Project Assessment:

A Search for Root Causes

"All truths are easy to understand once they are discovered;

The point is to discover them."

- Galileo Galilei (1564 – 1642)

Master Thesis Assignment
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Project Assessment:

A Search for Root Causes

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Management Summary

Many organisations use projects to attain specific IT related goals. Unfortunately, there are no guarantees for project success and many projects have difficulties attaining project success. This master thesis will assess one such IT project, the Configuration Calculator project.

The thesis objective is to identify and assess the (potential) problems at the Configuration Calculator project by gaining a deeper understanding of the background of these problems to be able to predict, detect and decrease these kinds of problems in similar projects.

To be able to measure project success and the progress towards that success, two models have been created; one is aimed towards a technical point of view and one aimed towards an organisational point of view. Besides the two models a list of success criteria (that can be mapped to the models) has been created to check against a project.

The Configuration Calculator project has been assessed using the project success criteria and the two models and it failed to satisfy most of the criteria. After further analysis of the problems using the root cause analysis methodology, four main problems have been identified that are major contributors to the problematic situation the project was in. The main problems were: the ever-present unrealistic time pressure, the continued change in sponsor expectations, the start of development before the analysis could deliver (some) committed requirements, and the overall underestimation of the complexity of the project.

A number of recommendations can be made to the Configuration Calculator project and are valuable for most other project as well. Important is to work towards a realistic and defendable project plan throughout the project and keep the key stakeholders united. Define a set of committed requirements to begin working with and carefully manage all changes to that set by conducting an impact analysis of these changes and by keeping the schedule, scope and budget of the project in alignment.

Preface

This thesis describes the results of an assignment performed in the final stage of my Business Information Technology study.

I would like to thank my colleagues for their time, support and feedback during my assignment. Furthermore I would like to thank Gerben Blaauw and Rob van de Weg for their continued patience and feedback as mentors and supervisors from the Twente University. Also, I would like to thank my parents for their trust in me and their enthusiasm about my work.

Eemnes, The Netherlands, Augustus 2007

Fabian Scherpenzeel

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Section 1: Introduction

"Thought has been the father of every advance since time began."
By: Thomas J. Watson, Sr. - Founder of IBM

There have been numerous failed IT-projects in history, from the early days of software engineering [BRO79] and a decade ago [STG94], till the present day where many organisations still fail to successfully deliver their IT projects [LAN06], [ZAR03, p1], [TOE07].

The subject of this thesis is a software development project at ISU (InterSoft United) called the Configuration Calculator project. A project with difficulties facing a fast-changing environment in a time where pressure is high and time is money.

My assignment when I first talked with people at ISU was to analyse the Configuration Calculator project and to give some pointers to improve the chances to deliver a successful project. Much time was spent identifying and analysing the problems and their relations before the causes began to surface. When I finished my research at ISU, the project was already frozen. I still provided them with some recommendations on the project, since they were general enough to be usable in similar projects.

The research for this project is mainly focussed on the practical environment at ISU, which is expressed in the document by the tight integration of the Configuration Calculator case. The research was intended to support ISU in turning the Configuration Calculator (and likewise troubled projects) for the better. Also, the findings can be used to avoid or guard against troubles encountered at the Configuration Calculator case. The master thesis research will consist mainly of analysis of the current problematic situation and of a diagnostic view on those problems and their relations.

In this chapter the Configuration Calculator project case shall be introduced and a reading guide shall be presented that describes the structure of the document.

1.1 The Thesis Subject: the Configuration Calculator Project

The Configuration Calculator project is an internal ISU software development project that is plagued by problems. Symptoms of those problems at the project include: running out of budget and passing target dates, without being able to deliver satisfactory results for the internal customer. The project started in June 2005 and has been stopped in March 2006.

The Configuration Calculator project is a project to develop a web-based application to support marketing and sales processes. A Configurator is a tool that provides an easy way for its users to come up with standardized solutions for their customer's needs. It enables the users to calculate and manipulate different configurations of products and services based on the needs of the customer.

The SpreadSheet Calculator project envelops mainly the maintenance (and some enhancing) of a Lotus 1-2-3 spreadsheet-based application and is meant to be fully replaced by the Configuration Calculator tool once it has equal functionality. For further information on the SpreadSheet Calculator project and the Packaged Offerings Calculator project, please read Appendix A.

The Configuration Calculator project has some specific properties:

- It is essentially a re-engineering project of the SpreadSheet Calculator
- International project spanning two continents
- There are two major project sponsors
- The SpreadSheet Calculator is the collection of functional requirements
- There is very limited knowledge about the SpreadSheet Calculator

1.2 Reading Guide

This reading guide contains an overview of the thesis document structure. It will describe the content of the main sections in the document.

In section 2, the master thesis objective is laid out and the problem definition is given and its boundaries are defined. The thesis research approach is described and the central questions are defined.

In section 3, the main theoretic topics are discussed and the criteria to identify a successful project are abstracted from these discussed topics. The criteria will be integrated into two models, one from an organisational and one from a technical point of view. Finally, section 3 contains a discussion of a problem analysis technique.

In section 4 the Configuration Calculator case is discussed, analysed and assessed by using the criteria and the models generated from section 3. Also the problem analysis technique will be put into use to get an overview of the problems and how they are interrelated.

Section 5 is the discussion session where interesting findings in the case and the process, as well as interesting subjects that were touched by the research but not within its scope are discussed as well.

Section 6 begins with a summary of the previous sections and contains the conclusions and recommendations of the master thesis.

Section 2: Problem Definition

"A definition is the start of an argument, not the end of one."
By: Neil Portman (1931-2003)

In the problem definition chapter, the objective of the thesis shall be defined and the research area shall be demarcated. The structure of the research is then described in the research approach after which the central thesis question shall be introduced. Following the central thesis questions, some core definitions of often used words or phrases shall be summarized.

2.1 Thesis Objective

To understand the problems that plague the Configuration Calculator project, it is important to systematically analyse the Configuration Calculator project and its environment. The results of this analysis should lead to a better understanding of the problems of the Configuration Calculator project. When there is a clear picture of identified problems, recommendations for ISU can be made to decrease the problems plaguing the Configuration Calculator project. The thesis objective can be summarised as in Table 1.

The objective of the thesis is to identify and assess potential problems at the Configuration Calculator project by gaining a deeper understanding of the background and origins of these problems to be able to predict, detect and decrease these kinds of problems in similar projects.

Table 1: Thesis Objective

The objective of the research is considered completed and successful when:

- A list of criteria is made to analyse the project.
- A thorough analysis of the project is conducted.
- A detailed overview of the project problems can be presented.
- A detailed overview of their relations and origins can be created.
- A list of recommendations is made to decrease the problems causes.

2.2 Demarcation

The subject of this practical research is the Configuration Calculator project at ISU; a project that shows several symptoms of being a problematic project. The thesis will aim to detect and describe the (possible) problems at the Configuration Calculator project and to provide insight in the origins and relations of the detected problems.

The aim of detecting and describing (possible) problems of a practical situation can be identified with problem detection research as described by Verschuren. The main goal of this type of research is to answer the following questions for each fact that is considered a possible problem:

1. Is the fact actually a problem?
2. What is the problem?
3. Why is it a problem?

Also, it is important to make a clear distinction between the factual situation and the desired situation [VER00, p39].

The second part of the research can be identified as diagnostic research, which focuses on getting a clear overview of the backgrounds of the identified problems and their relations [VER00, p40].

Since the subject of this thesis is a software development project in an IT environment and my background is in IT for businesses, the research is focussed on software engineering and project management problems.

To be able to thoroughly conduct the research, theory about identifying, analysing and describing problems in general is also needed, as well as theory to identify and structure relations between the found problems.

2.3 Research Approach

This paragraph will describe the approach of my research illustrated in Figure 1. The research will start with an analysis of information technology (IT) and organisation literature about requirement engineering, and stakeholder and project management (focussed on software development projects) will produce an overview with criteria to analyse a software development project.

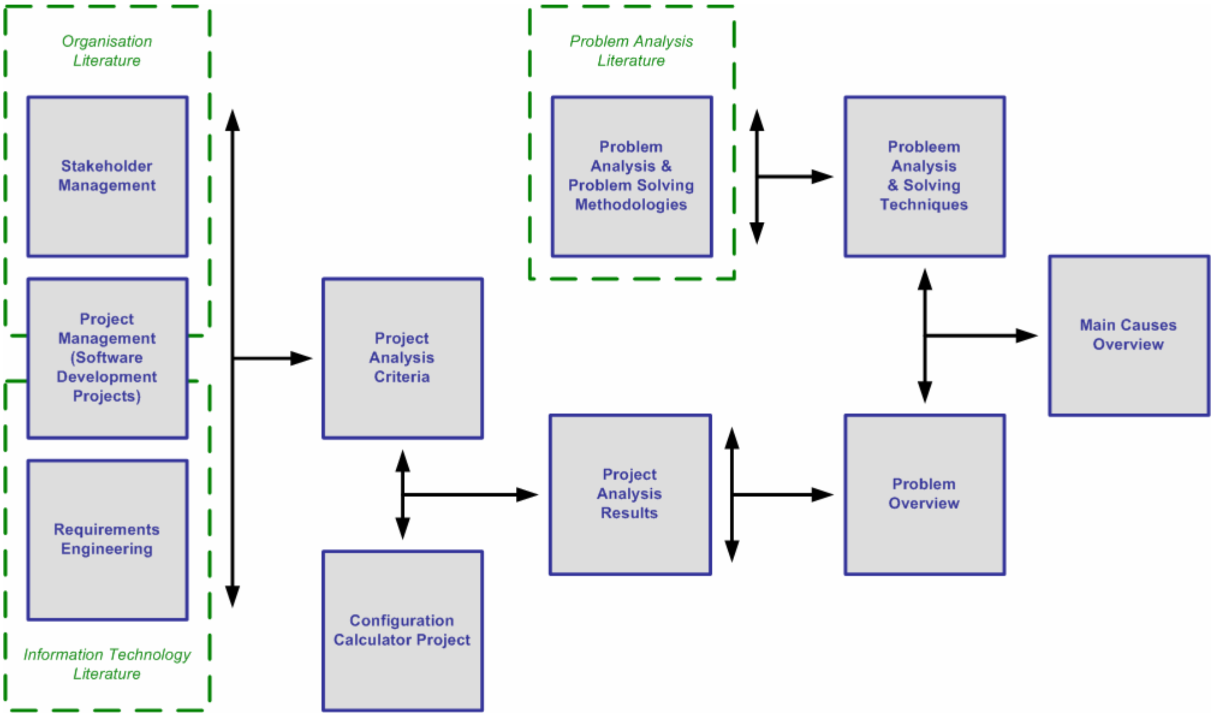


Figure 1: Research Approach Visualisation

Using this overview with criteria, it is possible to map the problems of the Configuration Calculator project in its current situation. The mapped problems will be limited to problems concerning stakeholder management, project management and requirements engineering. Problems with a significant impact that are not mapped because of the thesis demarcation will be discussed in the thesis reflection/discussion.

The mapped problems will form the foundation of a thorough analysis into the relationships between the mapped problems and their (common) settings.

Based on the obtained insight in the relations between the mapped problems it is possible to determine the main causes that led to the problematic situation using literature that covers this topic.

Based on the determined main causes, it is possible to make some brief and general recommendations.

2.4 Central Thesis Questions

The central questions of the master thesis are based on the master thesis objective, and when answered properly they should provide the answers needed to meet the objective.

From the research model, five central thesis questions were extracted:

1. Which criteria are needed to carefully assess the functioning of a software development project?
    a. Which criteria can be borrowed from theories describing effective project management?
    b. Which criteria can be derived from literature concerning stakeholder management?
    c. Which criteria can be extracted from theories concerning requirements engineering?
    d. Which criteria can be selected or deduced as a result of confronting the criteria from sub questions one to three.

2. How will the analysed project be judged in the light of the formulated criteria?
    a. Which project management methodologies are used in managing the project?
    b. Which stakeholders are involved at the project and which roles do they occupy?
    c. In which way are the requirements formulated and managed at the project?

3. What insight does the analysis of the project presents us, focussed on identifying possible potential problems at the project?
    a. On which criteria does the project score poorly?
    b. How do the stakeholders think about the project?
    c. Where do the stakeholders think the problems lie?
    d. Which problem areas can be distinguished at the project?

4. Which method is best suited to analyse the found problems and aims to identify the (hidden) main causes of the majority of these problems?
    a. Which methods are available that can guide its user from a field of problems to a select set of main causes?
    b. What method is best suited for identifying the set of main causes at this specific research?

5. Using the selected method, which main causes can be discerned that have a profound impact on (the majority of) problems at the project?
    a. How do the different problems relate to and influence each other?
    b. What problems or causes can be distinguished that severely contribute to the existence or/and growth of other problems?
    c. Which conclusions can be drawn based on the found main causes?

2.5 Core Definitions

Software Development Project

In this thesis a software development project is a project where the main target is to develop a piece of software.

Successful Project

In this thesis a project is successful when all planned product(s) meet their planned specifications while being delivered on schedule and within budget.

Problematic Project

In this thesis a project is problematic if it is not successful.

Problem

In this thesis a problem is defined as an undesirable situation that has a negative impact on the project planning (specification, schedule or budget).

Cause

In this thesis a (main) cause is either a root cause or a problem that severely impacts other problems more then it is impacted by other problems.

Section 3: Managing a software engineering project

"In theory there is no difference between theory and practice.
In practice there is."
By: Yogi Berra (1925) - Famous Baseball Player

In this section the first central question shall be answered; the section shall conclude with a list of criteria needed to assess a software development project and its functioning. The criteria shall be based on project management, stakeholder management and requirements engineering literature. Since the criteria should ultimately be usable in the future for likewise projects, it is important to determine what type of project it is in terms of the literature stated above. All criteria defined are in the following form: "A project is most likely successful if …"

3.1 Project Management Criteria

The reason for creating a set of criteria is not only to establish exactly in which areas the Configuration Calculator project does not perform as needed, but also to establish if the Configuration Calculator project is a problematic project at all.

What is a project?

The main subject of the thesis research is a project, making it a very important element that needs to be accurately described. In many references a project definition is presented, but each definition is different [WRS90, pp30-32] [KOR98, p23] [ISO 10006] [NEW98, p266] [ROS84, p301] [DAV87, p223] [SLA01]. In most of these definitions, the following three elements come forward.

- **Temporary**; the project has a distinct (planned) begin and end date before the undertaking even starts.
- **Unique**; each project is different in some distinguishing way from similar projects, whether in specified result and/or in environment.
- **Specified result**; the (set of) products or services that form the project result are specified beforehand.

In this thesis a slightly adapted project definition of the Project Management Institute [PMI00, p204] shall be used since it is compact and encloses three elements specified above. In this thesis a project is a temporary endeavour undertaken to create a unique result within a specified scope.

To identify projects like the Configuration Calculator project, it is important to identify some key project attributes, especially since each project is unique by definition. In the scope of this thesis the generic project context, the project being an Information Technology (IT) project, is already defined. Other project attributes are the project organisation, (software development) methodology, customer, people, project size, product or service complexity, and project environment [PRE00, pp54-56] [PMI96, pp 4, 17, 24] [BRO79, pp 98, 108].

Project Successfulness

In this thesis, a problematic project was defined as a non-successful project, thus it can be measured by the success factors of a successful project. The most logical way of measuring project success is by evaluating the project results against the specified results that form the basis of the project, thus:

> *“...the goal of the project is carefully specified.”*

This makes it possible not only to evaluate and validate the project end result, but will also help keeping all stakeholders focussed on the end result. There are various ways to identify these project goals, called elicitation techniques, each having its own strengths and limitations. Some techniques are able to produce better work products then others and some are specialised to produce specific products, and yet other techniques are more general [LAU02, p338].

The basic measurement of project successfulness in project management is by checking the triple constraints [ROS84, pp 11, 302] [STG94, p1]. The triple constraints of project management are: resources, time and scope as pictured in Figure 2.

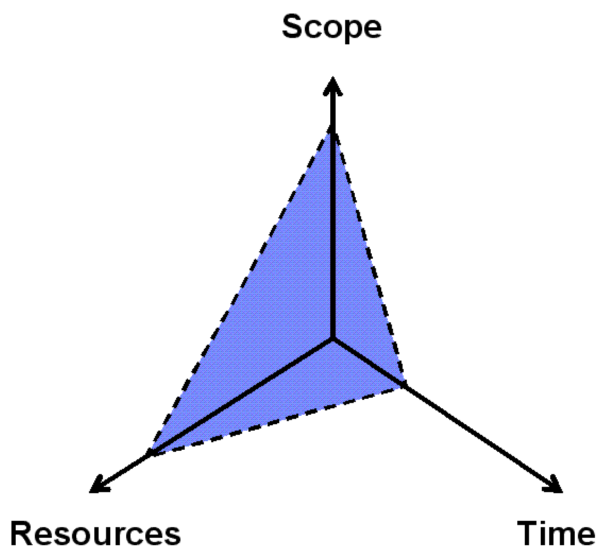


Figure 2: Triple Constraint

Constraints	Real	Planning
Resources	Costs	Budget
Time	Duration	Schedule
Scope	Performance	Specification

Table 2: Constraint Naming

When a project is completed on-time and on-budget, with all features and functions implemented as initially specified, it is considered a project success [STG94, p1]. Thus, the planned resources, time and scope can be checked against reality. The following mechanics (see Table 3) can be used to determine how successful a project is (in a triple constraint point of view):

• Efficient use of resources:	Costs	=<	Budget
• Efficient use of time:	Duration	=<	Schedule
• Quality of product:	Performance	>=	Specification

Table 3: Triple Constraint Mechanics

If all the above mechanics prove to be true to a project, then the project satisfies the triple constraints and is therefore considered successful in project management. Thus, criteria based on the triple constraints can be defined:

"...it satisfies the triple constraints at a given moment in time."

To be able to satisfy the triple constraint at a given moment in time, a careful planning of these constraints must be made, the project planning. The project planning must be carefully planned and structured [DAV87, p224] and preferably fragmented, with specified deliverables for each period to assess project progress [PAR95, p58] [HUL05, p158].

"...it is carefully planned and structured while staying realistic."

The realistic component in the criteria above is added because a project must have a real chance to succeed. Making an entire information system in a day is not realistic, no matter how many resources are available [BRO79].

3.2 Stakeholder Management Criteria

A project is run by, for and with people, each having its own stakes, responsibilities and rights. This paragraph will discuss stakeholder management, first defining what stakeholders are, and then searching for criteria concerning stakeholder literature to assess a project.

What is a stakeholder?

Stakeholders can be defined as any group or individual who can affect or is affected by the achievement of the firm's objectives [FRE84, p46] when looked from a business management angle. So, from a project management angle, project stakeholders are those who can affect or are affected by the achievement of the project's objectives. Since stakeholders are involved in some way or another in the project and/or its achievement [PAR95, p27], it is imperative that they are known to the project manager. Stakeholders need to be identified and analysed to get a clear picture of the desired project objectives.

Project Successfulness

In many literature concerning stakeholders it becomes quite clear that besides trying to manage the triple constraints, another important facet of a successful project is the satisfaction of the customer [BEN95, p4]. But it cannot be denied that the users play an, at least, as important role, mainly after the project is implemented. Since the role of customers, users and other stakeholders and their impacts can differ in various projects, it might be better to use broader criteria.

Since many theories identify that the involvement and/or participation of key stakeholders increases the chance for a project to succeed [HUM90, p429-430] [STG94, p2], a more generic criteria shall be used.

> *"...its most salient stakeholders are satisfied."*

Using Mitchell et al their stakeholder typology model (see Figure 3), it is possible to analyse stakeholders to identify if they have low, moderate or high salience [MIT97, p874], thus distinguishing the most salient stakeholders.

Mitchell et al defines salience as the degree to which managers give priority to competing stakeholder claims [MIT97, p869] and is translatable as 'what really counts' [MIT97, p873]. The analysis of the stakeholders does not only give a clearer picture of the stakeholders' objectives, but can also enrich problem structuring [ELI01, p1] and be used to monitor estimated benefits of the project [PAR95, p42].

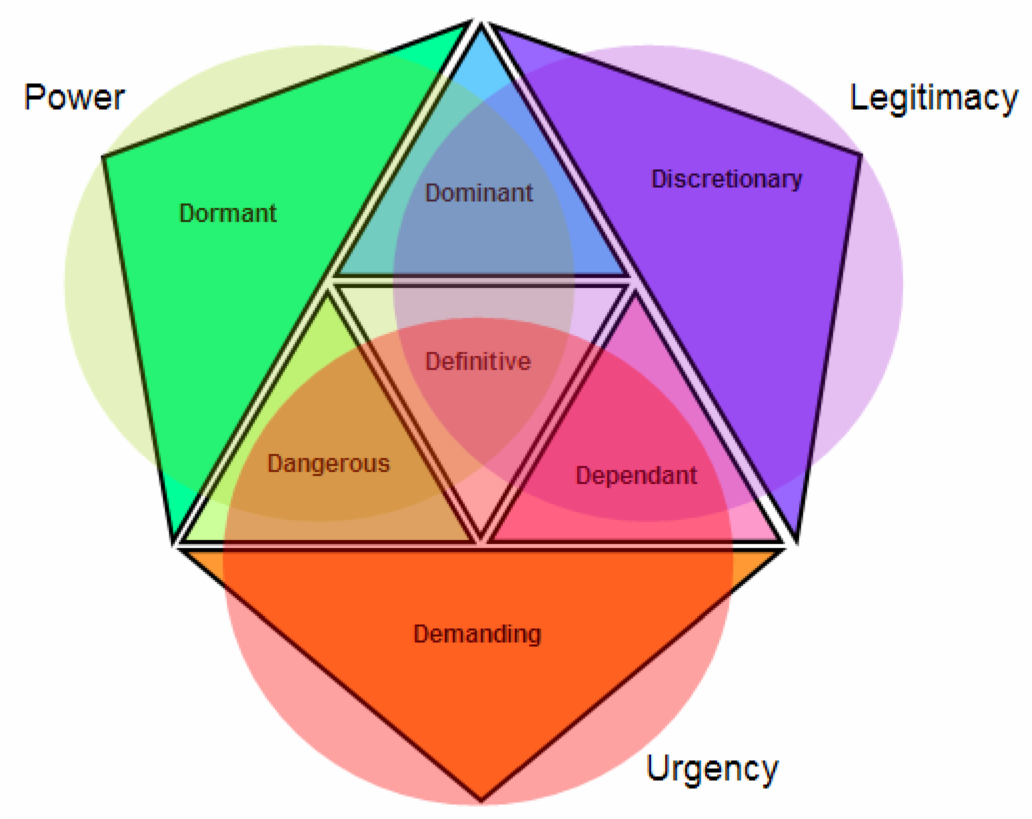


Figure 3: Stakeholder Typology [MIT97, p874]

Although participation and involvement of a project's (most salient) stakeholders will definitely work towards a successful project, real commitment of the most salient stakeholders (especially from higher layers of management) can really pull a project through [ZAR03, p11]. The difference between involvement and real commitment is made clear by the following humorous statement [BEN95, p48]: "In ham and eggs, the hen was involved, but the pig was committed!"

In project management methods the impact of a selected group of committed and salient stakeholders is not only recognized but embedded in core project processes such as steering groups/project boards [WRS90, p121] [PRI07].

> *"...a selected group of salient stakeholders is committed to the success of the project."*

Thus the above criteria can also be added to assess if a project is most likely to be successful. More information about stakeholder analysis can be found in Appendix B.

3.3 Requirements Engineering Criteria

In this paragraph requirement engineering shall be defined followed by the distinguishing of criteria for project successfulness shall be discussed based on requirement engineering literature.

What is requirement engineering?

Requirements engineering is defined by Zave (1997) as follows: 'Requirement engineering is the branch of software engineering concerned with the real-world goals for, functions of, and constraints on software systems. It is also concerned with the relationship of these factors to precise specifications of software behaviour, and to their evolution over time across software families' [NUS06, p1]. Lauesen (2002) distinguishes four different level of requirements, each focussed on a more detail level of the project; goal-level, domain-level, product-level and design-level requirements (see Table 4) [LAU02, p20].

Requirements	**Description**
Goal-level	These describe the reason for the product.
Domain-level	These describe the activities outside the product.
Product-level	These describe the in and output of the system.
Design-level	These describe the product interfaces.

Table 4: Requirement Levels

It is important to note that using only product-level requirements to formulate a requirement specification, as unfortunately is the case in most requirements specifications, is rarely a good idea and is often a source of problems [LAU02, p27].

Project Successfulness

A precise definition of stakeholder expectations into project deliverables is a very difficult task [LAU99, p10], but it is also considered a critical process [DAV87, p130] since it not only serves as a blueprint for developing the project results but also as validation of stakeholder expectations [BEN95, p15]. When performed poorly, it is very difficult to determine if the delivered project results have been successful or not [SWE04, p34]. Thus the following criteria for project successfulness can be added:

> *"...stakeholder needs and expectations are carefully defined in clear unambiguous requirements."*

Since project environments are known for their unstable nature and their effects many times lead to changes in needs and expectations of stakeholders, it is imperative that changes in requirements are managed very carefully. Managing these changing scope requirements is therefore a very important part of managing a project [ZAR03, p7].

> *"...changes in requirements are carefully estimated, prioritized and managed."*

The above criteria for project successfulness can be added, since it is known that one of the hardest project management tasks is carefully managing requests in scope [HUL05, p156]. Looking at Lauesen's different requirement levels, it is possible to formulate another criteria:

> *"...besides the product, requirements also specify project success and domain activities"*

3.4 Project Assessment Criteria

In this paragraph the criteria that have been established in this section are summarized and confronted with each other.

Summary

A project is most likely successful if…

- …the goal of the project is carefully specified;
- …it satisfies the triple constraints at a given moment in time;
- …it is carefully planned and structured while staying realistic;
- …its most salient stakeholders are satisfied;
- …a selected group of salient stakeholders is committed to the success of the project;

- …stakeholder needs and expectations are carefully defined in clear unambiguous requirements;
- …changes in requirements are carefully estimated and managed.
- …besides the product, requirements also specify project success and domain activities.

Confrontation

When analysing the criteria in the summary it becomes immediately clear that many criteria already are tightly interwoven. Satisfying the scope constraint for instance, is impossible if stakeholder needs and expectations are unknown, and the need to define them for development reference and validation is also imperative. The following list of criteria is the result of the confrontation of criteria and theories discussed in this section.

A project is most likely successful if…

- …the goal of the project must be specified to enable project result evaluation;
  - Keeping the goal of the project clear at all times.
  - Enables validation of project results.
- …it satisfies the triple constraints at a given moment in time;
  - Keeping the project progress along the project planning.
  - The triple constraints are balanced.
- …it is carefully planned and structure while staying realistic;
  - There is a valid business case for the project.
  - The planning represents a reflection of future progress.
- …its most salient stakeholders are satisfied;
  - The project stakeholders are identified, analysed and managed.
  - The project results meet stakeholder expectations and needs.
- …a selected group of salient stakeholders is committed to the success of the project;
  - Salient stakeholders carry responsibility for success and failure.
  - Salient stakeholders assess the project progress at regular intervals.
- …stakeholder needs and expectations are carefully defined in clear unambiguous requirements;
  - Requirements are a reflection of stakeholder needs and expectations.
  - Requirements are clear, unambiguous and understandable for all stakeholders.

- …changes in requirements are carefully estimated and managed.
  - Each change in requirements has a valid business case and the impact on the project is carefully estimated.
  - Changes in requirements are followed by a change in the triple constraints.
- …besides the product, requirements also specify project success and domain activities
  - Both tangible factors (costs & benefits) and non-tangible factors are accounted for in the goal-level requirements.
  - Domain activities and processes can be managed to support the product in delivering project success.

3.5 Problem Analysis Techniques

When problematic areas are discovered, by using the defined criteria in the previous paragraph, it is not just these problems that have to be tackled, but rather the (common) causes of these problems. Root cause analysis (RCA) is an approach to study and evaluate problems, and involves detailed investigation into why the problems were introduced and how to prevent similar errors in the future [ATT90, p69].

A cause is a condition or an event that results in an effect [DOE92, p3]. A root cause is thus an underlying reason for the occurrence of one or more problematic effect(s). Rather then a definition of a root cause Rooney and Vanden Heuvel define the properties of a root cause rather then trying to exactly define root cause. They state [ROO04, p46]:

- Root causes are specific underlying causes.
- Root causes are those that can reasonably be identified.
- Root causes are those management has control to fix.
- Root causes are those for which effective recommendations for preventing recurrences can be generated.

There are different modelling techniques that can be used in a root cause analysis. They basically all stem from Kaoru Ishikawa’s Cause-and-Effect diagram (better known as fishbone diagram) [WIK01]. The most well-known RCA modelling techniques are the Cause-and-Effect Diagram, the Current Reality Tree Diagram and the Interrelationship Diagram. In Appendix C the different RCA modelling techniques are critically discussed and compared in the light of the case.

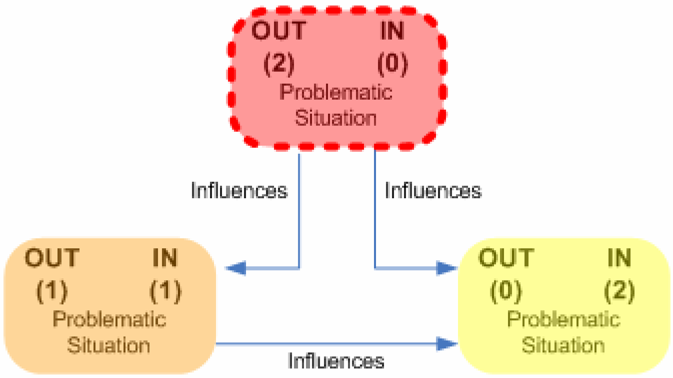


Figure 4: Interrelationship Diagram

In summary, there is no one best tool for root cause analysis [DOG04, p7-8]. There are several differences between the different methods that make one or the other better in specific situations. The interrelationship diagram (ID) modelling technique (see Figure 4) will be used in this thesis because it is possible to pin down (several) important root causes without having to go through a steep learning curve. For more details on the other modelling techniques, please read Appendix C.

The Interrelationship Diagram (ID) is a tool used for identifying root causes of problems that can be complex and multivariable, and require non-linearly thinking [DOG05, p37]. Constructing an ID is not very complex, as it only consists of (potential) problems and arrows that indicates a relationship between two (potential) problems and points from the cause to the effect [DOG05, p37].

Step 1:	Collect information from a variety of sources.
Step 2:	Use concise phrases or sentences as opposed to isolated words.
Step 3:	Draw diagrams only after group consensus is reached.
Step 4:	Rewrite diagrams several times to identify and separate critical items.
Step 5:	Do no be distracted by intermediate factors that do not directly influence the root causes.

Table 5: Mizuno's Steps for ID Creation [DOG05, p38]

An example of a simple ID is shown below in Figure 5. Each arrow that comes from a (potential) problem increases its OUT by 1 and each arrow that goes towards (potential) problems increases its IN by one. In this example the lack of warehouse input procedures is the root cause since this is the problem that influences the most other (potential) problems.

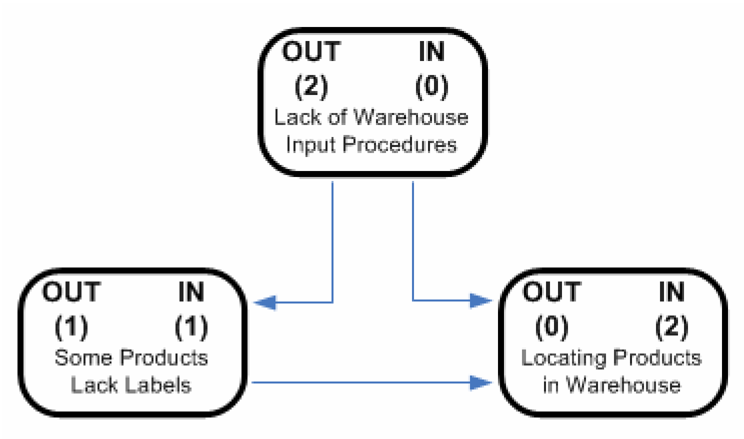


Figure 5: Example ID (Based on [BOG04, p8])

3.6 Theory conclusions

In this theory chapter, I have established a link between four main factors that define project success from an organisational point of view. These four factors are:

- Stakeholder Management & Commitment
- Cost, Time and Scope Management
- Planning & Tracking Progress
- Change & Requirement Management

These factors are all related and influence each other. In the figure below (Figure 6), an attempt is made to visualise the main factors, each having one assessment criteria from the earlier paragraphs in this chapter.

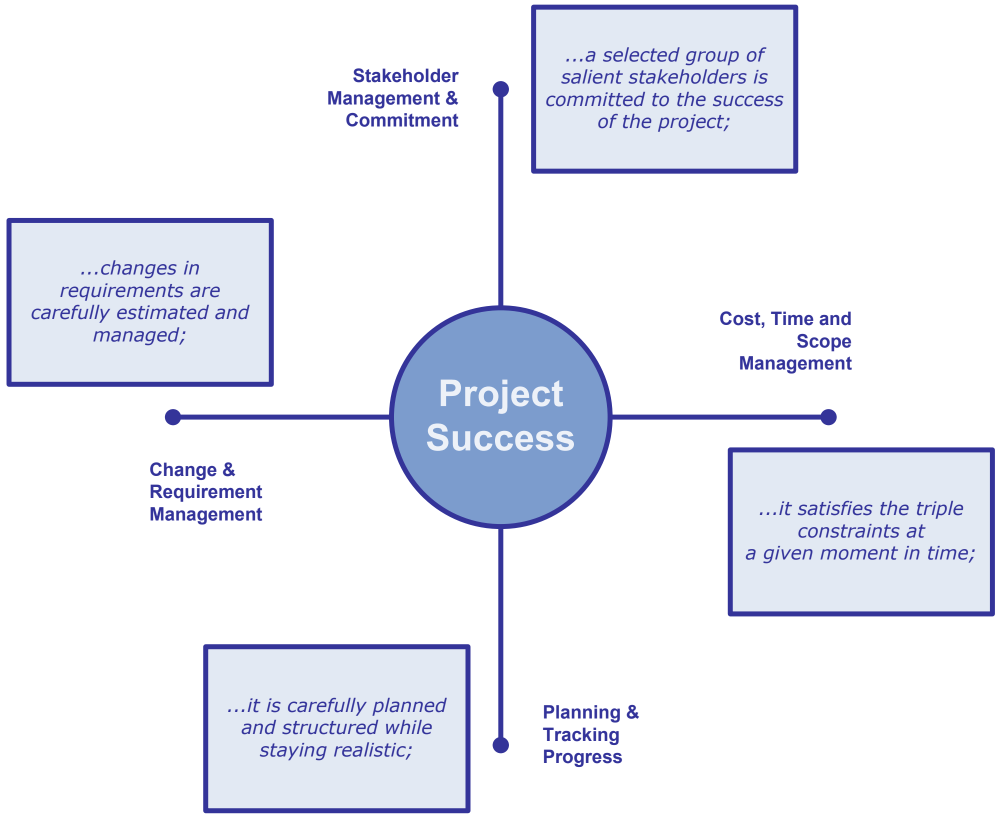


Figure 6: Project Success Model

Besides the organisational point of view, I have also looked from a more technical point of view, in which the other four assessment criteria have their place. For this technical point of view, I have used the essence of the Z-model [ISG06, p5] in two different ways, first to understand the optional relations between the business and (supporting) system, and between (their) goals and solutions (see Figure 7).

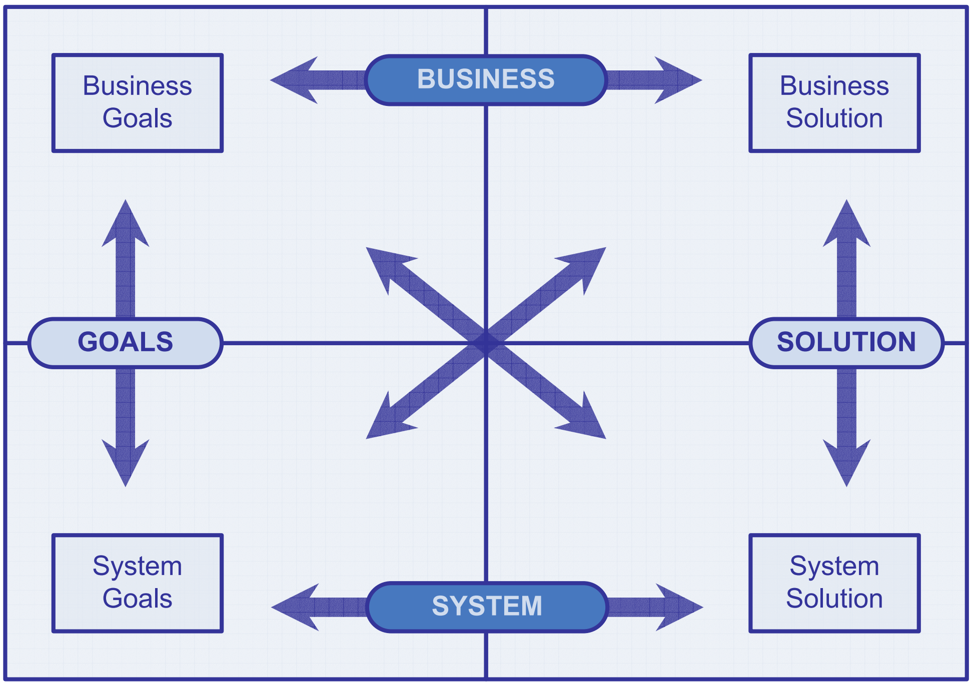


Figure 7: The Z model relations (Without the characteristic Z)

The characteristic Z-shaped path through this model, which represents the ideal requirement analysis process, is represented in the model below where the quadrants (and their dimensions) are removed for better overview. Besides the Z-shaped path (covering arrows 2, 3 and 4) there is also a project trigger (arrow 1) in the Z-model (see Figure 8). However, I have added another step (arrow 5) to the process and added the two missing relations (relations 6 and 7) from the previous model (Figure 7).

The extra step from system (or software) solution to the business goals is the feedback step that defines the project success. Because the ultimate target of the system solution is to support the business goals. It is sometimes difficult to directly measure the influence from the system solution on the business goals, but this can also be done by traversing the z-path in reverse. The added relations (arrows 6 and 7) can be used to align (and to check the alignment of) the business and system goals and their solutions.

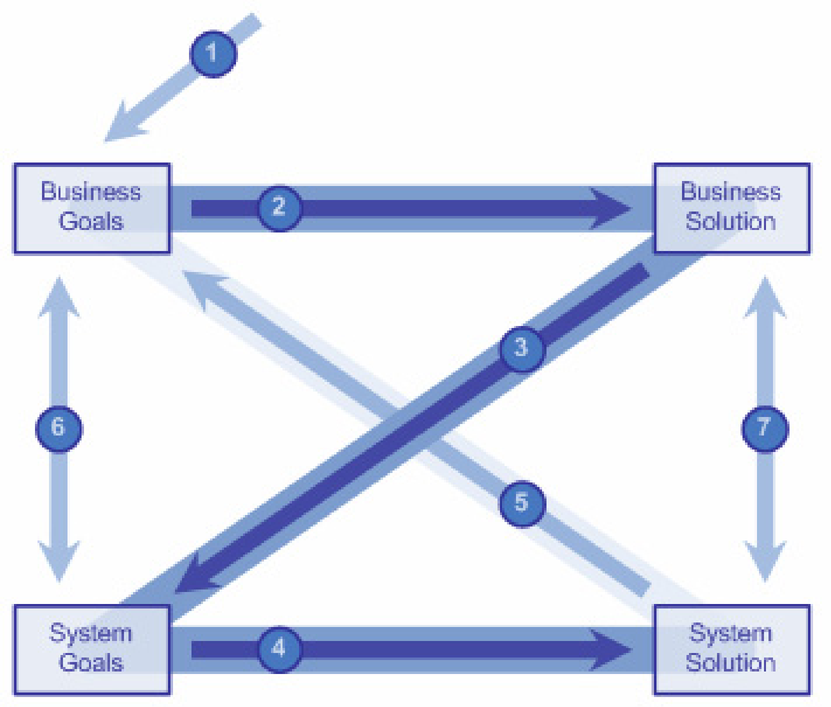


Figure 8: The Z model (Including the characteristic Z-shaped path)

The assessment criteria, discussed in the previous paragraphs in this chapter that have not been covered in the organisational point of view, can be mapped to the steps in the process illustrated by the Z-path (see Figure 9).

Figure 9: Assessment Criteria fitting the Z-path

In the remainder of the thesis, the organisational point of view (Figure 6) and the technical point of view (Figure 8) shall be used to illustrate the analysis coverage of the Configuration Calculator case.

Section 4: Case Project Assessed

"Usually, [...], the disaster is due to termites, not tornadoes; and the schedule has slipped imperceptibly but inexorably."
By: F.P. Brooks – The Mythical Man-month [BRO79, p154]

This case study will begin with a introduction to the Configuration Calculator project and will proceed with an analysis based on the project success criteria from section 3. In the assessment the project success criteria will be directly confronted with the analysis results. The case assessment is followed by the results of a survey held with the aim to uncover new problems and to validate the results of the assessment.

Together, the assessment and the survey present enough problematic situations for a root cause analysis to be conducted. Finally, the outcome of the root cause analysis will be described.

4.1 Introduction

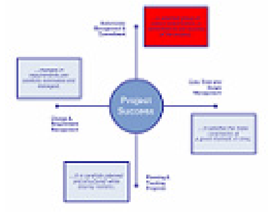
The Configuration Calculator project is a software development project that effectively concerned reengineering the SpreadSheet Calculator spreadsheet to a central web based Configuration Calculator tool (See Appendix A for more detailed case information). The project was started in June 2005, and was stopped in March 2006 after nine months of hard work and involvement from all parties. In March 2006, the tool that has been built is a solid working, but basic and empty (without content), Configuration Calculator.

"If you do not change direction, you may end up where you are heading."
- Lao Tzu

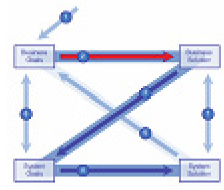
ISU Nederland wants to know what caused the problems on the Configuration Calculator project, and what could have been done to prevent this.

4.2 Case Analysis

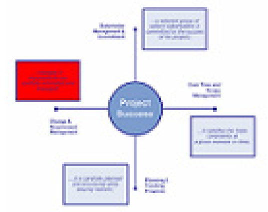
The Configuration Calculator project was a project started in relative haste with the aim to quickly develop a web-based tool to replace the SpreadSheet Calculator. A careful analysis of the costs and benefits (tangible or intangible) was never done and a real business case was never present.



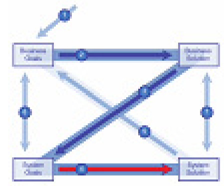
"Without this information [project objectives and scope], it is impossible to define reasonable (and accurate) estimates of the costs; an effective assessment of risk; a realistic breakdown of project tasks, or a manageable project schedule that provides a meaningful indication of progress."
- R. S. Pressman [PRE00, p55]



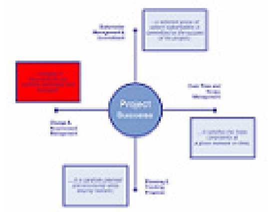
The Configuration Calculator project management was based on Rapid Application Development and was time-boxed. The Configuration Calculator project is in-house development.



"Traditionally, these [in-house] projects are carried out without specified requirements, and many projects end in disaster."
- S. Lauesen [LAU02, p8]

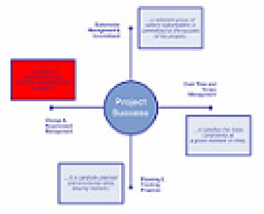


They aimed for a quick delivery of a working product in a fixed scope and fixed timeframe. The product goal was to replace the SpreadSheet Calculator with a decentralised web based variant.

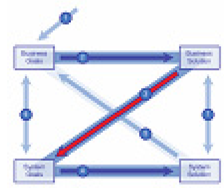


"RAD requires developers and customers who are committed to the rapid-fire activities necessary to get a system complete in a much abbreviated time frame. If commitment is lacking from either constituency, the RAD project will fail."
- R. S. Pressman [PRE00, p33]

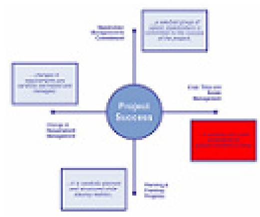
From the beginning of the project, it was obvious the timeframe was very short and it would be very hard to do a thorough analysis and develop the whole application. Since the Configuration Calculator was basically the SpreadSheet Calculator in another technology, the analysis was done rather rapidly to have enough time to develop the application itself.



"You have to make sure that original expectations are not allowed to exceed what is possible for a project performing at a reasonable and accepted standard performance."
- T. Demarco [DEM82, p5]

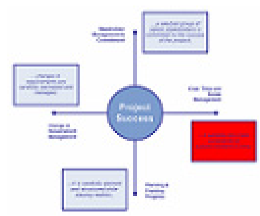


As time passed it became obvious that the development time was way more then initially planned for and the project management shifted to a more sequential character. Also, there was still quite a lot of disagreement among the different stakeholders what the requirements were exactly.

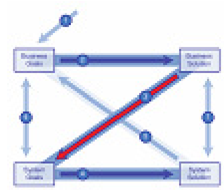


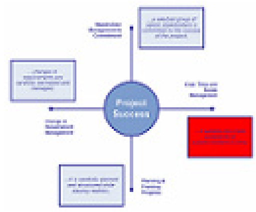
"If different customers/users cannot agree on requirements, risk of failure is very high. Proceed with extreme caution."
- R. S. Pressman [PRE00, p254]

Thus, the project failed to satisfy the triple constraint shortly after its start and never got back up. In the beginning of the project, the triple constraints were not balanced with a very short time cycle and a rather large (and unexplored) scope.

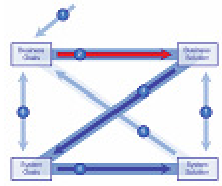


"If you don't know where you are going, every road will get you nowhere."
- Henry A. Kissinger (American ex-President)

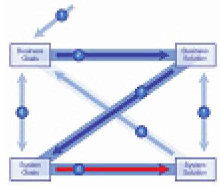




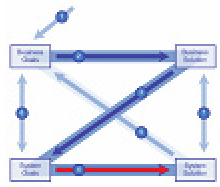
When the first target (the short development cycle) was missed, there was no real concrete updated project plan. Also, even though the lack of analysis now became clearer, most of the effort was put into developing the product instead of prioritising the lack of clear and unambiguous requirement set.



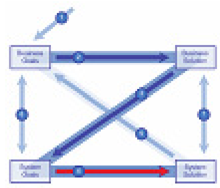
Besides having a loose set of product requirements, domain-level requirements and goal-level requirements were even more difficult to find specified.



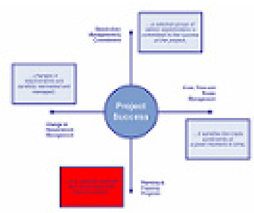
"You can't control what you can't measure."
- T. Demarco [DEM82, p3]



As the development continued, more and more hidden requirements for the Configuration Calculator were found in its predecessor, the SpreadSheet Calculator. And they were more complex than anyone had ever imagined and required a lot of extra analysis and development time.

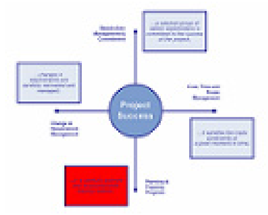


"Defining a product is crucial; many failures concern exactly those aspects that were never specified."
- F.P. Brooks, Jr. [BRO79, p142]

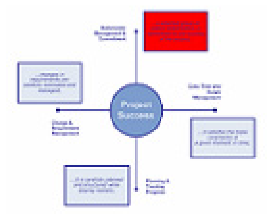


In the course of the Configuration Calculator project, the stakeholders' expectations have changed considerably. Many of these changes have had effects on the project, thus changing the scope of the Configuration Calculator gradually over time. However, the project's schedule and attributed resources did not match these changes.

"A negotiated change in one dimension of the Triple Constraint should be accompanied by changes in the other dimensions."
- M. D. Rosenau, Jr. [ROS84, p42]



To analyse the project stakeholders it is important to first identify the different stakeholders and their relations to the project and to each other. In Figure 10, these roles and relations are visually represented. The role of portfolio manager and program manager are arguably also (respectively) part of business and management and the project customers.



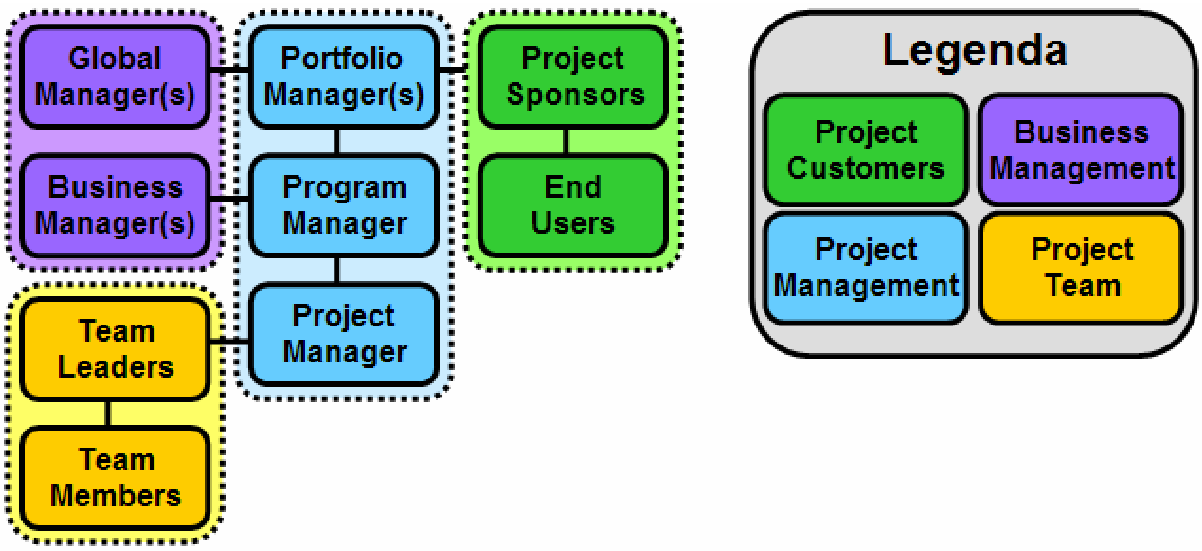
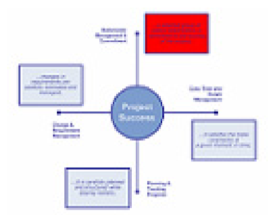


Figure 10: Project Stakeholders (and project relations)

Using Mitchell's stakeholders model it is possible to identify the stakes of each stakeholder to identify their salience, by identifying their power, legitimacy and urgency in the project. See Appendix B for more information on how the stakeholders received their level of power, legitimacy and urgency.



Stakeholder Power

In Table 6 the power of the different stakeholders on the project is described and based upon that description a choice is made whether to define the stakeholder as powerful or not. It has been taken into account that each stakeholder has some amount of power, but clearly the relative powers can have major differences.

Stakeholder Role	Description	Power
Project Sponsor	The project sponsor has access to all instruments of power; the strongest and most obvious power is the compensatory power since it provides the (financial) resources to run the project. Property and organisation are both important sources of power for the project sponsor with property being the most important one.	3 (Yes)
End User	The project user has access only to conditioned power, since the project results are effectively created for the users.	1 (No)
Portfolio Manager	The portfolio manager can use both condign and compensatory power; the portfolio manager can drop the project from the portfolio or choose to make it top priority. Organisation and property are both important sources of power for the portfolio manager, with organisation being the most important one.	3 (Yes)
Program Manager	The program manager can use its position to provide or withhold support from the project but it cannot use the condign and compensatory powers to the same effect as the portfolio manager as its position (organisation) and its wealth (property) reach far less than the portfolio manager.	1 (No)
Project Manager	The project manager is a special case because it can influence the project since it is his responsibility. On the other hand he has no real power source and must influence others for power. The main power source of the project manager is therefore personality and its power instrument is the conditioned power.	1 (No)
Global Manager	The global manager can create massive constraints for a project, and can support a project globally, elevating its status and mainly its priority. The most important power sources for the global manager are organisation and property, with the organisation as the most important one.	2 (Yes)
Business Manager	The business manager has an influence over the project because of its property power source (mainly human resources). Also the business manager can use both compensating and condign power instruments to influence the project through all project members by its position (organisation power source).	3 (Yes)
Team Leader	A team leader does not have power over the project. A team leader can only indirectly influence the project through the project manager.	1 (No)
Team Member	A team member does not have power over the project, just like the team leader, moreover the influence on the project manager is smaller than that of a team leader and must often go through the team leaders.	0 (No)

Table 6: Power of Project Stakeholders

Stakeholder Legitimacy

The most legitimate stakeholders are the sponsor, the portfolio and the program manager and the business manager (see Table 7). This is mostly because they all have structural rights and responsibilities to their management resulting in resolve. Other stakeholders that have resolve mostly lack the responsibilities or the rights to make them the part of the most legitimate stakeholders.

Stakeholder Role	Rights	Responsibilities	Resolve	Legitimacy
Project Sponsor	X	X	X	3R – Leader
End User	X	X		2R – Officer
Portfolio Manager	X	X	X	3R – Leader
Program Manager	X	X	X	3R – Leader
Project Manager		X	X	2R – Advocate
Global Manager	X			1R – Abstainer
Business Manager	X	X	X	3R – Leader
Team Leader		X	X	2R – Advocate
Team Member			X	1R – Supporter

Table 7: Legitimacy of the Project Stakeholders

Stakeholder Urgency

As urgency is referred to as the degree to which the stakeholders claim demands immediate attention, one can also describe urgency (in the light of project stakeholders) in terms of how important (the outcome of) a project is for the stakeholder.

Stakeholder Role	Description	Urgency
Project Sponsor	The project outcome is extremely important for the project sponsor as the sponsor has invested a lot of money in the project.	3 (Yes)
Project User	Although the project user is the one who has to work with the project result, as long as he does not use the project result yet, the urgency is not there.	1 (No)
Portfolio Manager	The project is important for a portfolio manager since it is part of their portfolio, and also because they have invested in it.	2 (Yes)
Program Manager	The project is important for a program manager since it is part of their program and, in many occasions, is somehow linked to other projects in the programs.	3 (Yes)
Project Manager	The project is extremely important for the project manager as he is the one responsible for the project, when it fails completely, the project manager has failed.	3 (Yes)

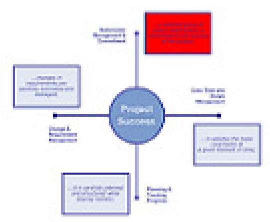
Global Manager	Although the global manager has influence on the project, it has only minimal effect on the global manager, making it not urgent.	0 (No)
Business Manager	The business manager has invested in the project with human (and financial) resources, thus making it very important for the business manager.	3 (Yes)
Team Leader	The project outcome is of importance to the team leader, although he is not responsible for the project. However, he can be held accountable by both project and business managers making the team leader an urgent stakeholder.	2 (Yes)
Team Member	Although the team members mostly have worked a while on the project and thus have some emotional urgency, the project only has a minor urgency.	1 (No)

Table 8: Urgency of Project Stakeholders

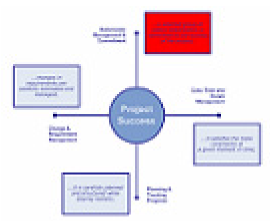
As described in Table 8, the most urgent stakeholders are the project sponsor, the program and project manager and the business manager. They are followed by the portfolio manager and the team leader.

Stakeholder Role	Power	Legitimacy	Urgency	Stakeholder Type
Project Sponsor	Yes	Yes	Yes	Definitive
End User	No	Yes	No	Discretionary
Portfolio Manager	Yes	Yes	Yes	Definitive
Program Manager	No	Yes	Yes	Dependant
Project Manager	No	Yes	Yes	Dependant
Global Manager	Yes	No	No	Dormant
Business Manager	Yes	Yes	Yes	Definitive
Team Leader	No	Yes	Yes	Dependant
Team Member	No	No	No	Non-stakeholder

Table 9: Project Stakeholders Typology



The results of the analyses are summarized in the above table (Table 9), with the most salient stakeholders being the project sponsor, the portfolio manager and the business manager. According to Mitchell, one has to keep watch on the global manager, since it is only by the global manager's choice that its type is only dormant.



The different stakeholders regularly meet (via conference calls) according to schedules, but many were cancelled due to too less participants. Apparently the project was either of lower priority compared to other work, or the participants were not very committed to the project.

4.3 Assessment

Using the analysis, it is possible to check in what way the project does satisfy the project success criteria. The outcome of this assessment is shown in the table below (see Table 10).

A project is most likely successful if...	Criteria Satisfaction
..the goal of the project is carefully specfied;	-
* To enable evaluation and validation of project results.	-
* To keep stakeholders foccused on the specified common goal.	+/-
..it satisfies the triple constraints at a given moment in time;	- -
* Keeping the project progress along the project planning.	- -
* The triple constraints are balanced.	- -
..it is carefully planned and structure while staying realistic;	- -
* There is a valid business case for the project.	-
* The planning represents a reflection of future progress.	- -
..its most salient stakeholders are satisfied;	-
* The project stakeholders are identified, analysed and managed.	-
* The project results meet stakeholder expectations and needs.	- -
..a selected group of salient stakeholders is committed to the success of the project;	-
* Salient stakeholders carry responsibility for success and failure.	-
* Salient stakeholders assess the project progress at regular intervals.	+/-
..stakeholder needs and expectations are carefully defined in clear unambiguous requirements;	-
* Requirements are a reflection of stakeholder needs and expectations.	- -
* Requirements are clear, unambiguous and understandable for all stakeholders.	-
..changes in requirements are carefully estimated and managed.	-
* Each change in requirements has a valid business case and the impact on the project is carefully estimated.	- -
* Changes in requirements are followed by a change in the triple constraints.	- -
..besides the product, requirements also specify project success and domain activities	- -
* Both tangible factors and non-tangible factors are accounted for in the goal-level requirements.	- -
* Domain activities and processes can be managed to support the product in delivering project success.	- -

Table 10: Satisfaction of Project Success Criteria

4.4 Survey

After the project assessment was done, a survey was held to provide an objective, at least from a multiple-person-view, overview of the perceived problems that plague the Calculator projects. The goal of the survey was both to validate the assessment of the project and to gain additional information from the stakeholders.

The survey (Appendix D) consists mainly of two parts; the problem area part and the problem scenarios part. In the survey results, the problem areas and problem scenarios have also been mapped to the knowledge areas from the

Project Management Body of Knowledge [PMI96], also known as PMBOK. All three parts will be clarified and their results discussed.

Problem Areas

There are six different problem areas introduced in the survey (see Table 11), and there was an option to add additional problem areas.

Problem areas	Example(s) of the problem area
Commitment	Formal agreements and expectations
Communication	Communication, collaboration and negotiation
Environment	Business transformations and global standards
Methods	Project and organisational (management) methods
People/Resources	Human resources, roles, authorities and responsibilities
Quality	Measurement of quality
Other	Project complexity

Table 11: Problem area example(s)

In the survey the respondents were asked to rank the top three problem areas, with the first being the most problematic area and the second being of next most importance, etc. Additionally, they were asked to explain and/or describe why they have chosen this ranking and what, according to them, are the main problems in these problem areas. Also they were asked their opinions about the foundation(s) of these problems.

The findings of this survey concerning the problem areas are presented in two diagrams that both show the problem ratio between the areas.

The first diagram (see Figure 11) presents an absolute ratio (the ratio between the number of times a problem area is mentioned and the total amount of mentioned problem areas) while the second diagram presents a weighted ratio (the ratio between the ranking of a mentioned area and the total ranked problem areas).

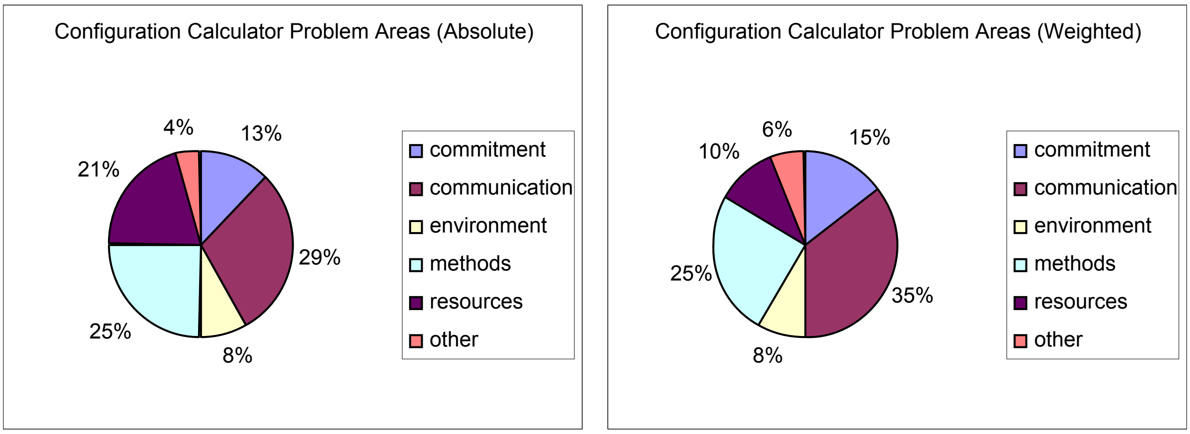


Figure 11: Configuration Calculator weighted and absolute problem areas

In Figure 11 an overview is presented of the percentage of respondents that mentioned the particular problem areas. Both diagrams show that the respondents have found communication to be a problem, as well as the methods, commitment and in lesser amounts the resources. A critic note can be made on the high percentage of respondents that identify communication as a problem area, since when there are problems the communication usually suffers first because of these problems and this might be more a result of deeper problems.

Problem Scenarios

In the survey, the respondents were confronted with several problem scenarios they were challenged to rate according to how much the hypothetical situation also was a practical situation in the projects. There were four levels to rate the described situation as well as a 'not enough information' level.

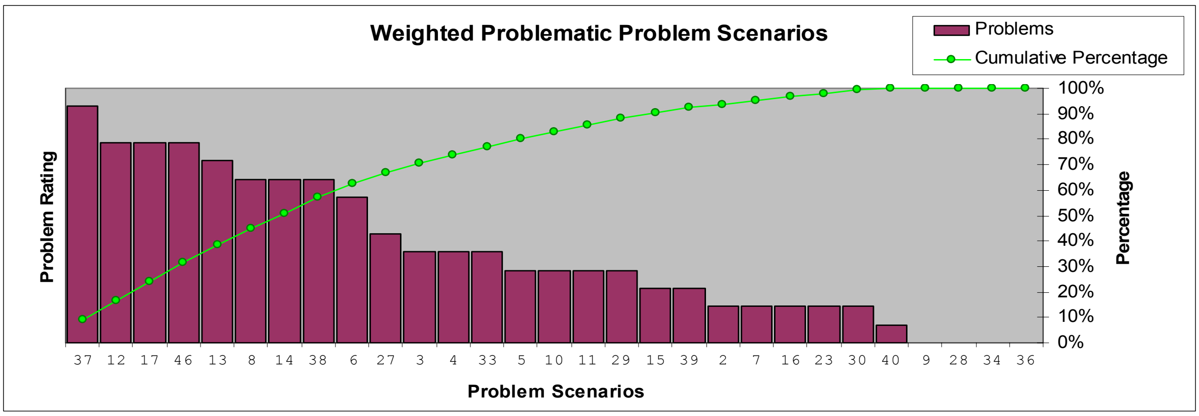


Figure 12: Weighted Negatively Perceived Scenarios

In Figure 12 and Figure 13 the problem scenarios are weighted (according to the rating) and displayed in order of importance (with Figure 12 displaying the scenarios that were considered problematic in the projects and Figure 13 visualising the scenarios that were not considered problematic in the projects).

From the individual problem scenarios diagrams the top five hypothetical situations (for an overview of all scenarios, see Figure 12) that have been rated as most problematic are:

- Negotiations with the sponsors. [*scenario 37*]
- Project control is too much based on a single aspect [*scenario 12*]
- A planning that changes too often. [*scenario 13*]
- The shortage of resources. [*scenario 17*]
- Decision-making has not always been done in time. [*scenario 46*]

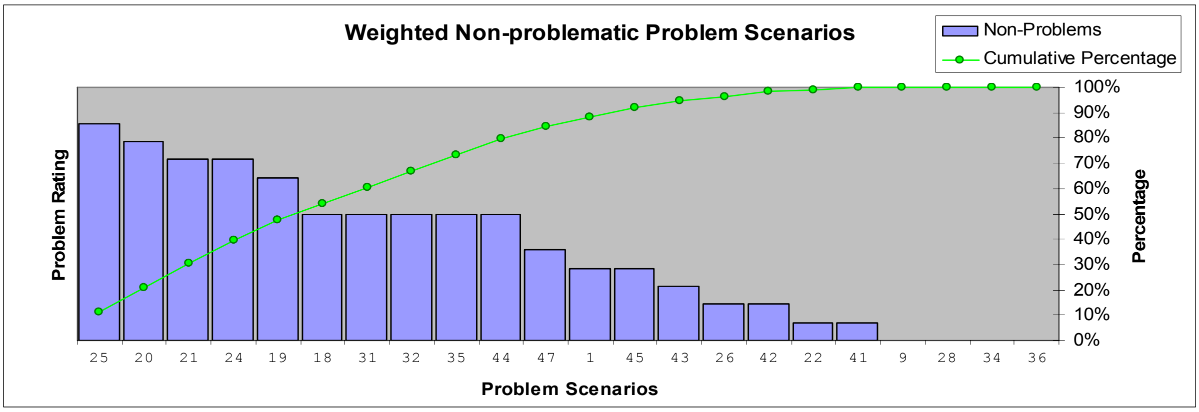


Figure 13: Weighted Positively Perceived Scenarios

The non-problematic problem scenarios charts present the more positive situations. The top five hypothetical situations that have been rated as giving the least (or no) problems:

- Personal conflicts do not lead to business conflicts. [*scenario 25*]
- Team members do not regard management as a bother. [*scenario 20*]
- The project management seems to be involved. [*scenario 21*]
- Most people are considered flexible. [*scenario 24*]
- Project management was informed on exceptional situations. [*scenario 18*]

Knowledge areas

Another way to group activities and processes is by project management knowledge areas (see the list below) from PMBOK. The hypothetical problem scenarios from the survey (see Addendum) can be divided among these knowledge areas.

- Scope
- Time
- Cost
- Quality
- Integration
- Human Resources
- Communications
- Risk
- Procurement

There are a few differences between the knowledge areas from PMBOK and the knowledge areas used in the survey results (Table 12). To map the problem scenarios on the knowledge areas an extra knowledge area – stakeholder knowledge area – is added, because in the PMBOK stakeholder problems are not be placed in an explicit knowledge area and thus are able to escape attention. Also the scope, time, cost and quality knowledge areas are pooled together as project boundaries. Finally, the procurement knowledge area has been left out since no problem scenario mapped on this knowledge area.

Knowledge Areas	Knowledge area: (processes)
Boundaries	Staying within project boundaries (scope, time, cost and quality).
Integration	Coordination of the various project elements.
Human Resources	Making effective use of people involved in project.
Communications	Collection and dissemination of project information.
Risk	Identifying, analysing and responding to project risk.
Stakeholders	Creating, maintaining and ending stakeholder relationships and communicating and negotiating commitments.

Table 12: Description of the used knowledge areas

When using the mapped knowledge areas to visualise the problems (as done in Figure 14), three knowledge areas really stood out; the human resource area stands out because the majority of survey respondents found it to be non-problematic, and the integration and risk areas because they were perceived to be largely responsible for the problems.

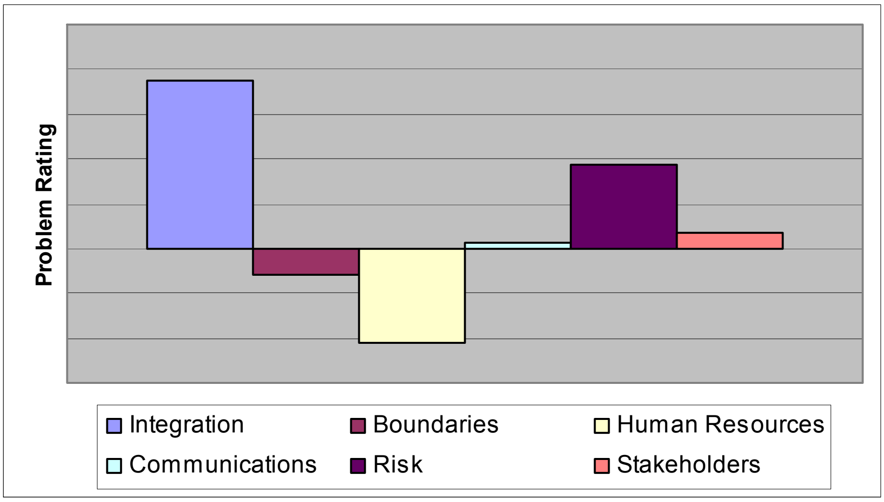


Figure 14: Weighted problem perception per knowledge area

Conclusions

The survey responses indicate that the respondents view the communication and the methods problem areas as problematic areas in the projects. To a lesser degree they find the resources and commitment areas to be problematic (although commitment was not mentioned by most respondents, those that did mention it gave it a high importance). Conversely, many respondents mentioned resources as a source of problems, but those respondents rated it as low importance.

An analysis on the individual problem scenarios shows that decision-making has not always been done on time and the negotiations between stakeholders were difficult. Sometimes the results of these negotiations have been instable. Generally, planning has been too optimistic and has been subject to change. On a positive note, the respondents view the people as flexible and consider management as involved and informed. The project integration and project risk knowledge areas are the knowledge areas where the survey respondents indicated the most problems lie.

In the answers on the open questions, many reasons were given to why certain project scenarios have occurred. Also, there were several descriptions of example situations that illustrated the problems. These have mainly been used to gain more insight in the current situation and the relations between problems and these have also been used in the initial root cause overview.

4.5 Root Causes Laid Bare

Root Cause Overview

The combined problematic situations and problem areas from the Configuration Calculator analysis, the assessment based on the criteria and the survey results have led to a set of problematic situations. This set was used solely to make a first mapping of the problematic situations and their relations. The first iteration of the diagram then was presented to several project stakeholders and the received critic and comments were incorporated to make the second iteration more realistic.

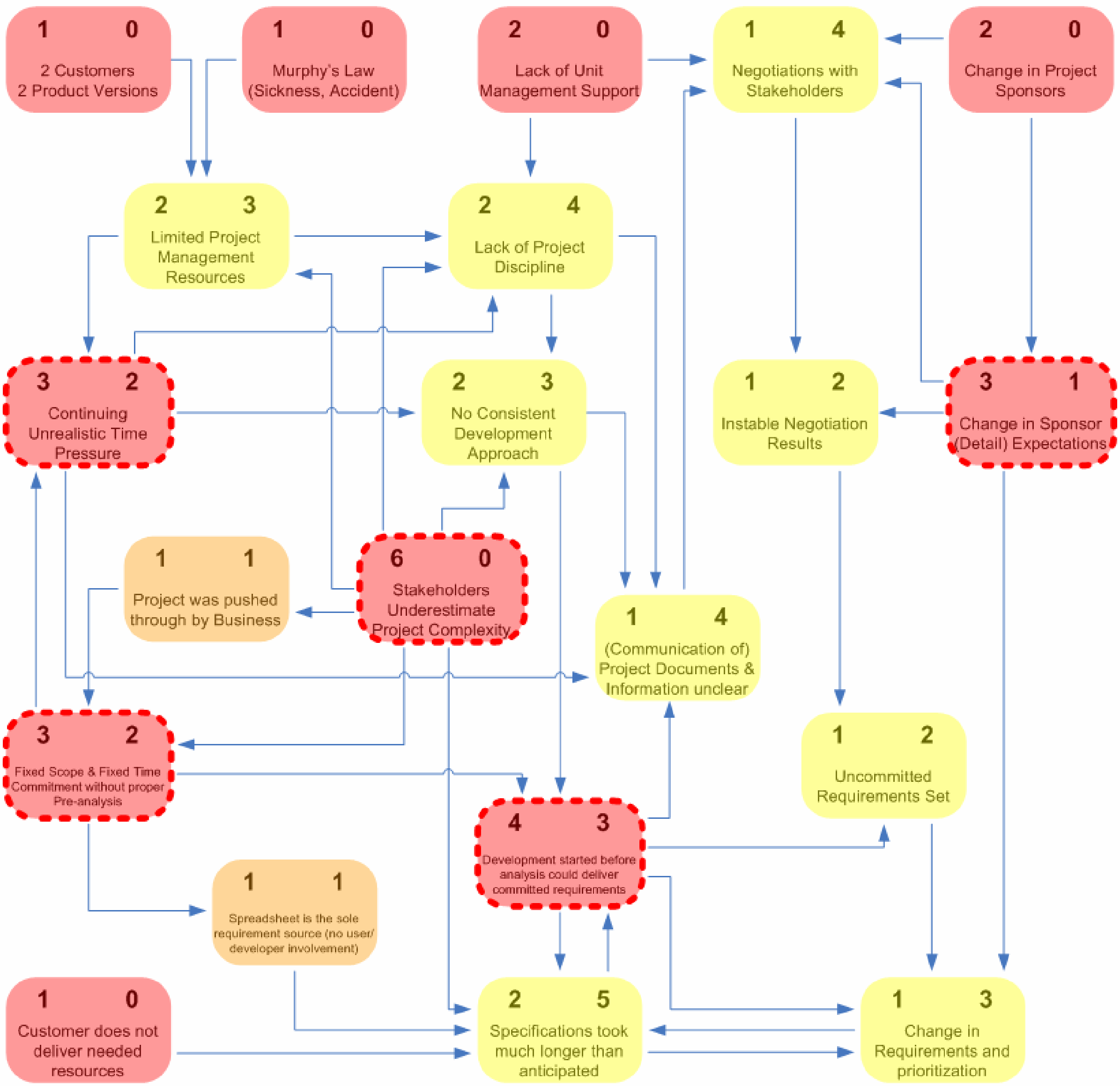


Figure 15: Configuration Calculator Problematic Situations

In the above diagram (Figure 15) the different problematic situations and their relationships are mapped using the Interrelational Diagram modelling technique.

From the overview diagram several problematic situations seem to have more relations and impact on other problems than others. Using these relations it was possible to identify what problematic situations had the most (negative) impact on the project.

Four problematic situations have been identified as the root causes of the problematic situations that plague the Configuration Calculator project.

Stakeholders have greatly underestimated project complexity

The first problematic situation qualified as a root cause is the situation where stakeholders have underestimated project complexity (see Figure 16). Not only did this cause influence many other problematic situations, but since this cause has been present since the start of the project its impact on the project has been severe.

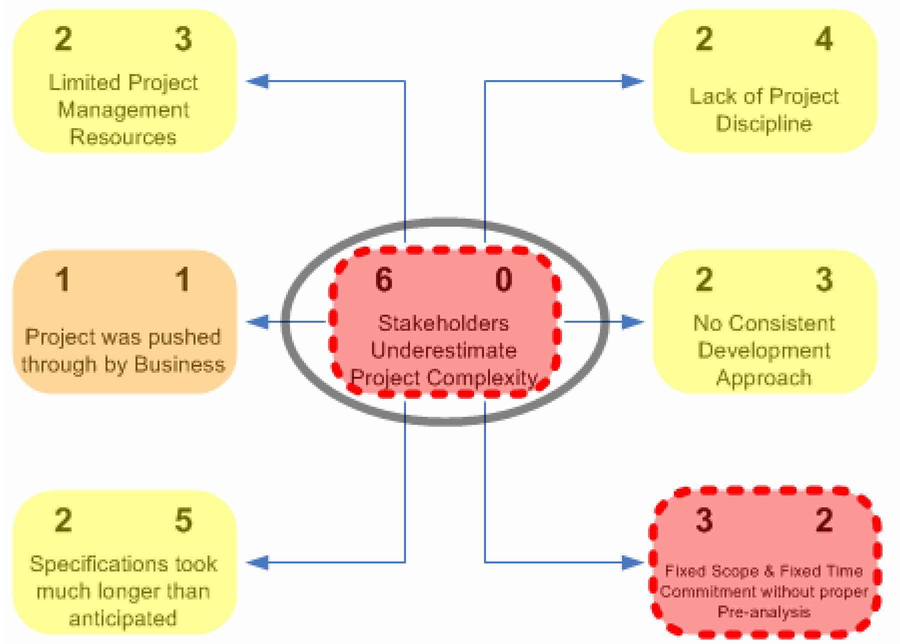


Figure 16: Stakeholders Underestimated Project Complexity

It can be argued that by thoroughly analysing project complexity it is possible to produce better specifications, better estimates and a more realistic business case. Thus a more realistic and defendable project plan can be created so that project success can be better managed.

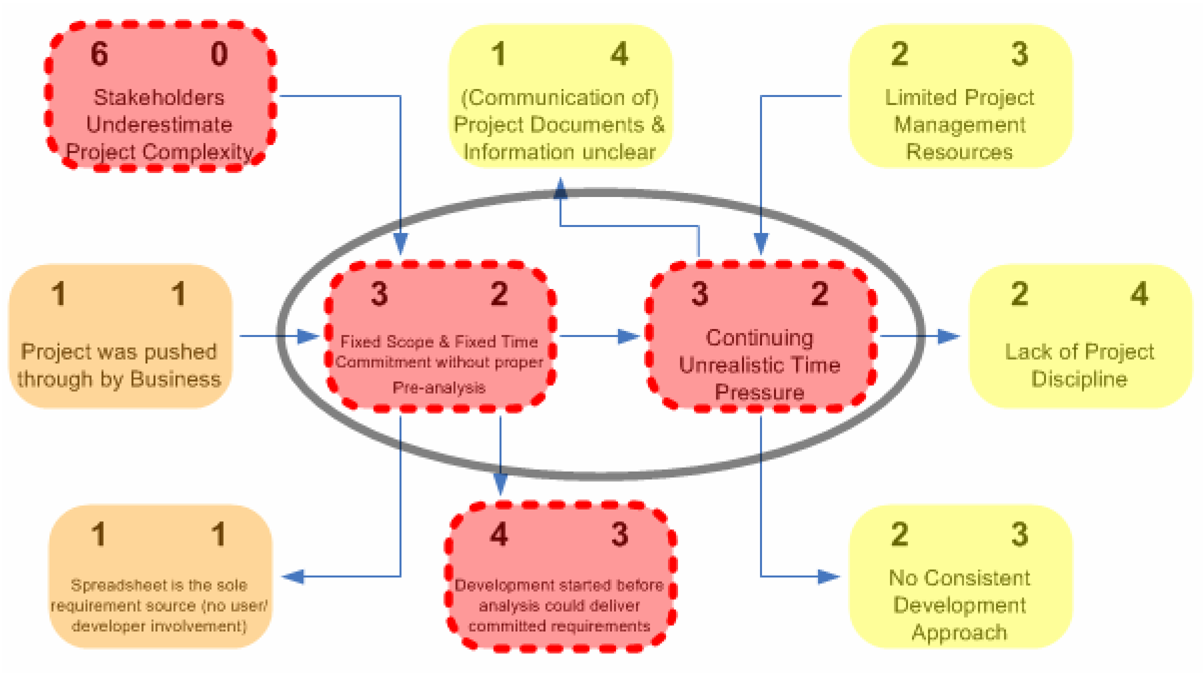


Figure 17: Ever-present unrealistic time pressure

Ever-present unrealistic time pressure

The next root cause that has been identified is actually a combination of two situations; the fixed scope & fixed time commitment together with an unrealistic schedule (Figure 17). This cause mainly disturbed prioritizing processes, leading to the skipping of careful documenting of project meetings and project planning, and an inconsistent development approach.

Development was prioritised over analysis

In the Configuration Calculator project, the development started well before the analysis process could deliver committed requirements. This prioritisation can be attributed to the enormous time pressure and to the underestimated project complexity, but the effects of this choice has greatly affected the Configuration Calculator project (see Figure 18).

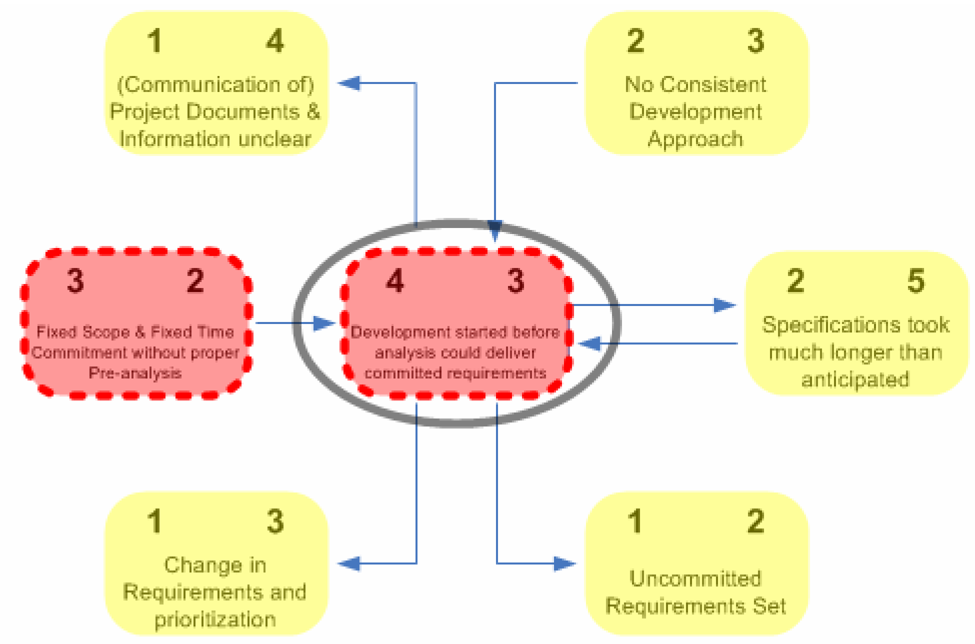


Figure 18: Development was prioritised over analysis

This prioritisation has also been distinguished as a root cause since its impact on the project has been enormous and the defining of committed requirements is a basic necessity to measure and distinguish project success.

Change in sponsor expectations

The last identified root cause in the Configuration Calculator project is the constant change in sponsor expectations (see Figure 19). The constant changes in sponsor expectations together with the absence of committed requirements and a carefully defined project goal made the project shift in different directions over time wasting a serious amount of time and resources.

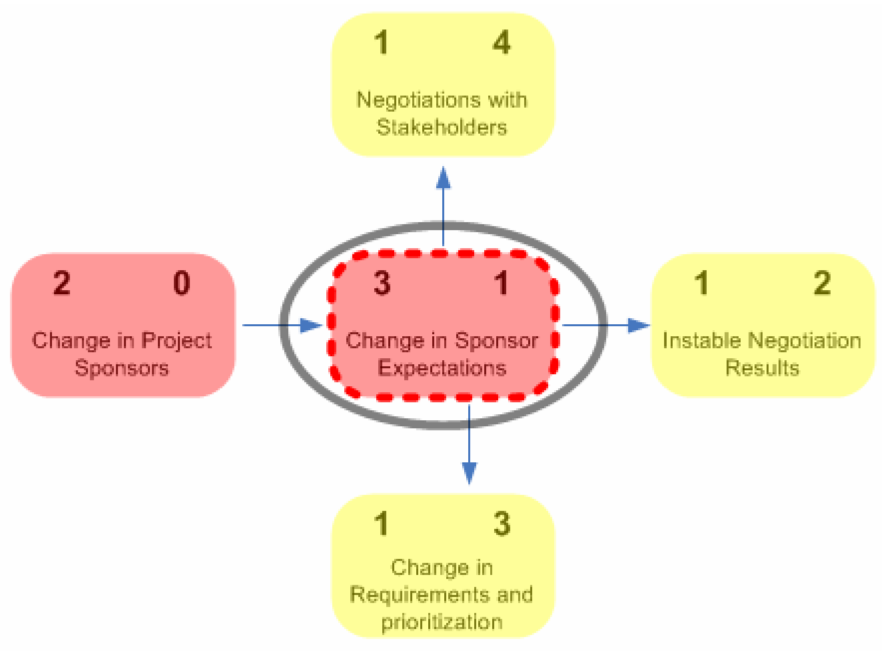


Figure 19: Change in sponsor expectations

4.6 Results

To summarize the findings of the project analysis and assessment together with the survey findings and root cause analysis results, it is clear that there were multiple problems at the Configuration Calculator project.

The project starting conditions were far from ideal:

- There are no Configuration Calculator specified requirements
  - No goal and domain-level specifications
  - No specified product-level requirements
- The complexity of the SpreadSheet Calculator is unknown
  - SpreadSheet Calculator users are not allowed to be involved
  - There is an absence of SpreadSheet Calculator documentation
  - Original SpreadSheet Calculator developers are not available
- The project has a non-negotiable target date and a narrow timeframe

Symptoms of problems while the project already was on its way:

- Project is unable to deliver its results on time
- Activities are far more time consuming than estimated
  - Spreadsheet analysis
  - Requirement formalisation
  - Stakeholder negotiations

- Negotiating with stakeholders is difficult and negotiated results are not very stable
- After missing the first target date, the project is getting a much harder time acquiring (additional) budget

The four identified root causes:

- Stakeholders have greatly underestimated the complexity of the project
- Ever-present unrealistic time pressure
- Development started before the analysis could deliver committed requirements
- Change in sponsor (detail) expectations

Section 5: Discussion

"Knowledge is true opinion."
By: Plato (Greek Philosopher)

This section contains a number of discussions that came to mind during the master thesis project research and while writing this report.

5.1 Influence from the other Configurator projects

In this master thesis, the focus was mainly on the Configuration Calculator project, and because the SpreadSheet Calculator is the Configuration Calculator's predecessor, it was also discussed. However, there is another project that faces many of the same challenges as the Configuration Calculator project; the Packaged Offerings Calculator project (for more information about the Packaged Offerings Calculator project, see Appendix A – Configuration Calculator Project Relationships).

Not only do the two projects (Configuration Calculator and Packaged Offerings Calculator) share broadly the same business goals, they also share many stakeholders. Thus the projects also might have influenced each other through these stakeholders. Good results on one project might have inspired the other project, or maybe the exact opposite. A delay in one project might have impacted the schedule of others. It seems very interesting to further analyse the relationships between projects and the effect it on project success.

5.2 Elicitation Techniques

Introduced in the theory section, the elicitation techniques are processes to identify requirements. In the discussion of the case, I have described how in several instances the present requirements didn't adequately cover the stakeholders' needs and expectations.

It would be an interesting subject of further study to research which elicitation techniques have been used in the project and why they have been selected. This is especially interesting in combination with the different levels of requirements (goal, domain, product, design) identified by Lauesen [LAU02, p24].

Besides the use of elicitation techniques in the Configuration Calculator project, several elicitation techniques have also been used to gather information for my master thesis. One of the elicitation techniques I have used was a survey to verify my research and to gain further insight in the Configurator project(s). It might have been better to have split these processes, allowing the insights to be acquired sooner in the process.

The root cause analysis that has been performed by me to first gathering information and analysing it before trying to link different problems to each other. Then I have presented the results to the group to validate my findings and to gain new insights. Another way to do it is to facilitate to share their knowledge and discussion it with each other to create a root cause model in consensus. This last approach might have been faster then the first approach, although it also might be less neutral.

5.3 Project Success Criteria

The two models were adapted and constructed using literature that either focussed on or was limited to IT environments. The end result, both the success criteria and the organisational and technical mapping of these criteria into the models also seem to be suited for projects in a non-IT environment. A study of a project in a non-IT environment using the same criteria might be a very interesting case.

Section 6: Conclusions & Recommendations

"One worthwhile task carried to a successful conclusion is worth half-a-hundred half-finished tasks."
By: M. Forbes (1917-1990) – Publisher of Forbes Magazine

The conclusions and recommendations section will start with summaries of all previous sections, after which the thesis questions will be answered. After that, conclusions from the theory, process and case will be drawn. At the end of the section a set of recommendations is presented.

6.1 Summary

In this paragraph each discussed sections is summarized.

Introduction

Numerous IT projects are experiencing problems, and my assignment is to look in detail at one such a project; the Configuration Calculator project. The Configuration Calculator project is a software development project that aims to produce a web-tool that supports the sales process.

Problem Definition

The objective of the thesis is to identify and assess the potential problems and their origins at the Configuration Calculator project. This is done by first defining a set of criteria based on a literature study, then analysing and assessing the Configuration Calculator project against those criteria. The results of this assessment, together with the results of a survey (also used to validate the analysis results) are used as input for a root cause analysis. A selected root cause analysis method is used to identify the main causes for the projects problems.

Managing a Software Engineering Project

Eight criteria, divided into organisational and technical criteria, have been identified that together can assess the project successfulness. These focus on; project goal and success specification, satisfying the triple constraints, realistic

planning and structuring of the project, identifying and satisfying salient stakeholders, gaining commitment, identifying and specifying stakeholder needs and expectations, and managing these specified needs and expectations.
The root cause analysis method chosen to identify the Configuration Calculator project's root causes is the Interrelationship Diagram modelling technique.

Case Project Assessed

The Configuration Calculator has been analysed and assessed based on the assessment criteria through my project success factors model and (an adapted version of) the Z-model and has failed to satisfy most of the criteria. The project was suspected of being a problematic project, and the assessment proved this statement to be true.

The problems at the project were not so different from any other IT project, but they were numerous and already present at the start of the project making it a very difficult challenge to actually make it a success.

Discussion

Several interesting other subjects of (further) research have been identified and are shortly discussed. In the influence of the other Calculator projects on the Configuration Calculator project is discussed as well as the use of elicitation techniques (in the project and in this master thesis).

6.2 Thesis Conclusions

This paragraph will answer all the thesis questions presented in the problem definition section.

Which criteria are needed to carefully assess the functioning of a software development project?

A combination of organisational and technical assessment criteria are needed to carefully assess the functioning of a software development project. I have found a combination of organisational project success factors and (an adapted version of) the Z-model to be a good basis to assess a software development project.

How will the analysed project be judged in the light of the formulated criteria?

The Configuration Calculator has been analysed and assessed based on the assessment criteria through my project success factors model and (an adapted version of) the Z-model and has failed to satisfy most of the criteria. The project was suspected of being a problematic project, and the assessment proved this statement to be true.

What insight does the analysis of the project presents us, focussed on identifying possible potential problems at the project?

The problems at the project are mainly basic problems at a software project that could have been predicted, and might have been managed given a strict project and requirement management and better stakeholder commitment.

Which method is best suited to analyse the found problems and aims to identify the (hidden) main causes of the majority of these problems?

In this research, considering the lack of my experience and the project environment, the Interrelationship Diagram could give me the best root cause analysis results.

Using the selected method, which main causes can be discerned that have a profound impact on (the majority of) problems at the project?

The following root causes have been identified:

- Stakeholders have greatly underestimated the complexity of the project
- Ever-present unrealistic time pressure
- Development started before the analysis could deliver committed requirements
- Change in sponsor (detail) expectations

6.3 Approach Conclusions

The many changes in my project plan and in the main objective, research questions and the thesis structure have severely slowed the process. Putting more effort in the problem definition before analysing the case or describing theories has really helped me get back on track. In retrospect, I should have first concentrated on defining a set of committed requirements.

In the analysis period of my project I have spent a lot of time trying to process all information that I have gathered, wanting to understand all before confronting others with my findings. Looking back, it was probably more efficient to confront others sooner with my findings. Asking one question that I didn't need to ask would probably be more efficient then sorting everything out beforehand and have less time and possibilities to interview the stakeholders.

6.4 Theoretic Conclusions

When constructing the framework to get a clear overview of the discussed theory, the Z-model came into view. After careful consideration the Z-model seemed to fit into the framework better than I would have ever suspected. The only thing the (original) Z-model didn't have was the direct feedback line, the one that actually can confirm project success.

Many quotes from the literature discussed in the theory section have been right on the spot for the Configuration Calculator project. They mostly predicted a change in risk and/or delay in the project and it was often the same way as it occurred in the Configuration Calculator project. The two that were most fitting were:

- "It different customers/users cannot agree on requirements, risk of failure is very high. Proceed with extreme caution."
- "Defining a product is crucial; many failures concern exactly those aspects that were never specified."

6.5 Recommendations

The research of the Configuration Calculator project has showed how easy it is to forget the most basic of project management rules. And also, how much the absence of a realistic project plan costs the project over time. In almost any project management book, and many software development and requirement engineering books the project plan is mentioned when talking about projects.

A realistic and defendable project plan

Thus, the first general advice is to spend time on constructing a realistic and defendable project plan, favourably together with the key project stakeholders. The project plan must at least carefully state the business goal of the project and must consider both its tangible costs and benefits as well the intangible factors. Also, the project plan must be the central overview to document uncertainties, the assumptions, the estimations and the risks.

'Stakeholders have greatly underestimated the complexity of the project.'
&
'Ever-present unrealistic time pressure'

And of course, the project plan must serve as a primary source of planning, to evaluate project progress. At each milestone, the assumptions, estimates and risks must be updated to reflect the increased project and product knowledge and experience. Also, the business case needs to be updated to reflect any possible changes, so that decision on the right course of action can be made based on the right information.

Defining a set of committed requirements

The third general piece of advice is to focus first on defining a set of committed requirements. This not only sets the proper endpoint for (a phase in) the project, but also reduces risks by enabling much better estimations and planning. And it also serves as a psychological beacon to work towards.

'Development started before the analysis could deliver committed requirements.'

Unite the key stakeholders

The second piece of general advice is to unite the most salient stakeholders in a project board, or steering committee. The purpose of the project board is to make the important decisions at the project start, the milestones and when severe problems are present. It must therefore consist of a small amount of people with enough influence and/or authority to make fast decisions about important issues. Essential in this board is therefore the shared responsibility for project success to ensure commitment throughout the project.

'Development started before the analysis could deliver committed requirements.'

In Figure 20 the project board is visualised.

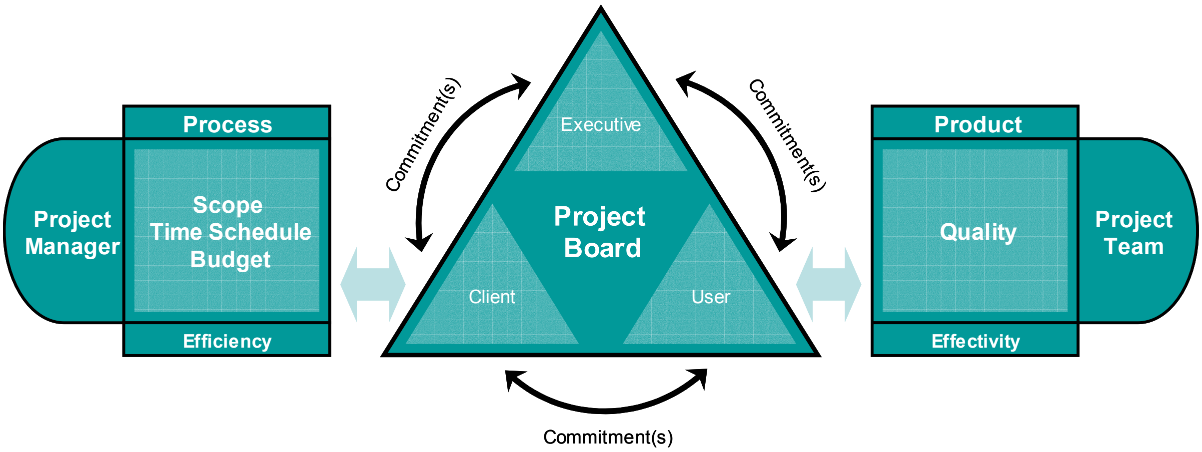


Figure 20: The Project Board

Requirement Management

The last general piece of advice is to stress the importance of requirement management. To have a committed set of requirements not only in the beginning, but all throughout the project is the ideal situation. But since there are bound to be changes, it is necessary to manage them carefully; evaluating their impact on the project and compensating for that impact. This means making changes in the project plan, so project progress can still be measured using the project plan.

'Change in sponsor (detail) expectations'

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Section 8: Appendices

Appendix A:	Configuration Calculator Project Relationships
Appendix B:	Stakeholder Identification, Analysis and Salience
Appendix C:	Root Cause Analysis Methods
Appendix D:	Survey

Appendix A – Configuration Calculator Project Relationships

The Configuration Calculator (CC) project is part of a larger program that includes three Configurator projects that support marketing and sales processes. An overview of the three Configurator projects can be found in Table 13.

SSC	The SpreadSheet Calculator is a Lotus 1-2-3 spreadsheet based Configurator for complex offerings that approaches the end of its life cycle since it is spreadsheet base, can no longer support additional functionalities.
POC	The Packaged Offerings Calculator is a Configurator for standard fixed price offerings with a simple scope. The Packaged Offerings Calculator is developed using a standard software development framework.
CC	The Configuration Calculator is a Configurator for complex offerings and should replace the SpreadSheet Calculator once it is ready. The Configuration Calculator is custom developed.

Table 13: Description of the Configurator Projects

History

There was a need for some standardization of calculations geared towards opportunities. This standardization would make marketing and sales processes faster and more accurate. From this need, the SpreadSheet Calculator project was born. A Lotus 1-2-3 spreadsheet based application that can give estimations for complex offerings. Over the course of several years, the SpreadSheet Calculator became a common tool and the hands of many marketing and sales people. As the tool was being updated with new prices, new functionalities and thus became increasingly complex, the maintainability also became increasingly complex. Also, keeping track of the different versions became rapidly harder.

Facing these challenges while the need for more standardization became only more imminent, the need arose to duplicate the SpreadSheet Calculator in another application environment. Instead of countless decentralized stand-alone applications, a central accessible web tool would be developed to optimize the maintainability while minimizing version control and allowing expandability. The Configuration Calculator tool was born.

Configurator Program Relations

Being the predecessor of the Configuration Calculator tool, the functionality of the SpreadSheet Calculator tool is the functional bases for the Configuration Calculator tool. It is focused to support marketing and sales processes and geared towards complex offerings.

To better support marketing and sales processes geared towards more standardized offerings, another project was created, the Packaged Offerings Calculator project. The Packaged Offerings Calculator tool, because of its more standardized offerings can be spread to a larger user group. Like the Configuration Calculator project, the Packaged Offerings Calculator project will be developed as a web tool to support a large audience while keeping the tool maintainable. Also, the Packaged Offerings Calculator tool is not a custom build application, but developed using standard components from a software development framework.

Appendix B - Stakeholder Identification, Analysis and Salience

Stakeholders can be defined as any group or individual who can affect or is affected by the achievement of the firm's objectives [FRE84, p46] when looked from a business management angle. So, from a project management angle, project stakeholders are those who can affect or are affected by the achievement of the project's objectives. Since stakeholders are involved in some way or another in the project and/or its achievement, it is imperative that they are known to the project manager. Stakeholders need to be identified and analysed to get a clear picture of the desired project objectives.

Mitchell's defines salience as the degree to which managers give priority to competing stakeholder claims [MIT97, p869]. According Mitchell's et al, to get a clear picture of who and what really counts, the stakeholder-manager relationships need to be systematically evaluated, both actual and potential, in terms of relative absence or presence of all or some of the attributes: power, legitimacy, and/or urgency [MIT97, p864]. Mitchell's principle of who or what really counts, rests upon one assumption [MIT97, p873]: Stakeholders salience will be positively related to the cumulative number of stakeholder attributes perceived by managers to be present.

Power Attribute

Power can be defines as the ability of those who possess power to bring about the outcomes they desire [MIT97, p865]. Mitchell et al use Etzioni's suggestion of using categories of power based on the type of resource used to exercise power [MIT97, p865]; coercive, utilitarian and normative power. Galbraith [GAL84, p16] also distinguishes different types of power, but divides them in sources of power and instruments of power.

Galbraith's instruments of power are condign, compensatory and conditioned power [GAL84, p17-18]. The instruments of power that Galbraith distinguishes are comparable to Etzioni's resources to exercise power (see Table 14).

Etzioni (1964) [MIT97, p865]		Galbraith (1984) [GAL84, pp17-18]	
Coercive	Application of physical means; physical resources of force, violence, or restraint.	Condign	Submission by inflicting or threatening appropriately adverse consequences.
Utilitarian	Material or financial resources; goods, services and money.	Compensatory	Submission by offering an affirmative reward (something of value).
Normative	Symbolic resources; symbols like prestige, esteem, love and acceptance.	Conditioned	Submission by changing belief by persuasion, education of social commitment.

Table 14: Etzioni (1964) vs. Galbraith (1984)

Apart from instruments of power, Galbraith also distinguishes sources of power, they are personality (quality of physique, mind, speech, moral certainty, or other personal traits), property (property and wealth) and organisation [GAL84, pp19-20].

Legitimacy Attribute

Legitimacy can be defined as a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed systems of norms, values, beliefs, and definitions (Suchman, 1995) [MIT97, p866]. This definition implies that legitimacy is a desirable social good, that it is something larger and more shared than a mere self-perception, and that it may be defined and negotiated differently at various levels of social organization [MIT97, p867].

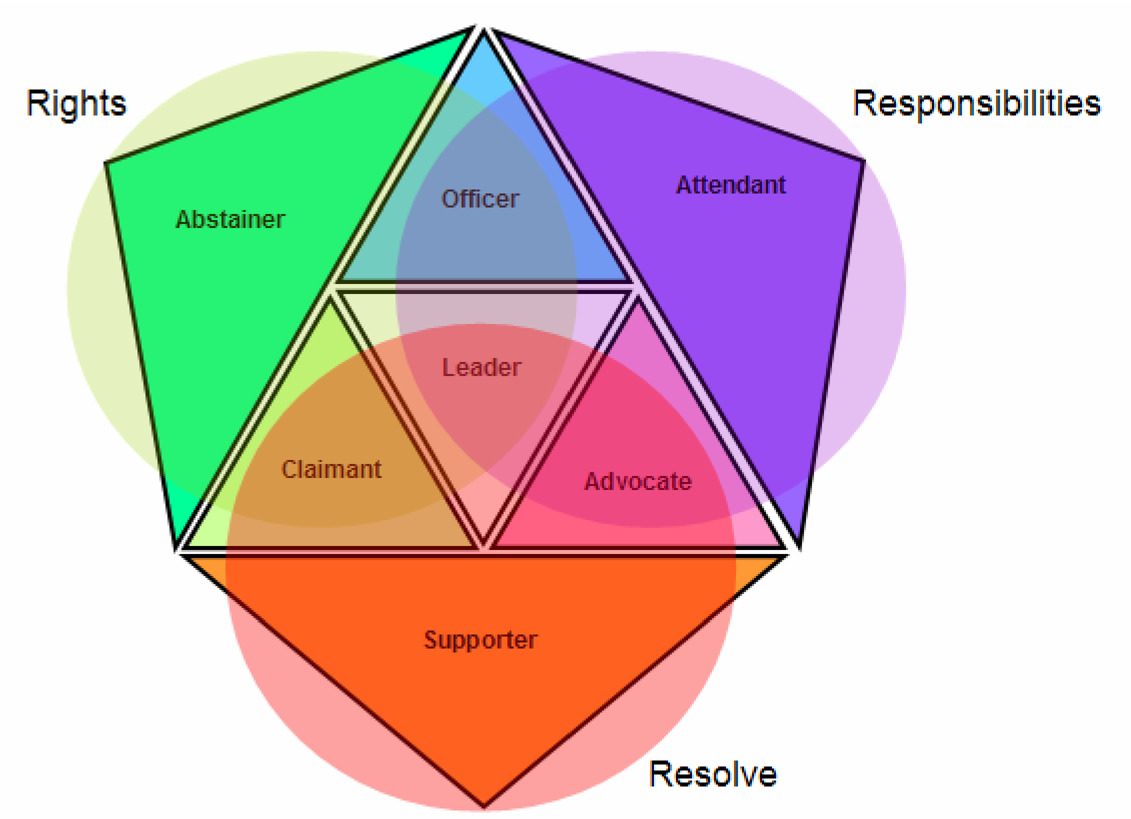

Figure 21: Legitimacy Model

The model of Chevalier (see Figure 21) is very similar to that of Mitchell's in shape and workings, but it only describes Mitchell's legitimacy attribute.

Urgency Attribute

Urgency can be defined as the degree to which stakeholder claims call for immediate attention. According to Mitchell et al, two conditions need to be met for a stakeholder to possess the urgency attribute: (1) when a relationship or claim is of a time-sensitive nature and (2) when that relationship or claim is important or critical to the stakeholder [MIT97, p867].

Stakeholder Typology

Given that an identified stakeholder may possess one, two or all three of the attributes, various combinations of attributes are possible. In Figure 22 all seven possible combinations are given, and of course there is also the non-stakeholder.

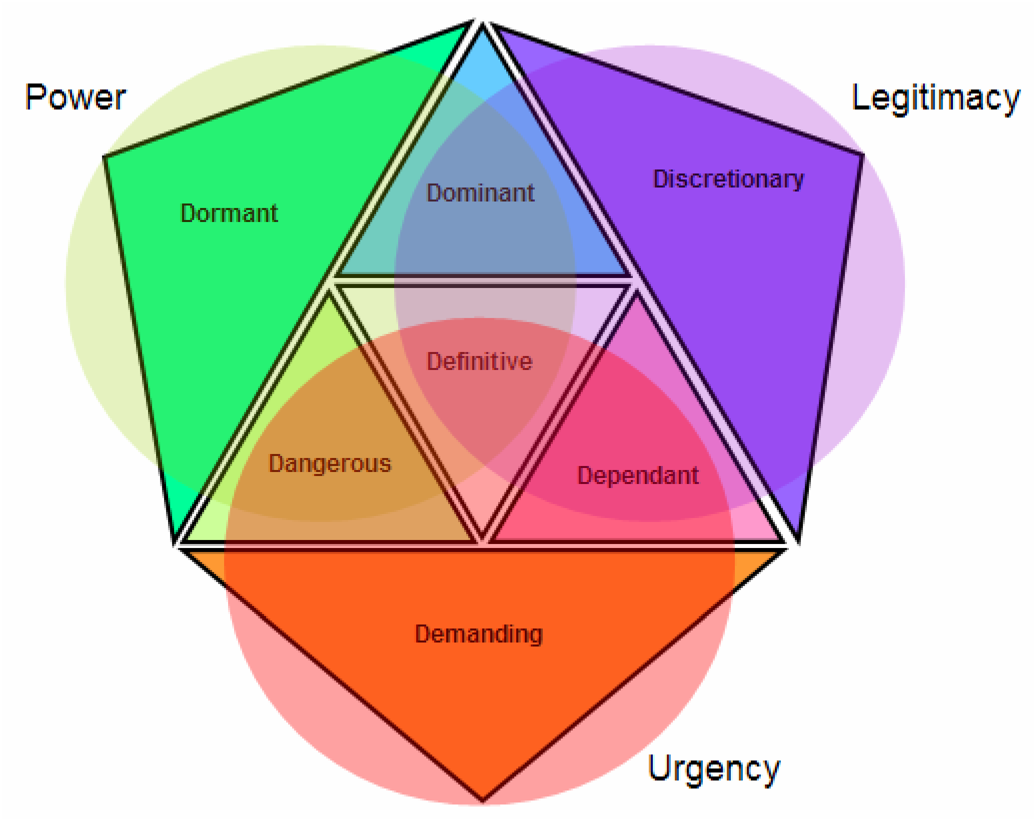

Figure 22: Stakeholder Typology [MIT97, p874]

Mitchell et al recognises that because managers mostly have limited time, they only respond or even identify with the most importance.

Proposition 1a – Stakeholder salience will be low where only one of the stakeholder attributes is perceived by managers to be present [MIT97, p874].
Proposition 1b – Stakeholder salience will be moderate where two of the stakeholder attributes are perceived by managers to be present [MIT97, p876].
Proposition 1c – Stakeholder salience will be high where all three of the stakeholder attributes are perceived by managers to be present [MIT97, p878].

These propositions are summarized in Table 15.

Latent Stakeholders	Stakeholder salience will be low.
Dormant	Stakeholders with power.
Discretionary	Stakeholders with legitimacy.
Demanding	Stakeholders with urgency.
Expectant Stakeholders	Stakeholder salience will be moderate.
Dominant	Stakeholders with power and legitimacy.
Dependent	Stakeholders with legitimacy and urgency.
Dangerous	Stakeholders with urgency and power.
Definitive Stakeholders	Stakeholder salience will be high.
Definitive	Stakeholders with power, legitimacy and urgency.

Table 15: Stakeholder Typology Descriptions [MIT97, p874-879]

Stakeholder Participation

When stakeholders are identified and analysed the stakeholders with high salience, and probably also the stakeholders with moderate salience, are known to the manager. The next step in this process is stakeholder participation. Stakeholder participation can be defined as the process of interaction between different stakeholders or their representatives [GAO97, p16]. It is known that involvement and/or participation of stakeholders in software development projects will increase the chance of the project succeeding [HUM90, p429-430] [STG94, p2].

The difficulty with involvement and/or participation of stakeholder is that there tend to be gaps between the stakeholders on the user side and the stakeholders on the software development side. Gao distinguishes three different of those gaps, namely a knowledge gap, a power gap and an interest gap [GAO97, p69]. To encourage involvement and/or participation, attention has to go to bridging the different gaps.

Appendix C – Root Cause Analysis Methods

To solve a problem, one must first recognize and understand what is causing the problem. Root cause analysis (RCA) is an approach to study and evaluate problems, and involves detailed investigation into why the problems were introduced and how to prevent similar errors in the future [ATT90, p69].

A cause is a condition or an event that results in an effect [DOE92, p3]. A root cause is thus, an underlying reason for the occurrence of more then one problematic effect, although it is very difficult to find a precise definition of root cause. The definition of Rooney and Vanden Heuvel shall be used here since it defines the properties of a root cause rather then trying to exactly define root cause. They state [ROO04, p46]:

- Root causes are specific underlying causes.
- Root causes are those that can reasonably be identified.
- Root causes are those management has control to fix.
- Root causes are those for which effective recommendations for preventing recurrences can be generated.

There are different modelling techniques that can be used in a root cause analysis. Three diagram methods shall be discussed that can all be used to conduct a root cause analysis; these are the Cause-and-Effect Diagram, the Current Reality Tree Diagram and the Interrelationship Diagram.

Cause-and-Effect Diagram (CED)

The Cause-and-Effect Diagram (also called fishbone or Ishikawa diagram) was first used by Kaoru Ishikawa in the 1960s and is one of the basic tools of Quality Management [WIK01]. This technique shows the relationships between a given effect or symptom and its potential causes [ATT90, p20]. The original intent of the CED was to solve quality-related problems in products caused by statistical variation, but Ishikawa quickly realized it could be used for solving other types of problems as well [DOG05, p35]. An illustrated fishbone diagram is modelled in Figure 23.

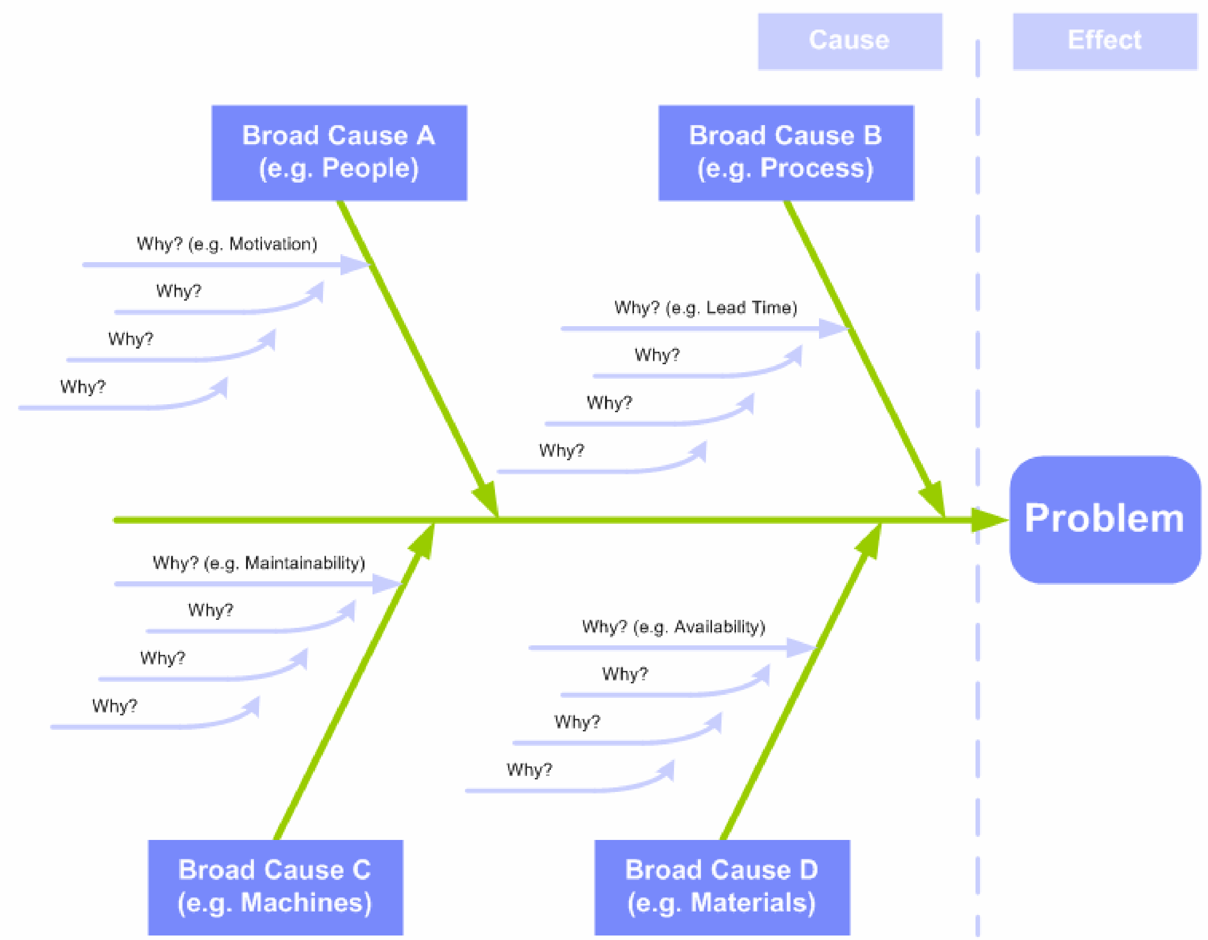

Figure 23: Ishikawa or Fishbone Diagram (Based on: [ATT90, p21-22])

To create a CED, Ishikawa has outlined five steps [DOG05, p35-36]:

1. Decide on the problem to improve or control.
2. Write the problem on the right side and draw an arrow from the left to the right side.
3. Write the main factors that may be causing the problem by drawing major branch arrows to the main arrow. Primary causal factors of the problem can be grouped into items with each forming a major branch.
4. For each major branch, detailed causal factors are written as twigs on each major branch of the diagram. On the twigs, still more detailed causal factors are written to make smaller twigs.
5. Ensure all the items that may be causing the problem are included in the diagram (illustrated in Figure 23).

Critics/Shortcomings of the model

Drawback of this model is that the CED lacks a specific mechanism for identifying a particular root cause [DOG05, p36]. Within the diagram it is not possible to have one cause lead to multiple effects, although it is possible in the diagram to have multiple equal causes for different effects. If there is one or a select few underlying root causes it does not become immediately observable in the diagram. Also it is not possible to have any loops in the cause and effects. For example, it is not possible to have a cause (indirectly) being triggered by its effect. In reality, it is perfectly possible for an effect to influence the occurrence or the impact of the cause.

Current Reality Tree Diagram

The Current Reality Tree (CRT) diagram is a tree-like diagram that lays out and connects causes and effects [GOL94]. Making a CRT is useful since it helps to better understand the experienced modelled causalities and the diagram can be used to communicate these causalities in a clear way to others [NEW98, p31]. An example CRT can be found in Figure 24. The strengths of the CRT tool lies within its strict mechanism that almost enforces attention to detail, integrity of output and an ongoing evaluation [DOG05, p41].

Figure 24: Current Reality Tree (Based on: [GOL94, p55-58] and [NEW98, p33])

An CRT is always read from the bottom up, and each box (representing an entity) connected by an arrow should be read as; If <starting entity = cause> then <ending entity = effect>. An ending entity (effect) that is reached by two arrows is triggered by either one (cause). When the arrows are joined together by an ellipse, then both starting entities have to be present for the effect to occur [NEW98, p31].

To clarify these reading rules, the example diagram relations shall be discussed. The relations in the example of Figure 24 should be read as following. If I have no job (1) and my bank account is empty (2) then I have no money for a vacation (3). And If I have important meetings during vacation period (4) or I have no money for a vacation (3) then I cannot go on vacation (5).

Critics/Shortcomings of the model

The major shortcoming of the CRT tool is its difficulty to use, because of its complexity of construction and rigorous logic system. This complexity also makes it time-consuming [DOG05, p41].

Interrelationship Diagram

The Interrelationship Diagram (ID) is a tool used for identifying root causes of problems that can be complex and multivariable, and require non-linearly thinking [DOG05, p37]. Constructing an ID is not very complex, as it only consists of (potential) problems and arrows that indicates a relationship between two (potential) problems and points from the cause to the effect [DOG05, p37].

Step 1:	Collect information from a variety of sources.
Step 2:	Use concise phrases or sentences as opposed to isolated words.
Step 3:	Draw diagrams only after group consensus is reached.
Step 4:	Rewrite diagrams several times to identify and separate critical items.
Step 5:	Do no be distracted by intermediate factors that do not directly influence the root causes.

Table 16: Mizuno's Steps for ID Creation [DOG05, p38]

An example of a simple ID is shown below in Figure 25. Each arrow that comes from a (potential) problem increases its OUT by 1 and each arrow that goes towards (potential) problems increases its IN by one. In this example the lack of warehouse input procedures is the root cause since this is the problem that influences the most other (potential) problems.

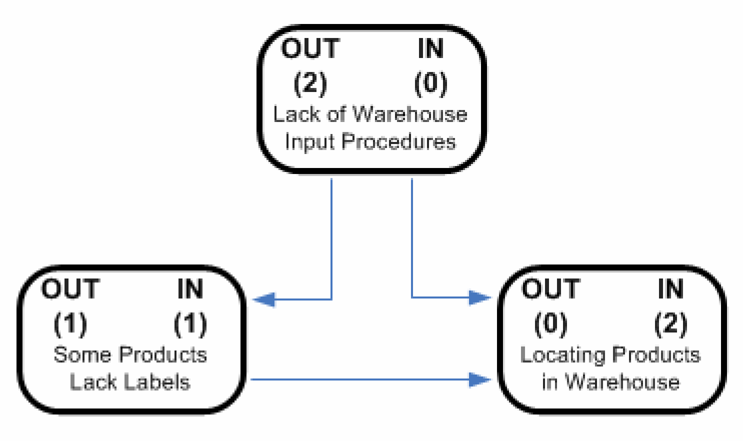

Figure 25: Example ID (Based on [BOG04, p8])

Critics/Shortcomings of the model

A weakness in the ID tool is the lack of a formal mechanism for evaluating the integrity of the root cause. Also, it may rely too heavily on the subjective judgements of its creators about the relationships between the (potential) problems [DOG05, p39].

Comparison of Root Cause Analysis Tools

All of the three root cause analysis tools; the cause-and-effect diagram (CED), the current reality tree (CRT) and the interrelationship diagram (ID), can produce root causes in a given case. However, each tool has its unique traits.

Doggett tries to identify the best tool for root cause analysis by comparing the root cause analysis tools statistically, but was not able to identify one best tool [DOG04, p7-8]. He did however identify that using a CRT was more difficult to use for first-time users and takes longer to come up with a root cause than by using CED or ID [DOG04, p5-6]. On the other hand, the ID and CED tools lack a formal critical evaluation system which the CRT tool does possess [DOG04, p7].

Using the CED tool, it was easier to find cause categories [DOG04, p5], but it was harder to pin down specific root causes, in which the ID tool proved to be easier [DOG04, p6].

The ID tool shall be used throughout the thesis, since I am a first time user of root cause analysis tools and the added value of easier finding of cause categories did not apply since finding these categories was not deemed necessary.

Appendix D – Survey

General Information

What is your role in relationship to the Calculator projects?

Select a project role or fill in your role on the dotted line. And to which project does this role relate? There is room to comment on the project role.

Configuration Calculator	Packaged Offerings Calculator	SpreadSheet Calculator	
			Project Sponsor
			Project Management
			Project Team Leader
			Project Team Member
			....
			....

....
....

What problems do you see with the projects?

Which of the following areas contains the most problems related to the Calculator projects? Please rank the top 3 problem areas, with ´1´ being the most problematic area, and ´2´ being of next most importance, etc.

#	Area
	Commitment (i.e. expectations)
	Communication (i.e. collaboration)
	Environment (i.e. transformations)
	Methods (i.e. project management)
	People (i.e. roles & responsibilities)
	Quality (i.e. measurement)
	....

If explanation is needed, please describe the problem(s) in the top 3 areas.

....
....

What are, according to you, the foundation(s) of these problem(s)?

....
....

Project Approach

Please select if the described situation is applicable (1), slightly better (2), better (3) or the opposite (4) in the current situation. If you not know, please select the last option (5).

	Situation:	1	2	3	4	5
1	The project end result is not clear.					
2	The requirements are not prioritized.					
3	There are no clear milestones.					
4	Decision-making is done without proper impact analysis. (impact on project boundaries or quality)					
5	Decisions are made ad-hoc.					
6	Decisions on uncertain aspects are postponed.					
7	The uncertain aspects are underexposed.					
8	There is no clear risk management.					
9	Prevailing ´Act first, think second´ approach.					
10	A lot of talking, but no collaboration.					
11	The break-down in activities is unsatisfactory tuned to the specific nature of the project.					
12	Control is based too much on a single aspect (time, budget or performance)					
13	The planning (activities, time schedule & budgets) has to be changed too often.					
14	The planning is constantly too optimistic.					
15	Changes in specifications take place uncontrollable.					
16	Roles, responsibilities and authorities of project stakeholders are unclear.					
17	There are not enough resources available for the project.					
18	The project management is not informed on exceptional situations.					

You can comment on the above questions if needed, please reference to the question number.

....
....

Project Team and execution

Please select if the described situation is applicable (1), slightly better (2), better (3) or the opposite (4) in the current situation. If you not know, please select the last option (5).

	Situation:	1	2	3	4	5
19	There is no team spirit in the project.					
20	Team members regard management as a bother.					
21	Project management is not involved.					
22	Cultural differences make it hard to work together.					
23	There is too much freewheeling.					
24	People are too inflexible.					
25	Personal conflicts lead to business issues.					
26	Business issues lead to personal conflicts.					
27	Project Management (PM) has too little support.					
28	Project Management provides too little support.					
29	Project Management has lost track of the overview.					
30	PM has not enough influence/power.					

You can comment on the above questions if needed, please reference to the question number.

....
....

Project Environment

Please select if the described situation is applicable (1), slightly better (2), better (3) or the opposite (4) in the current situation. If you not know, please select the last option (5).

	Situation:	1	2	3	4	5
31	The problems/needs of the users are not clear.					
32	Relationship between project initiation reasoning and the project end result is not clear.					
33	Too many people interfere with the project.					
34	The ownership of the project is not clear.					
35	The sponsorship of the project is not clear.					
36	Convincing users of the importance of the project (and their role in the whole) is difficult.					
37	Negotiations with the project sponsor(s) are difficult.					
38	Results of those negotiations are instable.					

39	Results of those negotiations are interpreted differently by each stakeholder.					
40	The requirements are under constant change.					
41	There are contradicting interests between sponsors.					
42	Other projects get in the way of the project.					
43	Priority of the projects is not clear.					
44	The project impacts on the users are not clear.					
45	Stakeholders have a hard time combining projects and relations with their (functional) support.					
46	Decisions are not made in time in the project.					
47	No interaction between project and its environment.					

You can comment on the above questions if needed, please reference to the question number.

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Comments and Suggestions

Please provide any comments and suggestions you may have regarding the project problems or the research.

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