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Defining a Budgeting Tool for Projects

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Abstract

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The objective of this engineering study was to systemize the budgeting process and to define the data sources for budgeting to improve budgeting accuracy. The expected outcome of this study was to define a prototype budgeting tool to support Project Managers in managing budgets.

The first phase of the study was the current state analysis, mostly carried out with multiple interviews of project managers. Meetings with project excellence IT development team and meetings with the company study steering group were also utilised as data. The findings of the CSA revealed the strengths and weaknesses of the current budgeting process.

The second phase was literature study and conceptual framework based on the findings of the current state analysis. It concentrated on the best-known practices for the study, including project management knowledge, cost estimating methods, finance and budgeting, artificial intelligence, Excel budgeting and programming methods. The conceptual framework included an overview of the key findings of the studied literature.

The initial tool was developed based on the needs revealed by the current state analysis and using the findings in the literature study. The tool development started by discovering and defining data sources and utilizing it together with the support of the steering group. In the first hands-on phases, the data was modelled and evaluated. Eventually, the tool was developed using feedback from the steering group.

The validation consisted of validating the data, the functionality of the tool and the benefits. The first validation was done together with the steering group. The second validation was done using real projects as comparison. The last validation was done by testing the actual tool together with Project Managers. Feedback was gathered and the final feedback was that the tool fulfilled the expectations and could be used to support project managers. More information about costing data and the budgeting weaknesses were discovered.

Keywords: budgeting, projects

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Tämän insinöörityön tavoitteena oli systematisoida budjetointiprosessia ja määritellä budjetoinnin tietolähteet sen tarkkuuden varmistamiseksi. Työn oletettu lopputulema oli projektipäälliköitä tukevan budjetointityökalun prototyyppi.

Ensimmäinen vaihe koostui nykytilan analyysista, joka suoritettiin enimmäkseen projektipäälliköiden haastattelemista apuna käyttäen. Myös tapaamisia projektien IT-kehitystiimin kanssa ja yrityksen insinöörityön ohjausryhmän kanssa hyödynnettiin. Löydökset koottiin heikkoudet ja vahvuudet -taulukon muotoon.

Toinen vaihe oli kirjallisuustutkimus ja viitekehys aikaisempaa nykytilan analyysia hyödyntäen. Se keskittyi parhaaksi todettujen menetelmien tutkimukseen, mukaan lukien projektien hallintaan, kulujen ennustamismenetelmiin, taloukseen ja budjetointiin, tekoälyyn sekä Excel budjetointi- ja ohjelmointimenetelmiin. Viitekehys sisälsi yleiskuvan päälöydöksistä kirjallisuusanalyysista.

Työkalun ensimmäinen versio kehitettiin nykytilan analyysissa todettuja tarpeita ja kirjallisuusanalyysin löydöksiä käyttäen. Työkalun kehitys alkoi löytämällä ja määrittämällä tietolähteet ja hyödyntämällä niitä ohjausryhmän apua hyödyntäen. Ensimmäisissä vaiheissa tieto mallinnettiin ja arvioitiin. Viimeiseksi työkalu kehitettiin ohjausryhmän avustuksella.

Validointivaihe koostui tiedon arvioinnista, työkalun toiminnallisuuden arvioinnista ja hyötyjen arvioinnista. Ensimmäinen validaatio tehtiin yhdessä ohjausryhmän kanssa. Toinen validaatio tehtiin oikeita projekteja hyödyntäen. Viimeinen validaatio tehtiin projektipäälliköiden käyttökokemuksella. Palautetta kerättiin, viimeisen palautteen mukaan työkalu täyttää odotukset, ja projektipäälliköt voisivat käyttää sitä hyödyksi. Lisää tietoa kustannusdatasta ja budjetoinnin heikkouksista löydettiin.

Avainsanat: budjetointi, projektit

Contents

List of Abbreviations

CPQ: Configure, Price, Quote software, a software used to configure and determine pricing and costing for new orders in sales

ERP: Enterprise Resource Planning-system, a system integrating key processes of a company, including warehousing, production, and finance.

FBC: Fully Burden Cost

STD: Standard cost

PO: Purchase Order

LD: Liquidated Damages

1 Introduction

This thesis focuses on creating and specifying a prototype budgeting tool with instructions for a project unit in an industrial company. The purpose of the study is to improve accuracy and forecasting in project financials. The study is supplied to the case company with instructions for usage and obtaining data.

1.1 Business Context

The case company is a large Finnish internationally operating industrial company with around 17000 employees worldwide. The case company's key industries are pulp, board and paper, tissue, and energy. The thesis is carried out for the flow control business of the case company, with around 3000 employees worldwide, offering industrial valves, additional devices, and service for the key industries of the main company. (Valmet)

Particularly the thesis is created for Flow Control Business Line's Project Unit, which focuses on executing valve delivery projects. The project unit consist of project engineers, delivery team, documentation team, and project managers.

The thesis is conducted in co-operation with the project excellence project management development project. The team consists of a development consultant, an IT manager, IT specialists, and a business controller. The purpose of the development project is to improve project financials and particularly budgeting.

1.2 Business Challenge, Objective and Expected Outcome

The thesis concentrates on budgeting of project management. This study is created especially for supporting project managers, who are creating project budgets to improve projects financial controlling and reporting, also to the business line management.

The challenge is that real-time budget estimation and forecasting are lacking accuracy in reporting. The business challenge is that the project unit is willing to have more transparency in project budgeting for better financial estimation. The project unit and the company want to avoid loss of profit margin or in other words margin erosion after project execution. Transparency in costing is poor for example in different hourly labour costs and logistics costs.

The objective is to systemize the process for budgeting and to improve the accuracy of budgets and estimations. This is done by defining the data sources for budgeting. A concise process for gathering financial data for budgeting is to be defined.

The expected outcome of this study is a prototype tool for Project Managers to support them in budgeting and making estimations.

A streamlined process including guidelines for project managers would systemize budget creation. Data for budgets is meant to be specified properly to support budgeting. A good budgeting forecast and real-time accuracy supports the project's financial estimation through its timespan.

1.3 Outline of Thesis Report

The scope of this thesis is choosing best data and attributes for budgeting for the case company project management. It also includes instructions for project managers for systemized budgeting process. It does not focus on technical adaptation of costing data in the ERP-system. It is not meant to fetch all data automatically.

The thesis contains seven sections. The first section contains the context of the thesis and an introduction of the study. The second section contains a project plan on how the study is executed and the timeline how time is managed throughout the study. The third section describes the current state analysis in order to create a background for the later upcoming sections. In the fourth section, the conceptual framework is introduced by exploring existing

knowledge to tackle the findings of the current state analysis. The fifth section is the proposal built on knowledge gathered from section three and four. The sixth section is focused on validating the proposal in co-operation with case company. The seventh section summarizes the study and introduces the final outcome.

2 Method and Material

This chapter describes the research design, thesis plan, and data collection and analysis.

2.1 Research Design

This study is conducted in six different stages, as pictured in the research design diagram below. The figure also shows data used for stages and the outcomes resulted from each stage. Data collected for the study is on the left, different stages of study are in the middle, and outcomes of the stages are on the right.

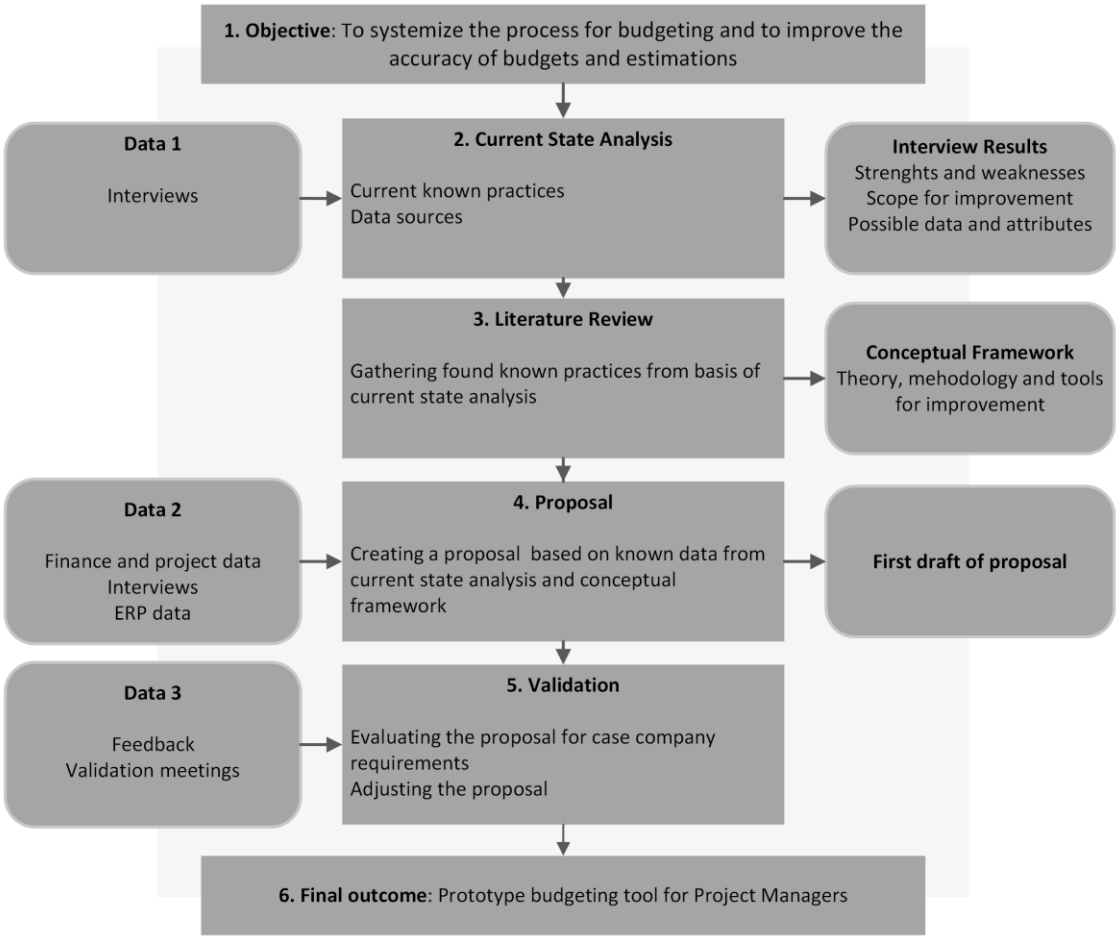


Figure 1. Research design diagram

The first stage of the study is the objective setting and introduction for the thesis. This step is mainly based on needs and requirements from the case company. In this stage, the timeline for the thesis was defined, and based on that, the scope and outcome were decided. Technical possibilities had to be clarified when defining the scope. The second stage of the study is analysis based on the current state of budget creation, costing data and data sources used. It also consists of figuring out the needs and requirements for the future based on *Data 1*.

The third stage is conceptual framework for the study, based on earlier current state analysis. It gathers knowledge from literature and other sources for framework in the thesis, resulting in case examples and knowledge base for further steps. The fourth stage is proposal built on basis of stages two and three. *Data 2* is gathered from case company costing data, and more interviews were made to support final proposal sculpting. Outcomes of this stage are the final examples for data validation which is the next stage number five.

For stage five, the validation stage, *Data 3* compiles the feedback from proposal final examples, and they are validated in the validation phase together with case company. Additionally, final adjustments are made to release the final outcome of the study: *A budgeting tool for Project Managers.*

2.2 Project Plan and Schedule

The schedule for the project is presented in weeks in figure 2 below. The schedule is divided based on the sections of the study.

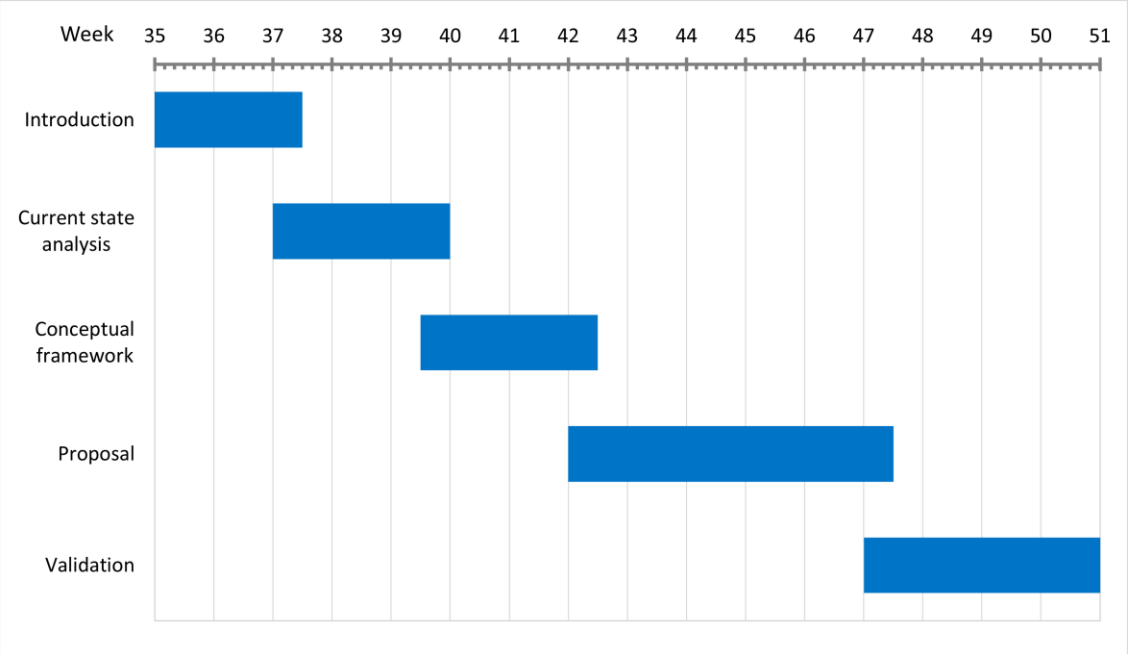


Figure 2. Project schedule

The introduction phase includes Business challenge, objective and outcome, Research design and thesis plan, Data collection and analysis, and it is executed in weeks 35-38, from August 29 to September 15. The current state analysis phase is executed in weeks 37-40 from September 15 to October 9. Conceptual framework phase is executed in weeks 39-43 from September 28 to October 26. The proposal phase is executed in weeks 42-48 from October 17 to March 30. The validation phase includes reporting the final outcome and summary, and it is executed in weeks 47-52 from March 21 to December 22.

2.3 Data Collection and Analysis

The data is collected from different sources for the study. The main method for data collection is meetings with the case company representatives as referenced in Table 1 below.

Participants, role	Type	Topic, description	Date, length	Documented as
Data 1, Current State Analysis				
Kick-off meeting: Director of Projects, Manager of Projects,	Teams meeting	Requirements for study: objective and outcome	August 31, 0.75 hours	Recording, field notes

Business Controller				
Development meeting: Business consultant, ERP Specialist	Teams meeting	Current budgeting development in ERP	September 13, 1 hour	Field notes
Meeting: Director of Projects, Manager of Projects	Teams meeting	Possible outcome, scope, and current state	September 16, 1 hour	Recording, field notes
Interview: Project Manager 1	Teams meeting	Budgeting process, strengths, and weaknesses	September 22, 0.5 hours	Recording, field notes
Interview: Project Manager 2	Teams meeting	Budgeting process, strengths, and weaknesses	September 22, 0.5 hours	Recording, field notes
Interview: Project Manager 3	Teams meeting	Budgeting process, strengths, and weaknesses	September 22, 0.5 hours	Recording, field notes
Interview: Project Manager 4	Teams meeting	Budgeting process, strengths, and weaknesses	September 27, 0.5 hours	Recording, field notes
Interview: Manager of Projects	Teams meeting	Current state, strengths, and weaknesses	September 23, 1 hour	Recording, field notes
Interview: Business Controller	Teams meeting	Usage of costing data from ERP and CPQ, compiling reports	September 27, 0.5 hours	Recording, field notes
Meeting: Manager of Projects, Business Controller	Teams meeting	Current state analysis finale, next steps	October 3, 1 hour	Recording, field notes
Data 2, Proposal				
Meeting: Director of Projects, Manager of Projects, Business Controller	Teams meeting	Development of the proposal	October 21, 1 hour	Field notes
Meeting: Manager of Projects, Business Controller	Teams meeting	Development of the proposal	November 10, 1 hour	Field notes
Interview: Project Manager 1	Teams meeting	Development of the proposal	November 14, 0.5 hours	Field notes
Interview: Project Manager 2	Teams meeting	Development of the proposal	November 15, 0.5 hours	Field notes
Interview: Special Material Planning Manager	Teams meeting	Development of the proposal	November 17, 0.5 hours	Field notes
Meeting: Director of Projects, Manager of Projects, Business Controller	Meeting, Teams meeting	Development of the proposal	November 18, 0.5 hours	Field notes
Meeting: Manager of Projects,	Teams meeting	Development of the proposal	November 25, 1 hour	Field notes
Meeting: Director of Projects, Manager of Projects,	Teams meeting	Development of the proposal	November 30, 1 hour	Field notes

Business Controller				
Data 3, Validation				
Validation meeting: Manager of Projects	Teams meeting	Feedback and validation, final adjustments	December 9, 1 hour	Meeting: Manager of Projects
Validation and feedback: Project Manager 3	Teams meeting	Feedback and validation, final adjustments	December 14, 1 hour	Field notes
Validation and feedback: Project Manager 5	Teams meeting	Feedback and validation, final adjustments	December 16, 1 hour	Field notes
Validation meeting: Manager of Projects, Business Controller	Teams meeting	Validating proposal, final adjustments	December 16, 1 hour	Field notes

Table 1. Data collection

As seen in Table 1, The first round of data collection, Data 1, firstly includes having a kick-off meeting with the steering group in order to clarify the objective and requirements for the outcome. Second step is finding out about current developing of budgeting with the project excellence team, and after that having interviews with end users of the tool, Project Managers. Finally discussing about the current process and development ideas for budgeting with the steering group.

The next round of the data collection, Data 2, is about developing the proposal, which included interviews with Project Managers and discussing with the steering group about the direction of the proposal development.

The final round, Data 3, is to validate the created proposal together with the steering group, end users and project management.

3 Current State Analysis

This part contains the current state of the budgeting process in the case company's project management. It is focusing on process diagrams gathered from project manager interviews, costing model and reporting processes used in the department. The final subsections of this part contain the strengths and weaknesses of the current methods are summarised as a basis for exploring existing knowledge and building the conceptual framework.

3.1 Budgeting process timeline

Budget creation starts with the sales organisation creating the first budget for the project. A quotation is created to Salesforce CRM and inputted to Tacton CPQ. This first budget is called as-sold budget where sales has included freight costs in addition to the sales calculated product prices. As-sold budget is clarified in detail in a separate Project Analysis sheet. The as-sold budget is then inspected by project managers when a project execution request is created by sales. Additional costs are then added by project managers such as other costs, including project unit costs and logistics. Then, the first PM budget is created, which includes the full project value including addons and changes. After then, budgeting is managed by project managers. Change management such as additional orders and different freight costs are taken into account during the project timeline. An estimate and changes are reported for monthly reporting.

Figure 3. Basic budgeting process for case company's projects (Company internal material)

Figure 3 shows the timeline of case company's current project budget. It starts with sales budget created by the sales department. Second step is the Project Manager initial review of the budget. The third step is order specification and configuring the order for ERP entry. The fourth step is creating an estimate of the budget in project execution phase. The fifth and final step is the delivery phase, where the existing budget accumulates into actual budget.

3.1.1 Data flow

This part of the analysis is used to describe the information flow in the company to understand connections in budgeting data and the related processes. The swim lane diagram below, Figure 4 illustrates the data and processes between the different departments of the company in the budgeting process. Budgeting is presented from a starting point of creating a frame contract and finishing to receiving the actual budget.

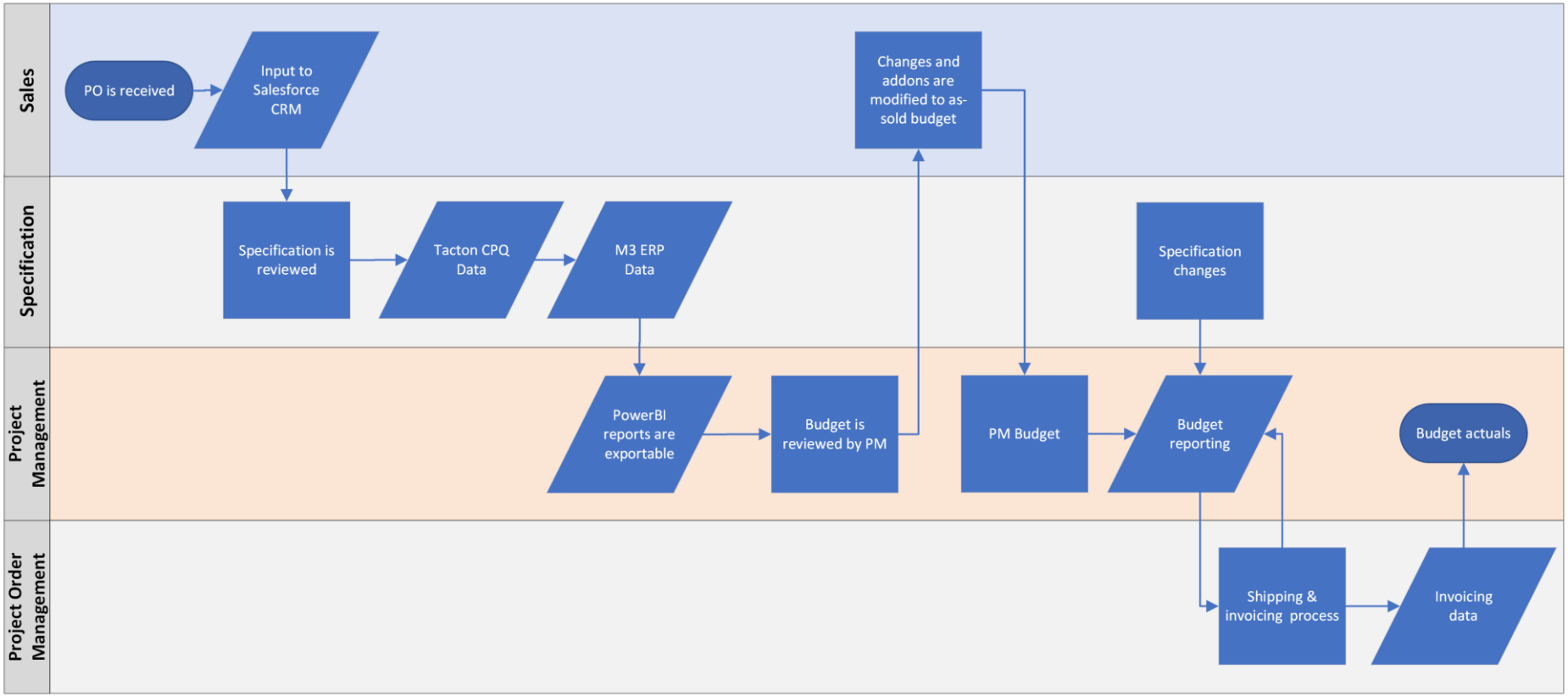


Figure 4. Detailed swim lane chart of data flow in the project budgeting process.

As seen in Figure 4, the process starts with creating the frame contract. After the frame contract is created, sales start to process the purchase orders for the project. The prices are calculated, and quotations created. Quotations are inputted to Salesforce CRM system. Prices and calculations are inputted to different key systems. The first system in this process is Tacton CPQ, where costs and prices are calculated. Specification team reviews the specification and makes required changes. Then the costs get transferred to M3 ERP. The project manager then reviews the first as-sold budget. Sales and specification will make their final changes on the budget according to addons and changes received from the customer. Then project manager creates the first PM budget. Now project manager oversees the budget and manages the changes according to sales and revision costs from specification team. The Project Order Management team will arrange the shipping and shipping actions will be reported in the budget monthly by the project manager. Then Project Order Management team creates invoices for the customer. This invoicing data creates the budget actuals which are the final actual completed sums in the budget.

3.1.2 Costs

FBC or Fully Burden Costs are the first basis of project management budgeting in the case company. Fully burden costs include product's direct costs or STD costs and additionally indirect costs not associated directly with the product. They are created in CPQ depending on the product and used to estimate the main costs of the budget. They are fetched to M3 ERP from Power BI reports.

STD costs or standard costs or direct costs are costs allocated directly to certain orders or products. They include material costs, material handling costs and assembly and manufacturing costs. In budgeting they are calculated from FBC using a formula:

FBC / FBC rate = STD

For the actual budget, the STD costs are available in the system and in that phase, it is used to calculate FBC costs using reverse formula:

STD × FBC rate = FBC

Other costs include costs are costs that are related to the project, which are not included in FBC costs. Other costs include for example project unit hours used, including project management, engineering, documentation, order handling and outbound freight costs. They are created by sales but must be often completely reviewed or re-calculated by project managers.

LD or liquidated damages are costs that are certain contractual penalties set for example from late deliveries. The risk of liquidated damages is assessed by project manager in budgeting at least monthly. It is calculated in budgeting using formula:

Revenue recognized / Total budget value × LD risk × 80%

(Company internal material)

3.2 Methods

One of the key points observed in the analysis was differentiations between Project Managers when gathering data for budgeting. When different project managers were interviewed, different working processes were observed. Many Project Managers had different steps especially in creating the first budget. Most common method was gathering FBC costs mainly from CPQ. On some occasions, gathering the data from CPQ was problematic, as there is no list form report available to export with all cost information for the desired project. One method was gathering FBC costs exclusively from GDC. There was also no commonly used tool or method for creating the PM budgets and different sheets or methods were used.

3.3 Reviewing

The financial review is done on a monthly basis. The reporting for review basically consists of four different main budget elements; sales as-sold budget, project manager budget, estimate and actual budget. These elements are currently gathered by project managers and summarized into an excel sheet, where they are transformed into a pivot for reporting by the business controller. These figures are being gathered from all the different project management departments in the company. The current workflow of budget controller in this process is criticised by the business controller, as it contains unnecessary steps for human errors to occur in transferring the data from project manager created excel sheets to another.

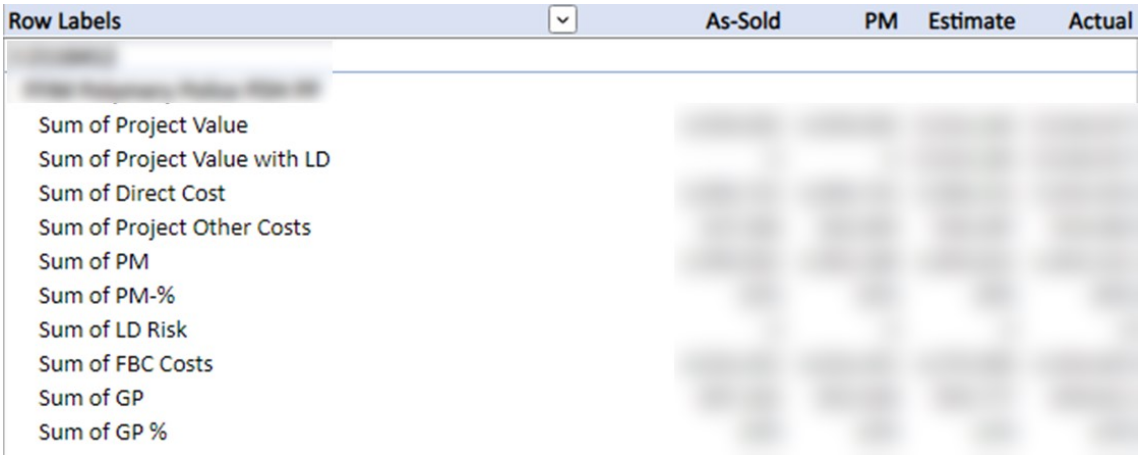


Figure 5. Example of budget pivot in review process

Budget review pivot table is described in Figure 5 above. The pivot table contains certain key figures of the budget for an overview of the budget. The figures are divided into As-Sold, PM, Estimate and Actual.

Target Date	JUN 2021	JUL 2021	DEC 2021	JAN 2022	FEB 2022	Totals
Invoice Status	Invoice Sum, Euros (tot)	Invoice Sum, Euros (tot)	Invoice Sum, Euros (tot)	Invoice Sum, Euros (tot)	Invoice Sum, Euros (tot)	Invoice Sum, Euros (tot)
Planned						
Invoiced						
Paid						
Totals (6 groups)						

Figure 6. Example of invoicing plan in GDC

Additionally, as seen in Figure 6, invoicing status is reported using invoicing sums for tracking. The data is reviewed and updated in GDC. This is used to track the planned, invoiced and paid amounts of customer invoices.

This reporting is then finally used to review budgeting project by project in a financial meeting with project managers, management, director and business controller to convince their accuracy and validity, and to discuss the issues faced in project financials.

3.4 Current development

The project excellence team is building a proposal based on the needs of the financial reporting process. The goal is to reduce human error in project reporting. The current outcome is to transfer the figures to M3 ERP system, where project managers would manually input the budgets. As a result, a concise report can be exported from the system.

This is done to help business controllers work in creating reports and reducing the steps required to gather reports. On the other hand this would create more steps for project managers to learn input their budgets to the M3 system. However, there could be potential to fetch costing data automatically or to import it from an excel file to ERP. Either one of these options could improve the process for project managers.

3.5 Strengths and weaknesses

This part of the current state analysis is used to describe the strengths and weaknesses considering the current state of budgeting, mostly gathered from interviews with different employees.

Strengths	Weaknesses
- Simple and understandable figures - Simple data sources - Accurate first Tacton CPQ FBC estimates - Effective project budget review process	- Poor visibility to production costs, as-sold budget, and other costs - Unknown FBC costs - Poor communication inside project unit and customers - Difficult LD predictability - Inaccurate estimations - Limitations of Tacton in big projects with multiple PO's - Slow and manual data combination

Table 3. Strengths and Weaknesses

More weaknesses than strengths were noted in the current state analysis. However, primarily noted strengths include that the first FBC cost estimates created in Tacton CPQ can be accurate when no major changes occur, and when the product is considered as a high-volume standard product. Although, special products are common in the industry.

It was also noted as a strength that key figures for budgeting are simple in project manager viewpoint as there are not that many figures considered. The concept is simple, as there are not so much costing data or different viewpoints to be taken into account.

The monthly project budget review process was also seen as a strong point. It increases communication and transparency in the budgeting process. The process urges project managers to keep their figures up to date at least on a monthly basis.

The most noted weakness was visibility and estimation to production costs. There is no valid solution to see production costs easily in ERP. These costs are not seen in the production process, and commonly seen when the product is finished without proper visibility to the root cause. Commonly additional costs are charged, and it can be a surprise in project management and especially in budget estimation.

Transparency to sales as-sold budget was also considered lacking. This is related mostly to different costs. At times an accurate product related FBC cost budgeting is received, but more commonly FBC costing is taken from many different sources and is considered as inaccurate and has no transparency to the figures. Occasionally the sales budgeting has no proper budget calculation at all to available to review. The FBC costs can differ in different data sources. Connections between CPQ and ERP are unknown.

Different project unit parts do not always communicate properly in order to gather possible information for upcoming costs inside the company. For example, occasionally engineering costs can be big and no reason is defined in the end. These costs might have been avoided with discussion with the customer. For example, packing or flight freight costs can also be just entered to other costs without proper visibility. Translation costs for documents need to be considered when shipping to certain customers. Other costs in general can be unknown.

Liquidated damages are also not always demanded by the customer even though the conditions could have come true. This could be taken into account when predicting the estimations.

Estimating is only done to estimate the final actuals, but it could be done more actively to forecast the different timepoints in the project. System dates to forecast order finishing from factory can have issues and they can have negative impact in estimating shipping and upcoming financials.

Tacton CPQ was also considered as a poor tool for gathering costs for bigger projects. When creating PM budget using Tacton and looking for example the FBC costing data for a new project, every purchase order must be gathered from separate files and directories to the project budget data one by one. This can take a large amount of workload for big projects where many orders must be gone through, and it does not fulfil the purpose.

The management and upper management consider margin deviation as a negative part of project financials. Margin deviation was considered to be caused mainly by the poor visibility to different elements of budgeting. It does occur mainly because costs are underestimated especially in the sales phase. This is considered as a challenging part of estimating project financials.

In this section, the strengths and weaknesses of the current budgeting process were identified. They were gathered mostly from interviews of the employees. The next section is about the literature practices based on the current state analysis.

4 Previous Knowledge Based on Literature

This section of the study is about best-known practices found in sources of the field. It introduces budgeting and the recommended ways to handle budgeting specially in project management. It also features the future of budgeting and forecasting and budget analysis. Choosing costing systems and driving profitability and performance is also considered. It features usage of algorithms in finance. Finally, usage of Excel as a tool in finance and financial analysis is studied.

4.1 Budgeting in Project Management in General

Developing a budget translates the known activities into cashflow. The main purpose is to show what you need to spend and what are the returns going to be. Firstly, budget should be developed by choosing the costing categories. They can be usually broken into these categories for projects in general: personnel, travel, training, supplies, space, research, capital expenditures, overhead. After choosing these, it should be considered that what is additionally necessary to add, mostly different costs for example. Finally, budget is only the best-known estimation, whether how well it is planned. Actuals should be carefully tracked, as they can deviate from the original estimates. (Harvard Business Review, 2014: 56-60)

The most straightforward approach to budgeting is estimating the cost expected with each milestone in the progress. These costs are assigned to specific dates based on the project schedule and a time-phased budget can be created. It might only be a partial budget since some of the indirect costs are usually not included in certain phases of the budget. Key concepts in budgeting are expenditures, revenues and cash flow. (Gardiner, 2011: 265)

Monitoring is a vital part of the budgeting as the costs rarely match to what is originally budgeted. A good project manager also marks down that in what kind of cases the budget is exceeded or subceeded. When the actual costs are

monitored, these uncertainties should especially be looked out for: Price increases from suppliers, usage of different costing methods - hours or dollars can make a difference, unplanned personnel costs, or unexpected overhead costs. Differences in budgeted amounts should be always looked after, and the reasons should be found. Commonly spending less than your budget, it is considered as good news. Small runs over the budget are easier to handle than big ones and therefore expenditures should be tracked weekly. (Harvard Business Review*,* 2014: 56-60)

4.2 Techniques for Cost Estimating

Cost estimating means approximating the costs of resources needed to complete activities for a project. All resources of the project must be estimated that are going to be charged for the project for accurate estimation. Included costs are for example: labour, materials, supplies and special categories. Cost estimating should not be confused with pricing. Many other points are also considered in pricing. Here are the most common traditional methods used in cost estimation: (Gardiner, 2011: 267-268)

Analogous estimating (or top-down estimating) uses the actual cost as a basis for estimating the costs of the project. It uses previous similar project as a basis for estimation. It can be used in early phases of the project when limited information is available. It is considered less accurate than the other methods, but it can be executed fairly easily and therefore is a less costly method. It requires in fact similar project for baseline. (Gardiner, 2011: 267-268)

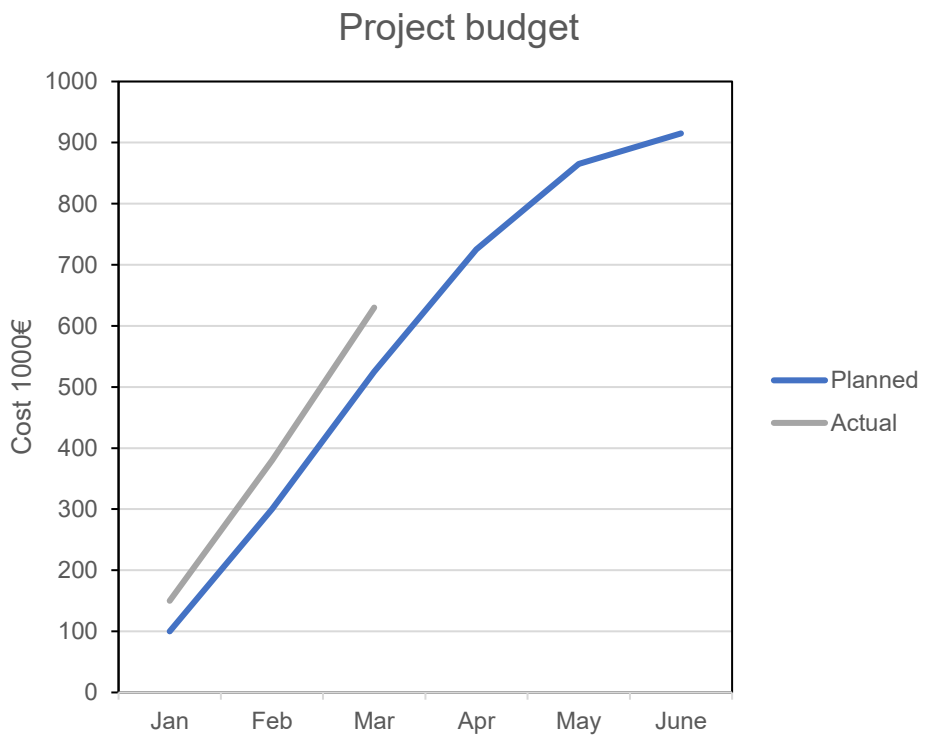
Parametric estimating uses projects typical features for estimating, for example weight and volume to predict costs. Models can be simplistic or more complex. The results of usage of this model vary widely in terms of cost and accuracy. Expectedly, the project used must be scalable easily and accurate historical information needs to be available for use. (Gardiner, 2011: 267-268)

Definitive estimating (or bottom-up estimating) uses individual cost work items and sums them up to estimate a project total. This technique is generally the most accurate but also the costliest. The factor of higher cost must be evaluated with the benefit of accuracy when considering this method in budgeting use. (Gardiner, 2011: 267-268)

4.2.1 Costing Analysis

The control of costs is essential to all organizations, even though some companies do not follow their costs of their projects. The most costs come from the resources used or the operating costs.

Cost performance can be measured using a simple graph using cumulative cost:



Planned, 1000€	100	200	225	200	140	50
Actual, 1000€	150	230	250			

Figure 6. Planned versus actual project cost (Young, 2007: 238-241)

This can be a simple solution; however, it does not take several important factors into account. Firstly, it does not tell whether work is getting done in the background or not. Second, it does not tell if data from finance team is up to date as there can be a significant lag possible. Lastly, estimating is not done to tell the remaining months of the project. (Young, 2007: 238-241)

4.2.2 Cost Control

Cost control measures are introduced for controlling project costs. These kinds of measures are used to use earned value analysis. (Young, 2007: 238-241)

The four key cost control measures include:

BAC (budget at completion), based on the budget at completion for the whole project.

BCWS (budgeted cost of the work scheduled), is based on the scheduled amount of work in the project. It is calculated using a percentage of the scheduled work. Using formula: Scheduled completion x BAC = BCWS

BCWP (budgeted cost of the work performed), is based on the completion of the project. It is using the value of the project in calculating, when the costs are not actualized yet. Using formula: Percentage actual completion x BAC = BCWP

ACWP (actual cost of work performed), is based on the actual cost incurred in the project. The actual cost can be compared with earned value (BCWP).

Other terms include: **CV** and CV% (cost variance), difference between the performed work value and the actual cost of the work. Negative CV means the actual cost is above budget: CV = BCWP – ACWP. **SV** and SV% (Scheduled variance) is difference of the value of the work already performed and the scheduled work value. SV = BCWP – BCWS. **FTC** (forecast to completion), used to calculate the remaining work in the project, calculated often with an

analysis model or simply the actual cost with additional estimates to complete the project. (Young, 2007: 238-241)

The measures can be visualized using a cost control diagram, using measures above:

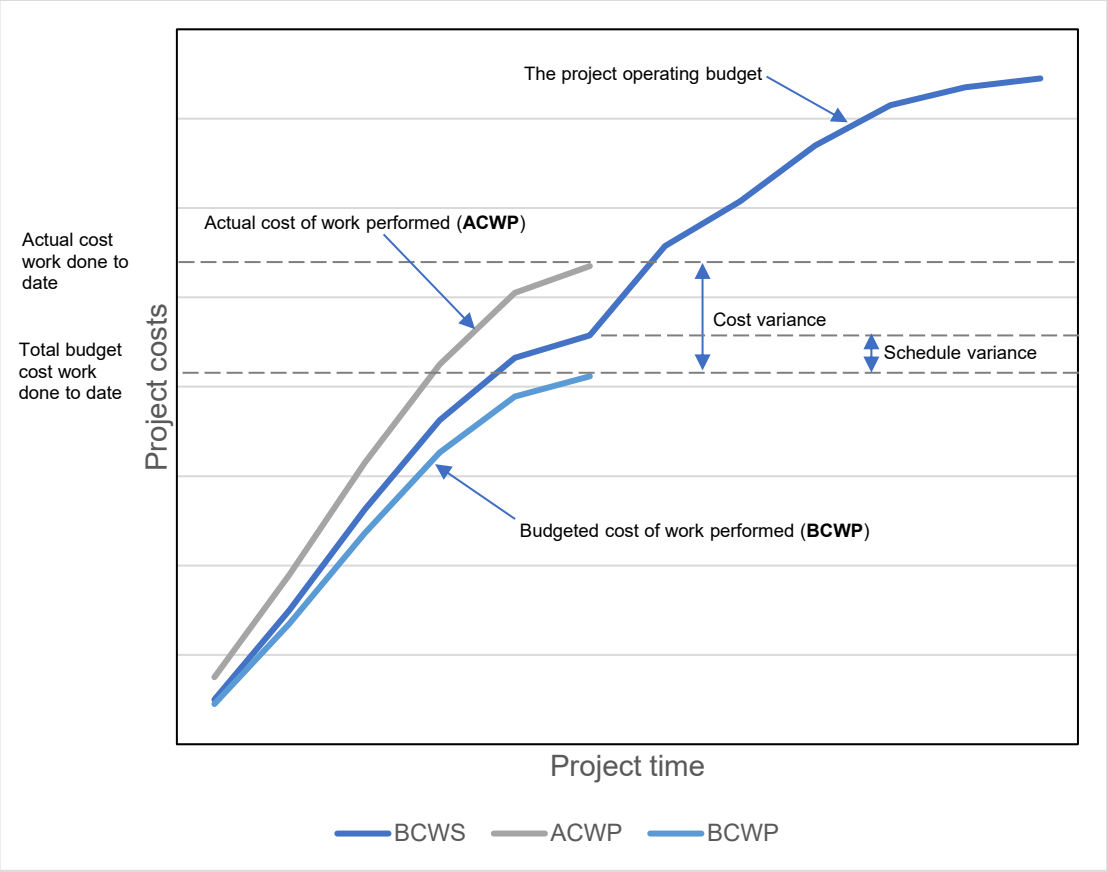


Figure 7. Cost control diagram (Handbook of PM)

Note from the diagram, if BCWP continues the same trend shown, the project is very late from the schedule. Also, if ACWP continues the same trend, the project budget will be overrun evidently. Cost variance (VC) deviation can be seen clearly in the diagram. (Young, 2007: 238-241)

4.3 Forecasting and Budgeting

Budgets and forecasts are often confused. Forecast is an update of a budget to figure out what it is most likely to look like. Budgeting may include some forecasting. Normally, a good practice is to keep the original budget intact and use it in measuring. (Wyatt, 2012)

In addition, comparing actuals and the budget, the forecasting is done to use the information gathered to be used in projections for future use. But the old estimates should not be forgotten. They should be compared on how close they were with what was actualised. This data can be used to improve your estimates the next time. (Harvard Business Review, 2014: 87-88)

Communication is key in adjusting the forecasts. If the forecasts are seen to be out of track, it should be communicated to senior management and the causalities should be found. This can then be used as a data for the whole team to correct the necessary adjustments into the forecast or communicated properly to be considered. (Harvard Business Review, 2014: 87-88)

Forecasts can be divided into different categories. Forecasts too soon are not considered to be useful, as there is not enough time to make changes to fix the direction of development in the business. The first category of forecasts is the soon as possible kind of forecasts, which are the most common used ones especially in hour-based budgeting. They are made to provide immediate feedback to directors. The CEO does not want to be surprised in terms of future insights. Of course, good, or bad news should be brought up as soon as possible. But causations should also be looked out for. (Åkerberg, 2017: 98-101)

Deviations should not be the only focus for the board of directors. Actually, any kind of results should not be a surprise for the directors. The reasons for positive or negative deviations in results should be known a good time before they become actual. If that is not the case, the board of directors should

sharpen their thinking and focus more on following the performance indicators. (Åkerberg, 2017: 98-101)

The second category of forecasts is considered the forecasting of development of the business. The time horizon is longer than in the previous example, and therefor this allows the change of directions when challenges are seen. The challenge in this is budgeting, again. If all resources are used to making short-paced changes, the larger and more significant indicators can be unseen. (Åkerberg, 2017: 98-101)

The last category is strategical forecasts. Creating a strategy forecast actually means making forecasts for a long time period. A chosen road is committed in the strategy, and no significant changes are made unless something critical happens. (Åkerberg, 2017: 98-101)

A good forecast is made by a professional in its scene and made without a fear or pressure of manipulation, which could lead to actions. Before responsibility (cost) centres, human resources and allocation of capital are locked, the possible options should be open for as long as possible for the project. However, it is important to keep the lead time as short as possible and therefore the process should not be lengthened. (Åkerberg, 2017: 98-101)

4.4 Artificial Intelligence and Finance

In a survey made by ICT-study and consultancy company Gartner autonomous finance was seen positively, in fact the results showed that two-thirds of the accompanying CFOs believed that autonomous finance will be reality in six years. Some technologies are already implemented in the study companies, and the results are pleasing in favour of implementing even more. (Gannon, 2022: 28-35)

Especially short-term financial forecasts are believed to be predicted with assistance of AI. In the upcoming year, even half of all large financial

departments are estimated to use the artificial technologies. (Gannon, 2022: 28-35)

Implementing AI in finance is a difficult topic. Some companies have made implementing possible with good results. Still others are hesitated and frozen with no progress. (Gannon, 2022: 28-35)

The cause for companies not chasing AI solutions is actually not as cost and technologically limited as people usually think, but it is more about the mindset of financial leadership with traditional ways of thinking in means of usage of the same processes and the same way of working as used to before. This tells us how different the world of implementing IT with traditional financial thinking is. There is apparently a ledge between the autonomous world and the financial world. (Gannon, 2022: 28-35)

Often the misconception is trusting people making all the decisions, even though there is evidence that technology is better and more accurate compared to humans. Humans tend to prefer the familiarity of working with other humans. (Gannon, 2022: 28-35)

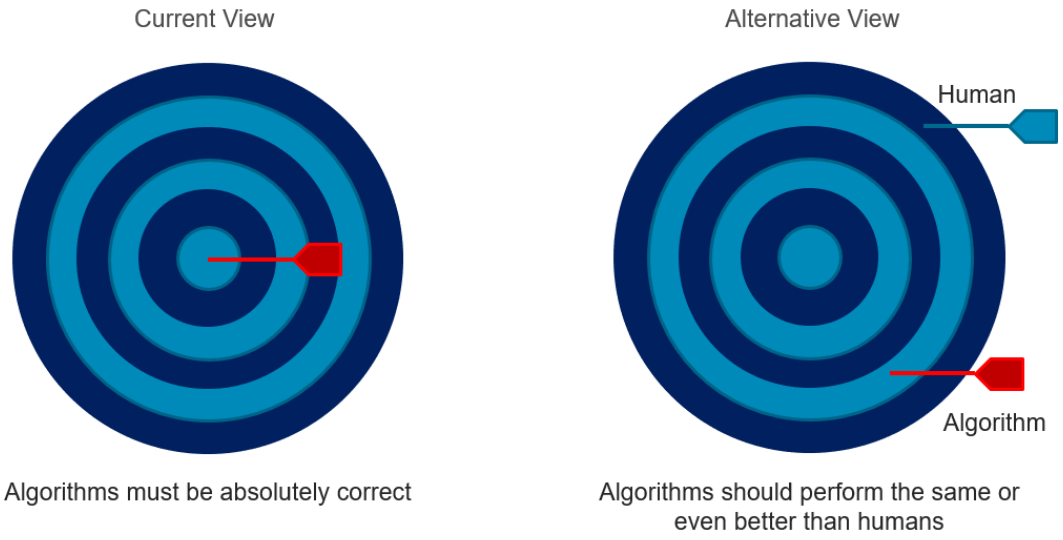


Figure 8. Algorithm performance compared to human performance (Gannon, 2022: 28-35)

As described in the current view of the figure, CFOs often demand more from technologies than from human performance. This can be explained with the difference in trust between technology and humans. Instead of comparing algorithm performance to absolute perfection, the view should be on comparing it with human performance, including slight errors. This allows implementing artificial intelligence sooner. It must be also taken into consideration that absolution in financial forecasts is impossible to reach in sense. (Gannon, 2022: 28-35)

4.5 Budgeting in Excel

Budget templates in the form of standard Excel-spreadsheet models should be promoted. They will aid with costs and all related calculations. The templates should be standardized across organization. Individuals building their own models could lead to distraction and imperfections in calculations. The templates should contain protected standard formulas and fixed figures that shall not be changed. (Wyatt, 2012)

Explanatory notes in the template are great for helping making judgement for decisions based on the figures. They will also help when reviewing the budget and explaining the causes. It will challenge the creator of the budget to think about the assumptions more. These found causes can then be also reported more easily when judging deviations and budgeting accuracy. (Wyatt, 2012)

4.5.1 Excel Tools for Budget Spreadsheet Creation

Below is a list of some of the most useful Excel built in and add-in tools used in budgeting and financial forecasting:

Pivot tables – Summarising and analysing tool for data tables

Goal Seek – Optimisation tool, tells what you need to change a factor to for desired result or the minimum or maximum result

Solver – More advanced than goal seek, works the opposite way

Scenario Manager – Allows creation of different scenarios in the same spreadsheet, no need to switch between many spreadsheets for testing scenarios

Analysis ToolPak – Statistical add-in with extra tools including forecasting tools

FORECAST functions – FORECAST function in excel for easy forecasts, MSE and MAPE functions for measuring forecast accuracy (Wyatt, 2012)

4.5.2 Excel VBA Programming

Visual Basic for Applications (VBA) is Microsoft's own programming language developed to build programs for controlling Excel and the other Microsoft Office applications. Benefit of VBA is fast and accurate operation of Excel with specified actions and formulas. VBA can be applied to almost any functions in excel, and therefore the applicability of the functions is wide for many different purposes, including forecasting and budgeting.

Especially in professional terms, VBA code mechanized programs inside Excel files are more often referred as *macros. Macro* stands for executing specified keystrokes and mouse actions, which are executed in Excel in this case. (Walkenbach & Alexander, 2019)

4.6 Conceptual Framework

The existing knowledge in section 4 was explored to be used to build the proposal for this study and reflected with information gathered from the current state analysis. The knowledge is compiled in the conceptual framework, described in the table below.

Key Findings from Literature	Addressed Topic from Literature	Reference in Section 4	How the Literature Source is Used?
Budget is only best-known estimation, milestones and tracking are mandatory	**Project Budgeting –** Translating the known activities into cashflow (Harvard Business Review, 2014: 56-60)	4.1 Budgeting in Project Management in General	To define project budget frame and key aspects
Simple tracking of costs is not optimal, many different methods are used together for good estimation	**Cost Estimating** - Cost estimating means approximating the costs of resources needed to complete activities for a project (Gardiner, 2011: 267-268)	4.2 Techniques for Cost Estimating 4.2.1 Costing Analysis 4.2.2 Cost Control	To define and evaluate methods for analysing costs in budgeting
Frequent and fair communication is vital, history should be used for improvement	**Forecasting** - Forecast is an update of a budget to figure out what it is most likely to look like (Wyatt, 2012)	4.3 Forecasting and Budgeting	To define knowledge for forecasting
Algorithms are not meant to surpass humans		4.4 Artificial Intelligence and Finance	To define the future of budgeting
Standard and professional spreadsheets should be promoted	**Excel Budgeting** - Budget templates in form of standard Excel-spreadsheet models should be promoted to aid with costs and all related calculations (Wyatt, 2012)	4.5 Budgeting in Excel	To define how Excel should be used in this context
There are several tools available to use in budgeting when using MS Excel		4.5.1 Excel Tools for Budget Spreadsheet Creation 4.5.2 Excel VBA Programming	To create budgeting template with Excel

Table 4. Conceptual framework of the study (based on the selected knowledge and industry's best practices)

As shown in the table above, the first component is Project Budgeting in General with ideas taken from *Project Management* by Harvard Business Review. The second component is Cost Estimating and costing analysis with solutions taken from Gardiner and Wyatt. The third component is Forecasting and AI Finance with ideas taken from Harvard Business Review, Wyatt, Åkerberg and Gannon. The fourth and final component is Excel Budgeting, with ideas and tools taken from Wyatt, Walkenbach & Alexander.

The conceptual framework sums up the literature review. The next section is the proposal of the study, based on the current state analysis and the conceptual framework.

5 Proposal

The proposal of the study is introduced in this section. The results of the study are summarized from gathering information from interviews and steering group meetings. Results are based on current state analysis findings and rounded up using knowledge gathered from the conceptual framework.

The result of the study is a prototype budgeting tool. The tool is built based on the specifications and needs of project managers. The tool includes instructions for usage and is divided into three sections.

5.1 Overview of Proposal Building Stage

The objective of this thesis is to systemise the process of budgeting and to improve budget and estimation accuracy. It also includes defining sources for information used in project budgeting. An initial prototype tool using these characteristics was developed during the process to help Project Managers in budget creation and estimation. The tool is based on interviews with Project Managers, Special Material Planning Manager and proposal meetings with the company steering group. Steering group meetings were held once in two weeks at the start of the project, but the meetings were adjusted to more frequent weekly meetings in end of the proposal building to support and steer the building process towards the end of the study.

Meanwhile alongside with the study, project excellence IT-team was developing to move project budgeting to M3 ERP budgeting module. This building phase and the meetings came hand in hand with the study development, and eventually, a new budgeting structure was defined alongside the new planned IT changes. When the budgeting structure chosen in project excellence meetings was selected and the completion time was in-line with the study progress, the new budgeting structure was decided to be included in the study.

In the early stages of the development phase, the available data sources of budget were evaluated based on information from current state analysis and additional further interviews. Main selecting criteria for data was project manager interviews based on their previous experience when creating budgets. Testing was done to ensure the validity of the data source selected. After the data was initially chosen, it was compared and later, modelled to have insight on possible errors and to validate its authenticity. The data was at first used to have insight on possible deviations.

After the selection and the first models of the data, a master report with maximal data available was exported. It was reviewed and then prepared by filtering all possible errors. At first, all borderline cases and clear errors were removed. These changes were recorded by taking notes and by creating a pivot including all the changes for possible modification. Later on, the last remaining data errors were removed by hand. This provided insight to the data and was useful later in the study. This visualised data was presented to the steering group.

Finally, the actual prototype tool building started. The main point for building the tool was that it should be simple to use for budgeting. The data source used, was the same report as previously, except there is necessary for individual reports to be imported by project by the user, meanwhile the file is using the modified master data in background for analysis. Additionally, new features were implemented to support the new budgeting structure, using VBA, excel formulas and an hour labour report. These features included: labour split based on historical data and dividing costing data according to new budgeting structure principles. Prototype was modified according to real project data and using ideas from steering groups and interviews.

5.2 Data Analysis

According to the Current State Analysis (CSA), costing data was selected as the main key factor for budgeting, as data for analysis was easily available and it was the most noted factor in the interviews. It was concluded that deviations

in costing data can eventually lead to deviation in budgets. The other factor to be specially noted in this study, is other costs category, including labour costs and other additional costs for example in logistics.

5.2.1 Costing Data Selection

The proposal phase initially started with evaluating the costing data. The best-known sources of costing data in the CSA were Tacton CPQ and furtherly investigated, Power BI reports. The problem with Tacton is that there is no possibility to list all costing information for a given project for example in a concise form. Tacton works as per quotation, and there can be a vast number of quotations in one project. This was also noted in the CSA.

The evaluation started with analysing the Power BI-reports and their data, since clear sources or creators of the report were unknown at this phase. The strength of Power BI is also the long lifetime as an application compared to the other available systems in the company containing costing information. Eventually out of the company Power BI reports available, *Orders Report* was selected as the initial report to use, based on it containing the most costing, and other possible useful data for a possible tool. With a Project Manager to support, this data was then compared to Tacton CPQ data using an example project for information. The first tests showed that initial FBC data matches in CPQ and in the report. With this information, it was selected for further examination.

The key report cost information includes End Customer Order Value, FBC Cost Value, STD Cost Value and Realized FBC. In previous research, End Customer Order Value and FBC Cost Value were tracked down as similar values in Tacton CPQ costing information. STD Cost Value and Realized FBC were identified as “actual” values from researching project data, or at least the values were confirmed as actualising during production. During steering group meetings, Realized FBC was eliminated as a false value, as the ratio between

all FBC and STD values is 1.27, which correlates with the field being calculated from STD with an old FBC rate. This was noted later in the study.

5.2.2 Costing Data Modelling

The report was then exported into a big master file for further analysis. The report included all rows from June 2020 to November 2022, according to the start of Tacton usage in June 2020. The report was exported to excel, and it contained approximately 43000 rows of data including product and costing information. The first issues were the data limitations of Power BI reports. Certain projects and quotations were not found when searching from the data. The data limit issue was mitigated by limiting the order division to only projects managed in Finland. Still some data is missing, but it is more relevant for use in Finland.

The research then conducted into FBC data analysis, and more closely into comparing how realized values and Tacton first estimates compare in the *Orders Report*. As discovered in the previous chapter, a new column was mandatory to create in order to consider the ratio miscalculation in realized FBC and realized STD values in the original report.

The first filtration of the dataset was to include only invoiced items, to make sure the realized values are the actual invoiced values in the data and to not include rows in production. Also, a percentage difference of the Tacton estimates and realized values was added as a column for analysing. It was also used to track down borderline cases where either of the values is apparently invalid. These cases were often identified as spare parts and third-party components for example. The chosen kept percentage difference (Tacton FBC and Realized FBC) range was -100% to 99%. Also, bare shaft, actuator and spare part product categories were ruled out. Total approx. 17000 rows of data remained at this point.

Row Labels	Sum of FBC Dev €	Average of FBC Dev %
DBA Horgau Operations		
FBA Helsinki Operations		
FFA FC HKI Spare Part Center		
HAA China sales		
HBA Shanghai Operations		
HBJ Jiaxing operations		
IBB Ambernath operations		
INP Vadodara operations		
KBA Korea Operations		
Grand Total		

Figure 9. First modelling of data sorted by warehouse.

The first model was a pivot indicating the warehouse, or where the products are manufactured. This model is not the best for this use case, since it does not have enough detail for using it in analysing certain project budgets. However, it can be interesting information for the management of the company.

For the tool, the modelling and analysis then concentrated on product types as they are presented in the next figure of the pivot table model.

Row Labels	Count of PL Hierarchy Level 4	Average of FBC diff
4000 series		
7000 series		
860 Mod C		
860 Series W/S (MOD A)		
9000 series		
AB		
AM		
BE		
BH		
BW		
BWX		
Complementary valves		
D1F, D3F, D4F, D5F		
D2C/D, D3C/D, D4C/D, D5C/D		
E2 & E6		
FC		
GB		
GM		
GU		
J4		
J9		
JA		
L1		
L12		
L6C/D		
L6F		
LG_C		
LG_D		
LW_C		
LW_C ModD		
LW_D		
M1		
M2		
Neles topwork		
RA		
RE		
T-series		
Wafer-sphere 14"-20"		
Wafer-Sphere 2 1/2"-12"		
XA/XB/XC/XT/XU		
XG/XM		
XH		
Grand Total		

Figure 10. Listing costing data by product type.

Lastly, the data range was then presented as a pivot table, with average difference of FBC as the chosen value to compare. The final listing category was by product, to analyse the difference in FBC deviations by product types. Additionally, counted sample per product type was added in order to see the sample amount of each product to estimate the reliability of the predictions of each product group. Products where samples where under 15, were not included as they were considered unreliable. Finally, conditional formatting was added for more convenient comparison and analysis. It was noted, that after filtration of the data, by product type was the model where most correlative deviations were seen. Different product ranges were stated the best separating factors what effect the development of costs in manufacturing. For example, material and manufacturing costs differ between the product ranges.

5.3 Budgeting Tool Development

The development of the prototype tool started with sketching a budget template and figuring out what would be useful in terms of functionality. The main newly planned changes to budgeting in project excellence were the split of costs into own and 3rd party, splitting other costs into certain project unit labour fields: documentation, engineering, project management and other labour. Also, other costs field was still present to be used for the rest remaining costs. These costs were added into a budgeting template when creating the first sketch.

Considering the findings of the CSA, the costs were one of the focusing points for budgeting. The correlation of margin deviation and costs is a point of interest, when considering the interviews of Project Managers and management. Therefore, costs were selected a one key factor for the tool. An old budgeting tool was accidentally found in the steering group meetings, and it was used as reference for the cost part.

Another point noticed also in the steering group meetings was the labor split in terms of defining how much work is spent by each part of the project unit. Dividing the labour costs into documentation, engineering, project management

and other labor. This was not done before in budgeting and is a part of the new budgeting structure.

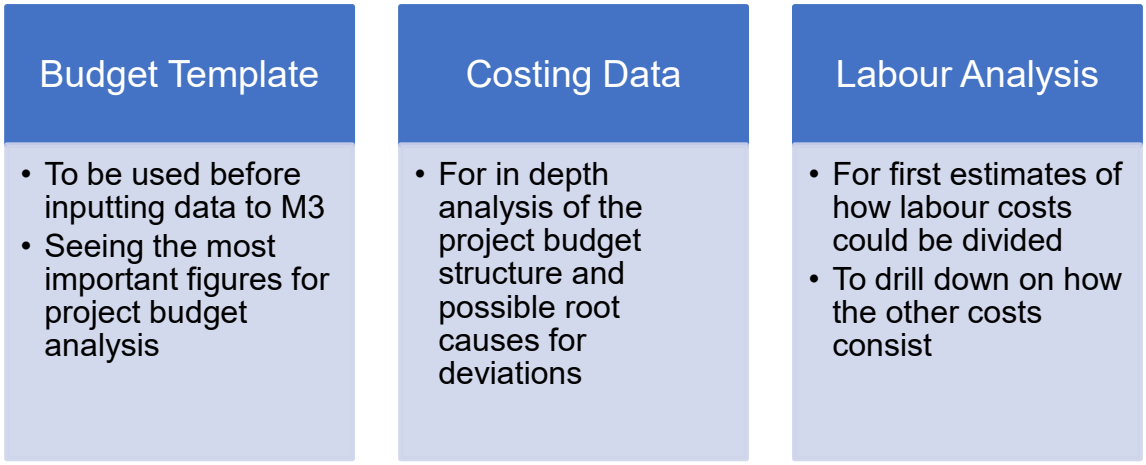


Figure 11. Key factors of the proposal and their respective purposes.

The figure above presents the key factors discovered in the proposal for budgeting and the different parts of the proposal. The proposal divides into three different subjects: Budget Template, Costing Data and Labour Analysis. Above the main subtitles are explanations why the chosen subjects are important in the proposal process.

5.4 Budgeting Tool Proposal

This part of the proposal focuses on building the budgeting tool prototype with the given specifications mentioned in the current state analysis and the other mentioned definitions sculpted during the proposal process.

As mentioned, the building started with a simple template for budgeting. Further on, the labour was analysed, and a separate labour analysis sheet was created. Costing data was made to be imported from Power BI Excel sheets, and lastly the modified costing data was used for further analysis in the tool.

5.4.1 Budget Template Sheet

The most important part of the template was to be able to utilize the new planned budgeting structure and transfer it into Excel form. Also, key figures in budgeting were implemented as formulas to help budgeting. The purpose of this part of the tool was to help project managers in planning the budgets before inputting them to M3 ERP.

The new basis budgeting structure contains:

- Net sales
- FBC (Own)
- FBC (3rd party)
- Documentation cost
- Engineering cost
- Project Management cost
- Other labour cost
- Other direct cost
- Penalty LD
- Commission costs

Firstly, different calculation formulas were added, including calculating total project unit costs and total percentage of labour costs, as in previous budgeting. Also, STD and overhead calculations were added at this point.

The budget template was split into as-sold, PM-budget, estimate and actual sections, with each one containing the same values as above. This was created just in mind for project managers to save and manage their budgets in Excel.

5.4.2 Labour Analysis Sheet

The labour analysis tool was created using Power BI data sources, as they were the best available when creating the tool proposal. A work hour Power BI report was selected for further analysis. The report was exported to excel with

maximum possible work information, that was proven reliable. It was noted during the proposal process, that the costs were presented incorrectly in the report. This was eliminated by selecting hours for the unit of the report instead of currency. Then amount of work per project unit part could be properly analysed.

A pivot was then created of the data to calculate the percentage of different project unit parts. Also, data was separated by industry. A slider was added to select industry. The percentage values would then change depending on industry selected. Formulas were created to calculate estimated labour costs for each part of project unit depending on user inputted project value and total percentage of project unit costs, or formerly called other costs. The parts were sorted as in the new budgeting structure: Documentation, Engineering, Project Management and other labour.

5.4.3 Product Cost Analysis Sheet

Cost analysis is the most complex part of the prototype tool. The idea of cost analysis is to import data from Excel report to simply evaluate the costs of a project. This was done using Excel VBA code. Also, initial cost analysis was utilized for trying to predict how the costs change throughout the project.

As in data analysis, the product type was selected as the way to analyse deviations. The same Power BI *Orders Report* is used, expect in data analysis, this time the report was filtered to certain project. The way the tool works, is by importing the filtered report into the tool. This is done via VBA coding. The code selects the certain columns of information that contain the costing information.

The selected columns were *Order Value LTP RCUR* as the total sales value per row. *Order FBC Cost Value RCUR* as initial FBC value per row. *Order STD Cost Value RCUR* as Actual STD. Also, *Hierarchy 4* as product type and additionally general status was also added to analyse the completion of the items in the budget.

This data was imported into *Project Data* sheet of the tool as the raw data. Required additions are then implemented as columns in the *Project Data* sheet. For example, the prediction of FBC was added. This was calculated from the data analysis findings. A *Ratios* sheet was added, which contained “corrected” FBC rates for each product type. They were calculated by adding 1,3 to the previously calculated change of FBC. The prediction FBC column then works by using VLOOKUP function in excel from the *Ratios* sheet to find matches of product type in the imported *Project Data* sheet. *Predicted FBC* value is then calculated by using the difference of FBC rate to multiply the initial FBC value.

The *Project Data* was then presented as pivot tables in a *Budget Proposal* sheet. The main table is FBC costs. Total values are shown and separated into FBC Own and FBC 3rd party. The separation was done using VLOOKUP function on product types, as certain product types are 3rd party products. Another pivot table is project status, which displays how many percent and value amount of the project value is in each status in the project.

Additionally, revision and cancellation rows are separated in *Budget Proposal* by separating certain product group using a pivot table.

The first draft proposals finish this section. The next section is about validating the proposal. In the validation, the proposal is polished into a presentable form.

6 Validation

This part of the thesis is about the validation stage of the project. The validation was done using two project managers, management and the steering group. The validation is separated into two parts. The first part, data validation is about validating the data itself, the sources and how it compares. Tool validation is about the actual functionality of the tool.

6.1 Data Validation

The data validation started by analysing the accuracy of the presented values. Firstly, the data sources itself were independently evaluated. Then further data validation was done by using actual projects by loading them into the tool. The figures were then compared with actual budgets.

The main source of data for the tool was the Power BI *Orders Report* costing information. It was validated with project managers that this is the best overall source of information at the moment. The data was compared with initially with Tacton CPQ, and later with old Softemis RepIt reports. The first test showed that Tacton CPQ FBC information matches. But with RepIt, it was found that the sales value information might be slightly incorrect for some projects. "Discounted" value showed the correct information, even when discount was not present. The PBI report does not have this information it uses the "normal" sales value instead.

The comparison with actual budgets showed especially the mismatch of *Complementary Valves* category which is considered as a 3rd party item. This was corrected to the tool by calculating FBC's from the sales value, instead of reading them straight from the report. This was eventually corrected for all 3rd party items, as the information seemed to be unreliable for this category.

Additionally, changes of the report data columns can become an issue with the usability of the tool. During the data validation process, some columns changed

places in the report and the VBA code in the tool had to be modified accordingly. This can become a problem if PBI reports are modified occasionally. This can be fixed by instructing the Project Managers to change the column values in the code if changes are detected.

6.2 Tool Validation

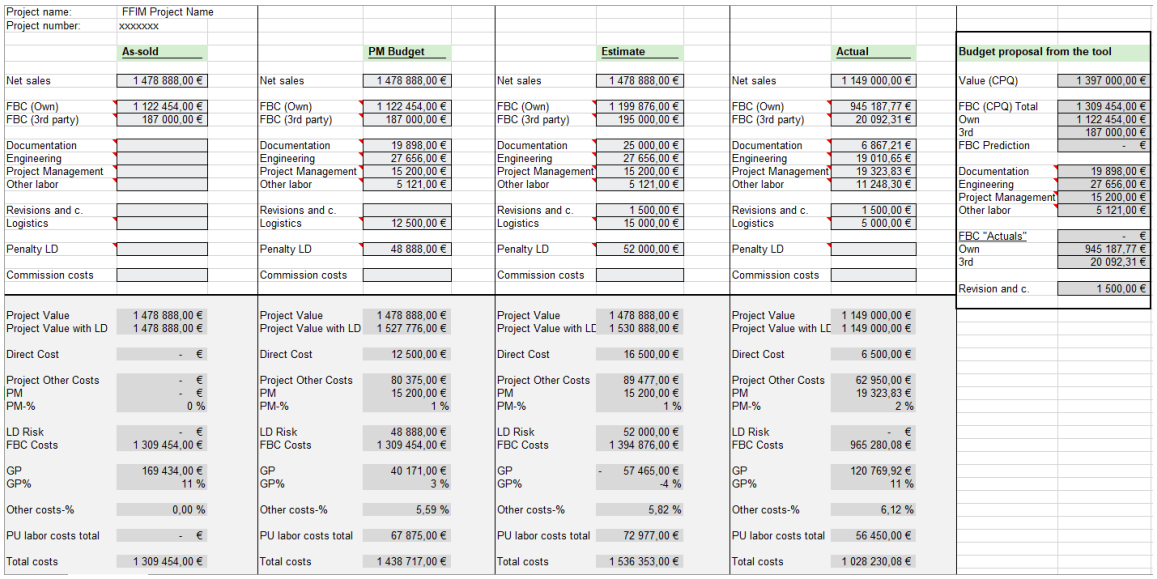
This part of the validation concentrates on mostly visual and functional changes made to the tool, especially the Template sheet.

The validation started by presenting the proposal to steering group and making adjustments in terms of usability. Most of the changes were related to the *Template* sheet, the structure of the budgeting and the related financial figures.

Finally, the functionality of the tool was also tested by two Project Managers. Eventually, the tool was proven to be functional, and the figures were relatively accurate. Explanations were found to deviations between actual budgets and the tool results when discussing with Project Managers. Some of the changes found previously had not been corrected to the actual budget yet, but they were present in the tool analysis already and therefor viable.

6.3 Final Proposal

The final proposal was proven functional and usable throughout the validation process. The final proposal tool is presented using the three figures of the parts of the tool below. The first part of the tool is the template sheet.



Project name:	FFIM Project Name								
Project number:	xxxxxxx								
	As-sold		**PM Budget**		**Estimate**		**Actual**		**Budget proposal from the tool**
Net sales	1 478 888,00 €	Net sales	1 478 888,00 €	Net sales	1 478 888,00 €	Net sales	1 149 000,00 €	Value (CPQ)	1 397 000,00 €
FBC (Own)	1 122 454,00 €	FBC (Own)	1 122 454,00 €	FBC (Own)	1 199 876,00 €	FBC (Own)	945 187,77 €	FBC (CPQ) Total	1 309 454,00 €
FBC (3rd party)	187 000,00 €	FBC (3rd party)	187 000,00 €	FBC (3rd party)	195 000,00 €	FBC (3rd party)	20 092,31 €	Own	1 122 454,00 €
								3rd	187 000,00 €
Documentation		Documentation	19 898,00 €	Documentation	25 000,00 €	Documentation	6 867,21 €	FBC Prediction	- €
Engineering		Engineering	27 656,00 €	Engineering	27 656,00 €	Engineering	19 010,65 €		
Project Management		Project Management	15 200,00 €	Project Management	15 200,00 €	Project Management	19 323,83 €	Documentation	19 898,00 €
Other labor		Other labor	5 121,00 €	Other labor	5 121,00 €	Other labor	11 248,30 €	Engineering	27 656,00 €
								Project Management	15 200,00 €
Revisions and c.		Revisions and c.		Revisions and c.	1 500,00 €	Revisions and c.	1 500,00 €	Other labor	5 121,00 €
Logistics		Logistics	12 500,00 €	Logistics	15 000,00 €	Logistics	5 000,00 €		
								FBC "Actuals"	- €
Penalty LD		Penalty LD	48 888,00 €	Penalty LD	52 000,00 €	Penalty LD		Own	945 187,77 €
								3rd	20 092,31 €
Commission costs		Commission costs		Commission costs		Commission costs			
								Revision and c.	1 500,00 €
Project Value	1 478 888,00 €	Project Value	1 478 888,00 €	Project Value	1 478 888,00 €	Project Value	1 149 000,00 €		
Project Value with LD	1 478 888,00 €	Project Value with LD	1 527 776,00 €	Project Value with LD	1 530 888,00 €	Project Value with LD	1 149 000,00 €		
Direct Cost	- €	Direct Cost	12 500,00 €	Direct Cost	16 500,00 €	Direct Cost	6 500,00 €		
Project Other Costs	- €	Project Other Costs	80 375,00 €	Project Other Costs	89 477,00 €	Project Other Costs	62 950,00 €		
PM	- €	PM	15 200,00 €	PM	15 200,00 €	PM	19 323,83 €		
PM-%	0 %	PM-%	1 %	PM-%	1 %	PM-%	2 %		
LD Risk	- €	LD Risk	48 888,00 €	LD Risk	52 000,00 €	LD Risk	- €		
FBC Costs	1 309 454,00 €	FBC Costs	1 309 454,00 €	FBC Costs	1 394 876,00 €	FBC Costs	965 280,08 €		
GP	169 434,00 €	GP	40 171,00 €	GP	- 57 465,00 €	GP	120 769,92 €		
GP%	11 %	GP%	3 %	GP%	-4 %	GP%	11 %		
Other costs-%	0,00 %	Other costs-%	5,59 %	Other costs-%	5,82 %	Other costs-%	6,12 %		
PU labor costs total	- €	PU labor costs total	67 875,00 €	PU labor costs total	72 977,00 €	PU labor costs total	56 450,00 €		
Total costs	1 309 454,00 €	Total costs	1 438 717,00 €	Total costs	1 536 353,00 €	Total costs	1 028 230,08 €		

Figure 9. Template sheet of the tool prototype with figures for example

The template sheet is the basis for the prototype budgeting tool. In the figure above, the sheet is filled using imaginary project figures for example. The template is divided into: As-sold, PM Budget, Estimate and Actual as defined before for budgeting. The upper part of the template sheet is mainly for Project Managers to fill to keep on track of the budgets. The lower part of the sheet is using formulas to calculate the key figures for budgets for Project Managers to evaluate. On the right-hand side, there is a table taking data from other parts of the tool for an overview.

The next figure shows the second part and view of the tool, the labour calculation tool. That part of the tool does not use external data sources, user inputs the figures independently.

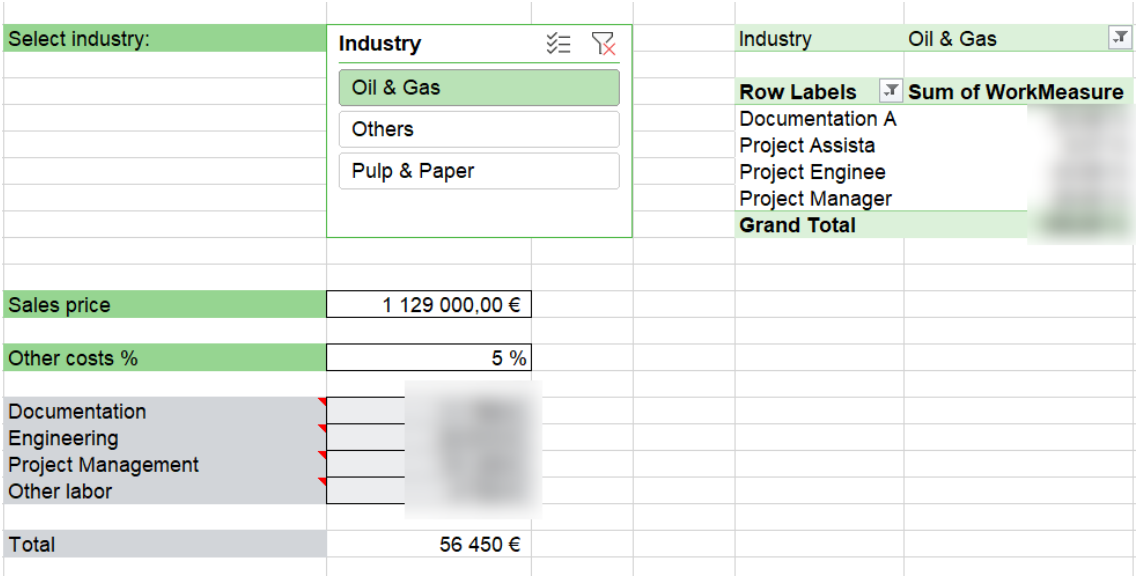


Figure 12. Labour calculation

The labour calculation tool is for dividing *other costs* into different work types. The slicer is used to select industry of the project, then total sales price and other cost percentage is inputted by the user. The tool will split the labour costs according to new budgeting structure using the historical percentage estimations that are injected into the pivot table. Additionally, the total other costs are presented for the user.

The next figure shows the last view of the tool, the product cost analysis. The product analysis uses also additional project data sheet and product FBC prediction ratio sheet not mentioned in this example, imported from a separate PowerBI report sheet.

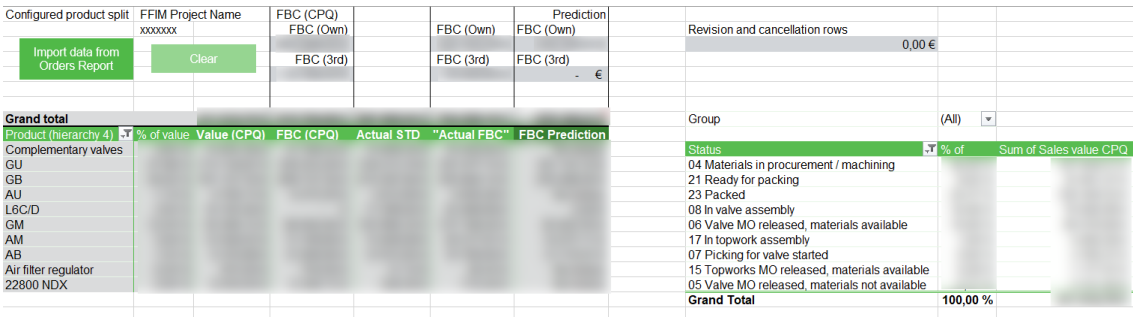
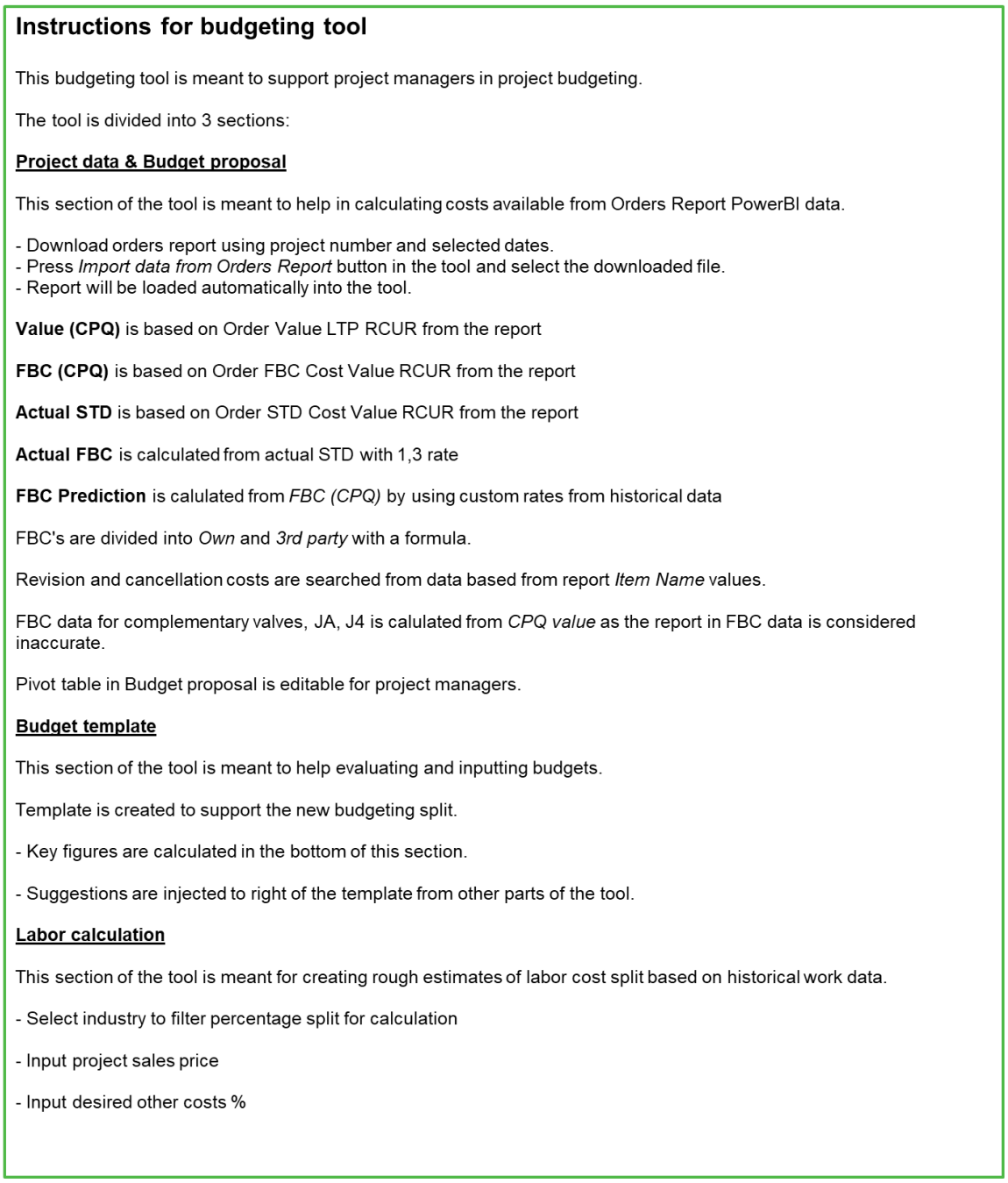


Figure 13. Product cost analysis

This part of the tool is using PBI report information for an overview of project cost structure. The user utilizes the “Import data from Orders Report” button for importing project data from the report. Tool is using automated VBA functions for the process. The tool then splits the sales values and costs by product type in the left-hand side pivot table. Prediction of FBC development is presented also in the tool using historical product data. Total costs are presented in the top part of the grey pivot table. The costs are divided to own and 3rd party costs just above the exact pivot table. Additionally, a formula is seeking for revision and cancellation rows from the report data in the right. The right-hand side pivot table is dividing the value of the project into their correspondent statuses for quick overview of the project progress.

The next figure is a view of the instructions included in the excel file for the user. They are divided according to the three corresponding sheets in the final proposal.



Instructions for budgeting tool

This budgeting tool is meant to support project managers in project budgeting.

The tool is divided into 3 sections:

Project data & Budget proposal

This section of the tool is meant to help in calculating costs available from Orders Report PowerBI data.

- Download orders report using project number and selected dates.
- Press *Import data from Orders Report* button in the tool and select the downloaded file.
- Report will be loaded automatically into the tool.

Value (CPQ) is based on Order Value LTP RCUR from the report

FBC (CPQ) is based on Order FBC Cost Value RCUR from the report

Actual STD is based on Order STD Cost Value RCUR from the report

Actual FBC is calculated from actual STD with 1,3 rate

FBC Prediction is calulated from *FBC (CPQ)* by using custom rates from historical data

FBC's are divided into *Own* and *3rd party* with a formula.

Revision and cancellation costs are searched from data based from report *Item Name* values.

FBC data for complementary valves, JA, J4 is calulated from *CPQ value* as the report in FBC data is considered inaccurate.

Pivot table in Budget proposal is editable for project managers.

Budget template

This section of the tool is meant to help evaluating and inputting budgets.

Template is created to support the new budgeting split.

- Key figures are calculated in the bottom of this section.

- Suggestions are injected to right of the template from other parts of the tool.

Labor calculation

This section of the tool is meant for creating rough estimates of labor cost split based on historical work data.

- Select industry to filter percentage split for calculation

- Input project sales price

- Input desired other costs %

Figure 14. Instructions for the tool

This figure is representing the instructions included in the tool for use. The instructions are divided via the sheet names used in the Excel tool. The instructions are divided into subtitles based on the sheets in the tool. They are meant to help the user in terms of usability of the tool and to inform about the data sources used.

The instructions finish off the final proposal section. The next section is about the conclusions of the study. The conclusions are based on all of the learnings throughout the study.

7 Conclusions

This section is the final section for concluding the learnings of the study. It consists of the summary, the recommended next step, evaluation and final words.

7.1 Summary

The objective of this study was to systemize the budgeting process and to define the data sources for budgeting to improve margin deviation. The outcome of this study was a prototype budgeting tool to support Project Managers in managing budgets.

The first phase of the study was the current state analysis. The current state analysis was mostly carried out with multiple interviews of project managers to get an overview of the current budgeting process. Meetings with the Project Excellence IT-development team and meetings with steering group were also utilised as data. The findings of the CSA revealed the strengths and weaknesses of the current budgeting process. The findings were presented to the steering group and evaluated.

The second phase was the literature study and conceptual framework based on the findings of the current state analysis. It concentrated on the best-known practices for the study, including project management knowledge, cost estimating methods, finance and budgeting, artificial intelligence, Excel budgeting and programming methods. The conceptual framework included an overview of the key findings of the studied literature with current state analysis shown also for comparison.

The proposal and the prototype tool development phase were executed together with the steering group. The tool was developed with the needs revealed by the CSA in mind and using the findings from the literature study. The tool development started by discovering and defining data sources and utilizing it together with the support of the steering group. Most of the time went

to selecting the data sources and to thinking of the ideas how it should be used. The chosen data sources for the study were the Power BI Orders Report and Power BI Work Hours report. In the first hands-on phases, the data was modelled and evaluated. Eventually, the actual tool development kicked off and it was developed using the feedback from the steering group.

The validation consisted of validating the data, functionality of the tool and the actual benefits. The first validation was done together with the steering group. The second validation was done using real projects for comparison. The last validation was done by testing the actual tool together with Project Managers. Feedback was gathered and the final feedback was that the tool fulfilled expectations and would be helpful for supporting project managers. More information about costing data and the budgeting weaknesses was also discovered. The tool was validated successfully. The final tool was presented in the end of the validation phase.

7.2 Recommended Next Steps

The key next step would be the deployment of the tool and supporting the usage. The support includes instructing and directing the use of the tool for project managers. Feedback of the process should be used for improving the tool. Managers should be directing the deployment process.

Weaknesses of the current budgeting process were identified, and resolutions were offered in the study, but there is still work to be done for more accuracy. Considering the data, known errors were already found during the process, and more are possible to be found during the deployment and support. The final validation for the usability of the tool and the data is done over time by analysing the accuracy of the results in different scenarios. The findings should be used to improve the finance master data.

Additional Power BI report improvements would be a beneficial improvement for Project Managers; thus, the cost data could be more easily understandable in

the starting point from the reports. The report columns should be more easily readable when exported from PBI to Excel in the first place.

PBI tools or SharePoint implementations for reading the costing information could be developed to support project financials in deeper detail instead of having to export reports in the start. Nevertheless, modifications and improvements for the data are necessary for reliable analysis. More accurate costing data would lead to more accurate financials. Additionally, gathering more historical data would be beneficial for comparing different customers for example in the analysis.

The labour data analysis could be done better if data could be transformed into more usable form from the systems. Also, different work locations could be taken into deeper consideration when calculating the estimated costs. Historical information could be used as an advantage and different project varieties could be implemented over time, for example project length and customer data.

Additionally, budgets should be more properly defined during the sales process. This would improve the budget accuracy during the full lifetime of the project. Mistakes in the first phase can follow through the project and cause margin deviations in the end. The analysis in the starting phase could also be used to better judgement on the profitability of different projects.

Gathering more feedback and taking the tool into actual use would benefit in developing the tool and data into desired direction using the user feedback. The deployment of the tool would be the final phase of the validation, supported with developing it into the chosen direction.

7.3 Evaluation

The objective and outcome of the thesis were reached during the process. There was a lot to learn about project budgeting and all the related parts, and a big part of the thesis was the learning of different processes and applications used. No direct data sources or definitive instructions were available at the beginning of the

study. The thesis process was done by problem solving and using many own ideas for development. Taking also into consideration that this development process was not done directly with the assistance of any IT unit and no source data was available for use, the outcome and results can be considered excellent.

7.4 Final Words

The development and proposal definition were long and difficult processes but thinking of the scope and outcome was very beneficial in the end. However, this study proves how data accuracy is mostly dependant on where and how it is gathered, rather than how it is processed. When using data analysis or AI for decision making, certain contingencies are always present and have to be taken into account for the most favourable results.

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