record interviews for purposes of my thesis, I used high functioning hand recorder.

Choosing right companies for my case might be one of the biggest problem I faced doing this thesis. I made decisions of the size in the early steps, I also decided that I'm going to interview companies that have experience of outsourcing mechanical design. I chose companies that create mechanical solutions as their core competence. In these companies I interviewed personnel whose area of expertise is in mechanical design and projects. Mine interviewed personnel had worked at least 5-years in this position, this was also criteria for choosing, because I wanted personnel whom had lot of experience in that field. Two out of three companies had light weight design team. Third had bigger design team and agency in Sweden. They did lot of co-operations between agencies, but some projects were completely standardized in Sweden and then only modified to specific needs in Finland.

My goal was to find out reasons why companies outsource their mechanical design. I created questions in a way that they would answer this question best way possible. I used knowledge I had gathered from my theory overview. I had few assumptions from theory overview that I used in these questions, such as resource shortage. I created questions, which I then sent to subjects in the companies before the actual interview.

3. RESULTS

In this section I will tell what we discussed during the interviews with managers in the companies that I chose for my thesis. I will tell how managers saw outsourcing mechanical design in general and how it affects the field where they work.

3.1 WHAT IS BEING OUTSOURCED

Companies in this field outsource activities that aren't their key functions, but it is hard to define clearly what is being outsourced. Projects might be large or small, but amount of recourses needed defines projects and part of the projects that needs to be outsourced.

In this scope there was only one company that outsourced strength analysis and structure designs, but other companies also told that these two are common practices that are being outsourced in companies these days. I will be focusing on these to practices that are being outsourced. Strenght analysis measures how different weldings can take different erosions and weights. Structure design can be used in many wyas where you need to design some structures.

All three companies said that specific projects are most commonly outsourced, projects that are hard to define with few sentences, because they vary so widely. Need for this kind of projects in this group came from outside, their customers order normally something so hard or resources were already in use, so they were forced to outsource mechanical design.

What is being outsourced	company 1	company 2	company 3
Strenght analysis	x		
Structure design	x		
Specific projects	x	x	x

Table 1. What is being outsourced.

3.2 REASONS FOR OUTSOURCING

Biggest reason seems to be resource shortage, companies admitted that resource shortage is most common reason for outsourcing mechanical design, this reason also weights most in the scale. Resource shortage was also mentioned in the theory overview

as important reason. It was clear already by then that resource shortage is one of the main reasons why companies outsource their mechanical design.

Subjects whom I interviewed all said that there is just sometimes too much to do that they would be able to do everything in time. Subjects also admitted that business cycles determine the need. Field of mechanical design workshops determine how much new design are needed. Company 2 and 3 also mentioned that public procurements determine the need for mechanical design. Two of these three companies had light weight design team, which is one reason that they followed business cycles and outsourced their mechanical design if needed, because of the active phase in the business cycle. Resource shortage is greater when whole field of business is doing well and it is hard to predict these cycles, so companies respond to this problem with outsourcing mechanical design when needed.

Company 3 had bit different way of handling thing because they outsource most of their mechanical designs. They followed business cycles, but they differed from other companies in a way that they didn't always have the needed skills to complete the project, so they outsourced that part of the project they weren't able to design their self. This company had biggest fears that how company will keep its competitive edge against competitors when mechanical design is outsourced. This company had standards that needed to be filled when creating designs. These standards guided this company's reasons for outsourcing

Reasons for outsourcing	Company 1	Company 2	Company 3
Resource shortage	x	x	x
Business cycles	x	x	x
No in house cababilities			x

Table 2. Reasons for outsourcing.

3.3 BEST PRACTICES FOR CHOOSING CRITERIA WHEN OUTSOURCING MECHANICAL DESIGN

In this section I will tell you how my target companies make criterion's for choosing the right company to outsource their mechanical design. Last part of this section I will tell how they would make criterions better if they would have unlimited time to compare the alternatives. Two out of three companies said that they really don't use this cost based competitive tendering, because the quality of the product is more important. Company 3 stated that cost is one of the main reasons they have when choosing the company that they are going to outsource their mechanical design to.

All three companies admitted that old contacts were first contacted if they would have skills and time to take the current project. One of these three companies admitted, that they don't use different reasons than old contacts when deciding where to outsource their mechanical design. It was company 1 that used only old contacts and it also had the biggest design team in house, which might be one reason's why they are able to only use old contacts. This shows me that old contacts, is the first option if possible, because outsourcing mechanical design have so much uncertainty, which is reduced with old contacts whom they already know personally and know their skill sets.

Company 2 was only one that highlighted that how important it is to think projects case by case. First company needs to define goal that need's to be achieved in the current project, after that they should define how to reach these goals. In this point it starts to come clear what attributes are needed most and what criterion's can be ignored in this project. Project defines that what attributes should be valued, some projects are more critical on time tables, so companies that get hired, are able to take the project right away, doing it fast and in time, in a way that quality of end product is not compromised.

Some projects aren't so time dependent. If skill and knowledge is the most important attribute, company should focus to get the best knowledge of the skillset that companies have when choosing between different companies to outsource their mechanical design to. I talked about quality with all of the companies and all of them admitted that it is really

important attribute, but two out of three companies also stated that projects that they outsource are so simple that it is not so big problem.

High quality and low price doesn't always combine. (one chapter maybe)

Criterias for choosing	Company 1	Company 2	Company 3
Old contacts	x	x	x
Case by case		x	
Fast		x	x
Delivery time		x	x
Respond time to order		x	x
Quality of end product		x	x
Price			x

Table 3. Criteria's for choosing external designer.

I discussed with all the managers about how they would make decisions between different companies if they wouldn't have restrictions with time and money. Biggest similarity in answers were in how to have detailed information about experience in mechanical design and have a basic understanding of all the skills designers have that they want to outsource their mechanical design to. Everyone said that the genuine understanding of the skills is hard to obtain.

Chemistry between personnel is of course important, but it's importance get's highlighted in outsourcing mechanical design. To create something completely new, to create new design, it takes lots of skills and innovations. Co-operations and shared knowledge is in core of design activities. The fluency of team work is key. It is hard to understand in the early stage of knowing somebody, how well can you work together. Company 2 highlighted that knowing the people whom with you work is important when you outsource your mechanical design.

In this section it came clear to me why company 1 didn't use other than old contacts. Reason was that they didn't have the time to find out all the information they would want to know about the company they are going to outsource their mechanical design to. They felt that it is very hard to find designers whom fit for their needs. They also had biggest trust issues about outsourcing in general.

What could be done better	Company 1	Company 2	Company 3
Detailed information about degree of knowledge	x	x	x
Chemistry between personnel		x	
Price	x		
Delivery time	x	x	
Experience in mechanical design	x	x	

Table 4. What could have been done better in criterion choosing.

3.4 DISADVANTAGES OF OUTSOURCING MECHANICAL DESIGN

In this chapter my goal is to go deeper in to the real reasons why companies outsource their mechanical designs and what are the biggest disadvantages when they do so? Is the quality only main factor that can be compromised because of the outsourcing, or is there more to it? I also looked into reasons why these disadvantages occur and how they could be avoided.

Biggest fear that managers face, when they outsource mechanical design is that quality of the project is compromised. Managers biggest concerns were that outsourced designs, would be lacking quality and goal of the product wouldn't be achieved. Quote from manager in the company 2; "When designers don't understand whole operational environment, they are not able to achieve the goal as wanted." Company 2 added that this is more common with designers straight from school's bench. They normally can't understand all the objects and components. Designer straight from school bench might not have raised so high knowledge of mechanical design in general.

Managing projects require more work and whole managing process becomes more complex with outsourced designers whom managers don't know so well. Managers need to handle team chemistry in the same time as he manages all the pieces of the projects. With outsourced designers you might have problems with communication. Because designer doesn't have knowledge enough or are just talking about things with different words and explanations. Designer knowledge of the field where company whom

outsource their mechanical design work might lack. They don’t know all the details that they should about the project and manager isn’t able to communicate all these important details what they should know. Such problems may occur if designer don’t know something in production. This kind of problem might be if designer don’t know that some welding needs to take 1000kg, they design it to be 1100kg, because they didn’t know enough about their production line, whole process fails.

When managing and communication need increases too much because of outsourcing, it starts to have negative effect on final result and expenses normally increase. Like I already mentioned in the theory overview that there seems to be point where outsourcing starts to have negative effects and this effect is visualized in u-curve. When managing takes too much time, outsourcing won’t free resources as wanted, expenses might be higher.

Company 3 talked how big problem it is if company that does their mechanical design don’t meet the delivery time. It depends on the project, but company 3 had that type of projects that it is important to meet the delivery time. They admitted that it is one of their biggest fails that might occur when outsourcing mechanical design.

Disadvantages of outsourcing	Company 1	Company 2	Company 3
Quality of the product is dangered	x	x	x
Higher requirements for managing projects	x		
It doesn't free resources as hoped	x		
Doesn't meet the delivery time			x

Table 5. Disadvantages of outsourcing.

Problems with managing projects	Company 1	Company 2	Company 3
Best knowledge is in house, all the needed knowledge is hard to distribute	x		x
Different ways to work and think		x	
New technology mitigate communication problems			x

Table 6. Managing problems listed.

I want to go bit deeper to reasons why these disadvantages occur and what managers told how they try to avoid these disadvantages to occur. If manager fails in managing process many disadvantaged may occur. It probably would decrease quality of the product, it wouldn't free time as wanted and could even effect on the delivery time. Managers told me that there is different kind of managing tools such as Microsoft project. If everybody uses this tool and ads all the resources they need in their projects, risk that over allocations occur is smaller. Everything is dependent on the managing skills of the managers, but good designers help whom understand big picture.

External designer normally don't understand the whole operational environment and they might have very different ways to work. This might end up hurting quality and the time what it takes to finish the project if these things aren't taken in to consideration. There is ways how you can reduce this risk, such as using old contacts, but this risk is really hard to completely remove. This risk is time dependent, more they try to create team spirit that time is out from design time. With more complex and longer projects it is wise to use more time to create better team spirit. If the project is small, it might be smarter to just live with the problems that occur, in that case learning will happen during the process.

When I talk about resources in this context I mostly mean, knowledge based resources. In mechanical design knowledge based resources are most important. One reason why projects fail is that some knowledge is too hard to obtain, or it is very expensive. It is possible that some resource are in use, this might be the case with scarce resources.

Reasons for disadvantages	Company 1	Company 2	Company 3
Too much managing sub-contractors	x		
Outside designers doesn't know all the details that they should about the company and the project	x	x	x
Different ways to work and think		x	
Don't have the resources available what are needed			x

Table 7. Reasons for disadvantages.

3.5 KEY BENEFITS OF OUTSOURCING MECHANICAL DESIGN

In this section I will tell about advantages of outsourcing mechanical design. Companies that I interviewed had similar understanding on the topic, with few extra notions from managers.

Biggest need for extra designers was because of the business cycles and cost efficiency. Sometimes there is demand, but that demand isn't that big that companies should hire more designers. Companies biggest advantage that they receive from outsourcing were extra resources. Companies can answer the demand in different times and with different demands with outsourced designers.

If managing designers doesn't bring more work than outsourcing takes away, the result will be that managers are able to use that extra time in more important functions. They can focus more on planning and planning execution when somebody else is executing the process. This might also give more liberties for other designers too when some task can easily be done with outsourced designers. Another option would be to learn that task itself, but it might take much time.

Outsourcing mechanical design offers companies different approach for their business models. It seems that small light weight design teams are popular in small companies with revenue between 1-15 million. It enables possibility that they can get along with big companies and business cycles.

Advantages of outsourcing	Company 1	Company 2	Company 3
Extra recources	x	x	x
Free's time to more important functions		x	
Long term benefits	x		
Company can have light weight design team that is cheap with expenses			x
Cost efficient			x

Table 8. Advantages of outsourcing

3.6 ABOUT MODULES

In this chapter I will tell how managers that I interviewed use modularity in their companies. How they see module structure design benefits and disadvantages towards mechanical design.

Modularity was well known among managers that I interviewed. Still utilization of modularity was less than I thought. My thought were created in theory overview where it came clear to me that modularity is commonly used and it have many benefit to mechanical design. Small and medium sized companies in Finland haven't taken it to exploit it in mechanical design according to my research. One of the three managers told me that modularity is big part of their designs and work. That manager told me that they think about modules and how they could create solutions that work commonly in more situations. Manager also told me that its big part of their planning in general. In addition to this one company also said that it uses old design as a base, which is some sort of modularity. Basic idea for modularity is to systematically come up with module base that fits in more common situations, not just randomly come up with new ideas that fit the module portfolio. Manager that uses modularity did say that one of the biggest benefits of modularity is that project become more easily to manage.

I also talked about disadvantages of modularity. It seemed that biggest disadvantage managers that I interviewed faced had to do with quality and uniqueness of the product. They were afraid that the customers need for special attributes in the projects couldn't be met with modularity. Basic solutions don't work in every project. For some projects it would be even harder to create design because there wouldn't be modules or knowledge how to tackle completely new project because of the light design team, which is straight result from modularity and its benefits.

Managers added that they see modularity's big potential if well planned and implemented. They believed that it will be more commonly used in the future.

Modularity	Company 1	Company 2	Company 3
Utilization	x	x	
Standards and modules are important for the company	x		

Table 9. Usage of modularity in companies that I interviewed.

3.7 OUTSOURCING IN GENERAL AND IT'S EFFECTS ON FUTURE OF THE COMPANY

In this chapter I will talk about general feelings that managers feel about outsourcing mechanical design. I will also talk about how they believe it to impacts on the future of the company.

Managers saw mechanical design outsourcing as a positive force. All the companies used outsourcing and have had positive outcomes. Company 1 thought that outsourcing is one key factor to success with modules. Other two were more in the middle ground. Company 3 even stated that it might be threat if skills are not also mastered in house. In a big picture everybody believed that outsourcing will be used even more in the future and mastering it will give competitive advantage against competitors in the markets.

Outsourcing in general	Company 1	Company 2	Company 3
Possibility	x	x	x
Threat			x
Must	x		

Table 10. How outsourcing is generally viewed by the managers.

How outsourcing mechanical design affects companies competitive edge in the future	Company 1	Company 2	Company 3
It does have negative effect			x

Table 11. How outsourcing mechanical design affects companies competitive edge in the future.

3.8 ABOUT IPR

In this chapter I will talk about IPR when outsourcing mechanical design. I will tell basic idea how managers that I interviewed feel about IPR and its importance in their field.

Results were in-line with others and it came clear to me that IPR is not needed in this kind of organizations. Most of the projects just don't need IPR for many reasons. Projects are normally so unique that they don't fit in any other situations so there is no IPR theft risk because of that. Projects also are mix of already common practices so there normally isn't much to protect, because it's just a combination of already known practices and designs put together in some new way.

Companies that I interviewed didn't use IPR to protect their designs, but its good to remember that every project needs to be valuated, on its own. Project managers needs to estimate the need for IPR individually with every project. Some golden projects might be that good that it would be wise to build a patent to protect it. This kind of products/projects are rear and valuable, new ideas are hard to come up with.

IPR in the company	Company 1	Company 2	Company 3
Not in use	x	x	x

Table 12. How managers feel about IPR in the companies that I interviewed.

4. CONCLUSIONS

In this chapter I will conclude my thoughts and findings on the topic of outsourcing mechanical design. I have made these conclusions from theory overview and by interviewing managers from companies that fit my topic. First I will open this subject trough questions of my thesis. I will conclude my findings from theory and my own research.

My main question was about why S&M companies in Finland outsource their mechanical design to consultant firms or other designer firms and I aimed to answer this question with four sub-questions. Now I will conclude my findings from these sub-questions:

“What are biggest disadvantages for the company when outsourcing project?”

In the theory overview biggest disadvantages were seen that performance of the product is reduced and knowledge of the key functions of the product is outsourced (Zirpoli, Becker 2011). In my own research findings were aligned, but there was still more talk about how managing projects gets harder and it might bring more work than planned. I want to emphasize that all of this was found in both, but in my own interviews management side was more highlighted.

“What are the key benefits when outsourcing project?”

In the theory overview biggest advantage were said that acquiring more knowledge with outsourcing is one of the biggest benefits of outsourcing mechanical design. With this extra knowledge companies are able to create projects that they wouldn’t be able to create with out outsourcing (Grimpe, Kaiser 2010). In my interviews biggest benefit was with about doubt about extra resources that help companies manage trough business cycles. I learned from interviews that in Finland these S&M companies mostly use these extra resources to manage trough business cycles, when in theory overview extra resources seem to be used in more complex projects.

“Will outsourcing decrease knowledge in company and will company lose competitive edge against competitors in the future?”

In the theory overview this problem with outsourcing was highlighted. When companies outsource their mechanical design at least in a area that is crucial for the whole product,

company will lose it capabilities in this field eventually (Zirpoli, Becker 2011). In my interviews this problem was disregarded because they thought that it is enough what they know. Only one of the three admitted that this may be a problem in the future. One reason for this reaction is that companies that I interviewed mostly outsourced that kind of part of their design that aren't so crucial to the design of the whole product.

"How to choose right supplier between different suppliers?"

I took this question as an extra, because I thought that it gives nice insight about operations inhouse. In theory overview this subject wasn't concluded. In my interviews I found out that most of the companies use old contacts, and if not it was looked case by case. Time in order was one important criteria.

Overall view seems to be that outsourcing mechanical design is common and will be used even more in the future. Outsourcing mechanical design is key factor to maintain competitive edge against competitors in these fast times. S&M companies are at the mercy of business cycles. Decisions that big companies make have also an influence on demand for mechanical design and S&M companies have to find out new ways to maintain the competitive edge. Outsourcing seems to be answer for many companies, they can have different amount of resources in different times of the business cycles. That reduces their expenses and gives barrier for bad times when there isn't so much demand for mechanical designs.

I see there is two possible directions that outsourcing mechanical design can go to. Other one is that there come's few big players in the field, companies that are able to manipulate business cycles and create demand as they want so they can drive competitors out of markets with low prices and supply of designers that are always available. Modules would play big part in this scenario creating even more expense perks for the big companies. In this scenario quality of the products would decrease but productivity at least in short terms would get higher.

In the other direction there is partnership structured models which leans on trust and knowing your customers and people whom you work with. This would lead to higher learning with teams that are optimised for complex products. In this direction strategical planning for the whole field is harder because managing is grouped with small separate groups.

This all is very field dependent, so directions might be different in different fields. It is also of course possible that there are fields that are more in the middle ground where there is shown parts of the both directions.

4.1 POSSIBILITIES FOR MORE RESEARCH

Outsourcing mechanical design haven’t been researched so much in Finland. Next thesis should focus more on some specific field. This Field should be researched carefully and then researcher should try to find some specific attributes that are important in that field. These attributes should be used in a way that you could create module portfolio ideas for this field.

This topic has lots of potential. Companies in Finland that are in mechanical field could really benefit from extra research. But research should be more aimed for the company in hand. Extra research in general way maybe isn’t so fruitful because same basic principles seems to work in different countries and basics of this topic has been researched thoroughly. Extra research should be done from modularity or some other more specific topic like that.

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