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Capital Budgeting Plan for Case Company

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ABSTRACT

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This thesis was commissioned by an anonymous Pirkanmaa-based manufacturing company. Its objective was to form a capital budgeting plan for a new factory and research, which manufacturing line inefficiencies affect the company the most. Currently, the company operates on very slim margins due to various inefficiencies throughout the manufacturing process. With the new factory, the company is aiming to increase its operating margin and production quality by improving those inefficiencies found in this thesis.

In theoretical framework, different capital budgeting processes and performance measures were analysed to find the most suitable tools to assess the company's new investment opportunity. Various phenomena affecting the manufacturing line efficiency were also studied to find out, which factors contribute towards the efficiency the most.

Department chiefs were interviewed to gain a more holistic view of the current situation and study, which inefficiencies found in the theoretical framework part affect the company. Document-based research was also conducted to determine the company's current factory's dimensions, recurring expenses, and financial data which was then scaled up to meet the requirements of the new factory.

Capital budgeting analysis was conducted to estimate, how profitable the new investment is going to be with the company's primary operating margin target. The investment was also analysed with more conservative operating margins to determine the investment's breakeven point and potential risk. Research and calculations suggested that the company should undertake the investment opportunity since the incremental improvements required to turn the investment profitable were realistic. However, various factors of the future had to be assumed and forecasted, which lowered the capital budgeting analysis' overall reliability. Before the investment can be undertaken in practice, the company must conduct further research on areas that could not be addressed in this thesis.

Key words: capital budgeting, investing, manufacturing

CONTENTS

ABBREVIATIONS

ARR	Average Rate of Return
IRR	Internal Rate of Return
MMT	Modern Monetary Theory
NPV	Net Present Value
PP	Payback Period
RoR	Rate of Return
TPS	Toyota Production System
TVM	Time Value of Money
WIP	Work In Process

1 INTRODUCTION

Whenever a company is looking to expand its operations, they should always start with a capital budgeting plan since it will guide the company to choose projects that add value and avoid those that do not (Pinkasovitch, 2021). In the simplest terms, the main objective of a capital budgeting plan is to determine how much a given investment is going to cost in total, and whether it is going to be profitable over its lifetime. Some form of capital budgeting plan is necessary with every large investment since unaccounted costs can quickly get out of hand, which will turn the previously lucrative investment to a bad, irreversible mistake. The more accurately the costs and cash flows are estimated in the planning stages, the more successful the company will be as there will be less mishaps over the course of the business' life.

Olkiluoto 3, a nuclear reactor in Western Finland, is one of the most famous examples where the capital budgeting plan was far too optimistic and, in the end, did not reflect reality. Construction of the reactor encountered a delay of twelve years and took sixteen years in total instead of four years as set in the original plan, which consequently made the price tag of the reactor rise from three billion euros to 8,4 billion euros (Vanttinen, 2021). The reactor accidentally became the world's second most expensive building (Yle, 2019). This is the main reason why thorough and unbiased capital budgeting is crucial. With every investment, there are bound to be countless unexpected costs that are unforeseeable in the planning stages. However, being able to estimate a realistic ballpark figure is important to prevent such financial disasters from happening in the future.

1.1 Introduction to the case company

The case company of this thesis is a Pirkanmaa-based well established heavy metal workshop firm. It is categorized as a small-to-mid size enterprise as it has roughly 100 employees, and its annual revenues are between ten and twenty million euros. The company's most important customers are large corporations, some of which are listed in the Finnish stock market. The company's specialty is manufacturing welded steel structures, having a large manufacturing portfolio diverging from spare parts to complex projects. Even the most common products make up only about 2% of the company's total annual revenues.

1.2 Current situation of the company

Currently, the case company has three separate manufacturing process locations in the Pirkanmaa region. In those three locations, there are seven different types of departments including cutting, bending, welding, heat, painting, machining and assembly. In some cases, the goods must be moved between locations during the manufacturing process as not all the facilities have the same capabilities. From a long-term perspective, this is not wise as transporting goods does not add value to the product (Wang 2011, 2).

When the company was first established in the 1970's, the company started with only the welding department. Over the years as the company's customer base was growing, they noticed that there was a considerable market demand for a more well-rounded experience within the heavy metal workshop industry. From both the customers' and company's perspective, it was deemed more cost-efficient to process an item as far as possible within one location and one company rather than shipping an item between multiple subcontractors often in far-apart locations. As a result, the company started to create new departments when needed by customers.

This posed a problem though: since the original welding department was established on a relatively small piece of land, leaving little space around, the company had to look for other areas to build new departments. This led the company to becoming more inefficient as its operations expanded to multiple separate facilities and thus its manufacturing costs rose, which made the company less competitive. Establishing departments when needed was logical at the time when the company began its operations since slow expansion did not pose as high of a capital risk to the shareholders if the newly established company failed, and at that point, the company was viewed more as a specialized welding company in the beginning rather than an industrial "one stop shop", which it later did become.

With this approach initially, the future need of land was not considered since the initial idea the company started with, was not the direction the company took later on. This led the company to establish departments that were either sub-optimal space-wise by being close to the original welding department or sub-optimal distance-wise by being far away from all other operations. As the building layout has a significant effect on the efficiency of the factory, the importance of manufacturing facilities design cannot be undermined as it affects the company's productivity and profitability more than any other major corporate decision (Stephens 2019, 2).

In addition, there are several issues with the factory buildings themselves. Over the years, the current buildings have become outdated as both the number of orders and the size of products have increased substantially. The higher quality standards set by customers have put a considerable pressure on the current factory to keep up with the growing requirements. These factors have created numerous new problems: goods are lost on a weekly basis, the manufacturing process has slowed down as the new departments were created inefficiently, the consistency in delivery dates has decreased, and overall, the manufacturing process is not as smooth as it should be.

1.3 Aim and objective of the thesis

The main objective of this thesis is to determine with a capital budgeting plan, whether it is financially practical for the company to build a new factory and move all current operations there. This thesis will lay the foundation for that project by proposing, what the company needs to consider before the investment can take place. A new manufacturing plant construction is one of the largest investments a company can ever undertake and thus, it is crucial to thoroughly determine its feasibility beforehand (Stephens 2019, 3).

The main purpose of this new facility would not be to grow revenues from current levels but to increase long-term profitability by increasing manufacturing gross margins that are very slim currently due to the above-mentioned manufacturing issues. As this large project is still years away from materializing, the goal of this thesis is not to provide precise calculations but rather make rough estimations and forecasts on the amount of incremental improvements required to make the investment profitable. At this stage, there are still too many unknown factors to be able to form an accurate and full capital budget and thus, many of them will be disregarded and left as variables the company must conduct further research on. Later when the company has internally studied the effects of these variables, they can be added to the capital budget.

In the first phase, the company is planning on merging all operations near the original welding department into one designated manufacturing facility. The company does also have other manufacturing sites, which will be kept as separate entities, for now, since they operate independently and are not part of the same manufacturing process. The size of the proposed new facility in this thesis will, however, consider that in the second phase of the expansion, all the company's operations are moved to the same location.

The second phase of the facility expansion is not within the scope of this thesis, since the independent manufacturing sites are operating on a satisfactory level and do not face the same core problems described above. Additional space inside the new factory building will also ensure that in the future, the company does not run into the same congestion problem if the company's operations expand in ways that cannot be foreseen at this point. Transferring multiple operational activities to one building at once altogether is an extremely complex and resource intensive procedure from both the financial and technical standpoint, and hence the company has decided to do the integration in two phases rather than at once, to simplify the already difficult task.

2 THEORETICAL FRAMEWORK

2.1 Capital budgeting process

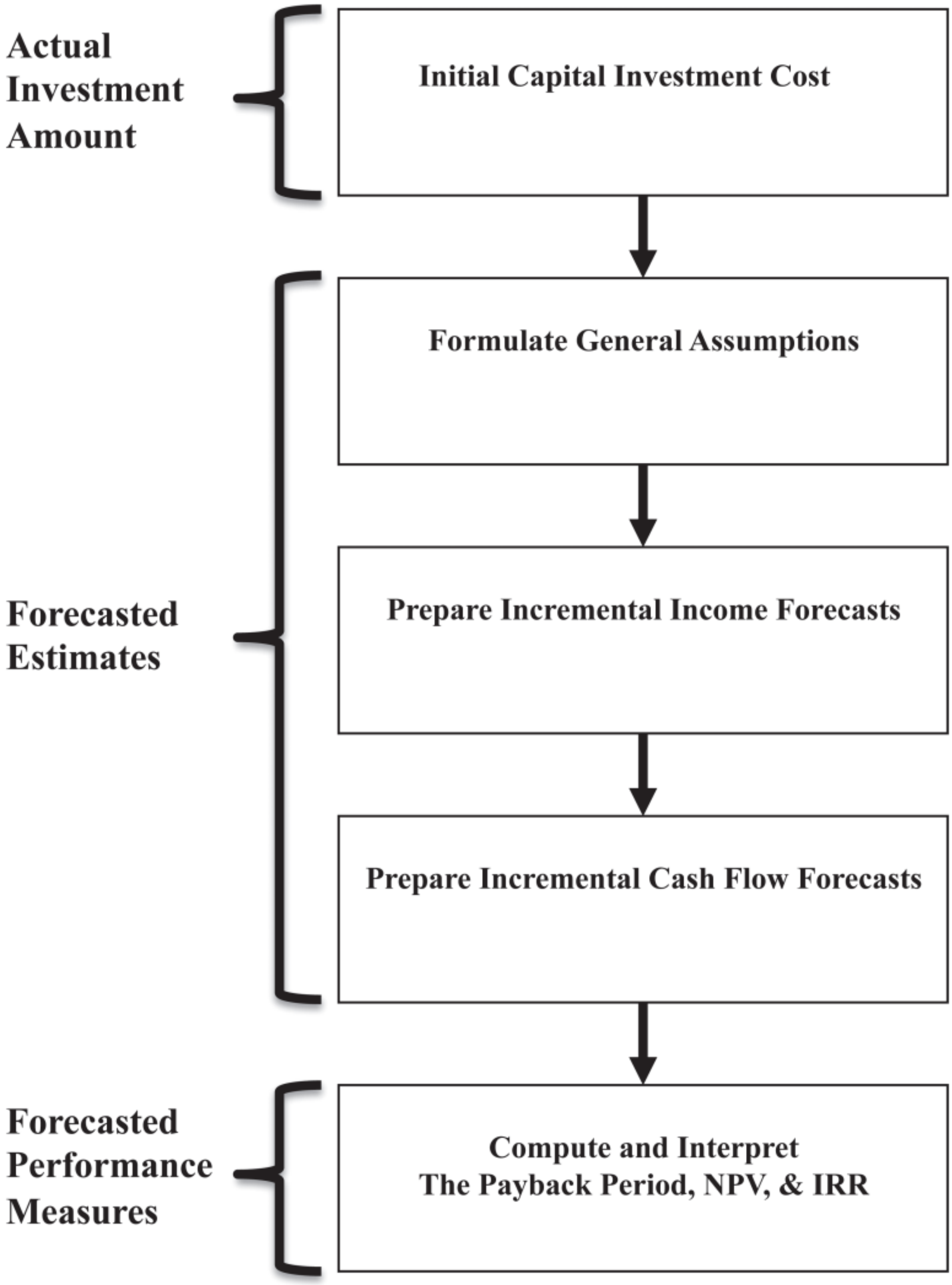
A capital budget is needed when a company is considering a decision that requires considerable amount of capital such as buying new machinery, acquiring another company, or building a new factory. The intent of such investments in fixed assets is to generate long-term returns (Goel 2015, 12). Careful analysis before any type of investment is made is necessary as capital budgeting decisions are often difficult to reverse, involve high degree of risk, require substantial amount of capital, and the break-even duration of the investment is long (Goel 2015, 13).

According to Sandeep Goel in his 2015 *Capital Budgeting* book, the capital budgeting process can be divided to four steps (Goel 2015, 14):

1. Preliminary screening of ideas: To determine that a capital budget is needed, the company needs to identify a possible investment opportunity. In this stage, financial outlay, market factors, and risk-return are determined.
2. Feasibility study of the proposal: the investment opportunity's economic-, commercial-, technical-, and financial viability is studied to determine how feasible is it to go through with the project.
3. Capital project evaluation: the project's thorough financial evaluation is made to determine how lucrative is the opportunity. These factors are considered in this part of the process:
    a. Cash flows that are a direct result of the capital investment decision
    b. Salvage value of existing assets if they are going to be replaced with new assets
    c. Depreciation of the investment over time
    d. Income tax effects are to be considered based on the type of the firm
    e. Inflation when estimating cash flows

f. Risk considerations: political risks, market fluctuations, competitors, among other risk factors need to be considered. Risks must be evaluated based on the type of investment.

4. Capital decision making: if the opportunity is deemed viable, the company will go forward with it. The successfulness of the project is dependent on the execution and how accurate the calculations and assumptions were in the capital project evaluation-stage.



PICTURE 1. Mark S. Bettner's capital budgeting process (Bettner 2015, 121)

According to Mark S. Bettner, initial capital investment cost is the only known variable in capital budgeting and everything from that point onwards is based on estimates (Bettner 2015, 120). This is because in most cases, the price of land, new machinery or a building is known to a reasonable level of accuracy since primary pricing data is already available from the object in question or from other items with similar specifications (Bettner 2015, 120). This is not the case with forecasted estimates and performance measures as the incremental income and cash flows resulting from the new investment cannot be predicted with certainty since there is no primary data available, like there is for initial capital investment cost (Bettner 2015, 120).

Next step in Bettner's capital budgeting process covers general assumptions surrounding the investment. Before performance measure calculations can be made, numerous factors must be estimated beforehand as most figures are based on the assumptions (Bettner 2015, 121). Bettner describes these assumptions as:

- *Estimated life of the investment*
- *Depreciation or amortization associated with the investment*
- *Incremental sales that the investment is expected to generate*
- *Incremental costs expected to be incurred as a result of making the investment*
- *Anticipated rate of inflation and how it will impact incremental revenue and expenses*
- *Estimated tax rate expected to be effect over the life of the investment*
- *Incremental debt and equity financing needed to acquire the investment*
- *Incremental changes in various working capital accounts expected to occur over the life of the investment*
- *Liquidation proceeds – if any – anticipated from the future sale or disposal of the investment* (Bettner 2015, 121-122)

Incremental income and cash flow forecasts are the last two steps in Bettner's forecast analysis to be able to calculate and use performance measures as investment analysis tools (Bettner 2015, 122). These incremental forecasts solely focus on the added value that comes as a direct result of the investment, not the company's overall income and cash flow performance (Bettner 2015, 122). Net Present Value (NPV) and Internal rate of Return (IRR) are the two most used capital budgeting tools that require the computation of incremental cash flow forecasts (Bettner 2015, 122).

2.1.1 Key differences in Goel's and Bettner's capital budgeting approaches

Mark S. Bettner's approach to the capital budgeting process in his book *Using accounting & financial information: analyzing, forecasting & decision making* (2015) is like Goel's, but it does have a few key differences. Goel's version of the process is broader since in addition to the cost-, cash flow-, and performance measure analysis, it also considers the risks in non-numerical form, technical viability of the project, and the business environment the company operates in. Goel's version also considers the preliminary stage of the process, which is when the company is still researching possible investment opportunities.

Bettner's version of the process is more technical, straight-forward and the focus is solely on the proposed investment itself as it begins from Goel's step three of the process which is the technical analysis of a specific proposal. This is not to say that Bettner's approach to capital budgeting is worse: as every company has limited resources, focusing only on the numerical analysis might produce more accurate estimates since the calculations are done more thoroughly. On the contrary, by only focusing on the calculations the company might miss some crucial factor in the business environment, which completely changes the accuracy of the calculations.

Which approach to capital budgeting process is better is completely situation dependent. If the company is moving to a new line of business, the business environment analysis is very important part of the capital budgeting process. In this case, Goel's approach is more suitable. If the nature of the investment is expansion of current operations and demographic-, economic-, political-, ecological-, sociocultural-, and technological factors surrounding the expansion do not change from the previous business line and thus, do not affect the capital budgeting calculations, then Bettner's version is the better option (Claessens, 2015). Combining some aspects from both capital budgeting processes is also a possibility if it is deemed that the focus should be kept on the calculations but there is also a need for some business environment analysis.

2.2 Capital budgeting tools

In the world of capital budgeting, there are many tools and formulas to help companies evaluate, compare, and contrast different investment opportunities objectively. The use of capital budgets is necessary with every large investment as without them, it is not possible to accurately compare different investment opportunities and individually determine the lucrativeness of each investment (Bettner 2015, 119).

2.2.1 Net Present Value

$$\mathrm{NPV} = \frac{R_t}{(1+i)^t}$$

NPV = net present value

R_t = net cash flow at time t

i = discount rate

t = time of the cash flow

PICTURE 2. The formula of Net Present Value (NPV) (Google 2021)

In capital budgeting, net present value (NPV) is one of the tools to determine the profitability of a given investment (Fernando, 2021). It is calculated by deducting present value of cash outflows from present value of cash inflows over a specified period. The core strength of NPV and the reason why it is widely used as a capital budgeting tool is that it considers inflation in the form of Time Value of Money (TVM), one of the main concepts of Modern Monetary Theory (MMT). Money loses value over time due to inflation, meaning that the same monetary value is more valuable today than it is in the future. However, if money is invested wisely, the future inflation-adjusted value can grow to a higher value than the current present value (Fernando, 2021).

The formula has three elements: net cash flow at time t *Rt*, discount rate *i*, and time of the cash flow *t* (Google 2021). Net cash flow at time t in the formula states the amount of cash flows over a period t after the investment has been made and the cash outflows have been deducted (Gocardless n.d). In addition, NPV calculation considers an alternative investment opportunity in the form of a discount rate. An average stock market yield of 6 to 10 percent is often used as a discount rate but the company may also have other in-house investment opportunities with higher discount rates. The future values are discounted with the discount rate, meaning that the earlier cash flows are more valuable than later ones because of TVM. Time of the cash flow in the formula describes, how long do the cash flows last resulting from the investment.

In short, if the result of the NPV calculation is negative, the investment opportunity has worse yield compared to the discount rate alternative over the specified period and thus, it should not be undertaken. If the result is positive, the opportunity has a better yield compared to the discount rate and should be undertaken (Fernando 2021). However, one major limitation of NPV is that it relies on the accuracy of future events predicted in the calculations and thus, one should estimate the cash flows as accurately and realistically as possible. If the estimations are just assumptions and are made without any kind of evidence to support them, the risk of the investment grows exponentially as the predicted future cash flows cannot be relied upon. Oversights in this area can mislead both the company itself as well as current shareholders and possible new investors if the future cash flow analysis is too optimistic and skews the result of the whole NPV calculation.

2.3 Sensitivity analysis

Sensitivity analysis, also known as what-if analysis, is used in financial modeling to determine how different values of input variables affect the target variable. (Kenton, 2021). The tool is commonly used in the field of economics by financial analysts and other people with similar job titles to forecast the future. If a connection between an input and target variable is known, one can predict what will happen to the target variable based on input variable changes (Kenton, 2021).

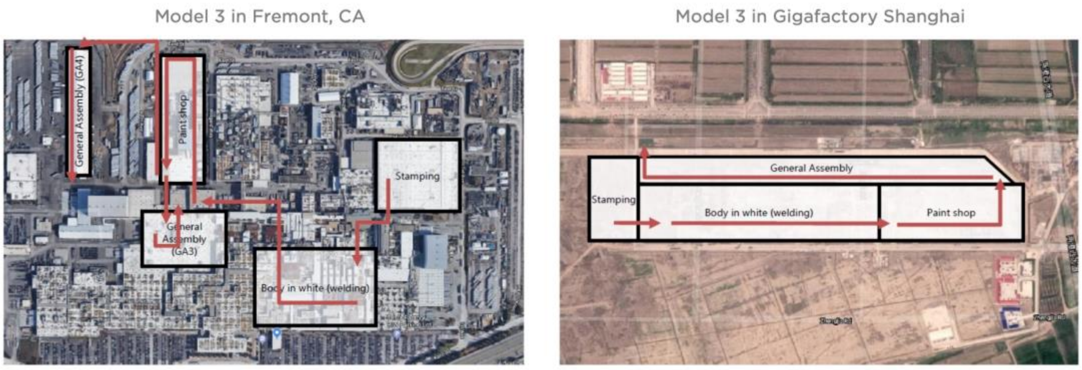
One limitation of sensitivity analysis is however, that the few variables studied in each scenario never interact in isolation and thus, the historical data is not necessarily an indication of future performance (Kenton, 2021). The relationship between given variables is in constant disruption as other variables constantly affect their relative strength.

2.4 Efficiency improvements from a better manufacturing facilities design

Manufacturing facilities design is a term used to describe company’s use of its physical assets, such as people, material, equipment, and energy (Stephens 2019, 2). Factory location(s), building design, factory layout and material handling are part of manufacturing facilities design. Layout is the physical arrangement of objects in each space, and it is one of the sub-categories of manufacturing facilities design (Stephens 2019, 2). In the context of a factory building, it consists of machinery, equipment, workstations, people, location of materials and material handling equipment (Stephens 2019, 2).

The world’s leading manufacturing companies such as Tesla are following this premise of nowadays building tailor-made factories rather than reutilizing existing factory buildings as it is more efficient (Impact Report 2020 2021, 17). Between 2010 to 2012, Tesla built their first vehicle factory in Fremont, California inside existing factory building as it was more capital efficient for a company to get the business running that way (Wolters Kluwer, 2020). As their business developed, more emphasis was put on efficiency and manufacturing facilities design. This led to them building out their own factories from the ground up instead of using the same strategy as with the first factory.

A better manufacturing facilities design is apparent from the picture below: Model 3 production line in Fremont compared to the corresponding line in Gigafactory Shanghai. For the past ten years, Tesla has been continuously optimizing the Fremont factory's operations but as the factory is divided into multiple separate buildings, it can never reach the same level of efficiency as Gigafactory Shanghai where the vehicles are assembled in a single building from start to finish. Production line efficiency is one of the most important things to focus on in manufacturing as it directly correlates with the product's gross margin.



PICTURE 3. Tesla Model 3 manufacturing process in Fremont, California compared to Gigafactory Shanghai, China (Impact Report 2020 2021, 17)

2.5 Material handling

In simplest terms, material handling is defined as moving material (Stephens 2019, 3). Improvements in material handling have affected workers work design and ergonomics more than any other area in industrial history (Stephens 2019, 3). From the business' perspective, improving material handling is beneficial as it directly reduces production costs. Material handling accounts for about 50% of all occupational accidents and 40-80% of all operating costs, meaning that even small incremental improvements can have a large impact. (Stephens 2019, 3).

Material handling as a subject is very closely related to the physical layout of equipment. Often in practise, these subjects are treated as one since the choice of material handling equipment will directly affect the layout of the factory (Stephens 2019, 3). Generally, investing in material handling equipment is wise if the price of equipment can be recovered in two years or less. The savings must directly come from reduced labour, material, or overhead costs (Stephens 2019, 3). When designing manufacturing facilities, one should keep the cost reduction formula in mind.

Ask	For every	So we can
Why	Operation	Eliminate
Who	Transportation	Combine
What	Inspection	Change sequence
Where	Storage	Simplify
When	Delay	
How		

FIGURE 1. The cost reduction formula (Stephens 2019, 3)

The figure will help the designer eliminate as many useless parts and processes from the manufacturing facilities design. It is read by first picking a question from the first column, then picking any action from the second column that can happen to a part throughout the manufacturing process and the third column has the efficiency improving measures one could execute to ultimately come up with a better manufacturing facilities design.

2.6 Lean manufacturing

Lean manufacturing as a concept can be described as producing goods with better efficiency by every measure compared to traditional mass production (Wang 2011, 1). Waste, human effort, manufacturing space, investment in tools, and engineering time are just a few examples a company can try to minimize by implementing lean manufacturing principles to their production line (Wang 2011, 1). Toyota was the first company to make the concept well known with their Toyota Production System (TPS) in which the focus is on reducing seven specific wastes, outlined below. The overarching theme of the management philosophy is to try to eliminate any process that does not add value to the final product (Wang 2011, 1). As the layout of a factory is difficult to change retroactively, the manufacturing facilities design should consider all these factors laid out in the TPS to maximize the manufacturing efficiency. This is crucial as points 3, 4, 5 and 7 are directly tied to the layout of the factory.

1. Overproduction – manufacturing an item before it is necessary, which ends up in a work-in-process warehouse, wasting space and capital that could be used elsewhere. Very harmful for the company as it directly degrades quality and productivity.

2. Excess inventory – clear indicator that there is a bottleneck in the company's operations, which will negatively affect the overall performance of the company. Closely related to overproduction as those same products will end up in excess inventory. Excess inventory increases lead time and takes up productive space.

3. Waiting – if the manufacturing process is not seamless, waiting occurs as the goods must wait for the next operation. The more steps there are within the manufacturing process, the more attention should be paid to the manufacturing facilities design already in the planning stages of a new facility. Waiting has a major effect on a product's lead time if it must wait a long time between steps.

4. Transportation – transporting goods within the manufacturing process does not add value to the product. The opposite is true as in some cases mishandling and excessive movement may cause damage to the product, decreasing the quality.

5. Unnecessary motion – compared to the previous point of transportation, unnecessary motion consists of movement of equipment, producers, or workers within the factory. May cause damage, wear, fatigue, and safety issues to both the manufactured goods themselves as well as everything else within the factory.

6. Overprocessing – wasting capital on more expensive resources when deemed unnecessary or adding design features that are not needed by the customer. Causes the product to have unnecessarily high sticker price, making it less competitive.

7. Defects – the more defective products come out of a production line, the more it affects the company's bottom line in a negative way and thus, they should be avoided as best one can (Wang 2011, 1-2).

3 QUALITATIVE RESEARCH

The qualitative research consists of three parts: the first part goes through the primary data that was collected via interviews, the second part covers document-based research that was conducted, and the third part analyses the current state of manufacturing process and estimates the new factory size and cost.

3.1 Research objectives

As the topic of the thesis is to create a capital budgeting plan for a new factory building for the case company, the intent of the qualitative research was to gain a more holistic view of the whole manufacturing process. By doing this, aspects that work well in the current manufacturing facilities design can be preserved and implemented again to the new factory, and, on the contrary, other things that currently slow down the manufacturing process considerably, can be improved.

As previously mentioned, manufacturing facilities design consists of the factory location(s), building design, factory layout and material handling (Stephens 2019, 2). The aim of the interview part of the research was to gain information about the factory layout and material handling through the lens of the department chiefs as they know best whether the current room layout of each department is sufficient for the intended use of the space. Factory location as a manufacturing facilities design concept was disregarded as it was deemed unintegral part of this thesis. The company may conduct their own internal research on this area in the future.

Document-based qualitative research was conducted after the interviews to gain hard data about the company to determine the requirements of the new factory building. Information about the company’s current factory dimensions, recurring expenses, revenues, operating margin, and other financial data was collected as it was necessary to be able to form forecasts, general assumptions, and performance measures, all of which combined form a capital budget.

3.2 Research methodology

Qualitative research was determined to be the most suitable research method since deeper understanding of the situation was necessary and the data collected was not numerical. Interviews were chosen as the primary data collection method to determine the strengths and weaknesses of the current layout. As this was an internal study and very case-specific, all the primary data was collected by the thesis author since there was no secondary data available.

In total, seven department chiefs, one from each department, were interviewed for the qualitative research part of the study. The interviews were conducted at the company’s premises over a two-day period. The interview was semi-structured as some questions could only be answered one way and others were more open-ended. The length of each interview ranged from 15 to 30 minutes, and they were not recorded. The interviewees answers were transcribed by the thesis author during the interviews and thematic analysis was conducted afterwards.

In addition, document-based research was conducted in collaboration with one employee familiar with the company’s current state of manufacturing. Discussions with the employee, company’s internal financial management system, and Excel sheets were used to gather document-based information throughout the whole thesis process between August of 2021 and November of 2021.

3.3 Interview observations

3.3.1 Space incompatibility

The overarching theme that came up in every interview was that the department’s premises are not compatible relative to the size of items manufactured in that space which hinders their ability to work efficiently. Over the years, the size and number of manufactured items has increased substantially. The space designated for each department is either too small in one or multiple dimensions or the general shape of the space is not practical for the department's needs. On top of being a hindrance, it makes the working environment more dangerous as proper safety distance cannot be kept to the machines. Processing large items also negatively affects the company's overall production as when large goods are processed or moved, work on other workstations must be halted temporarily since there is not enough room.

3.3.2 Storage shortage

Another thing that was brought up by almost every interviewee was that there is not enough or in some cases, any dedicated storage space for the Work In Process (WIP) goods, which results the items being stored in the factory floors. This further slows down the manufacturing process as stored goods must be moved each time when they are on the way. The storage problem is prevalent especially in those parts of the factory where multiple departments are right next to each other as sometimes when one's department is full, the WIP goods must be stored in the adjacent department's floors', which has a compounding effect on the storage problem. As some of the storage space is outside without roof covering, the amount of space available at any given time is weather-dependent since most goods cannot be stored in moist conditions because rust will soon begin to form on the surface of the items if left outside. In these instances, goods must be brought inside, regardless of whether there is suitable storage space left. If there is not, the items are stored on passageways as a last resort, making it impossible to move goods between departments efficiently, completely halting the whole manufacturing process. This is an issue especially during the autumn months as precipitation is a common occurrence.

3.3.3 Crane shortage

As most manufactured items are large and very heavy, they are mostly moved with cranes within each building. According to the department chiefs, the current number of cranes would be sufficient if there was coordination between departments for the use of cranes. As it stands, departments must share some of the cranes and since there is no reservation system in place for the use of cranes, sometimes multiple departments would need the crane simultaneously to proceed with manufacturing and other times, the cranes are not in use by anybody. A reservation system would promote efficient use of shared cranes as departments could plan their day-to-day manufacturing accordingly to prevent simultaneous need of the cranes.

3.3.4 Manufacturing line agility

Even though there are problems with the current manufacturing line, most interviewees expressed that in practise, production is still functioning on a serviceable level currently. Most items do not cause any major problems even with the current limitations as they have been considered in the manufacturing process. The workers' expertise plays a large role in how well the manufacturing line is working currently, given the circumstances.

Problems start to arise though when large, new items are first introduced to the current layout since there is always some level of adaptation required. The previously learned manufacturing methods suddenly do not work anymore with the new item and the department chiefs have the responsibility to think of new ways to manufacture as efficiently as possible. In some cases, however, it is concluded that it is not possible to complete some steps the most efficient way possible because of the said layout limitations. In these cases, time is wasted because the step must be done regardless of how efficient it is to complete.

3.3.5 Workplace safety

Interviewees expressed that occupational accidents are not a common occurrence even though the company's manufacturing facilities design, material handling, and hurry on a weekly basis would suggest otherwise. This is due to the working culture the supervisors and employees have adopted: even though there are elements that contribute towards a dangerous working environment in the company’s current premises, it is always wiser to take extra safety precautions rather than risk hurting yourself or someone else. This approach to manufacturing is beneficial to both the employees’ and the company itself since a safe working environment will contribute towards the employees’ wellbeing and happiness, which will in turn lower the company’s turnover rate and boost productivity.

3.3.6 Time waste from above mentioned development areas

Most interviewees estimated that around five to ten percent of all effective working hours are wasted due to the above-mentioned bottlenecks in the manufacturing process. Particularly, there has been an external study conducted on this matter on one department. A few years ago, a third party named Työtehoseuranta (TTS) visited the painting department and according to their findings, material handling takes up 30% of all their effective working hours. According to the department chief, things have gotten better since then, but the problem is still prevalent. This alone is a clear indicator that there is a lot to improve in the company’s manufacturing line. Similar studies by third parties have not been conducted in other departments but the same problems the painting department is facing, are present in almost every other department.

As there are seven departments which are all involved in the manufacturing process of some items, the production line is very susceptible to delays. Even one unaccounted problem in one of the seven departments can cause a delay to the whole factory since often the departments are working on the same item. This causes the delay to be compounded to the next department as they will not receive the item in time. Delayed items end up waiting on the factory floors as there is no other space for them, further taking up precious space, making the congestion problem worse and slowing down the manufacturing process of other items as the delayed goods must be moved as they are on the way.

3.4 Interview data thematic analysis

As Kent Löfgren describes in his video, qualitative analysis of interview data is a four-step process (Löfgren, 2013).

Step 1. Read the transcripts
Step 2. Label relevant concepts
Step 3. Create categories from related concepts
Step 4. Label the categories (Löfgren, 2013)

In this thesis, qualitative thematic analysis was used to group together both current issues and practical working methods that came up during the interview process. As the interview questions revolved around the current manufacturing process and more specifically it's functionality, it was possible to thematically divide the answers to both development areas as well as practical working methods with current manufacturing.

TABLE 1. Interview data thematic analysis

Development areas that could be improved already in the current factory	1. Interruptions in communication causes goods to be lost in transit between departments 2. No reservation system in place for industrial cranes between departments causing them to be used inefficiently 3. Departments do not follow the same guidelines in terms of manufacturing timetable. 4. Pedestrian traffic through some departments causes work to be halted temporarily
Development areas that require a new factory to be built	1. Outdated premises do not meet today's standards in terms of number of orders and size of manufactured items 2. Outdated premises cannot keep up with customers' risen quality standards 3. Multiple separate factory buildings 4. Inadequate storage solution

	5. Excessive material handling 6. Apparent bottleneck in the welding department 7. Processing large objects causes other work to be halted temporarily within the same department 8. The heating department is situated within two departments and does not have its own dedicated space.
Concepts and methods from the current factory that are practical and should be preserved and implemented in the new factory.	1. Occupational accidents are very rare with the current layout 2. Generally, co-operation between departments works well 3. Manufacturing is smooth with small- to medium-sized items

3.5 Current factory dimensions

TABLE 2. Size of each department in the current factory

Department name	**Size**
Welding	1 900 m²
Assembly	1 004 m²
Painting	900 m²
Machining	400 m²
Cutting	600 m²
Bending	500 m²
Total square meters	**5 304 m²**

3.6 Current factory's monthly recurring expenses

TABLE 3. Current factory's monthly expenses

Expense type	Building number	Expense amount €
Rent	Building 1 Building 2	25 506,28 7 525,44
Electricity	Building 1 Building 2	4 139,62 6 527,23
Heating	Building 1 Building 2	818,77 876,40
Total		**45 393,74**

Water is another expense that the company is paying monthly, but it was determined that its consumption will not drastically change from current factory to the new one as water usage is not an integral part of the manufacturing process. These expenses are an average the company is paying monthly of each expense type and the average was calculated from January to April 2021's invoices. What these averages do not consider are the seasonal changes in the invoice costs as the average was calculated from the winter months of 2021. Rent and electricity expenses stay approximately on the same level throughout the year, but the price of heating does change depending on the season, and that is the one limitation of this table.

3.7 Current factory's lean manufacturing analysis

TABLE 4. Case company's lean manufacturing analysis with the current manufacturing facilities design

Lean manufacturing principles are followed	Satisfactory	Lean manufacturing criteria are not met
1. Overproduction	7. Defects	2. Excess inventory
6. Overprocessing		3. Waiting
		4. Transportation
		5. Unnecessary motion

Currently, the case company's manufacturing process meets two of the seven lean manufacturing principles relatively successfully: overproduction and overprocessing. As the company's specialty is large, relatively low-volume items and on order basis, overproduction is not an issue for the company. Only the most manufactured items may be made in advance before an order is placed by a customer. Overprocessing is not applicable to the case company's manufacturing as the raw materials and feature-set of the product are decided by the customer when an order is placed and thus, the case company does not dictate which materials and features to use and include.

Defects is the one area in lean manufacturing that is on a satisfactory level. While mistakes do happen, they are relatively rare and generally customers are satisfied with the product quality. The company follows quality standards on their products laid out by their customers, which have become stricter over the years. For the most part, the standards have been met by the company thanks to the expertise of the employees but keeping up has become increasingly difficult as the current, outdated premises are the main limiting factor of current production quality.

As mentioned previously, the company's manufacturing process is divided to three separate facilities, which is the main inefficiency of the manufacturing facilities design. Excessive material handling, transportation and unnecessary motion does increase the number of defects the company produces, as laid out in the TPS. Outside the seven wastes, the departments not being next to each other also disrupts the flow of information between departments as some cannot directly communicate between each other about the possible issues at hand with the product(s), which results in possible quality control issues.

Where the company has the most issues with lean manufacturing currently is excess inventory, waiting, transportation and unnecessary motion. The company's struggles in these four areas are directly tied to the same core problem as with defects: the distance between the three manufacturing facilities. Currently, the company's manufacturing line is like that of Tesla's Model 3 manufacturing line in Fremont in PICTURE 3, in three separate buildings. Not all departments are in the same building, meaning that goods must be moved short distances with forklifts or other similar industrial vehicles from one department to the next.

Moving the goods increases the amount of unnecessary motion within the production line as the equipment needed to move the goods would not be necessary if the departments were next to each other. Building a new factory from the ground up with good manufacturing facilities design would streamline the whole manufacturing process as it is not fundamentally possible to drastically change the layout of the existing factory buildings and thus, there is a limit on how far the company can optimize the current production line.

3.8 New factory size

The company has estimated that the size of the new factory building should be around 12 000 m², in which each department is 20% larger from current sizes to prevent the congestion problem happening again in the new factory. This takes the total size of each current department to 6 364,8 square meters. In the current layout, the heating department's two ovens are located within the welding and assembly departments. In the new factory building, the heating department would have its own designated space next to the welding department as there is synergy between the two departments.

As the heating department does not take up large amount of space, 135,2 square meters is sufficient to round out the total need of space to 6500 square meters, leaving the new factory with 5 500 square meters of empty space for now. This is important because the company is planning to move all current operations, not just the operations around the original welding department, to the same factory in the second phase of the expansion. The second phase of the expansion is outside the scope of this thesis though as the company is initially focusing on integrating the most inefficient departments first, which are near the original welding department.

3.9 Land requirements

A general rule of thumb is to buy ten times more land than the building size to take possible future expansion into account (Stephens 2019, 342). As the new factory building is estimated to be around 12 000 square meters, the land the factory should be built on should be 120 000 square meters. Generally, front property adjacent to the public road is more expensive than back property and thus, the company should prioritize a rectangle-shaped piece of land with the short side being adjacent to the road to minimize the cost per square meter (Stephens 2019, 342).

TABLE 5. Example property in Rusko-region (Yritystontit n.d)

Variable	**Parameter**
Area	23 282 m²
Permitted building volume	11 641 m²
Price per square meter	20€

TABLE 6. Example property in Taraste-region (Yritystontit n.d)

Variable	**Parameter**
Area	44 308 m²
Permitted building volume	22 154 m²
Price per square meter	13€

TABLE 5 and TABLE 6 present two vacant industrial plots, retrieved from Tampere municipality's website on 23.10.2021 (Yritystontit n.d). Even though these plots do not exactly match the company's needs in terms of the permitted building volume and area, one can still get an idea of the general price per square meter in these regions. In Rusko, the price per square meter is 20 euros and in Taraste, the price is 13 euros. Theoretically if the company was able to establish the factory in these regions, the 120 000 square meter industrial plot with these prices would cost 2 400 000 million euros and 1 560 000 million euros respectively, if bought outright but it is also a possibility to build the factory on leased land. Source pictures for these tables can be found as Appendix 2. since the data in them is in Finnish.

In these examples, the cost difference between the front- and back land does not come up since the whole plot is sold at once and thus, only the general cost per square meter is stated. Another option is that there is no cost difference between the front- and back land in these two examples but this is unlikely since the land in front is always more useful and thus, more valuable for the landowner. When the company begins the search for a suitable piece of land for its factory, this difference in land cost between the front- and back land should be kept in mind even though it does not immediately come up from these examples since it could ultimately reduce the cost of the industrial plot by a significant amount without any sacrifices to the factory's efficiency.

4 CAPITAL BUDGETING ANALYSIS

As the intent of the new factory is to improve the manufacturing efficiency within the same industry and not move to a new line of business, Mark S. Bettner's approach to the capital budgeting process in his book *Using accounting & financial information: analyzing, forecasting & decision making* (2015) is more suitable in the case company's case than Sandeep Goel's version of the capital budgeting process described in his 2015 *Capital Budgeting* book. Business environment analysis is an integral part in the Sandeep Goel's version of a capital budgeting process. However, as it is not as important in the case company's case, Mark S. Bettner's capital budgeting process was chosen for this thesis.

To assess the profitability of the new investment, NPV was chosen as the only capital budgeting tool for this thesis since it was deemed to be the most appropriate. What sets NPV apart from most other capital budgeting tools is that it considers the concept of Time Value of Money (TVM) which was set as one of the requirements of the tool because of long time horizon related to the investment.

Other capital budgeting tools such as Internal Rate of Return (IRR), Average Rate of Return (ARR), and Payback Period (PP) were also considered, but they were determined to be too simple in nature, not consider the concept of Time Value of Money (TVM), or they make too many assumptions about reinvested risk and capital allocation (Fernando 2021). Another factor to consider is that as the whole capital budgeting analysis is built upon forecasts and assumptions in the case company's case, the preferred unit of measure is the monetary value the investment is expected to generate. NPV presents the result in euros whereas with many of the other tools such as ARR or PP, the result of the calculation is presented as a percentage or amount of time, which in this case is not as helpful to the company as a raw monetary value result.

Chapters 4.1, 4.2, 4.3, and 4.4 shall introduce and establish a baseline of the capital budgeting analysis. This will act as the starting point for a sensitivity analysis in chapter 4.5, in which different parameters are changed from the baseline analysis to see how it affects the profitability of the investment.

4.1 Initial capital investment cost

Initial capital investment cost in the case company's case consists of the land and the factory price. The total need of land is determined to be 120 000 square meters and the average price per square meter 16,66 euros. These factors bring the total of price of land to two million euros. The average price per square meter in the base case calculations was decided at 16,66 euros as it was similar to the average price per square meter prices found in TABLE 5 and TABLE 6 and this estimated price also considers the possible cost savings from a rectangle-shaped land, which lowers the average price per square meter. The company has estimated that the average factory cost per square meter will be approximately 333 euros, making the 12 000 square meter factory cost 3 996 000 euros. These factors bring the total initial capital investment cost to 5 996 000 million euros.

4.2 General assumptions of the investment

TABLE 7. General assumptions of the investment

Assumption	**Metric**
Estimated life	20 years
Incremental revenues	10% increase
Incremental operating margin	7% increase
Incremental costs	75 000€ annually
Incremental savings	400 000€ annually
Incremental effect	325 000€ annual savings

Life of the investment is estimated to be 20 years since large, fixed assets like in this case, a factory building is considered as a long-term investment for the company's future. Currently, the company's annual revenues are around 13 million euros with an operating margin of 3%. By building the new factory, the company has set a target to increase sales by 10% and gross margin by 7%. Discount rate of 7% was determined to be suitable as the stock market yields 7-

10% annually on average, depending on the index and the company does not have any alternative investments that would yield a higher return.

Currently, the company’s total annual electricity and heating costs are 150 000 euros in 5 304 square meter premises. Presumably, these costs will rise as the company moves to premises that are over twice the size but the increase in costs will not be directly proportional to the increase in factory size. Due to numerous factors affecting the proportionality between the cost and factory size, it is not feasible to accurately determine the increase at this point. For now, it is assumed that the total price of electricity and heating will increase by 50%, from 150 000 euros annually to 225 000 euros annually. The incremental cost increase is thus 75 000 euros.

The one area where the company will receive incremental savings as a direct result of the investment is rent. Currently, the company’s rent expenses are over 33 000 euros each month from the two buildings near the original welding department. This capital could be better spent on paying off debt from their own factory and land since the capital would still stay on the balance sheet instead of being a liability, like it is currently. In total, the rent costs close to 400 000 euros annually for the company just from the two buildings and land where the buildings reside. By moving all operations to one’s own premises and land, the investment will directly bring 325 000 euros incremental savings annually even with the increased electricity and heating costs since the elimination of rent as an expense more covers the other increased recurring expenses.

4.3 Incremental cash flow forecast

In the baseline analysis, it is estimated that the company can improve its operating margin from 3% to 10%, a net increase of 7% as a direct manufacturing efficiency improvement from the new factory. Another factor that contributes to the company’s improved operating margin is 325 000€ annual savings in recurring expenses. Even though the company’s electricity and heating expenses will increase, the elimination of rent as expense covers the increase in other recurring expenses. The company is also forecasting a conservative 10%

incremental increase in sales as a result of the investment although expansion is not the main motive behind the investment. This sales growth is due to shorter lead times in the new, more efficient factory. With the increase in sales and operating margin, the company is estimating an incremental growth of 1 040 000 euros in cash flows.

TABLE 8. Baseline incremental cash flow forecast

Variable	**Value**
Current revenues	13 000 000€
Current operating margin %	3%
Current operating margin €	390 000€
Forecasted revenues increase	10%
Forecasted revenues	14 300 000€
Forecasted operating margin %	10%
Forecasted operating margin €	1 430 000€
Incremental cash flow forecast	1 040 000€

4.4 Net present value analysis

TABLE 9. Baseline net present value analysis

Variable	**Value**
Initial investment	5 996 000€
Incremental cash flow forecast	1 040 000€
Discount rate	7%
Number of time periods	20
NPV	**5 021 775€**

According to TABLE 9, the investment should be undertaken since the value of NPV is positive. However, this is based on the notion that the forecasts and assumptions are accurate, meaning that the company will still have to do further research on how in practice they will achieve these estimates. It is relatively safe to assume that the company will achieve annual incremental savings of 325 000 euros calculated in TABLE 7 as a direct result of the investment, without any improvements to the manufacturing process itself. Thus, the investment is guaranteed to yield 325 000 euros of incremental cash flows. This means that the efficiency improvements within the manufacturing process itself must generate at least 715 000 euros worth of incremental cash flows for the TABLE 9 calculations to be accurate.

TABLE 1 is a thematic analysis of the interview data, which was gathered from the department chiefs. This table could act as the starting point for the company, from which those incremental 715 000-euro cash flows could be generated from since the table lists all the current development areas and practical working methods of the current factories. However, the data in the table is in non-numerical form and thus for now, it is not possible to know for certain the amount of incremental cash flows these factors would generate if they were to be improved in the new factory. Before the company can deem the investment profitable, further research outside the scope of this thesis is needed on how the company will generate the incremental 715 000-euro cash flows as the presumably guaranteed 325 000-euro cash flow are not enough to make the investment profitable.

4.5 NPV sensitivity analysis

The baseline analysis suggests that the investment would bring an NPV return of approximately five million euros. Next, two scenarios shall be introduced where the core assumptions and forecasts are altered to study how it affects the NPV profitability analysis. This is important since even though the figures used in the baseline analysis are the most probable at this point, using other figures will highlight the possible risk involved with the investment if the forecasts turn out to be inaccurate.

4.5.1 Scenario one: Decrease in property size

In scenario one, the company has determined that Stephens’ rule of buying ten times more land than the building size is redundant and therefore, the company is going to buy property that is seven times the size of the factory instead of ten times the size like in the baseline example (Stephens 2019, 342). In this case, it would be wise to buy the piece of land from a more rural area that has less competition as it would still leave the door open for future expansion if later deemed necessary. Land price per square meter will also consequently decrease if the land is bought from a more rural area.

It is estimated that the price per square meter will decrease from 16,66 euros down to 14 euros because of this move. In total, this will decrease the required land size from 120 000 square meters down to 84 000 square meters, which will in turn decrease the price tag of the land from two million euros to 1,176 million euros. As the company does not have as much space around the factory anymore, it is assumed that the size of warehouses outside the factory will decrease. This will in turn decrease the company's forecasted sales increase from 10% down to 5% as the company cannot work with as many products simultaneously because of smaller warehouses.

TABLE 10. Incremental cash flow forecast in scenario one

Variable	**Value**
Current revenues	13 000 000€
Current operating margin %	3%
Current operating margin €	390 000€
Forecasted revenues increase	5%
Forecasted revenues	13 650 000€
Forecasted operating margin %	10%
Forecasted operating margin €	1 365 000€
Incremental cash flow forecast	975 000€

TABLE 11. Scenario one's net present value analysis

Variable	Baseline analysis	Scenario one
Initial investment	5 996 000€	5 172 000€
Incremental cash flow forecast	1 040 000€	975 000€
Discount rate	7%	7%
Number of time periods	20	20
NPV **Difference %**	**5 021 775€**	**5 157 163€** **2,6% improvement**

According to TABLE 11’s net present value analysis, decreasing the property size from 120 000 square meters down to 84 000 square meters does improve the investments’ profitability by 2,6% even if it does sacrifice potential sales by 5%. This finding, however, does not consider possible expansion difficulties the company might face in the future. In this scenario, anyone can purchase the land to which the company was intending to expand later, which would be detrimental for the company’s expansion plans. From this point of view, 2,6% decrease in net present value is negligible if the future, the possible expansion either increases the company’s sales or operating margin further, which would in turn pay for the decrease in the past many times over.

4.5.2 Scenario two: More conservative operating margin percentage increase

In scenario two, it is assumed that the company’s operating margin percentage improves from 3% to 7%, as a direct result of the investment, instead of 10% like in the baseline analysis. In this scenario, the forecasted 10% revenues increase does not change from the baseline analysis as the company is still benefiting from the increased size of the factory which decreases lead times, thus making it possible to manufacture more in the same amount of time.

TABLE 12. Incremental cash flow forecast in scenario two

Variable	Value
Current revenues	13 000 000€
Current operating margin %	3%
Current operating margin €	390 000€
Forecasted revenues increase	10%
Forecasted revenues	14 300 000€
Forecasted operating margin %	7%
Forecasted operating margin €	1 001 000€
Incremental cash flow forecast	611 000€

TABLE 13. Scenario two's net present value analysis

Variable	Baseline analysis	Scenario two
Initial investment	5 996 000€	5 996 000
Incremental cash flow forecast	1 040 000€	611 000€
Discount rate	7%	7%
Number of time periods	20	20
NPV **Difference %**	**5 021 775€**	**476 942€** **90,5% decrease**

According to TABLE 12 and TABLE 13, even a three percent decrease in incremental operating margin decreases the investment's NPV by over 90% compared to the baseline analysis, which is a considerable effect on the investment's profitability. This highlights the necessity of incremental operating margin improvement related to the investment.

4.5.3 Forecasted operating margin % breakeven NPV analysis

TABLE 14. Forecasted operating margin % breakeven NPV analysis

Forecasted operating margin %	Forecasted operating margin €	Incremental cash flow forecast	**NPV**
5%	715 000	325 000	-2 552 945
6%	858 000	468 000	-1 038 001
6,68%	955 240	565 240	-7 839
6,69% (breakeven)	**956 670**	**566 670**	**7 310**
7% (lowest acceptable RoR)	1 001 000	611 000	476 943
8%	1 144 000	754 000	1 991 887
9%	1 287 000	897 000	3 506 831
10% (baseline)	1 430 000	1 040 000	5 021 774

On top of having a primary target to strive for, which in this case is the baseline analysis, it is also important to determine a secondary target which is the lowest acceptable Rate of Return (RoR) for any given investment and anything lower than that threshold is considered a financial risk. According to TABLE 14, the investment's breakeven operating margin is 6,69% with the baseline forecasts, meaning that any operating margin lower than 6,69% will yield a worse return than the discount rate alternative and thus, should not be considered. However, lowest acceptable return for the investment should be set higher than the breakeven point since there should be a clear incentive to invest in the opportunity and at breakeven, the opportunity and the discount rate are still equal in terms of the future returns.

As seen from TABLE 14, 7% operating margin is the first single digit number that yields a positive NPV return and at the same time, is considerably higher than zero, making it more lucrative than the discount rate alternative. Thus, 7% operating margin should be set as the lowest acceptable RoR. To achieve this return, the new factory must bring incremental cash flows of at least 611 000 euros, of which 325 000 euros are already guaranteed because of annual savings outlined in TABLE 7. This means that the efficiency improvements in the new factory should bring at least 286 000 of incremental annual cash flows for the investment to be profitable. On the contrary to achieve the baseline return, the new factory must bring incremental cash flows of at least 1 040 000 euros, of which 715 000 euros should come from the efficiency improvements in the new factory.

It is crucial for the new factory to bring at least some efficiency improvements because if only the annual 315 000 euros savings outlined in TABLE 7 were to change, the company's operating margin would only improve by 2% from current levels to a total margin of 5%. This would result the investment's NPV return to be over 2,5 million euros negative. However, this is not a likely scenario since if the company has determined that investment is profitable and thus, should be undertaken, then presumably the company has found ways to increase the operating margin since without any further improvements, the opportunity will not be profitable.

In summary, the company should invest in the new factory if they are able to increase operating margin by at least 4%, to a total margin of 7% Overall, operating margins of 7-10% are realistic if the company is able to solve even some of the current manufacturing development areas outlined in TABLE 1 in the new factory.

5 DISCUSSION

5.1 Factors that were not considered in the capital budgeting analysis

As there was no previous research conducted by the company about the new factory, the main objective of this thesis was to form a generalized view on whether the investment will be financially feasible to begin with. As this turned out to be the case, the company should now do further research on matters that were not addressed. The calculations have their limitations and should not be relied upon at face value since many factors had to be assumed. The accuracy of these assumptions has not been studied properly and will influence the feasibility of the project. This section shall elaborate on the factors that need further analysis for the decision making.

TABLE 15. Capital budgeting analysis' limitations

Assumption made in the capital budgeting analysis	**Limitation**
Development areas outlined in TABLE 1 will help the company to increase operating margin by 4-7%	Development areas outlined in TABLE 1 have not been quantified and it is currently unknown, how large of an impact on operating margin they will have
As the factory size doubles, recurring expenses increase by 50%	Estimated proportionality between factory size and recurring expenses could be inaccurate
More energy efficient building design will not significantly impact the recurring expenses	More energy efficient building design will decrease the recurring expenses
Transition to the new factory is seamless	Transition to the new factory will take time and will impact both revenues and operating margin

Manufacturing is immediately ramped up to maximum capacity and efficiency	Manufacturing ramp up will take time which will impact both revenues and operating margin
The company's or its customers' business environment does not change over the life of the investment	Both entities' business environment will most likely change over the life of the investment
A flat 20% increase in each department size is the most optimal way to increase operating margin in the new factory	Largest size increases in those departments that add the most value to the product is the optimal way to increase operating margin in the new factory
Location of the factory will not significantly impact the capital budgeting analysis	Location of the factory is one of the core principles of manufacturing facilities design and thus, will impact the capital budgeting analysis
Insurance as an expense is insignificant enough that it was not included in the capital budgeting analysis	Insurance as a recurring expense is significant and should be included in the analysis
Salvage value of existing machinery and cost of new machinery was included in the initial capital investment cost	Detailed analysis of the salvage value of existing machinery and cost of new machinery is required

In isolation, none of these factors is significant enough to affect decision making. However, as a group, they will have an influence on the opportunity's profitability. If further analysis on these matters is not conducted before a decision is made, it has a possibility to deceive the company in either direction. Even though the capital budgeting analysis at this point suggests that the investment should be undertaken, it cannot be completely relied upon before the effects of these variables are quantified.

5.1.1 Reliability of operating margin forecasts

In the capital budgeting analysis, it was forecasted that the company can increase its operating margin by 4-7% but it has not been studied, how these forecasts will be achieved in practice. TABLE 1 is a compilation of development areas laid out by department chiefs to be improved in the current and new factories, some of which will directly increase the operating margin. However, the data has not been quantified and it is currently unknown, will these measures increase the operating margin enough.

5.1.2 Accuracy of recurring expenses

In the capital budgeting analysis, it was assumed that if the factory size approximately doubles, the amount of recurring expenses will increase by fifty percent. This notion was just an estimation, and the actual proportionality between the building size and recurring expenses may be different and must be researched further by the company. Additionally, as the current factory building is built in the 1970's, the new and modern, more energy efficient factory will bring additional energy savings, but it is unknown by how much at this point. Presumably, a lot has improved over the last fifty years on this front, and it is certainly possible that the savings will be more than expected.

5.1.3 Transition to new premises

In the capital budgeting analysis, it was assumed that the company can seamlessly move its manufacturing from one location to another without any downtime or temporary revenue decrease since no transition period was considered in the capital budgeting analysis. In practice, this is simply not feasible. How large of a negative effect this will have is dependent on the company's ability to execute. The longer the transition period, the more the company will miss out on potential sales. On average, each moving day will cost the company over 35 000 euros of potential revenues as the company's current annual revenues are 13 million.

5.1.4 Manufacturing ramp up

After the company has moved to the new factory, presumably there will be a gradual increase in both the manufacturing capacity as well as efficiency. This is due to the employees having to adapt to the new premises by learning the most efficient working methods through trial and error. How long the manufacturing ramp up period will take is unknown as this factor too is down to the company's ability to execute as efficiently as possible.

In the calculations, the ramp up period was not considered, and it was assumed that the company will instantly begin production with maximum capacity and efficiency, which is unrealistic. A gradual percentage increase in both incremental revenues and operating margin until maximum efficiency is reached would more closely reflect reality as the company learns to utilize every aspect of the new factory over time. A ramp up scenario was not included in the capital budgeting analysis of this thesis since it was deemed too difficult to accurately forecast at this point, how long the ramp up period would last.

5.1.5 Time horizon

The estimated life of the investment is 20 years, which in today's technologically transformative world is considered almost a lifetime. Even if theoretically speaking, the company's business environment does not change over the life of the investment, some of the company's customers' role in the business world is bound to change as there are hundreds of them, which will indirectly affect the case company. Some customers will grow, resulting in more orders from the case company while others will ultimately fall short, resulting in a loss of that customer.

Over the life of the investment, the company's customer and product portfolio will change over time. For this reason, the company should forecast how the size, shape and weight of their products will change in the future. Clear market trends have been present in the company's business environment for a long time such as the steady increase in the size of manufactured products. If the company believes that this trend will continue in the future, the new factory should be built according to that forecast since it will be difficult to retroactively change the manufacturing process, like the company has now experienced first-hand.

5.1.6 Size re-evaluation of each department

In the document-based research, it was determined that a flat 20% increase across the board in each department will be sufficient to solve the congestion problem in the new factory. However, it is a possibility that the relevance of each department will change over time since not all products go through every department. The company should estimate, which departments' production will increase, and which role will diminish. Each current department will still have its place in the new factory regardless, but their role might not be the same in the future.

Another factor to consider is the operating margin of each department individually. As the company's main intent with the new factory is to improve the operating margin percentage, one relatively easy way to increase it would be to scale up the operations that have the best operating margins. However, it should be noted that not all departments can operate individually since they require the synergy from others to succeed.

Still, current department sizes should not act as strict guidelines since they were not built optimally to begin with and increasing the size of the most profitable departments is a possibility, to an extent. The company should seek balance between maximum output from the most profitable departments and minimum input from the departments that add the least value to the product, but which is still enough to allow the most profitable departments to thrive.

5.1.7 Location of the new factory

The location of the new factory was only considered in the initial capital investment cost part of the capital budgeting analysis. However, the location of the factory is an integral part of the manufacturing facilities design and should not be disregarded (Stephens 2019, 2). Besides the cost of land, it will have a large impact on the company's subcontractor network. The company should do further research, which region in the Pirkanmaa area has the most suitable subcontractor partners with whom the company could partner up with to create synergies between the companies. The shorter the distance between the most important subcontractors and the case company, the higher the company's operating margin will ultimately be since the cost of material handling will be reduced.

5.1.8 Insurance

Insurance as an expense was disregarded in this thesis due to its complex nature and relatively small impact in the grand scheme of things. Insured value, industry type, property size, number of employees, revenues and region among other factors all affect the insurance rate in a case-by-case basis (Farmers Insurance n.d.). Thus, it was deemed unreasonable to forecast a figure which alone will not be significant enough to sway the capital budgeting analysis in either direction.

5.1.9 Salvage value of existing machinery and cost of new machinery

Salvage value of existing machinery was another factor that was disregarded in this thesis since it was not deemed practical to estimate at this point. Presumably, outdated machinery will be salvaged and replaced with new machinery and recently acquired or otherwise functional machinery will be transferred to the new factory as is. The salvage value of outdated machinery and the total cost of new machinery was included in the initial capital investment cost in each scenario. However, more detailed analysis is required on which machinery will be salvaged and which spared. This will allow the company to calculate the incremental revenues from salvaged machinery and the incremental cost of new machinery.

6 CONCLUSION

To conclude, the company's current manufacturing process is very inefficient which is not ideal and some form of long-term solution to increase the operating margin should be sought. This would allow the company to fare better during difficult economic times since currently, the company's ability to turn a profit is at stake if sudden, external changes happen in the company's market environment. The company has already optimized the manufacturing process in current premises almost to its maximum potential. These measures done in the past still have not increased the manufacturing efficiency enough, meaning that some fundamental changes to the company's structure are required to increase the operating margin further.

The company has proposed that an investment in the form of a new factory could increase the operating margin to desired levels. In this thesis, the investment opportunity was studied by conducting qualitative research in the form of interviews and document-based analysis. Information gathered with these methods was used to form a capital budget, which suggested that the investment opportunity should be undertaken since the required incremental cash flows to make the opportunity profitable are realistic for the company to achieve. However, to arrive to this conclusion, many assumptions of the company's future performance had to be made in the capital budgeting analysis. The company must conduct further research on these areas since their effect on the feasibility of the project is currently unknown.

In addition, the new factory offers a possibility to overhaul the company structure completely. As the company has almost 50 years of experience from their field, they certainly have the knowledge, which of their operations are the most essential in their value chain. With this in mind, scaling up the size of each department in the same proportion in the new factory might not offer the best operating margin possible and instead, the company should specialize in operations that create the most value.

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APPENDICES

Appendix 1. Interview questions for the department heads

1. Is the current room layout sufficient for the department's needs? /
Onko osaston nykyinen pohjapiirros sopiva osaston tarpeisiin?

2. Would some layout changes increase the efficiency of the department? /
Olisiko jostain pohjapiirroksen muutoksista hyötyä osaston tehokkuuden kannalta?

3. Can you think of any apparent bottlenecks regarding the current layout of the department that slow down the manufacturing process considerably? Do you, for example, must often move items because they are blocking other items? /
Onko osaston tuotannossa jotain selkeitä pullonkauloja, jotka hidastavat tuotantoa merkittävästi? Joudutaanko esim. usein tekemään ylimääräistä työtä siksi, että tavaraa on toisen tavaran tiellä?

4. How efficiently does the manufacturing work with the current layout? Do some items fit the current layout exceptionally well? Are some items very clunky to manufacture with the current layout? /
Kuinka jouhevaa tuotanto on nykyisellä pohjapiirroksella? Sopivatko jotkut tuotteet nykyiseen pohjapiirrokseen toisia tuotteita paremmin? Mitkä tuotteet ovat erityisen kankeita nykyisellä pohjapiirroksella?

5. How smooth is the transition of goods between the departments? When the item is coming to your department next, are there multiple possible locations where you must retrieve the item from? Are the items lost sometimes? When the item is ready to leave your department, does it take longer for some departments to come get the item from you than others? /
Kuinka vaivattomasti tuotteet liikkuvat osastolta toiselle valmistusprosessin aikana? Kun tuote on seuraavaksi tulossa osastollenne, onko sillä monia mahdollisia paikkoja, joista se täytyy käydä hakemassa? Onko tuotteet joskus

hukassa? Kun tuote on valmis ja lähdössä seuraavalle osastolle, kestääkö joillain osastoilla hakea tavara teidän osastolta kauemmin kuin toisilla?

6. Are there any temporary warehouses within the department and if so, how many? Why do the temporary warehouses exist? Do you store items outside? /
Onko osastollanne välivarastoja ja jos on, kuinka monta? Miksi välivarastot ovat olemassa? Säilytättekö tavaraa ulkona?

7. How often occupational accidents related to moving goods happen? Are more accidents caused by worker's poor judgment or inadequate tools? /
Tapahtuuko osastollanne tavaroiden liikutteluun liittyviä työtapaturmia usein? Onko tapaturmien syynä useimmiten työntekijän huono harkintakyky vai vääränlaiset työvälineet?

8. Does your department spend resources on work in process packaging in terms of labor and material? How many resources? /
Käytetäänkö osastollanne resursseja tuotteiden välipakkaamiseen työvoiman ja pakkausmateriaalin osalta? Kuinka paljon?

9. How is the utilization of cranes currently? Does the current room height limit on cranes cause issues? Is the number of cranes sufficient? /
Kuinka työnteko sujuu nosturien kanssa? Aiheuttaako nykyinen huonekorkeusraja nostureiden kanssa ongelmia? Onko nostureita riittävästi?

10. How much unnecessary work is done either by employees or the department chief in your department? Are the transitions from one work stage to the next smooth or do you have to do excessive material handling, as an example? /
Kuinka paljon osastolla tehdään ”turhaa” työtä joko tiiminvetäjän tai työntekijöiden osalta? Esimerkkinä jouhevampi siirtyminen työvaiheesta toiseen, tuotteen ylimääräinen liikuttelu tai nostaminen.

One question only designated for the welding and assembly departments as the heat department is located within those departments:
11. Does the heat oven affect your work? /
Onko hehkutusuuni tiellä? Onko sillä negatiivinen vaikutus työntekoonne?

Appendix 2. Two example property pictures

Kohdetiedot

Yritystontit: tarjonta

id	25000
kiinteistotunnus	
luovutustapa	1
pinta_ala_m2	23282
rakennusoikeus_k_m2	11641
tehokkuusluku	0.5
kaavamaarays	T-25
kaavaselite	Teollisuus- ja varastorakentaminen
kaavayksikkolaji	
hinta	20 €/m2
status	Vapaa

Kohdetiedot

Yritystontit: tarjonta

id	20000
kiinteistotunnus	
luovutustapa	Myydään tai vuokrataan
pinta_ala_m2	44308
rakennusoikeus_k_m2	22154
tehokkuusluku	0.5
kaavamaarays	TJ-1
kaavaselite	Teollisuus, varasto- ja jätteenkäsittelyrakennusten korttelialue
kaavayksikkolaji	
hinta	13 €/m2
status	Vapaa

Relevant data from these screenshots was extracted to TABLE 5 and TABLE 6 as the information in them was not available in English (Yritystontit n.d.).