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Assessing and prioritizing Major Projects

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Jaakko Kiukkonen, project manager
Elina Happonen
Ilmari Ollila
Petri Valkama
Tuomo Vepsäläinen

Table of contents:

1	Introduction.....	4
1.1	Principal	4
1.2	Background for this research	4
1.3	Research questions.....	5
2	Literature review.....	5
2.1	Customer segmentation.....	5
2.2	Buying process stages.....	6
2.3	Company-wide project management	8
2.4	Selecting and prioritizing projects	9
2.5	Tender participation decisions	13
2.6	Steps in evaluating potential projects	15
3	Current process situation and new approach	16
3.1	Current process description.....	16
3.2	New approach	18
4	Profit-driven prioritization of projects	19
4.1	Analyzing project attractiveness.....	20
4.2	Deriving a model from concrete business foundations.....	24
4.3	Constructing an Excel program to apply the model.....	26
5	Conclusions.....	35
6	References.....	37

1 Introduction

1.1 Principal

Established in 1910, KONE is one of the world's leading elevator and escalator companies. It provides its customers with industry-leading elevators and escalators and innovative solutions for their maintenance and modernization. KONE also provides maintenance of automatic building doors. KONE provides safe and easy access for hundreds of millions of people daily in all parts of the world. The company guarantees local service for builders, developers, building owners, designers and architects in 800 locations in over 40 countries.

KONE has annual net sales of above three billion euros and about 29,000 employees. Its Class B shares have been listed on the Helsinki Exchanges since 1967.

KONE Major Projects is involved with big constructions and developments around the globe, such as airports, skyscrapers, etc. KONE Major Projects unit engineers and delivers projects that are very valuable, have a long duration or are technologically demanding. This unit also plans how many elevators should be in the building and what kind of elevators there should be.

1.2 Background for this research

KONE Major Projects receives numerous inquiries for new projects. As the market grows, the number of projects increases accordingly. In order to manage these projects, KONE must prioritize the projects and thus focus on the most important ones.

Evaluating the projects and ranking them is challenging task, since the aim of the KONE is naturally to serve all clients and participate in as many projects as possible before the tendering process. Taking care of key customers is especially important for KONE since they can bring in a high number of new projects. All these factors and several others have to be taken into account in a manner that in the end maximizes the total profit.

1.3 Research questions

The main research question of this project is:

How should the process of prioritizing projects be organized and conducted?

The main question can further be divided to four sub questions:

- On which criteria should the projects be prioritized?
- What kind of project monitoring- and evaluation process is at the moment and what it should be like?
- What kind of data there should be available for the evaluation?
- How the functionality of the model can be evaluated at present and in the future?

2 Literature review

2.1 Customer segmentation¹

Business-to-business (B-2-B) customers can be segmented into four different groups. The groups reflect the buying behavior of the customer. Business customers can be identified as:

- 1. Price-oriented customers**
- 2. Solution-oriented customers**
- 3. Gold-standard customers**
- 4. Strategic-value customers**

Price-oriented customers, base their decisions purely on the price, i.e. transactional selling. They don't consider other factors such as quality, service-level, etc. This evidently means that the lowest price in the tendering competition wins.

¹ Kotler P., Keller K. Marketing Management 12th edition, Pearson Prentice Hall, 2006 New Jersey, p.216

Solution-oriented customers want low prices but also consider arguments concerning lower total cost or more dependable supply or service. This kind of selling is consultative selling.

Gold-standard customers want the best performance in terms of product quality, assistance, reliable delivery, etc. in spite of the price. This is called qualitative selling.

Strategic-value customers want a fairly permanent sole-supplier with the seller. Therefore the price isn't the most important factor, nor is any specific detail but the overall long-term benefits.

When prioritizing different projects one major aspect should be the customer identification. This is important since different projects require different amount of effort from KONE Major Projects unit. Therefore one aspect of the prioritization ought to be identifying the gold-standard and strategic-value customers since they are the most profitable customers over longer period. Thus the prioritization should depend on the customer status.

2.2 Buying process stages²

The general business-to-business buying process has eight stages. The stages partly overlap in real life, but in Figure 1 they are sequentially to clarify the theoretical framework. The buying process has the following stages:

- 1. Problem recognition**
- 2. General need description**
- 3. Product specification**
- 4. Supplier search**
- 5. Proposal solicitation**
- 6. Supplier selection**
- 7. Order-routine specification**
- 8. Performance review**

² Kotler P., Keller K. Marketing Management 12th edition, Pearson Prentice Hall, 2006 New Jersey, p.220

In problem recognition the customer realizes it has a problem, say a new building must be suitable for office use – the building needs elevators.

In general need description the company identifies its general need, e.g. 5,000 people have to get to upper floors by elevators quick enough.

In product specification customer decides specifications for the elevators, for instance the journey from ground floor to the 10th floor mustn't take no longer than 20 seconds. Therefore the elevator must be capable of certain speed. The customer also specifies the number of elevators and how many persons must fit into one elevator.

In supplier search the customer searches for the suitable suppliers, for example the five major elevator companies. In the next phase (Proposal solicitation) the customer asks for proposals from each of the suitable suppliers. After these phases the customer chooses the suitable supplier to carry out the deal.

In order-routine specification the customer negotiates with the selected supplier about more specific terms, conditions, etc. Eventually in performance review the customer reviews the performance of the selected supplier. This phase eventually is the determinant of whether the same supplier will be used again.

When this framework is applied to the elevator business, there is one significant alteration. In certain projects, one supplier participates the buying process already in the general need description phase and stays on the process all the way till the tendering competition in phase 6. Then the supplier can still loose the tendering competition although it has put some effort already to the project. However, participating from nearly the beginning of the process will substantially improve the probability of winning in the tendering competition.

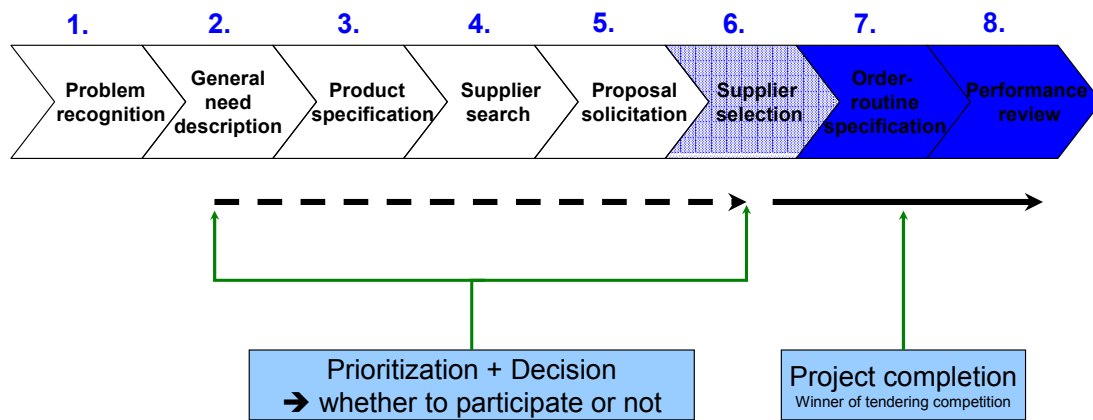


Figure 1. The stages of buying process

2.3 Company-wide project management³

According to the literature, an organization undertaking several projects should adopt a common project management approach for all projects in the program. In this particular case, KONE Major Projects can be seen as a “program”. Especially as a common project management approach should be used regardless of the type of the project, its size and the type of resource used, this concept fits KONE Major Projects –case too. An organization faces several major advantages when adopting the approach mentioned before. First, a consistent reporting mechanism can be adopted to give comparable progress reports across all projects in Major Projects division. Second, resource requirements can be calculated on a consistent basis, facilitating the management of different capacity constraints faced by the division. Third, people can move between projects without having to relearn the management approach used project by project. Fourth, smaller projects can be used as a trainee ground for managers and thus advance the success of large projects. Furthermore, it has been identified that where projects are inhomogeneous just like most Major Projects in KONE, better results and fewer failures for projects has been reported if a common project management approach has been tailored to fit the needs of different projects.

³ Rodney Turner, J. 1999. The Handbook of Project-Based Management. Second Edition. McGraw-Hill, p.351-356

2.3.1 Steps for assigning priorities to projects in a program⁴

Six basic steps can be enumerated when assigning priorities to projects for resources:

- Plan individual projects
- Calculate individual project's resource requirements
- Place each project into the master project schedule
- Assign each project priority
- Assign it a time and resource window in the master project schedule
- Manage each project within its window

2.4 Selecting and prioritizing projects⁵

The source book offers various ways for the portfolio of projects should be ranked. According to authors feasible projects should meet three criteria⁶: They must be aimed at:

1. achieving the organization's mission
2. achieving corporate objectives and strategy
3. delivering timely benefits which justify the expense

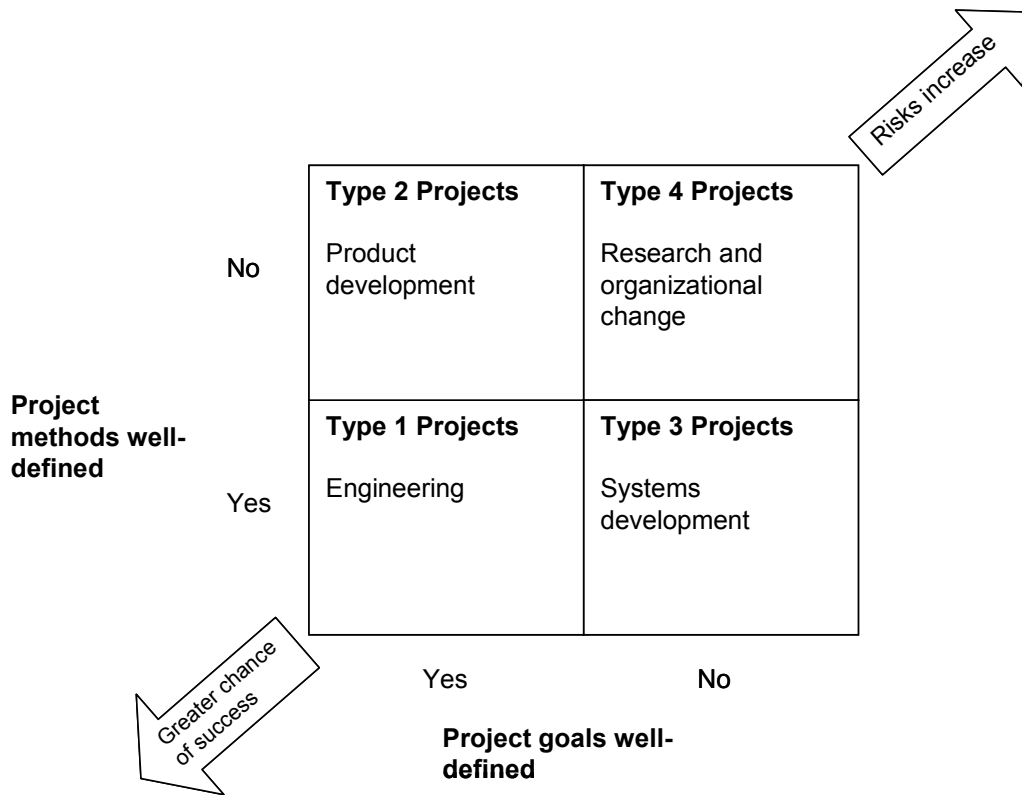
On the operative level projects should be assessed through their technical complexity, risk level and consumption of scarce resources. In addition it is possible to classify projects according to two dimensions, the first being how well defined are the goals of the projects, and the second how well defined are the methods of achieving those goals. The impacts of these factors on projects can be depicted in matrix-form on a following way⁷:

⁴ Rodney Turner, J. 1999. The Handbook of Project-Based Management. Second Edition. McGraw-Hill, p.346-347.

⁵ Rodney Turner, J. 1999. The Handbook of Project-Based Management. Second Edition. McGraw-Hill.

⁶ Rodney Turner, J. 1999. The Handbook of Project-Based Management. Second Edition. McGraw-Hill, p.48

⁷ Rodney Turner, J. 1999. The Handbook of Project-Based Management. Second Edition. McGraw-Hill, p.26



The projects that KONE is facing are mainly Type 1 Projects where both the goals and methods are well-defined. As a result it is possible to move quickly into planning the work to be done, and so you will find on engineering projects an emphasis on activity-based planning. In general these projects have a greater chance of success and thus the risk level is lower than in other types of projects. The key choosing criteria include profitability, the usage of scarce resources, schedule and the customer-relationship.

2.4.1 Prioritizing projects

The main thesis of the book concerning project portfolio selection is that projects should be only adopted if they deliver the organization's objectives. Further, projects should only be adopted if there are adequate resources to allow them to be delivered in a timely and effective manner. The book also emphasized the importance of financial measures such as Net Present Value (NPV), IRR and pay-back period. The approach is to assess cash flows against certain quantitative criteria, using given norms for the business.

2.4.2 Accounting for risk in quantitative methods

The risk is usually taken into consideration by scenario planning where future outcomes and their probabilities are assessed. The other option is to make some allowances in the figures calculated. Allowance for risk can be basically made in one of the three ways; by reducing the predicted income, by increasing expected cost or by increasing the discount factor or required IRR. The allowance which is made will depend on the impact of the risk, its chance of occurring, and the strategic importance of the project. The scenario planning can be combined to this by defining worst- base- and best case scenarios.

2.4.3 Managerial judgment

In addition to quantitative measures the final selection relies on managerial judgment of the situation. The reason is that there are many qualitative or heuristic elements to the decision, which can not be quantified. These heuristic elements include:

1. moral considerations
2. the reputation of the organization
3. the impact on existing business
4. the view of shareholders
5. the impact on the hygiene factors in the mission statement
6. the impact on the environment
7. public opinion

Clearly only few of these will be relevant in this study. The impact on existing business and the view of shareholders must be naturally assessed when ranking portfolios. Also view of other groups involved may have to be taken into consideration. These include views of users of the outcome of project, supporters such as subcontractors, suppliers, financiers etc. and stakeholders that can be defined by all those groups that are affected of affecting the project without direct benefit from it. These factors may be difficult to quantify and thus must be assessed quantitatively.

In conclusion in selecting projects:

- priorities must be assigned to projects so that there are adequate resources to undertake those selected
- they must meet investment criteria
- allowance must be made for risk
- final selection is based on managerial judgment taking account of both quantitative and qualitative criteria

As can be seen the literature is emphasizing the importance of financial measures and the efficient use of scarce resources. None of these are available at the moment on data according to which the project prioritizing process is undergone at the moment. This indicates that a complete feasibility study of a project should be conducted to figure out the attractiveness of a project. The feasibility study obviously ties resources, and thus the cost-benefit relation must be assessed carefully. According to the literature the following factors are normally assessed in the study⁸:

- **Market conditions**, which means that the competitive situation at the market must be assessed as well as the price sensitivity of the buyer. In addition trends and economic factors of the target market should be taken into consideration
- **Supply considerations**, the cost, quality and availability of capital equipment, raw materials and labor.
- **Financial prospects**, these include the normal measures (NPV, IRR, pay-back time). These are naturally influenced by economic conditions such as interest rates.
- **Risk and uncertainty**, risks may be linked to economical, financial, political, technological, environmental or legal factors

⁸ Rodney Turner, J. 1999. The Handbook of Project-Based Management. Second Edition. McGraw-Hill, p.273.

2.5 Tender participation decisions⁹

One very important decision making point in project marketing and sales is whether to make an offer or not. Making an offer can be seen as an investment, with uncertain return. Bidding competition can be won or lost, and the outcome cannot be fully predicted. When the decision has been done, it's difficult to withdraw without harming the customer relationship and company credibility. It's also essential to remember that the offer is binding. Offer that is made quickly and with negligence can become an unprofitable business if the customer approves the offer. Badly presented offer also leaves a bad image of the company.

When deciding on an offer many things have to be taken into consideration. What is the probability of winning the bidding competition? Is the project tempting and feasible for the company's business activities? Also the competitor's relationship to the customer needs to be considered. The customer may already be committed to some other supplier and the call for bids has been made without even an intention of buying. Long-term possibilities for forming a good customer relationship should also be taken into consideration when evaluating the attractiveness of the project. Well managed and delivered project can contribute more project possibilities in the future. In Table 1 there are examples of aspects that need to be evaluated.

Table 1 Important aspects for considerations

Characteristics of the invitation for tenders	<ul style="list-style-type: none">■ At what point is the customer's decision making in the investment project?■ Is there call for a firm or budget offer?
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⁹ Artto, Karlos; Martinsuo, Miia; and Kujala, Jaakko. 2006. Projektiliiketoiminta. First edition. WSOY Oppimateriaalit Oy.

<p>Situation in competition</p>	<ul style="list-style-type: none"> ■ What is our own relationship to the customer? ■ Who are the most probable competitors and what is their relationship to the customer? ■ Is there a possibility to interact with the customer when making the offer? That would provide for competitive advantage. ■ What are customer's decision making criteria and what is company's competitive position in those fields (for example price and technology)?
<p>Economic attractiveness</p>	<ul style="list-style-type: none"> ■ How big is the project and what is the contribution margin? ■ How does taking part in the bidding competition affect to the customer relationship? ■ How does participation affect to company's reliability and image in the market? ■ Does the project have reference value? ■ Is it possible to create or maintain relationships to most important subcontractors and partners in cooperation by means of the project?
<p>Technical attractiveness</p>	<ul style="list-style-type: none"> ■ What is the company's capability to meet the technical and delivery date requirements? ■ Does the company need a project to maintain its capacity utilization rate? ■ Does the possible new technology or operating procedure created by the project support company's strategic choices?

The table above shows that it is important to evaluate all the possible effects that the project could have on business operations. The decision process needs a wide group of people where all viewpoints come out early. If the company decides not to take part in the bidding competition it can refuse politely or make such an expensive offer that it can't be approved. To maintain good relationships it's important to inform the customer quickly if the company doesn't participate to the competition.

2.6 Steps in evaluating potential projects¹⁰

According to the literature, the following five-step process for evaluating potential projects can be identified.

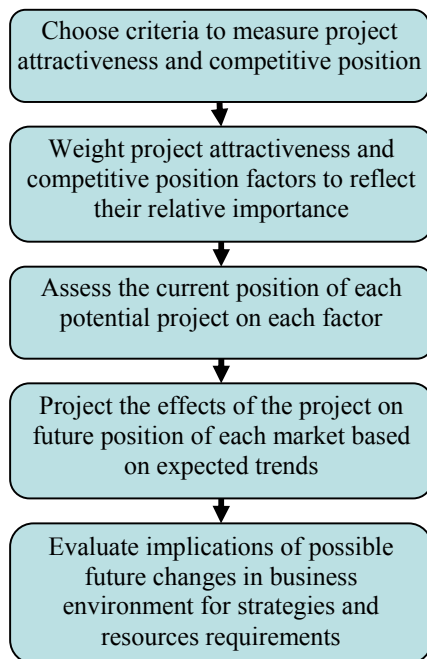


Figure 2 - Steps in evaluating potential projects

The fourth step is of big importance and therefore special attention should be paid for it. For example if KONE accepts a project, let's say in a new geographical location or using some new special technology, the estimated project NPV can be negative if it is probable that the project has an positive effect on future position in that market.

¹⁰ Walker, Mullins; Boyd, Larreche. 2005. Marketing Strategy: A Decision Focused Approach. Fifth international Edition. McGraw-Hill, p.144.

3 Current process situation and new approach

3.1 Current process description

3.1.1 General description

In the Figure 3 the general process in the Major Projects Unit (MPU) is described. The process begins when either the MPU gets a direct request or the country organization gets a new project through active selling. Once the pre-tender participation has been decided, the sales organization starts to look after the project. The technical designing follows quickly. MPU's main task is to participate in the planning and designing phase of the building. They also help to decide on the specification of the elevators. This helps the company to win the tendering process. In the beginning of the pre-tender phase a quick risk analysis and before the tender phase a more thorough risk analysis is conducted.

If the company wins the bidding and gets the order, from that moment on the main responsibility of the project moves on to project management. Project management is in charge of executing the plans.

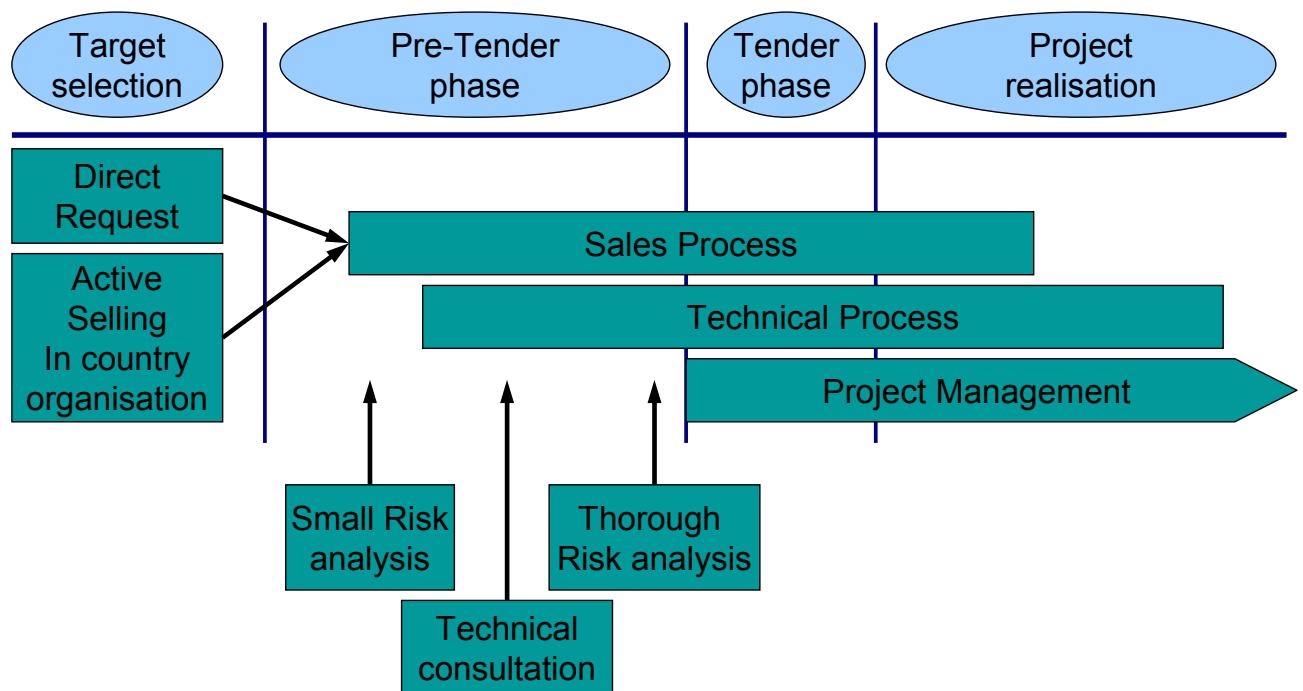


Figure 3 – The general major project process at KONE

3.1.2 Target selection

Target selection is where the whole process begins. It can start by two different types of initiators. Usually the country organization has done active selling and has managed to get a new project. When getting a major project they contact the Major Projects Unit (MPU) if they cannot take care of big projects in country organizations. Another way of getting a project is that the architect, builder, constructor, consultant or developer contacts the MPU directly. This is much rarer and happens mostly in very large projects. If contacted directly the MPU contacts the country organization since their participation and commitment is vital to a successful project.

3.1.3 Pre-Tender phase

The pre-tender phase is pretty long phase before the tendering phase. It can take up to few years. In the pre-tender phase the MPU goes through all the specifications in the project and suggests such lifting arrangements and specifications that work best with KONE solutions. However, they need to be defined so that competitors in theory can participate in the tendering phase.

In the beginning of this stage MPU carries out a quick risk analysis. This means that MPU evaluates mainly on the financial criteria whether the project is feasible at all and will it be realized. MPU also initiates technical consulting at this stage, i.e. they work with the main stakeholders in the project, assist them on lifting related calculations and offer suitable solutions.

When approaching the tender phase, at the end of the pre-tender phase, a proper and larger risk analysis is conducted. There MPU evaluates whether the project is interesting or not to, will it happen, and if KONE participates, will it cause severe financial, operational or other major risks to KONE. This is important to know before entering the tendering phase, because backing off from the tendering process is very costly, if possible at all.

3.1.4 Tender phase

In the tender phase the main focus is on the selling process. The selling process has started already earlier but is at its most intense stage now. This is the strategic moment where KONE either gets the project or not. If MPU has been involved in the pre-tender phase in the project, the probability to win the project is much better than if KONE only tenders for it.

3.1.5 Project realization

In the project realization phase the sales process consists of mainly after sales type of activities whereas the project management really takes the charge. The technical process still continues since there, in most cases, still isn't any kind of building yet constructed. The technical details need to be sorted out before the elevators can actually be fitted. At this stage there might still come some changes in the number of elevators, etc., but mainly the technical process is how to solve all relevant technical details.

The major activity takes part in project management, which MPU support according to its capabilities. It is project management's responsibilities to make sure the elevators are installed as ordered and that they work the way they are expected to. At this stage the MPU resources can mostly be reallocated to new projects.

3.2 New approach

We were provided with data of present ongoing projects that contains information about features that are currently used to rank them. This data is the main source of information that we were supposed to use when estimating the weights for parameters for RPM (Robust Portfolio Management¹¹) use.

One of the initial aims was to use the RPM software to rank current projects. The project group familiarized itself with the software and came to a conclusion that RPM shouldn't be used for project evaluation. Statistical analysis was made to find correlations between

¹¹ <http://www.rpm.tkk.fi/>

the factors supposed to have effect on the attractiveness of a project and if the project tender has been won or lost, for example. After thorough analysis, we did not find any kind of statistically significant correlations between let's say "a feasible architect" and "winning the tender" and with some factors, the correlation was even negative, needless to say: statistically insignificant. The analysis gave no signs of possibility to simply use multipliers to give weights to different factors. Instead, it showed that there is too much inconsistency and that kind of approach could not be used. In plain words we did not know whether a particular factor increased or decreased the attractiveness of a project. In addition some important explanatory variables were missing from the data. We also got too little history data for estimations, and we could not reliably estimate the significance of each variable and therefore we approached the problem from a different angle.

Thus the method of identifying weights is not the best one in terms of overall profitability of business. In the method the real effects of the chosen criteria on the financial performance of the company are not understood. Further, the weights are subjective estimates and it is very difficult to say how good estimates they really are. What is more, the method is not based on any concrete business-driven factors. This means that it is practically impossible to use data to objectively estimate the proper weights or to choose the right criteria. How would you for example objectively estimate the weight of "Strategic value" –criteria?

4 Profit-driven prioritization of projects

When analyzing the prioritization of projects, we ended up asking what the real basis of prioritizing projects is. In the end we came to the conclusion that on the first level of each model has to lay a firm business-driven foundation. In other words the projects must be prioritized in a way that in the long run maximizes the total monetary value of the business. The model has to be derived from this foundation. This kind of thinking is completely different compared to the first approach where some criteria and weights were just pulled out without real analysis or business foundation. The difference between these two types of models is described in Figure 4: Criteria-based and business-based prioritization models.

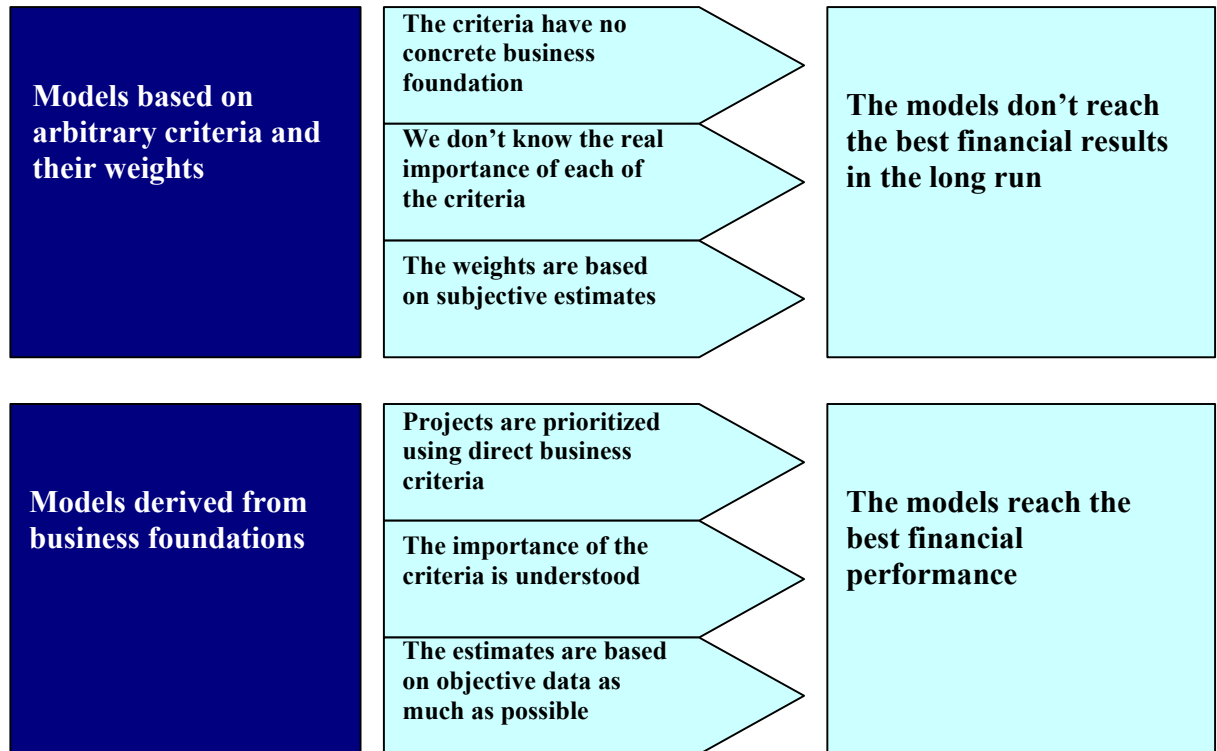


Figure 4: Criteria-based and business-based prioritization models

4.1 Analyzing project attractiveness

The challenge of prioritizing the project may be regarded from three levels. First we may have several projects but we are not able to participate in all of them due to resource constraints. In this situation the most efficient use of the scarcest resource is vital and the projects should be ranked accordingly. Second we may actually have resources to execute all projects, but we must decide in which we place substantial effort and use more resources. In major project business such as KONE this is important as the life cycle of the project is quite long and the assessment should be done along the way. In addition the quality and quantity of information increases as the project proceeds from its initial prospecting phase to pre-tender and finally tender phase. In this case it is essential to estimate the increased probability of winning the project and its monetary value and maximize this figure. The third option is a combination of these which means that the

overall value of the project is not a single figure, but a function of required resources and estimated revenue that are changing continuously over time.

In case of KONE the third option described above represents the situation best. However, after the discussion with employees it has clarified that the effect of increased efforts is very challenging to estimate and thus the ranking process must be based on the historical measures and the estimate of probability of winning the project. As a consequence the approach is to build a model that ranks the projects according to available information. It does not take into account the option to increase efforts to enhance the probability of winning a particular project. This is justified also by the fact that the effort of country organizations is not the scarcest resource and thus it is not vital to rank projects from their perspective.

The attractiveness of the project can be analyzed through three main aspects. On one hand we have the expected value of the project which can be further divided in subcategories. On the other we have the probability of winning the project which covers both the project in hand as well as future projects. The third aspect is the consumption of the scarcest resource which should be exploited in the most efficient way. In this case the scarcest resource is the time and efforts required to complete the tender and the required technical specifications and legal issues. This varies between different types of projects. The other challenge is the increase of knowledge during the Project Life Cycle.

4.1.1 Project value

Project value is a function of its instant monetary value and long-term strategic value. The monetary value is measured by financial measures. Strategic value is characterized by the value of future business which may be difficult to estimate.

Financial value

At present situation only sales value of the project is available. However it would be beneficial to take the profitability into account as well. The instant monetary value is the

difference between estimated revenue and cost, i.e. the Net Present Value (NPV) of the current project which may be negative due the emphasis on after sales. NPV was chosen as a measure of monetary value because it can be considered the most relevant figure as it takes into consideration the cost of capital and may also be adjusted for multiple scenarios taking the risk aspects into account. Other possible measures would be payback time and cash flow. Especially cash flow figure is important from the project finance point of view, but it is beyond the scope of this study.

Strategic value

Strategic value consists of value of the future business which can be further divided to the increased possibility of winning future projects as well as their increased future value. The strategic value of the project has to be quantified by assessing these figures and their increase if a certain project is undertaken.

The dummy variable MPB Agreed Target project is used currently as proxy for strategic fit. This deals with business unit strategic fit. However the fit with KONE Corporate Strategy would be too difficult to estimate with every single project as it would require the assessment of the board.

Reference value

The project reference value refers also to the increased possibility to win future projects. This value may be realized by technical reference if we are dealing with new innovations such as destination control system. The technical reference value is also difficult to express in monetary terms, but should be taken into account by estimating the size of future business related to it. This may also cover the after sales value which is very important in the Major Project business.

Target market

The circumstances in the target market also determine attractiveness of the project. One of the key prerequisites for a major project is the commitment and experience of the respective target country organization. First of all it is feasible that KONE has an

established organization in the country. Secondly their skills and motivation can be assessed by their past performance. A suitable indicator for their motivation is their assessment of winning the project. Other factors that should be taken into consideration are the size of the target market and the market share.

4.1.2 Probability of winning a project

The other determinant of project attractiveness is the probability of which the project will be won. These include the partnerships that may have an enormous effect on the project.

Partnerships

In KONE Major Project business the most relevant entities in process include Architects, Builders, Consultants and Developers. These affect the design and financing of the project and are active players in the tendering process as well. At the moment their feasibility is assessed through binary variable 0 or 1. However when conducting regression analysis we found no statistical significance between the binary variables and winning or losing the project. This may be due the lack of data as there were only few lost cases and the variables were missing from some of them. As a consequence current ranking system remains questionable. However they might be ranked according to hit ratio expressed as

$$\text{Hit Ratio} = \frac{\text{Bids won}}{\text{Pre - tender participations}}$$

This measure gives more reliable information about the feasibility of the partner from KONE's point of view. It is also a quantifiable measure that may well be used as an input to a mathematical model.

4.1.3 Abandonment criteria

In the major project business few criteria may be regarded as features that reduce the attractiveness of the project substantially. In KONE Major Projects these include the

design of the project which may be designed so that it is executed according to the specifications of a competing company. This happens due to various reasons which may be related to complex connections behind the construction project. In this case the most important feature is to recognize the situation as early as possible to avoid unnecessary consumption of resources.

The other criterion which may reduce the attractiveness is a difficult customer. These are usually known in advance, but the degree of disadvantage may be difficult to estimate. However it is important to assess the total customer relationship as a whole to determine the value of future business as well as to be able to offer right solutions for the customer. Infeasible design and difficult customer can be regarded as features that either exist or not. Thus they may be modeled with a binary variable.

The third abandonment criterion is risks of the project which may have a major impact on the attractiveness. The risks are assessed through a feasibility study that is conducted in two phases of the projects. The results may lead to the decision not to pursue the project any further. The risks are not taken into account quantitatively, but they have to be assessed in with every project.

4.2 Deriving a model from concrete business foundations

The objective of a model based on business foundations is to prioritize projects in such a way that the value of the organization is maximized. For businesses such as KONE this means maximizing the total value of the business. The total value V of a business can be defined as follows:

$$V = \int_0^{\infty} [e^{-rt} C(t) dt]$$

Where

t = Time
 r = Discount rate of return
 e^{-rt} = Discount multiplier
 $C(t)$ = The expected cashflow at the time t

In other words the objective in prioritizing projects is to maximize the total discounted cash flows of the whole business. This means taking into account the cash flow generated directly by the profit and the probability of winning the project, but also the effect winning the project would have on the probability of winning future projects and thus on their value. These factors can be summarized in the Figure 5: Analysis of project value.

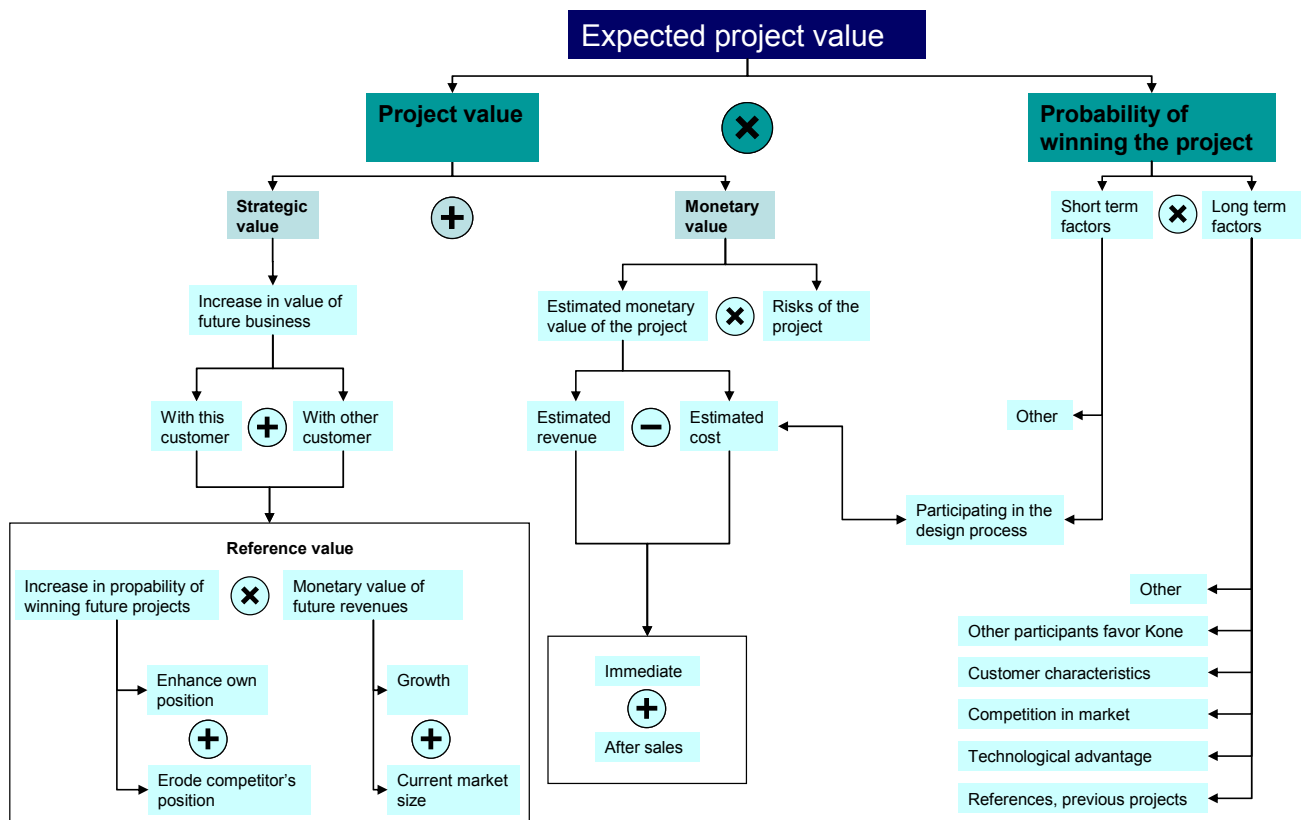


Figure 5: Analysis of project value

After this framework has been used to identify a projects total value, the analysis in the following figure can be used to prioritize them: Figure 6: Prioritization of projects.

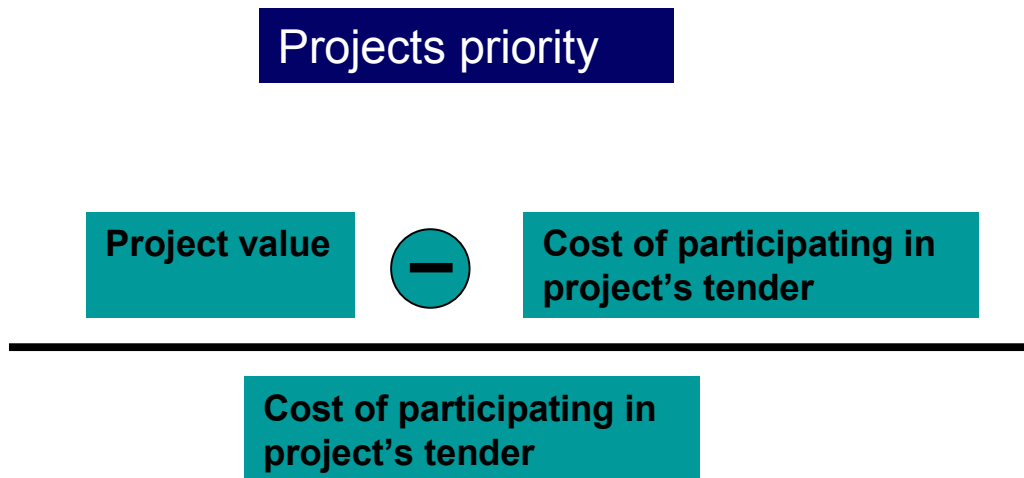


Figure 6: Prioritization of projects

In other words we should prefer projects that bring the largest value compared to the cost of participating in the tender process. This takes into account that participating in tenders is the limiting resource. The next step in this approach would be to use linear programming to identify the best portfolio that maximizes the total value, which would also take into account that when using only the proposed method some resources may be left unused and thus the result may be in some instances suboptimal. However, in most cases the amount of resources available for participating tenders is very difficult to estimate accurately. This means that the linear programming approach could actually turn on itself, choosing a portfolio that can't in the end be really used due to lack of resources.

Now that we have defined a model for prioritizing projects, we move on to applying it. The application of the project is explained alongside with the explanation of an Excel program that actually uses the model.

4.3 Constructing an Excel program to apply the model

4.3.1 General structure of the program

The program has three main functions

1. Estimates the probability of winning current running projects using historical data

2. Calculates the value of the running projects using the model in Figure 5
3. Prioritizes the projects using the model in Figure 6

The parts of the program are:

- A. User interface, on which are the guidelines for using the program and general inputs
- B. List of projects that have been either won or lost (After-TenderProjects) and data concerning them
- C. Regression analysis (Regression calculations) that takes the data of the After-TenderProjects and calculates the effect of certain “Probability determining variables” on the probability of winning a project
- D. List of running projects (Pre-TenderAndTenderProjects) and data concerning them. Using the coefficients of the Probability determining variables, calculated in the regression analysis, an estimate of winning the project is calculated for each of the running projects.
- E. Results of the project valuation. This takes as its main inputs the estimates of the revenues and costs of the projects provided by the user and the estimate of the probability of winning the project calculated above and/or entered by the user.
- F. Results of the project prioritization that is based on the project valuation and the costs of participating in the tender

Next we will go through the parts of the program in detail, along with the calculations involved.

4.3.2 User interface

On this page the user can read instructions for using the program. In addition, the user can enter two main inputs:

- The internal rate of return used when discounting cash flows during the analysis
- The weights based on the estimates of probability of winning the projects
 - o On the estimate calculated by the model
 - o On users subjective estimate

4.3.3 After-tender projects

On this page there is data on the projects that have been either won or lost, along with data about them. The following data is recorded of each project:

- Project name
- Project Status (Lost or Order)
- Subjective order forecast %
- Calculated forecast %
- Target project (1=yes, 0=no)
- Architect (1 if favors KONE, 0 if does not favor KONE)
- Builder (1 if favors KONE, 0 if does not favor KONE)
- Consultant (1 if favors KONE, 0 if does not favor KONE)
- Developer (1 if favors KONE, 0 if does not favor KONE)
- Tenant/Investor/QS Others (1 if favors KONE, 0 if does not favor KONE)
- Total Customer Value (average of the last 5)
- Project revenue
- Project cost
- Discounted after sales revenue
- Discounted after sales cost
- Country
- Number of previous projects done for customer
- Number of previous projects done for other customers in the country
- The date customer initiated the project = A (estimate)
- Date when KONE's participation started = B
- Tender delivery date = C (the date when all the tenders have to be delivered)
- Participation before tender ($(C-B)/(C-A)$ In other words a number between 0 and 1 describing for what portion of the total running time of the project has KONE participated in it)
- Project designed for competitor (Sometimes projects are already specified so that the customer has a certain competitor in mind. A subjective estimate.)
- Difficult customer (1 if yes, 0 if no)
- Number of participants in tender phase (estimate)

4.3.4 Regression calculations

This page includes all the projects on the After-TenderProjects page as links, along with data that is suitable for the regression analysis. The following data is used:

The dependent variable:

- Project Status (Lost = 0 or Order = 1)

The independent variables, in other words the Probability determining variables:

- Target project
- Architect
- Builder
- Consultant
- Developer
- Tenant/Investor/QS Others
- Number of previous projects done for customer
- Number of previous projects done for other customers in the country
- Project designed for competitor
- Difficult customer
- Number of participants in tender phase
- Participation before tender

Based on this data the program makes a multiple linear regression analysis with confidence level 95%. The program uses Excel's Analysis Toolpak to do this. The regression analysis is done as an iterative process that leaves the variable with greatest p-value off as long as it is over 5 %. This way we will end up with statistically significant variables and their estimated coefficients. Then the program includes them in the model with the coefficients given by the regression. The coefficients of other variables are entered as 0. This data is used on the following pages of the program.

All the other variables except the numbers of previous projects are used directly in the linear regression. The number of previous projects done for customer and the number of

previous projects done for other customers in the country are used on a logarithmic scale. This means that all the values are first scaled with the following formula:

$$\text{Scaled number} = \text{Ln} [1 + \text{number of customers}]$$

This is due to the fact that we assume the marginal value of a new project with the customer to decrease with time – the first project brings the largest value when personal relations are established and common practices are formed. After this each project continues to strengthen the bond but does not bring as much new as the previous project did.

There is one short coming in this regression analysis, namely it does not take autocorrelation of variables into account. This may reduce the reliability of the results, but within the required Excel format it was not possible to take this into account while keeping the program easy to use.

4.3.5 Pre-tender and tender projects

This page includes all the running projects along with data that is needed in the calculations. Namely, for each project the following data is required:

General information:

- Project name
- Project Status (Pre-Tender or Tender)

Calculated by the program:

- Calculated forecast %
- Total Customer Value (based on other entered data)
- Country (based on project name, for example CHN 12)
- Participation before tender (based on other entered data)

Used in calculating the probability of winning the project:

- Subjective order forecast %

- Target project (1=yes, 0=no)
- Architect
- Builder
- Consultant
- Developer
- Tenant/Investor/QS Others
- Number of previous projects done for customer
- Number of previous projects done for other customers in the country
- The date customer initiated the project
- Date when KONE's participation started
- Tender delivery date
- Project designed for competitor
- Difficult customer
- Number of participants in tender phase

Used in valuation of the project

- Project revenue
- Project cost
- Discounted after sales revenue
- Discounted after sales cost
- Purchases of the customer / year
- Size of rest of the market in the country / year
- Customer's projects in which KONE participates in tender, %
- Rest of the market's projects in which KONE participates in tender, %
- Cost of participating in tender process

The program uses the data listed under “Used in calculating the probability of winning the project” to calculate an estimate for the probability of winning the project. Other than

this, data and this result is used when valuing the project and when prioritizing the projects.

4.3.6 Project valuation

A project's value is composed of two parts

- Direct monetary value
- Increase in the value of future business

Direct monetary value is calculated as follows:

$$\text{Direct monetary value} = [\text{Immediate revenue from the project} - \text{immediate cost of the project}] + [\text{After sales revenue from the project} - \text{after sales cost of the project}]$$

Here it is assumed that all the revenues and costs have been discounted properly to the current date.

Increase in the value of future business is calculated as follows:

Increase in value of future business =

Value of future business * Increase in probability of winning future projects =

Customer's purchases / year *

Percentage of projects whose tender Kone participates in *

Increase in probability of winning a project due to having one extra project done with the customer *

Average after sales revenue / average project revenue *

Average margin /

Yearly internal discount rate (This discounts the profit to eternity, yielding the total value of this operation)

+

Market's purchases / year *

Percentage of projects whose tender Kone participates in *

Increase in probability of winning a project due to having one extra project done with on the market *

Average after sales revenue / average project revenue *

Average margin /

Yearly internal discount rate (This discounts the profit to eternity, yielding the total value of this operation)

We have done an approximation here that yearly profits and cash flows are the same on the long run. Considering all the other potential sources of inaccuracy in this model, we believe this is definitely not the biggest source of error and thus it can be well used.

Having calculated the direct monetary value and the increase of value in future business, we can now add these up and multiply the result by the probability of winning the project, which yield the expected value of the project:

Expected value of a project =

Probability of winning it *

[Direct monetary value + Increase in value of future business]

Where

Probability of winning it =

Either

Users own subjective estimate

Or

Calculated estimate

This way we have ended up with two estimates of the expected value of the project. This data is further used when prioritizing the projects.

4.3.7 Prioritizing the projects

At this stage we have for each project two estimates of its expected value. We can now calculate a weighted average of these using the weights the user has specified:

Weighted average of the expected value =

w_1 * Value based on users own subjective estimate of the winning probability +

w_2 * Value based on the calculated estimate of the winning probability

Where w_1 and w_2 were entered as inputs on the user interface page.

We now have a single estimate of the value of the project. We then deduct from this the cost of participating in the tender of the project and are left with the total profit of the project.

Total profit = Expected total value - Cost of participating in tender process

We then divide these figures with the cost of participating in the tender process, which gives us the final figure on which the comparison is based:

$$\text{Final comparison figure} = \frac{\text{Total profit}}{\text{Cost of participating in tender process}}$$

4.3.8 Use of the program in practice and automation

We have now described how the program functions. In practice the functions are supported by macros, which make using the program a lot simpler and easier.

In practice the file is initialized by entering lost and won projects on the After-TenderProjects –page. After this only new projects have to be entered to start prioritization. Every time the file is used the user should follow these steps:

1. Enter new running projects on page Pre-TenderAndTenderProjects
2. Change the status of lost or won projects on the same page to either Lost or Order (won)
3. Run macro Update Data. This macro first moves the won/lost projects on page Pre-TenderAndTenderProjects to page After-TenderProjects. Then it does the regression analysis and updates all data accordingly.
4. Run Prioritize macro. This macro arranges the order of the projects on page ProjectsPrioritized according to the final comparison figure.

Everything else in the model functions automatically, the only thing the user needs to do is to enter new projects and update their statuses as described in phases 1 and 2 above.

5 Conclusions

The model described above is derived from business foundations perspective and is relying on the fact that actually the value of technical references, customer segmentation and strategic considerations boil down to either increased size of future business or increased probability of winning it. The monetary estimations for future size of the market and after sales may be difficult to estimate, but at the end of the day they can not be avoided if projects must be prioritized. The major advantage of this model is that the

weights are used only to estimate the probability of winning a project not directly to measure its attractiveness. In addition statistically insignificant factors are not taken into account, but if they become significant over time they will enter the model. This way the accuracy of estimates should improve as more historic data accrues. Thus using up-to-date data is important. The historic data should have explanatory power on winning probability if the conditions in the market have not changed substantially.

The possible risks of the model include that the explanatory power of the regression remains low indicating either biased data or missing variables. We were not provided with all required information to our model and can not thus assess the situation thoroughly. In addition the program requires values for all explanatory variables for working properly, which means that some of the values must be assessed subjectively in some cases. The risks of the project are not taken into account explicitly when prioritizing projects, but they can be considered as abandonment criteria that should be taken into account subjectively. In addition their effect can be modeled through the discount factor.

The model is intended to offer an objective estimate for the probability of winning a project to be used in line with subjective estimate. It does not take into account all factors, but considers the most obvious. As stated in the literature review the final decision is made by managerial judgment, but this model is intended to provide objective data to support decision-making.

6 References

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