CityUniversity of Seattle

Risk and Uncertainty in new Installation Projects

By

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This Master's Thesis is dedicated to my mother's memory and to my father, for his unlimited patience and encouragement during this course in Project Management.

Athens June 2010

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BIOGRAPHY

George Countouris studied at the Department of Mechanical Engineering of the school of Mechanical Applications (Mechanical Department of Piraeus Technological Institute). Before his graduation he worked as a laboratory assistant in TEI Piraeus and as an assistant designer in ERGO SA. Since 1996 he is working in an international company specialised in liquid foods packaging. He started as a service engineer and the last one and a half year has moved to the Project and System Performance Department where he has the title of Project Engineer but with full responsibility for the project that are accomplished in Greece. From this position he has a direct involvement during the whole project life cycle and he is facing a lot of unpredictable situations mostly related with technical issues or unanticipated customer requirements.

ABSTRACT

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Thesis title: Risk and Uncertainty in new Installation Projects

The company I am working for two years ago decided to create a new department in order to handle the projects in a more efficient way. This thesis tries to identify the potential risk events may occur in a capital equipment project by analyzing a survey that was performed in 2009 for all projects that were executed in South Europe.

The outcome of this thesis is a risk breakdown structure where all possible risk events are represented in a structured diagram for easier identification, furthermore statistical analysis was performed on the survey results for deeper analysis of the identified risks.

The analysis of the survey shows that most risk events arise from technical problems due to inadequate technical knowledge on specific technical issues.

The outcome of this thesis is developed in order to facilitate risk identification and can become a very useful tool for the project managers for the benefit of the company's goals.

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Chapter 1 – Introduction

1.1 Nature of the Study

The Company I am working for is an international leader in liquid food packaging. This research will examine the project execution performance in South Europe countries where it appears that there is space for improvement.

One of the factors that affect the success of a project is the customer. By experience I know that customers are more concerned about quality issues and less about time or cost, except some special cases, since in the projects we execute, budget is defined from the beginning and the main discussion is regarding the quality of the produced product and the performance of the filling equipment. From the data I have examined the conclusion is in most cases, the issues that occur are more frequently related with technical problems in different stages of the project or due to unpredictable customer's demands. From the company's side the same technical problems correspond with delay in project execution which results in cost overrun.

The uppermost ambition of this study is to improve customer satisfaction by the use of Risk Breakdown Structure and with the support of the relevant literature of risk management.

1.2 Needs Assessment

Customer satisfaction is a very important factor which insures good collaboration after the project finishes but also creates a very good environment for future cooperation.

A successful project is one where there is a balance between customer satisfaction from one side and a project execution within time, within cost and with the required quality. "Clearly most projects are conceived with a business perspective in mind, and often with a goal which is focused on better results and organizational performance more profits, additional growth, and improved market position". (Shenhar, Dvir, Levi, & Maltz, 2001, pp. 700-725).

1.3 Purpose of the Study

The goal of this thesis is to provide the project manager with a tool which will help to minimize project risk events that occur by addressing and identifying all the possible risks, with a final outcome a risk mitigation strategy that will ensure that both the customer and the organization will meet their long term objectives.

1.4 Significance to Your Workplace

All the unpredictable events that occur during the project execution have a negative effect on the projects progress and create a lot of uncertainty for the customer.

The result is unsatisfied customers, additional costs in order to solve the problems and finally internal frustration in the company. For all the above reasons it is very important that the project handling will improve which is the main reason of conducting this research.

The target is to create a tool for all project managers which will help them to know the possible risk events in every phase of the project and decide in advance which strategy to follow for each particular risk event.

The implementation and incorporation of the Risk Breakdown Structure in the project management process will improve the company's performance in the segment of project execution. In today's competitive environment the application of risk management tools and techniques is fundamental in order to improve customer satisfaction and simultaneously to keep the project profitability at a good percentage and thus to secure the growth of the organization. That's why they have shown their interest for the creation of this tool and also promised support by providing all the necessary data for the projects performed in South Europe during 2008.

1.5 *Relation to the Program of Study*

The subject of this thesis is in direct relation with the following theories of the project management:

- PM508. Project risks and decisions. The theory of risk management and identification, qualification and analysis of the risk events is the topic of this thesis.
- PM512. Customer in the project process. Customer satisfaction is the essential characteristic for a successful project since the customer is the number one stakeholder with a very important role during project execution whose needs and wants, if not properly handled, could create a lot of risks in the project.
- PM 503. Project communication management. This theory is very important because most of the organization risks are related with the communication interface internally in the organization but also externally with the customer.

1.6 Definition of Terms

Generally the terms that will be used in this thesis are those that are frequently used in the Project Management Literature. Some specific terms that will be used are defined bellow.

RBS. – Risk Breakdown Structure

WBS. – Work Breakdown Structure

Chapter 2 – Problem Statement

2.1 *Problem Statement*

Unpredictable issues that occur during the installation of new filling equipment might set the project execution into high risk.

2.2 *Rationale*

New Projects is a very important tool in order to secure the growth of a company. A successful execution of a new installation project has a very positive effect on the development of the company. It gives the company the possibility to meet its commitment towards the customers and secure global competitiveness by delivering high quality products or services. On the other hand a failure in the project execution has a negative impact and sets the future of the company in a very critical situation due to today's very competitive business environment.

The issue is that the average customer satisfaction from the installation experience is quite low due to unpredictable events that occur during the implementation of an installation project. The reason for this is that the company I am working for, although it is a very big international organization, has started the implementation of project management tools and techniques only during the last years.

2.3 Objective

The goal is to clarify and address all the risks that affect the overall customer satisfaction throughout the whole project life cycle, analyze them, identify the areas that need improvement and finally recommend solutions in order to improve the company's performance in the segment of project execution.

The outcome of this research will be a risk breakdown structure diagram where all the risk events and the customer's comments will be documented and categorized. The conclusions will

be announced to all the project team members with final aim to drive a continuous improvement program in order to improve customer satisfaction regarding the project execution. The significance of the above mentioned issue is of huge importance for the future development of the company and this is the reason I was asked to conduct this research.

Chapter 3 – Literature Review

3.1 Overview

"Risk management is about defining sources of uncertainty (risk identification), estimating the consequences of uncertain events/conditions (risk analysis) generating response strategies in the light of expected outcomes and finally based on the feedback received on actual outcomes and emerged, carrying out identification analysis and response generation steps repetitively throughout the life cycle of a project to ensure that the project objectives are met". (Dikmen, Birgonul, 2008, p. 42) In the figure that follows we can see a schematic presentation of the different phases of risk management

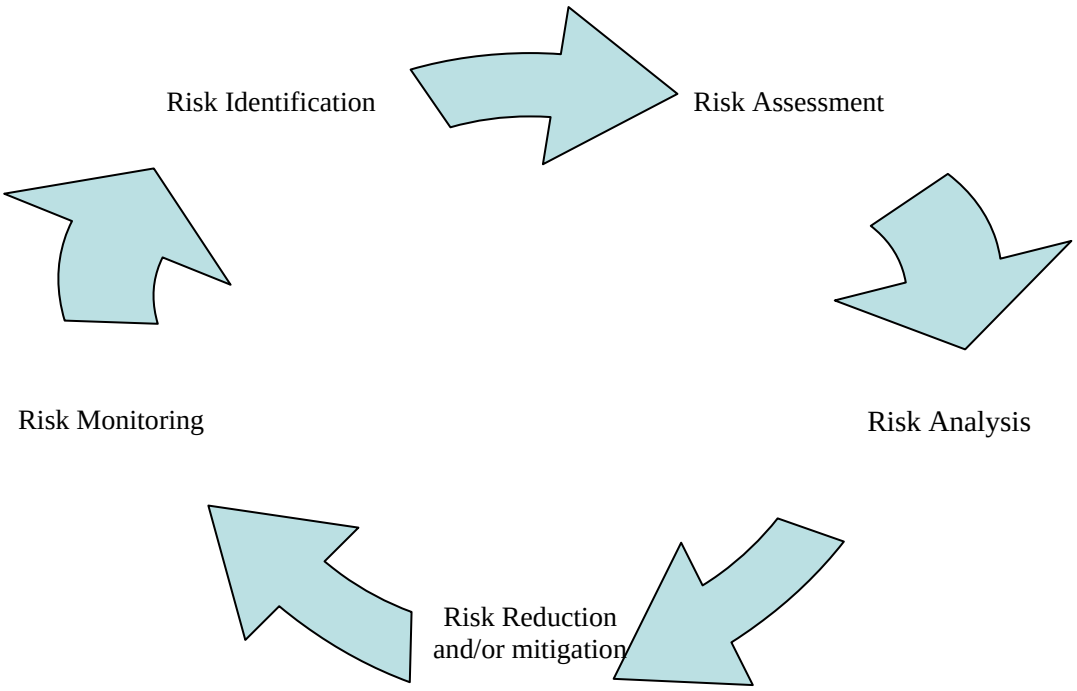


Figure 1: Phases of Project Risk Management

In order to follow the project risk management procedures in the installation projects I am executing, special attention was given to categorize the risks depending on the source of its

particular risk event that has occurred. Depending on the sources of risk, risks are classified as internal and external. The sources of external risks for an organization can be the inflation, exchange rates or specific governmental decisions. Such risks are excluded from the discussion of project risks because we consider that the environment where the projects are taking place is stable from social and political point of view and thus we are examining mainly the internal risks that are affecting the project.

Before we enter into the identification phase where we will decide which of the possible risks might affect the project there is the risk classification. From the literature I found a lot of different methods for classifying risks. “Perry and Hayes give an extensive list of factors assembled from several sources, and in terms of risks retainable by contractors, consultants and clients. Cooper and Chapman classify risks according to their nature and magnitude, grouping risks into the two major groupings of primary and secondary risks. Tah al. use Risk Breakdown Structure to classify risks according to their origin and to the location of their impact in the project.” (Carr, Tah, 2001, p. 848).

In this thesis I am going to create the RBS which will provide me with very useful information about the distribution of all possible risk events throughout all project phases.

Final and more important are the lessons learned from the usage of the above tool and furthermore the practical implementation in the project execution.

3.2 Risk Categories

“Project risk is an uncertain event or condition that, if it occurs, has an effect on at least one project objective. Objectives can include scope schedule, cost and quality. A risk may have one or more causes and if it occurs it may have one or more impacts” (PMBOK Guide 2008, p. 275).

There are three main categories of risks which can appear during the project life cycle of an installation project:

- Organizational risks. This type of risks has to do either with the organizational structure of the company and the influence on the project management or with the performance and the role of project manager during the whole project life cycle.
- Technical risks. This type of risks appears in every phase of the project from the contract phase where we have the technical specification of the equipment till the execution phase where the technical performance is very important. “Projects face technical risks that reflect their engineering difficulties and novelty: some of the risks are inherent in the designs or technologies employed”. (Miller, Lessard, 2001, p. 439)
- Commercial risks. This type of risk refers mainly to the risks that are arising during the discussion regarding the contract terms and secondly due to the perception the customer has regarding the value of the project deliverables.

Since by experience we know the different categories of risks that can occur during the project execution, the next step is to identify the risks. This will be achieved with a questionnaire which will be distributed to at least two different persons from the customer side since the customer is the most important stakeholder, who has direct involvement throughout the whole project life cycle.

3.2.1 Organizational risks

Organizational structure is the frame that determines the hierarchy inside the organization. An organization depending on its objectives and in order to be effective in achieving its goals can be structured in a wide range from functional to projectized.

In this chapter I am going to examine how the matrix organization structure affects the project management processes and any potential risks might be revealed due to this organizational structure.

In the balanced matrix organization the role of the project manager is to coordinate the activities of a project team which is changes from project to project. This temporary project team setup has become the source of many potential risks to appear during the project life cycle which are the following:

- Little commitment on the project objectives. Commitment to the project objectives is directly related with the trust and the team spirit between project team members. This can be achieved in a steady cooperating workplace where emphasis is given in the creation of mutual trust and not in the temporary working environment which lasts as long as the project exists.
- Less cooperation between the members of the project team. “The key to the successful application of Industrial Product Development is the achievement of genuine cooperation between project members. This involves collaboration both within departments and between departments, and often means the development of a new organizational culture that emphasizes cooperation and teamwork.” (Hovmark, Nordqvist, 1996, pp.390). Good cooperation means better working environment with less conflicts between team members with the final outcome, improved productivity during project life cycle.
- Small degree of autonomy for the project manager and the project team members. When in the project work there is involvement from several departments, there is high risk that the decision process will be prolonged. Furthermore the involvement of people from different departments in the decision process might not be the best for the project but instead to be more beneficial for the people who influence the decision.

- Diminished responsibility of the project manager. The project manager's role should be the acquiring of the project team members and furthermore the overall planning and coordination of the project work in such a way to avoid any possible delays in the project work or conflicts between team members and finally to coordinate the project work with the rest of the organization. Instead of this many times the project manager has to negotiate with the functional manager in acquiring the right project team members while during the planning there is also involvement from the functional manager since he is providing the team members and he is aware of their availability. Finally sometimes there is influence from the functional manager even in the decisions procedure due to the very good technical knowledge he has or due to the long cooperation with some of the project team members.

In conclusion the project that was governed by a functional or weak matrix organization is usually suffering from "weak team coherence, poor team spirit, and fragmented communications." (Hobday, 2000, pp. 882)

3.2.2 Technical risks

For project managers it is very important to identify risks early in the project development process. Early risk identification is giving the opportunity to the project managers to create risk mitigation strategies in order to maintain and improve if possible the financial profitability of the project.

Technical risks are mainly connected with the implementation of advanced technology in the projects. Project managers in order to obtain competitive advantages and achieve better performance they often use advanced technological applications. However the usage of advanced technology especially when it is not intergraded properly might create unforeseen technical problems which cannot be controlled and also produce negative financial results.

Another category of technical risks is related with engineering difficulties during the execution phase of the project. This type of risk is arising due to complexity of the system or to unpredictable technical failure of the equipment.

The result of both categories of technical risk if occurred is delay in the project schedule which results in cost overrun.

3.2.3 Commercial risks

Commercial risks in our projects are arising mainly due to the existence of the contract. The purpose of the contract is to create a cooperating project organization for all participants in order to achieve the project deliverables that are described in the contract. “The design of the project contract has a major impact on the economic success of both parties in their attempt to maximize their upside or protect themselves from a downside. Considering the impact of the contract top management of the respective parties should be involved in supervising contract negotiations and design.” (Branconi, Loch, 2001, pp. 119). Commercial risks that are occurring during the project life cycle are related first with the discussions between the contractor and the client regarding the content of the contract and second with the observance of the rules of the contract.

3.2.3.1 Fixed price contract

The most common type of contract which governs engineering projects is the fixed price contract. Fixed price contract is chosen by the company I am working for as standard type of contract under which all projects are being executed.

Fixed price contract is the simplest form of payment agreement between the contractor and the client. “With a Fixed price contract the client pays a fixed price to the contractor regardless of

what the contract actually costs the contractor to perform in theory. The contractor carries all the risk of loss associated with higher than expected costs in theory, but benefits if costs turn out to be less than expected." (Ward, Chapman, 1994, pp. 49)

Eight are the fundamental factors that are described in a contract:

- Fulfilment of technical specifications. In the contract there is a separate chapter where the technical specifications and a description of the final product are provided.
- Price, cost estimates. A detailed price list is provided for all the equipment specified in the technical specification chapter of the contract plus the services needed for the accomplishment of the project deliverables.
- Payment terms. In the sales agreement the payment terms are specified for example the percentage of the down payment or the payment upon the equipment delivery. Usually the payment dosages are connected with critical milestones affecting the project execution.
- Project schedule. Critical milestones are specified such as equipment arrival, mechanical completion or commissioning that are vital during the project execution.
- Performance guarantees (Liquidated damages). In order for the contractor to prove that the delivered equipment is performing according to the technical specifications, the performance is measured and if the specified figures are not reached then liquidated damages are applied.
- Warranties. Warranties are applied for a period of twelve or twenty four months in order to secure the performance of the delivered equipment. During the warranty period the contractor has to make sure that everything is performing according to the contract otherwise claims could be issued.

- Limitation of liability. Limitation of liability is a way to protect the contractor in the event of a breach of any warranty or obligation by specifying a maximum aggregate liability which can not exceed the total value of the contract.
- Securities. Both sides client and contractors are demanding securities to secure their investment. The client is asking for a bank guarantee from the contractor who demands for a letter of intent to secure his financial exposure due to the order of equipment.

The fixed price contract is chosen because it is proved that it can fulfil these eight fundamental factors very effectively and also for two more reasons which are related with the nature of this type of engineering projects:

- Low uncertainty for the final product
- Medium uncertainty of the process for delivering the product

Low uncertainty can be explained from the fact that over the last years serious improvements have been made in the performance of the filling equipment which is beneficial during the project execution. Of course even if the risk is medium due to the above mentioned reasons the client accepts to pay a little more to cover this uncertainty.

The advantage of this type of contract for the client is that it allocates all the responsibility to one main contractor who takes all the risk to provide the project deliverables. Therefore the contractor is motivated to keep the cost as low as possible by increasing the efficiency during the project execution. Furthermore since in this type of contracts there is no adjustment in price unless there is a demand for a scope change the contractor seeks for opportunities which will require a variation order to be made.

On the other hand the client has a risk of low quality of work during the project execution unless this is not specified properly in the contract.

3.2.3.2 Value for money

Value for money is the term used to define if an organization has obtained the maximum benefit from a service or a project. Value for money does not only measure the cost of the project but also accounts the mixture of cost, value, quality, resource usage and fitness for purpose.

So value can be expressed with two basic parameters, cost and worth. Cost is defined as the amount spent for performing the project plus the resources used. Worth for the investor is the economic value of the project and its contribution to the organization's objectives. If the project outcome is not aligned with the organization's strategy then most possible it will not provide any value. So the value for an investment can be represented as:

Value = Worth / Cost

Therefore value can be increased by increasing the worth or by decreasing cost. In order to achieve the best possible value for money outcome from a project the organization needs to focus on the following key aspects:

- Strengthen project management by making efficient planning and ensuring that planning is realistic and prepared as early as possible in order to save time and resources in the long run. Furthermore by making better assessment, management of risk and prepare a reliable contingency plan when needed.
- Reduce complexity and bureaucracy by trying to simplify complex processes which are increasing costs and the likelihood of error. Also reduce bureaucracy in decision making processes or activities for further reduction of the project cost.

- Improve productivity by better matching of resources to work load and better work allocation. Also benchmark activities and services against other similar activities in order to identify excessive costs and poor performance.
- Become commercially astute by making more efficiently procurement following the contract strategies. Also try to provide better value to the customers through the contracts and not just a lower price.
- Timely implementation of new policies and good practice examples whenever it is necessary.

3.3 Risk Breakdown Structure

The tools and techniques suggested by the PMBOK 2008 if applied in our case will provide a list of possible risks which will not be structured or organized, with result that the project manager cannot focus on the specific risk events which are most likely to occur in a certain phase during the project execution. The only possible way to have the data collected and analysed is by the creation of the RBS. Like the Work Breakdown Structure the RBS will provide the project manager with a very useful guide for the risk management progress. “The benefits of using the RBS are then outlined, including as an aid of risk identification or risk assessment, comparison of projects, providing a framework for cross-project risk reporting and constructing lessons to be learned for future problems” (Hillson, 2003, pp. 85-86).

As we already know the WBS provides a hierarchical structure of the project starting from the major tasks and continues until we reach the project deliverables. At the same time the RBS provides a hierarchical structure of risks on the project. “The combined use of WBS and RBS can be used to generate a matrix structure, which allows the project team to manage the risk

at a level of detail appropriate to the specific business context". (Hillson, Grimaldi, & Rafele, 2006, p. 63).

This tool will help project managers to understand and focus on the areas where most of the risk events appear and especially in my case where the projects are similar, create in the beginning of each project a reliable risk management plan, track and control the project more efficiently. The main usages and benefits of the RBS are the following:

- Risk identification aid. A risk identification checklist can be developed in order to identify a number of potential risks in each phase of the project execution.
- Risk assessment. Identified risks can be categorised by their source in order to find areas of risk concentration within the RBS.
- Comparison of projects. "The RBS allows risks identified on each project or tender to be structured in the same way, permitting direct comparison" (Hillson, 2003, pp. 3-4)
- Risk reporting. "The RBS can be used to roll up information on an individual project to higher level for reporting to senior management, as well as drilling down into the detail required to report on project team actions" (Hillson, 2003, pp. 3-4).
- Lessons learned. "One of the most difficult tasks in the post-project review is to structure the information so that it can be referenced and used for future projects" (Hillson, 2003, pp. 3-4)

3.3.1 Risk identification aid

Identification phase is the most important phase of the risk management process. The aim of this phase is to identify all possible risk events and their generic causes. This phase is starting by creating a list which contains possible risk areas during the project life cycle that might give us unpredictable risk events.

In this phase the whole management team should participate by answering questionnaires, filling checklists, collecting information from various stakeholders, making long discussions between project team members, visiting customers and acquiring information covering all the areas of the project. By doing that all macro risks would be identified and then with the aid of the WBS, which is a very useful tool for the risk identification because it is helping the project team to discover possible risk events, the project team would be identifying all possible risk events in every phase of the project.

Now with the creation of the RBS the project manager has a very useful tool as a guide for a more effective risk identification process. The benefits of the usage of the RBS in the identification phase of the risk management are the following:

- With the use of the RBS it is very easy to identify the potential sources of risks and thus to plan accordingly the mitigation or elimination of the consequence.
- Also it is much easier to clarify the inter-relationship between the risks and thus to identify the cause and the consequence of each particular risk event.

3.3.2 Risk assessment

The second phase in the risk management process is the risk assessment. During this phase potential risks are analysed and defined. The major characteristics that are examined for each particular risk event are the following:

- Probability of occurrence
- Severity of the impact

During risk assessment we are trying to quantify the probability of a specific risk event to occur and also the severity of the impact in the project objectives. As a result these two characteristics can be represented numerically by giving numerical values for example from 1 to

5 or by using variables such as low, medium and high. The outcome of this procedure is the risk assessment matrix which can be found in table 1.

This risk matrix is a small sample of the risk matrix created for an installation project where different risk events are identified. The probability is assigned with linguistic values which corresponds to numerical values with the following ratio 5= High, 3 = Medium and 1 = Low. The result of the multiplication between probability and impact is the effect. Any risk which has a score bigger than 10 should be further analysed and different strategy should be followed in order to reduce the effect of the risk event in the project objectives.

Table 1: Risk Matrix

RISK MATRIX						
Risk ID	Risk Description	Impact	Probability	Impact	Effect	Strategy
1.1	One of the filling equipments is prototype	Possible delay due to unpredictable technical problems	HIGH	4	20	5
2.1	New and sophisticated technology is incorporated in filling machine	Longer learning period for the operators of the equipment	LOW	4	4	2
3.1	Highly demanding and not very cooperative customer	In customer relationship	MEDIUM	4	12	3
4.1	Poor hygienic conditions and not enough quality control.	Quality of the final product in the market	HIGH	3	15	5

Strategy		**TetraStop**
1	Accept the risk	
2	Avoid the risk	**Project: Tetrastop**
3	Monitor the risk and prepare contingency plans	**Date: 12/10/2008**
4	Transfer the risk	**Prepared By: Team**
5	Mitigate the risk	**Risk Matrix Spreadsheet**

One very useful tool which can be used as an aid in the risk assessment is the RBS. “RBS is proposed in the case of large scale program risk management as the main tool to structure the information and aid comprehension. The RBS can assist in understanding and distribution of risks in a program or project, aiding in effective risk management.” (Zacharias, Panopoulos, Askounis, 2008, p. 175). Further to the above the RBS is very useful because the identified risks are categorized by their source. By doing this the project manager can very easily recognize areas of risk concentration in a project and prepare solutions accordingly.

Of course all risks do not have the same significance but with the assistance of the risk matrix and the calculation of the effect of each particular risk the project manager is able to rank the risks. The benefits of the categorization of risks are the following:

- Understand the type of risks that are affecting the project
- Find the root cause of each risk event
- Concentrate on the phases of the project where most of the risks events occurred
- Provide direct solution to the root cause of the risk
- Faster response from the early stages of the project

3.3.3 Comparison of projects

A project is very complicated and unpredictable work. It would be great for the project managers if we could discover a tool which will help them to identify early in the beginning of the project if it will be successful or not.

“Traditionally evaluation of projects results has been based on whether or not the project objective achieves its goals on time and within budget.” (Andersen, et all 2002, p. 602) This however is a very narrow way of describing the outcome of a project. In the literature three categories of criteria are identified to be connected with the success of a project:

- Project goals achieved
- Learning and motivation
- Project purpose achieved

Nowadays with the usage of the Risk Breakdown Structure there is one more tool which facilitates the project comparison and evaluation. The RBS can be used more for comparison between multiple projects which are occurring under a similar environment. A similar environment means that the outcome is similar or the project is performed under the same organization.

The comparison itself is based on a structured risk comparison which allows the project manager to compare future projects based on the risk identification list which is obtained from the risk breakdown structure. This is a very proactive approach for project evaluation and comparison based on the risk exposure of individual projects and not in the outcome as many other methods use.

3.3.4 Risk reporting

Risk reporting is one of the project manager's duties towards the senior management. The RBS is creating a structured list of risks spread throughout the whole project and this gives the opportunity to the project manager to early create a detailed report of all possible risk events. The benefits of risk reporting are the following:

- Improve communication and flow of information within the organization.
- Reinforcement of risk management role in the organization.
- Distribution of the appropriate information to different levels in order to obtain the right objectives. Different levels could be the various departments of the organization like financial or technical.

- Tool for making decisions
- Link risk management with the steering group of the organization with result the creation of a competitive advantage.

3.4 Lessons Learned from the RBS

Learning is a very important procedure which helps companies to overcome some of the difficulties that have faced in the past by proposing a new way of dealing with risk events. “By concentrating on the learning part companies may conceive risk management as a contributor to their performance along their learning and growth perspective rather than a standalone process carried out to predict what may go wrong in a project.” (Dikmen, et all 2008, p 43).

RBS is one of the tools that is used to facilitate the lessons learned, a function which is essential for every company to do in order to improve its performance regarding the project handling. This is done because the RBS can be identified as a risk storage memory where all risk information is stored and thus it is possible to retrieve this information any time needed for risk evaluation.

Furthermore another benefit of the usage of the RBS which I think is the most important is that it gives the opportunity to the organisation to review all the information about the risk events and “the ability to turn traps into advantages suggests that much of the technical risk in a program can be actively handled via a risk handling control not merely watched and resolved after problem occurs”. (Kerzner, 2006, p.750).

Chapter 4 – Methodology

4.1 Overview

The purpose of this research is to create a risk breakdown structure. Since the final outcome of this thesis is something tangible then this thesis will be a development thesis. In order to develop the RBS I need to identify all possible risk events that have occurred during the whole project life cycle of an installation project which are the following:

- Contract phase
- Equipment delivery
- Mechanical assembling of equipment
- Commissioning of equipment
- Performance validation
- Project closing

A detailed Work Breakdown Structure for an installation project can be found in appendix A.

The risk breakdown structure will be obtained by analysing a survey which has been conducted in 2008 for all projects that were executed in South Europe (Spain, France, Italy, Romania, Bulgaria and Greece). An internet link in order to perform the survey was distributed to at least two persons from each customer. These persons had direct involvement during the whole project life cycle each one with different role and their input is very critical for the risk identification process. The total amount of projects that were analysed is thirty four and the number of respondents is 96 as shown in table 2 that follows.

Table 2: Survey respondents

Year	Respondents	Number of Projects
2008	96	34

The survey was developed considering the objectives of the organization but also the findings from previous projects with final aim to improve the performance of the organization in the project execution. The survey comprises questions from all project phases and is divided in the following sections:

- Overall Evaluations
- Contract Phase
- Equipment Delivery
- Mechanical Completion
- Commissioning
- Performance Validation
- Project Team
- Survey Evaluation

The aim is to identify the risk events from each project phase in order to drive improvement programs when necessary. The survey was done through the internet because it is cheaper and much faster. The outcome of the survey is a list of customer's grades in specific questions and comments regarding events that occurred during the whole project life cycle. A detailed copy of the survey can be found in Appendix C.

The analysis of the complete survey requires first to read carefully each survey and then try to identify all the risk events that have occurred in each phase of the project. For each survey

a detailed data card was created where all risk events that occurred were included. The next step is the creation of the risk catalogue which provides us with a list of all the risk events that had occurred and in the final step based on the risk catalogue we obtain the risk breakdown structure. The source for the creation of the RBS is the risk catalogue. The RBS is defined as “A source-oriented grouping of project risks that organizes and defines the total risk exposure of the project. Each descending level represents an increasingly detailed definition of sources of risk to the project” (Hillson, 2002a, p. 2).

In order to create the risk catalogue and finally the RBS I am going to use the qualitative method instead of quantitative for the following reasons:

- Lack of historical data from previous projects
- Qualitative method is better when we are trying to discover the existing problems in a project
- The amount of projects we are examining is not so big with the result that the quantitative analysis will not provide us with secure results
- The qualitative method is preferred in smaller projects like those we are executing in the company I work for.
- Qualitative method is giving very good results in an unsteady environment with continuous technological changes and innovations.

More specifically after reading carefully each survey I will create a data card for each risk event that has occurred. This data card will contain the following data:

- Project name
- Risk event description
- Identification of the phase of the project where the risk event occurred.

- Cause and consequence of the risk event.

A detailed data card for one project can be found in figure 2.

The next step is the risk classification. “The subject of classification is to establish a cause and effect connection for risk events themselves, as well as for those with the project life cycle and work breakdown structure.” (Aleshim, 1999, p. 209).

The risk classification phase starts with the creation of the risk catalogue. After reading and examining very carefully the data card for each project I choose to fill the risk catalogue with all potential risk events that have been identified based in two characteristics reasons. The first reason is the low grade the customer had scored for specific events that occurred during the project life cycle. The second reason is the customer’s comments or remarks regarding certain altitude or reaction to unpredictable events that occurred.

A small part of the risk catalogue can be found in table 3. The items that are included in the risk catalogue are structured by project name, name of risk event, phase of project where the risk event occurred, work breakdown structure element in order to connect the RBS with the WBS and finally the possible reason and consequence of each particular risk event.

After finalizing the risk catalogue I will be able to structure the risks in a hierarchical representation according to the connection between the risks with final outcome a structured hierarchical system which is the RBS.

In order to perform a deeper analysis of the issues that occur during the project life cycle we are going to perform except qualitative also quantitative analysis. This will help us to focus and identify the risk events that appear more and thus to make the right conclusions and recommendations in order to improve the company’s performance in the segment of projects.

Table 3: Risk Catalogue for an installation project

	Project Name	Name of risk event	Phase of Project	Work breakdown structure elemen	Reason and Consequence
1	ARCHIPIELAGO	Packaging Line Layout Meeting Requirements	Mechanical Completion	1,3	Bad measurements, more operators to cover production
1	ARCHIPIELAGO	Poor training provided	Commissioning	1,4	Trainer not update
1	ARCHIPIELAGO	Performance figures	Performance Validation	1,5	Problems in the filling equipment
1	ARCHIPIELAGO	Lack of Spare parts store in Local country	Overall Opinion	1,7	Factory based on island
2	ALBALACT	Better communication, Inflexibility on special demands	Overall Opinion	1,7	?
2	ALBALACT	Poor training provided	Commissioning	1,4	?
3	CORALIS	Understanding Requirements	Contract Phase	1,1	Sale person knowledge
3	CORALIS	Explanation of how performance is measured	Performance validation	1,5	Knowledge of performance figures
3	CORALIS	Meeting Defined performance expectations	Performance validation	1,5	Cap 30 malfunction
3	CORALIS	Problem solving	Performance validation	1,5	Not enough experience in Cap30
3	CORALIS	Claim Handling resolution	Project team	1,6	?
3	CORALIS	Amount of training provided	Commissioning	1,4	
4	Carne 3000	Technical problems in A3/Flex and TCBP-70	Overall opinion	1,7	?
4	Carne 3000	Amount of training provided	Commissioning	1,4	
4	Carne 3000	Explanation of how performance is measured	Performance validation	1,5	Knowledge of performance figures
5	Caviro	Definition of how performance is measured	Performance validation	1,5	Preject manager should explain this
6	Centrale del latte di Vicenza	Clearly stated deliverables	Contract Phase	1,1	
6	Centrale del latte di Vicenza	Problem solving/issue resolution	Equipment Delivery	1,2	
6	Centrale del latte di Vicenza	Packaging Line Layout Meeting Requirements	Mechanical completion	1,3	wrong measurements, small area for operators
6	Centrale del latte di Vicenza	Problem solving/issue resolution	Mechanical completion	1,3	Poor knowledge of the filling machine
6	Centrale del latte di Vicenza	Definition of how performance is measured	Performance validation	1,5	
6	Centrale del latte di Vicenza	Professional/Knowledgeable/Competent Staff	Project team	1,6	Limited knowledge of the machine
6	Centrale del latte di Vicenza	Problem solving/issue resolution	Performance validation	1,5	
7	CIDACOS	Problem solving/issue resolution	Mechanical completion	1,3	poor technical knowledge
8	Clesa	Completeness	Equipment Delivery	1,2	Not enough info on the necessary unloading equipment
8	Clesa	Project Management	Project Team	1,6	Wrong measurements
9	Conserve Italia	Package appearance(bad formation)	Commissioning	1,4	Design problem

Figure 2: Example of Project Data Card

RISK EVENT IDENTIFICATION

Part A
Project: Cotre Bianca

Contractor:

Description of risk event
Customer is not satisfied from the training provided

Part B
Phase of Risk event

Project Phase	**WBS Code**
Commissioning	1.4

Part C

Risk event Cause and Consequence

Cause of risk event	**Consequence of risk event**
Bad Planning	Operator's poor performance due to insufficient training

Part D
Reference to Project Documentation

Project Documentation
1. Operator's Manual 2. Project plan 3.

Chapter 5 - Results

5.1 Results from the literature review

Similar surveys have also been conducted for other companies which had evidence that showed their company was not efficient in project execution and at the same time was not customer focused. The results from a survey that was done for Westinghouse (Bacon, 2007, p.351) show the following areas where customer was less satisfied than the company was expecting:

- Customer interface. There is no clear communication strategy between Westinghouse and the customer.
- Invoicing. Customers felt that Westinghouse's invoicing policy was wrong, not clear and therefore not actionable.
- Lead times. In one service area, customers felt that quoting and delivering time was too long and also the time required to solve technical issues was too long.
- Technically proactive. The Company was not following a proper scheduled maintenance system resulting in low performance of the equipment.
- Project management. Similarly, Westinghouse was not viewed as being proactive in responding to or resolving emerging issues.

Another survey which was performed for a construction company showed four areas which can produce risk events during a project life cycle. These areas are the environment, industry, company and the project itself. The outcome of the risk analysis performed for these areas of risks is the Risk breakdown Structure in Figure 3.

Figure 3: RBS for construction Design

LEVEL 0	LEVEL 1	LEVEL 2	LEVEL 3
Project risk	Environment	Statutory	Planning approval delay
			Legislation changes
			Ecological constraints
			…etc…
	Industry	Market	Increase in competition
			Change in demand
			Cost/availability of raw materials
			…etc…
	Client	Client team	Client representative fails to perform duties
			No single point of contact
			Client team responsibilities ill-defined
			…etc…
		PM team	Inadequate project management controls
			Incorrect balance of resources & expertise
			PM team responsibilities ill-defined
			…etc…
		Targets	Project objectives ill-defined
			Project objectives changed mid-design
			Conflict between primary & secondary objectives
			…etc…
		Funding	Late requirement for cost savings
			Inadequate project funding
			Funds availability does not meet cashflow forecasts
			…etc…
		Tactics	Brief changes not confirmed in writing
			Change control procedure not accepted
			Unable to comply with design sign-off dates
			…etc…
	Project	Team	Poor team communication
			Changes in core team
			Inadequate number of staff
			…etc…
		Tactics	Cost control …
			Time control …
			Quality control …
			Change control …
		Task	Site…
			Design…

From R.J. Chapman: International Journal of Project Management: Volume 19 ,issue 1999, p 154.

As we can see the RBS is composed from four different levels. Level one represents the area where risks events are occurring, in level 2 the work package is defined and in level three the risk event is identified.

Another application of the risk breakdown structure can be found in the large scale programs. The importance of this kind of programs is very high because it affects the national economy. Despite their importance there is no clear framework regarding the risk strategy that should be followed. Risk breakdown structure was used for a Greek CSF III (Program of Community Support Framework III) large scale program in order to facilitate risk analysis. The result is shown in figure 4.

Figure 4: RBS for Greek CSF III

Level 0	Level 1		Level 2		Level 3	
PROGRAM RISKS	A	Management	I	Operational Program Managing Authority	1	Organizational Structure & Culture
					2	Experience
					3	Procedures Knowledge & Observance
					4	Projects Approval
					5	Projects Monitoring
					6	Projects Auditing
					7	Internal Control & Quality Assurance
					8	Equipment & Resources
					9	Support Environment
			II	Project Implementing Bodies – Final Beneficiaries	1	Organizational Structure & Culture
					2	Experience
					3	Procedures Knowledge & Observance
					5	Projects Monitoring
					6	Projects Auditing
					7	Internal Control & Quality Assurance
					8	Equipment & Resources
					9	Support Environment
	B	Projects Implementation	I	Planning	1	Public Consultation
					2	Goals – Benefits
					3	Stakeholders
					4	Maturity – Studies
					5	Operability
					6	Project Type
					7	Complexity
					8	Technology
					9	Environmental Impact
					10	Licensing
					11	Project Site – Ownership
					12	Sub-Projects
					13	Consistency & Complementarities with other Projects
			II	Contract	1	Clarity and Completeness of Tender Documents
					2	Tendering Procedure
					3	Time – Schedule
					4	Penalties
			III	Construction / Implementation	1	Employees
					2	Logistics
					3	Sub-Contracting
					4	Insurance
					5	Health & Safety
					6	Quality Assurance
			IV	Operation	1	Maintenance
					2	Consistency & Complementarities with other Projects
	C	External	I	Unforeseen Circumstances	1	Natural Disasters
					2	Terrorism – Vandalism
			II	Political	1	Legal & Regulatory Framework
					2	Management Framework
					3	Elections – Governmental Change
					4	International Relationships
			III	Economic	1	Fiscal Policies
					2	Inflation
					3	Government Fiscal Framework
			IV	Social	1	Labor Market
					2	Traditions & Biases
	D	Operational Program Planning	I	Goals	1	Overestimate of Goals
					2	Goals Ranking and Evaluation
					3	Timetable
			II	Budget	1	Fund Raising of Private Capitals
					2	Sufficiency of Resources
			III	StakeHolders	1	Clashing Interests
					2	Coordination of Involved Parties
					3	Insufficient Information Flow & Identification of Issues

From O. Zacharias, D. Panopoulos, D. Askounis : European Journal Economics, Finance and Administrative Sciences :issue 12, p 176.

5.2 Results from the interviewers

The survey was completed by managers and directors from 34 customers from projects that executed in South Europe. The total budget for each project was more than 1.000.000 €. All the respondents had adequate knowledge of the project objectives and direct involvement in many phases. Most of them were technical or production managers, some were site managers and a few factory owners.

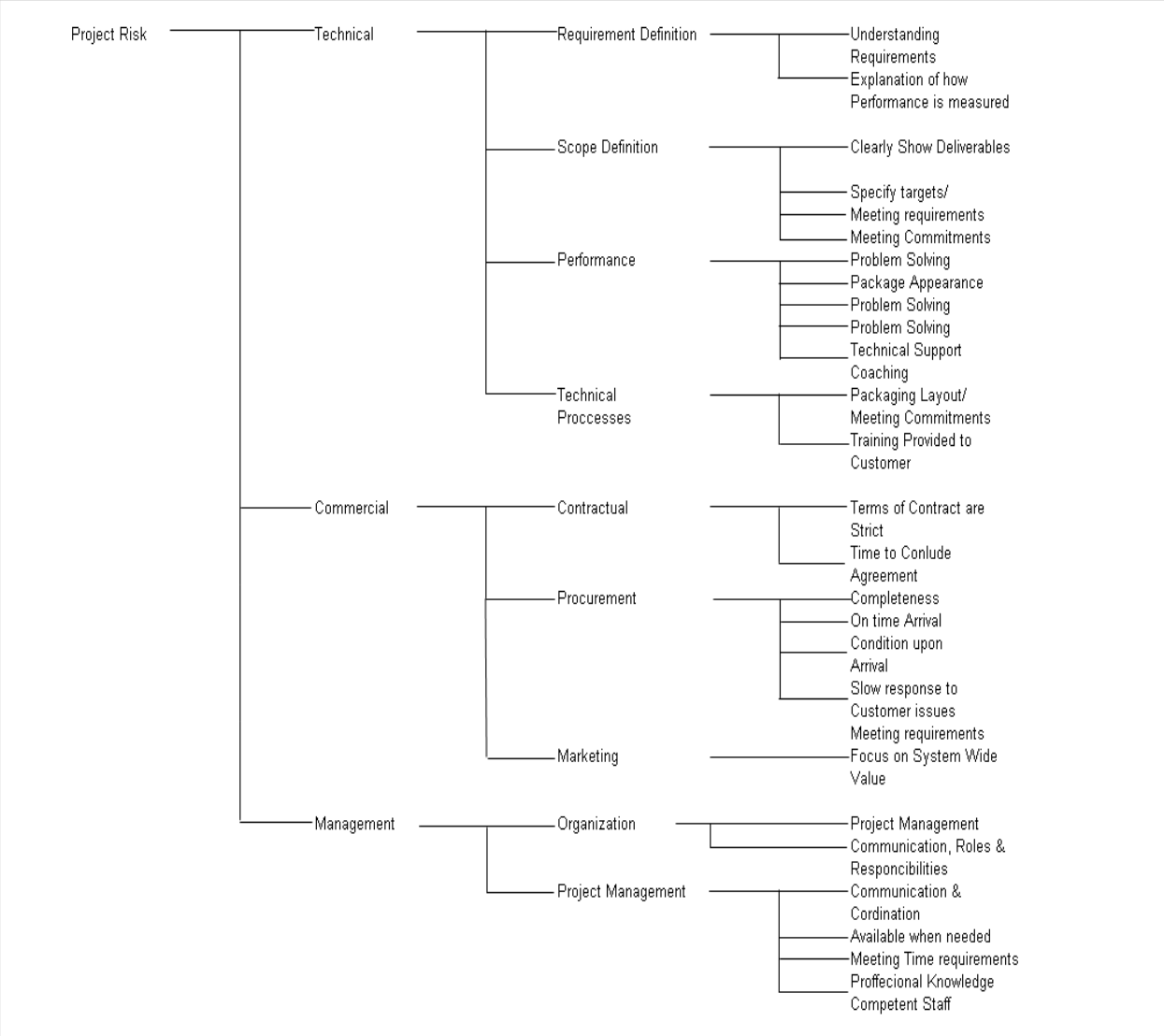
The aim of the survey was to identify issues and events that have created friction between the client and the contractor during the project execution. As described in chapter 4 I used the qualitative method in order to examine and analyze the respondents' answers regarding the various issues that appear during the project life cycle. The outcome of this analysis would be a list of risk events which after categorization according to its nature and source will create the risk breakdown structure for the capital equipment project.

Furthermore in order to perform a deeper analysis of the results and to reach more objective conclusions I have also performed statistical analysis of the results.

5.2.1 Risk Breakdown Structure

The risk breakdown structure is a tool that provides an organized description of any known risks that are arranged in categories according to their characteristics. In the risk breakdown structure the project team can find all project risks which if utilized properly can become a very useful tool. The risk breakdown structure like the work breakdown structure is placing the risks in a structure that gives the possibility to the project or risk manager to quickly and easily identify potential risk events and thus to plan the right response plan in order to eliminate the risk exposure.

Figure 5: Risk Breakdown Structure for an installation project



The risks events that are depicted in the risk breakdown are the outcome of the qualitative analysis performed and are described below.

- Understanding requirements. One of the responsibilities of the sales manager is to understand customer needs and offer the right solution from a large portfolio of products. This

requires frequent discussions and correct feedback from the customer in order to choose the right product which will keep customer satisfied and at the same time have a positive impact from the market. Understanding market needs requires the ability to see the world from the customer's point of view which many times is not achieved with the result of dissatisfied customers.

- Explanation of how performance is measured. In order to finalize the project and deliver the new filling equipment under the customer's responsibility, the company has to prove that the performance of the new filling equipment has reached a very good level. A measuring system incorporated in the filling equipment records the performance and detailed reports are created. One of the duties of the project manager is to explain to the customer the way this system is measuring the performance which appears that often is not done and results in conflicts which are created between the customer and the company.

- Problem solving. Problem solving is the ability of the technical staff to provide correct solutions to technical problems. Customers require fast response and quick problem resolution to any issue appearing during the project execution. This is one of the most common sources of conflict between the two sides. In order to avoid such events technical staff must show adequate technical competence for the successful accomplishment of the project objectives.

- Technical support coaching. Technical staff plays very important and multiple roles during the project execution. Except from the adequate technical competence, the role of a good coach is to drive the installation team during the project execution. In this role the technical leader has to design and develop plans for customer staff in order to achieve the level of competence that is required to support the business objectives. Furthermore he has to conduct coaching engagements with individuals in order to effectively transfer his technical knowledge.

Poor performance in this role creates a bad working environment between team members and prolongs the hand over period for the customer.

- Packaging layout meeting commitments. Correct packaging layout is very important in order to have the most efficient production. The most difficult thing is the correct placement of the filling equipment to fit the space requirement at the customer's plant in order to facilitate packaging material flow and also to provide the best operator location for easy access to the equipment. The benefits of a good layout are the following:
    - Increased productivity
    - Better utilization of the area used
    - High Line efficiency

In many installations due to either project engineer's competence or due to improper selected filling area the layout does not fulfil the above parameters which results in customer's complaints.

- Training provided to the customer. Training of the customer's technical staff is an essential activity for all projects. Training provides the technical staff with all necessary knowledge, confidence and develops the right skills in order to perform their job. Therefore professional training is an investment for the customer with the following short term and long term benefits.
    - Improve production efficiency
    - Improve filling equipment performance
    - Shorten the hand over period
    - Cost effective for customer because it is cheaper to train the existing stuff instead of recruiting new.

Therefore training is beneficial when it is done in a professional way by well trained instructors but many times due to various reasons training does not fulfil customer's expectations which creates a lot of complaints.

- Terms of contract are strict and time to conclude agreement. A contract is a legal agreement between two parties, the customer and the supplier. Terms of a contract are the various statements that bound the two parties together. Every contract contains two types of terms, the warranties and the conditions. What is special about the company I am working for is that although they are the suppliers they have their own contract which is explained thoroughly to the customer during the negotiation phase. The problem is that often the opportunity of negotiation the customer has is very little and the opportunity to make any serious changes is also very small. This attitude is considered from the customer as inflexible and creates friction between the two sides and complaints.

- Equipment delivery. One of the most important phases during the whole project life cycle is the procurement of the capital equipment. It is considered simple but it is not since many important project decisions regarding the purchase of the capital equipment had to be taken. This process has very high priority since any mistake in the equipment specification or any delay in the delivery has direct consequences on the project profitability and on the project time schedule. In order to prevent such events which are costly and sometimes create fatal problems the following steps had to be taken:

    - The project engineer must provide the specifications for the equipment where all relevant data like material requirements or other optional equipment should be included. Equipment specifications and optional equipment are very important especially in projects where there is performance measurements connected with

performance guaranties. Conflicts between the customer and the supplier are possible to occur if during the negotiation phase it is not clearly specified to the customer which options are included in the equipment.

- Next process is the ordering phase. In this phase it is important to check the delivery times of the equipment and arrange co-delivery of the equipment at the customer's site. The benefits of following this procedure is first the decrease of the transportation cost and second the fact that the installation phase starts smoothly since all the equipment arrive at the same time. Various events occur during the arrival of the equipment, sometimes there is partial damage during transportation or delay in the arrival. In any case there should be quick response from the project team in order avoid customer complaints.

- Organizational risks, roles and responsibilities, project management. Projects that are performed within a functional organization usually are suffering because in the project decisions several departments are involved. The result is very often delayed decision making process and also confusion in the human resources regarding roles and responsibilities. This happens due to the fact that the project within a functional organization has less autonomy because it is considered as one of the existing functions. This lack of autonomy means less opportunity to implement the project activities in a way that provides the best possible results in order to achieve the project objectives. The role of the project manager is mainly concentrated on the planning of the project which is very important in a matrix organization since a lot of activities are occurring in parallel. This confusion and the mixture of roles and responsibilities are detected by the customer and that's why it is included in the list of risk events. According to my experience customers prefer one person to discuss all issues regarding to project activities.

- Project management is the discipline of planning, organizing and managing resources in order to complete a specific project. A project is a unique endeavour with a predefined start and finish which aims to accomplish a specific goal within defined time, cost and with the adequate quality. The project manager is the person who has the authority to use the project management tools and techniques during the project life cycle in order to accomplish the project objectives. Communication is one of the most important skills for the project manager. Maintaining an open, regular and accurate communication with all people that are related with the project is vital in order to ensure the smooth flow of information. Except communication skills the project manager must be a good human resource manager since during the project he manages the team members which require strong interpersonal skills. If the project manager does not fulfil the above skills most possibly the project will face a lot of problems. Except from the project manager for every project there are resources that are involved to work on the deliverables of the project. These are the project team members who are assigned with the responsibility to perform various tasks. Their responsibilities are the following:
    - Understanding the work to be completed
    - Planning the assigned project activities
    - Complete assigned work for the project
    - Inform the project managers for issues regarding the project
- Focus on system wide value refers to the relative value of the amount of money spend for a good or a service compared with the benefits taken from that product. Value for money has to do with the balance between:
    - Cost to acquire the product
    - Productivity of the product

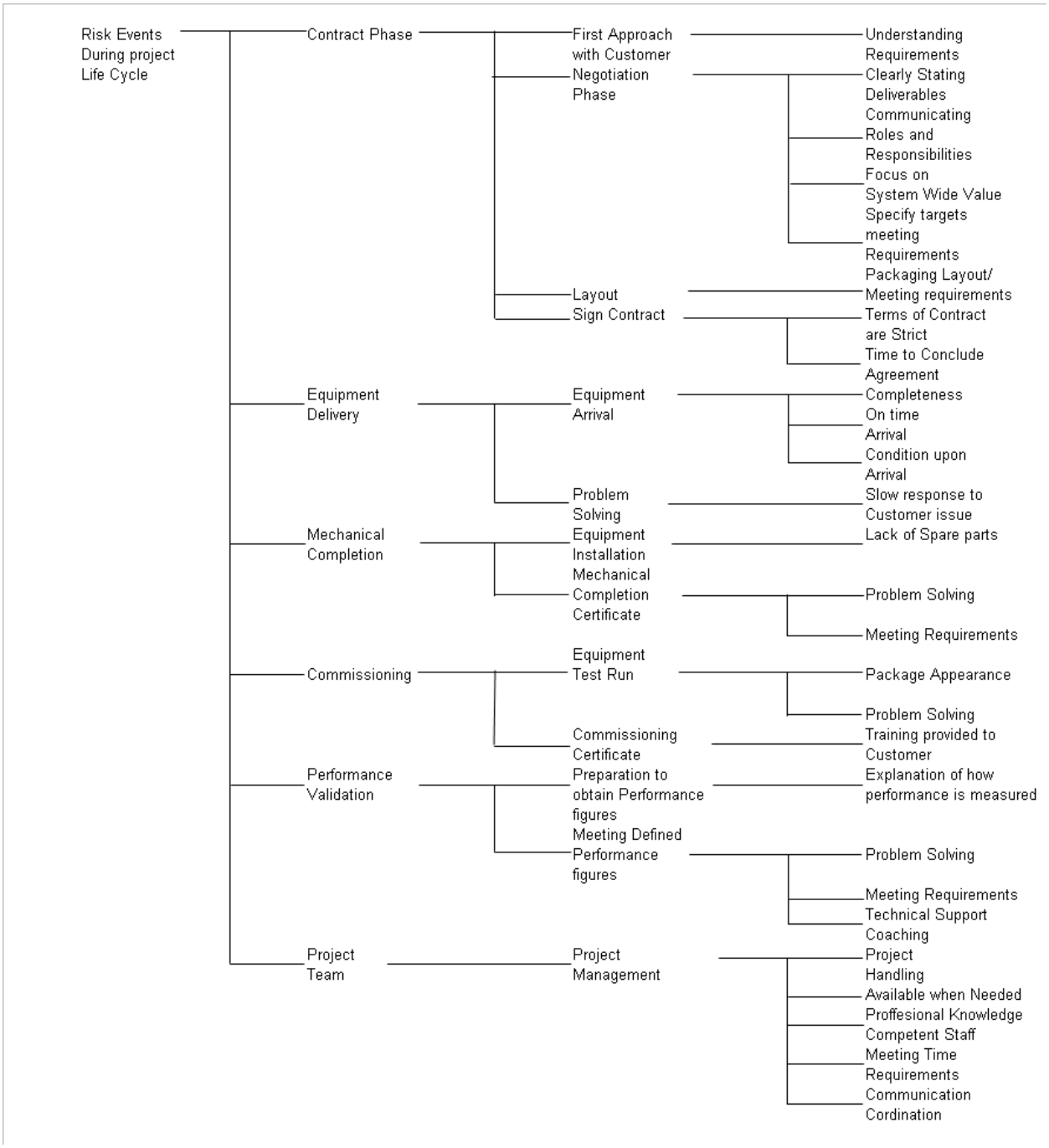
- Impact of the specific product

In reality from the interveners it appears that customers are weighing the benefits of a project against the cost of it and the results are negative. The main factors that are affecting customer opinion are the following:

- Maintenance and running cost of the filling equipment
- Filling equipment cost
- Spare parts cost
- Efficiency of the equipment
- Competitors costs in similar services

In figure 6 we can see the distribution of the identified risks versus the project phases. This table is very important for the future development of the organisation since improvements in project execution results in satisfied customers which will have a positive impact on the growth and prosperity of the organisation.

Figure 6: Risks per project phase



5.2.2 Statistical analysis of the results.

In the section that follows I performed a statistical analysis of the results. The goal is the deeper investigation of the issues that occur during the project life cycle and an attempt to focus on the risks that create the biggest problem and thus to prioritize the issue resolution. The research was based on the survey that was done for all projects that took place in South Europe during 2008 which is divided in the following sections:

- Overall evaluation where the respondents give their overall opinion regarding the whole project life cycle.
- Contract phase. The respondents give their opinion regarding the contract phase which includes all aspects from the first approach until the order of the equipment.
- Equipment Delivery where the respondents provide the opinion regarding the accuracy of the delivery date of the equipment and the condition upon arrival.
- Commissioning which includes the start up and the product validation.
- Performance validation where the respondents give their thoughts and impressions regarding the performance of the equipment
- Project team. The respondents provide their opinion for the project team who were responsible for the project execution.

In the table that follows we can see the average customer satisfaction for every project phase based on the grades of the respondents for all projects while in the table 5 is the customer satisfaction for every of the 34 projects separately.

Table 4: Average customer opinion per project phase.

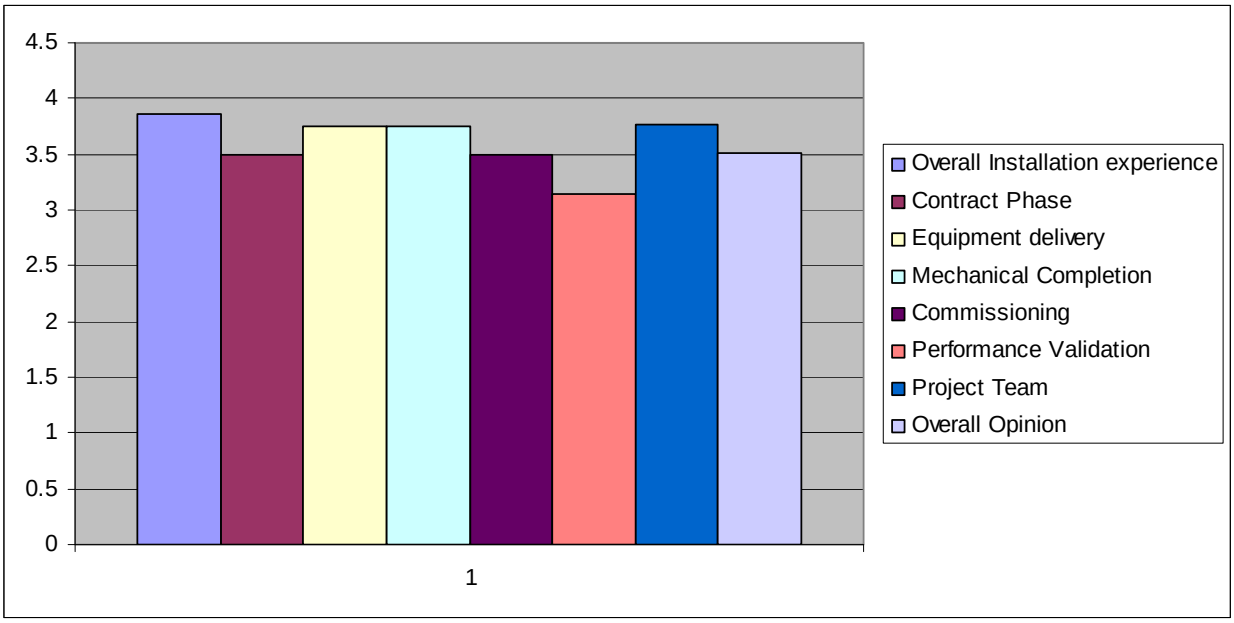
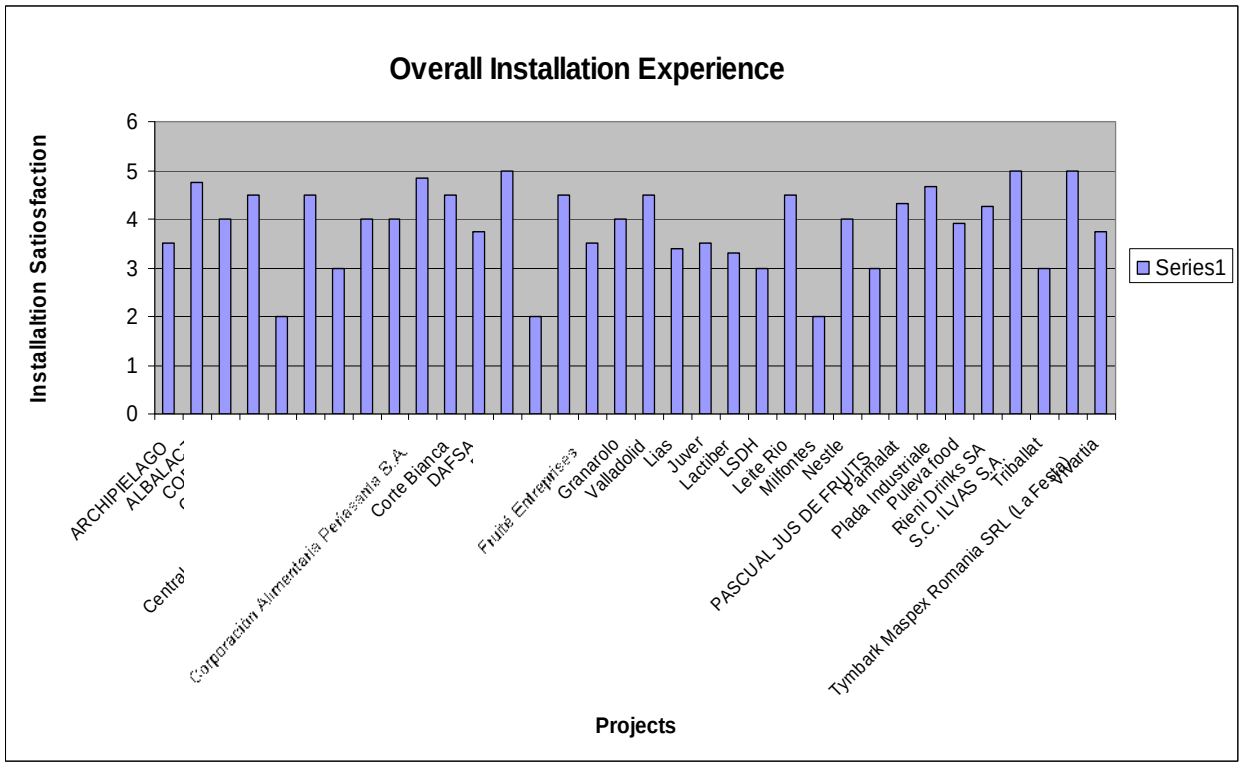
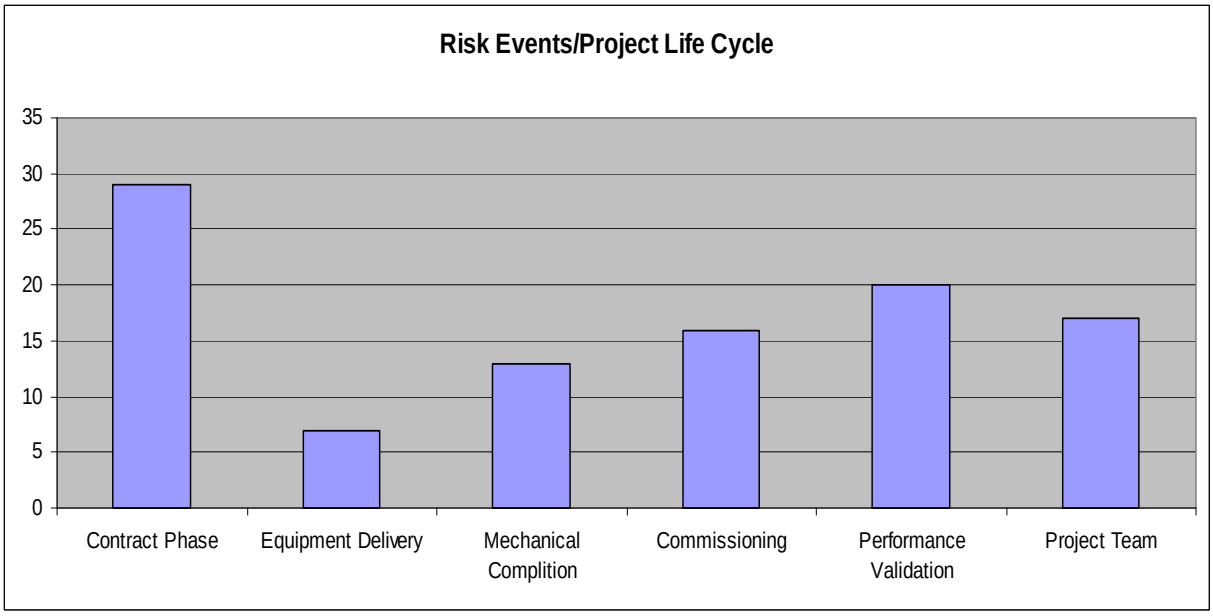


Table 5: Average customer opinion per project.



In the lists of tables that appear bellow I have performed a statistical analysis for every project phase in order to identify the risk events that are frequently occur.

Table 6: Distribution of risks during the project phases



The analysis of the above table shows that most of the risks appear during the contract phase. The explanation behind this is not very simple and not easy since the majority of the respondents from the customer are technical oriented and many of them were not between the team which negotiated the project. Another explanation is that the project objectives were not communicated to the customer personnel thoroughly which results to a list of issues that causes complaints from the customer.

Table 7: Risk Events during Contract Phase

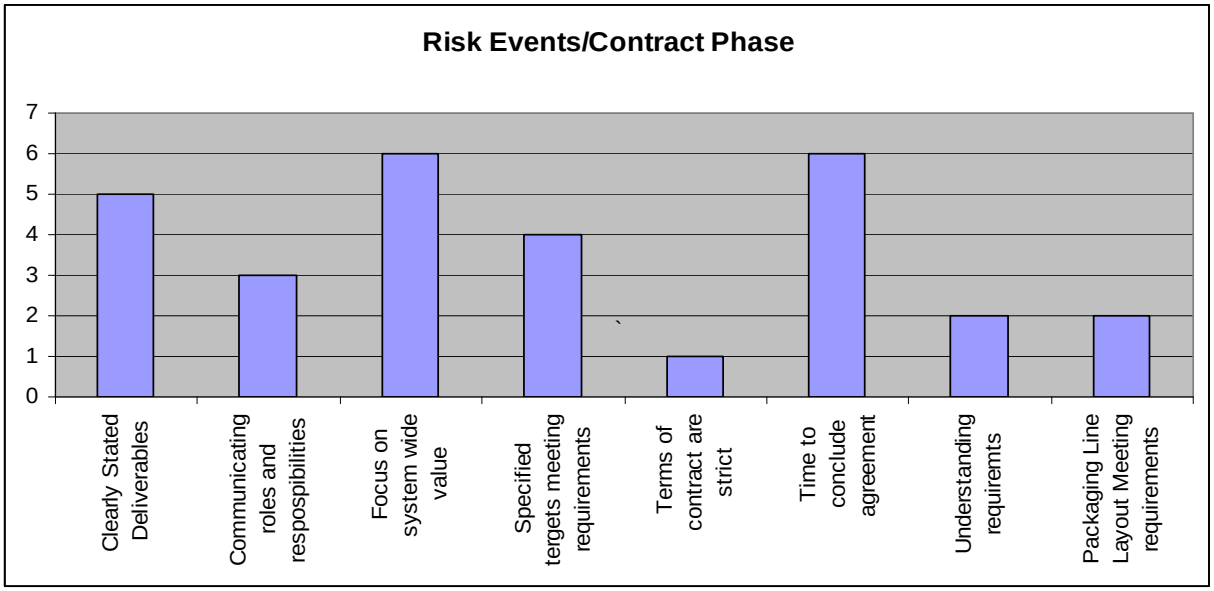


Table 8: Risk events during Mechanical Completion

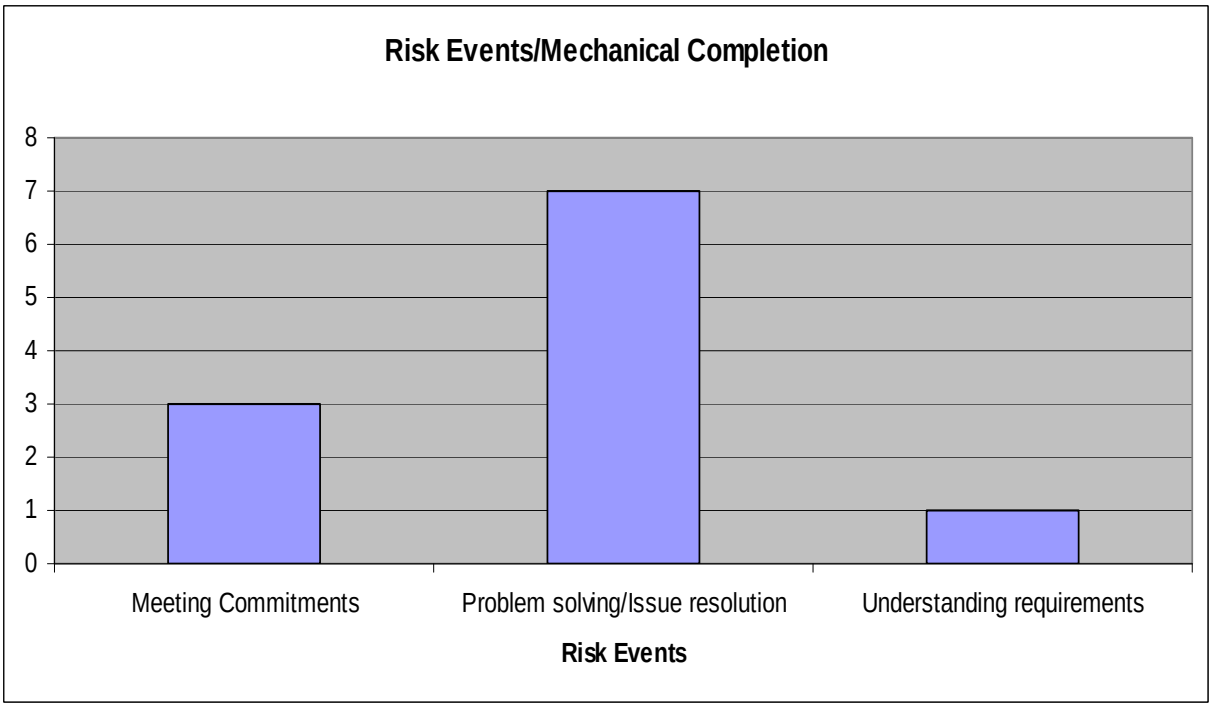


Table 9: Risk events during equipment delivery

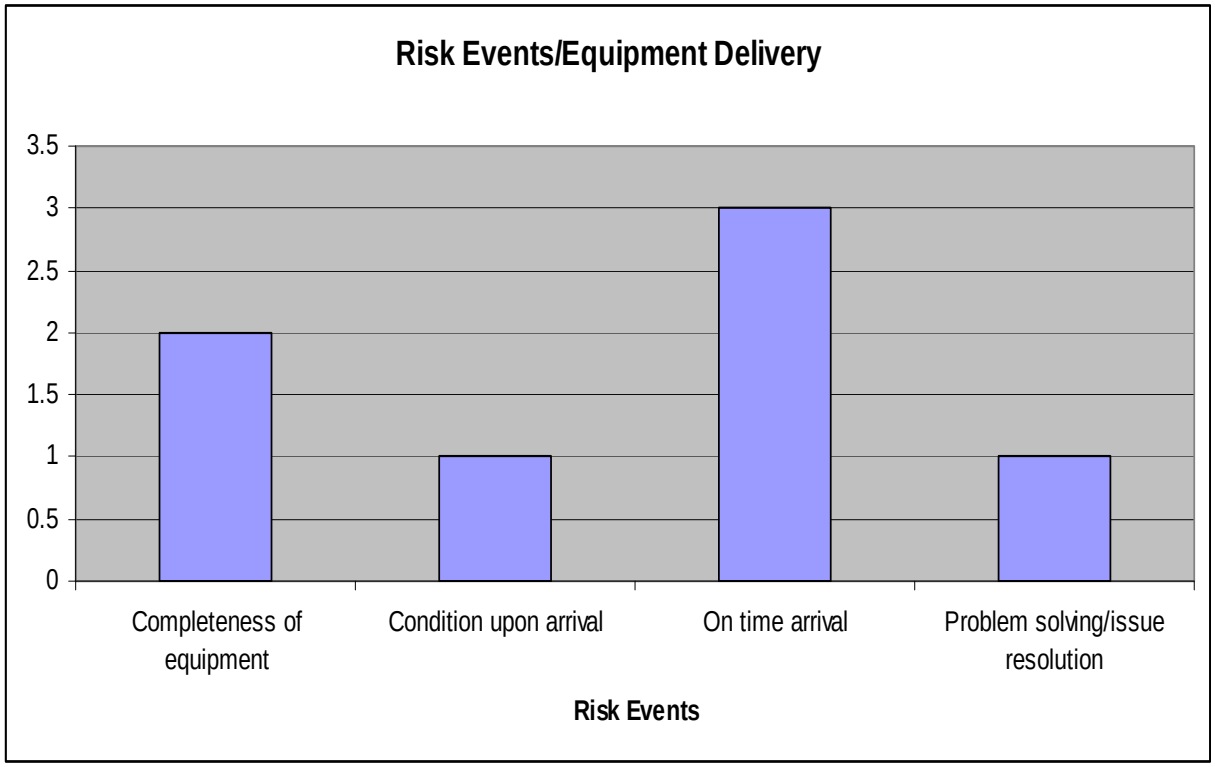


Table 10: Risk events during commissioning phase

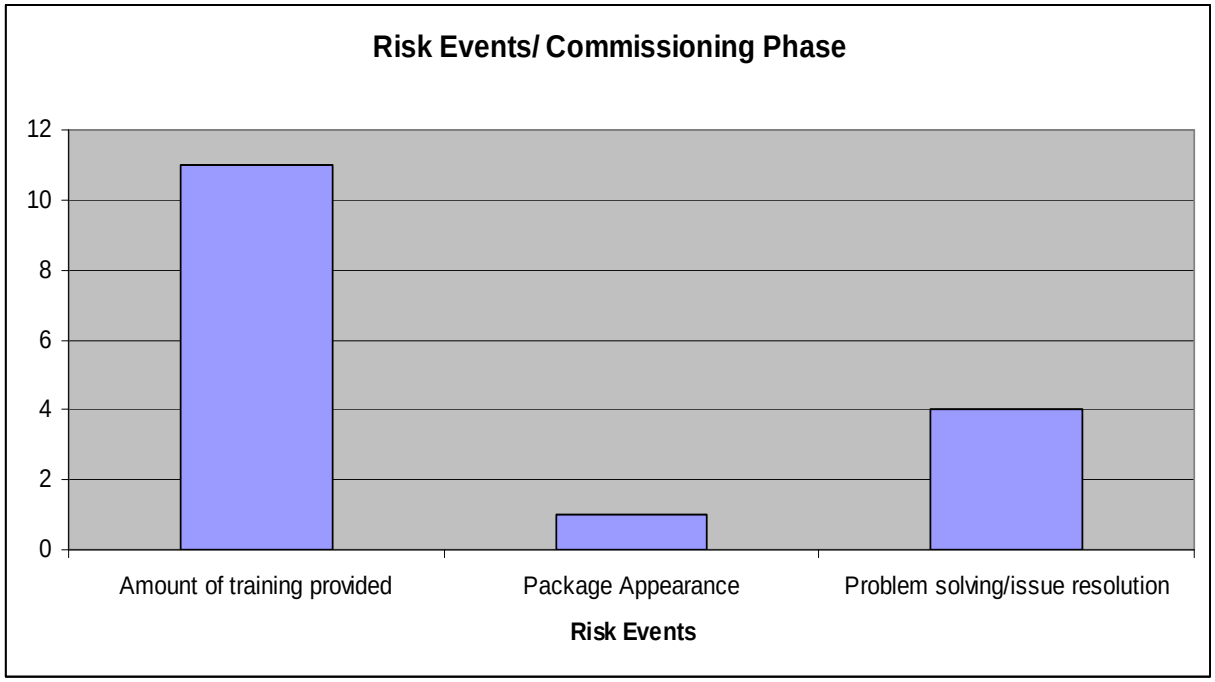


Table 11: Risk events during performance validation phase

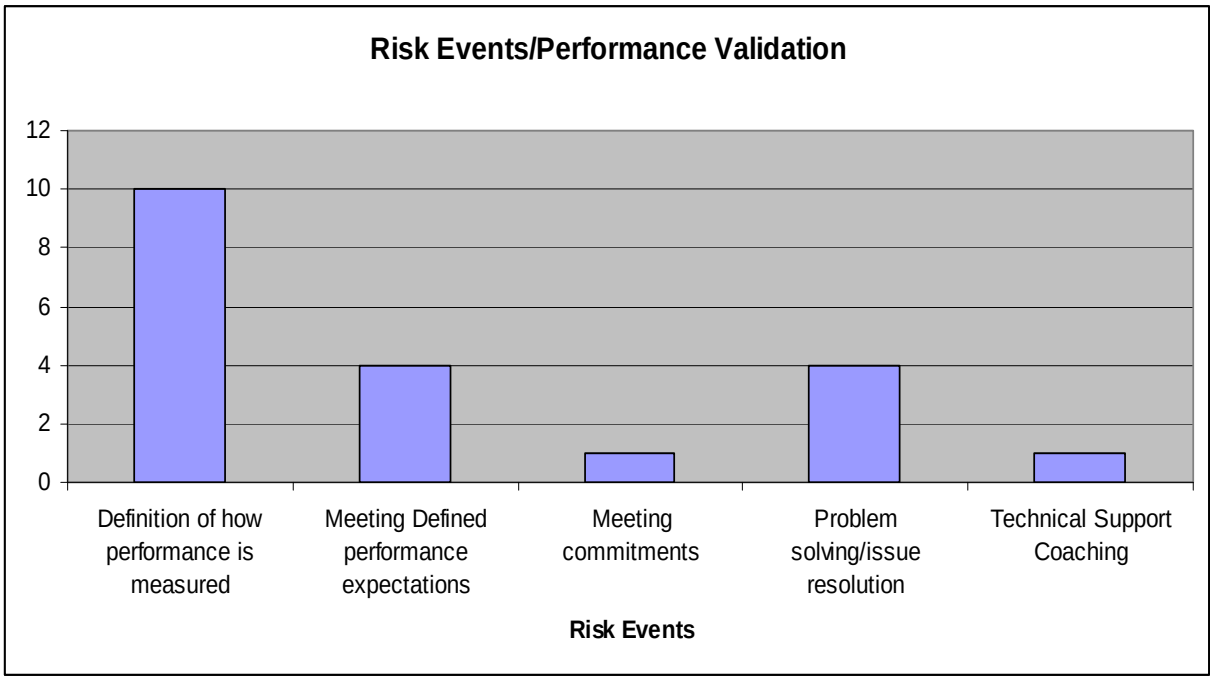
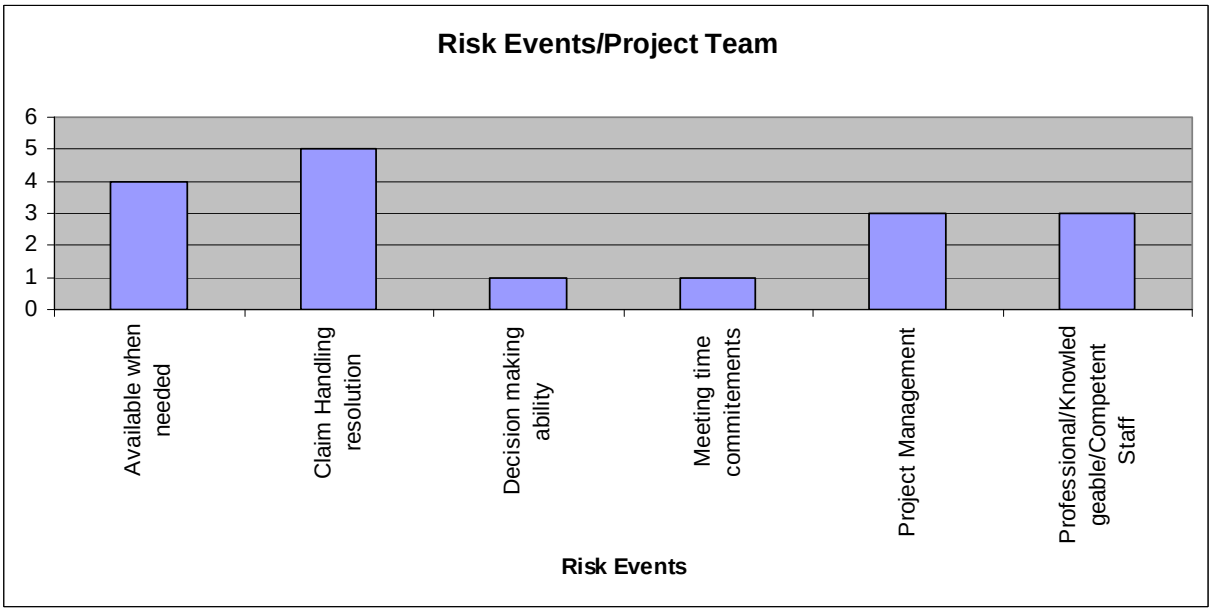


Table 12: Risk events for the project team



In the mechanical completion phase the risk event that appears frequently is the problem solving ability while in the equipment delivery phase the issue is the on time delivery of the equipment.

During the commissioning phase the customer worries mainly about the training provided to his employees while during the performance validation period the customer worries about the performance of the filling equipment.

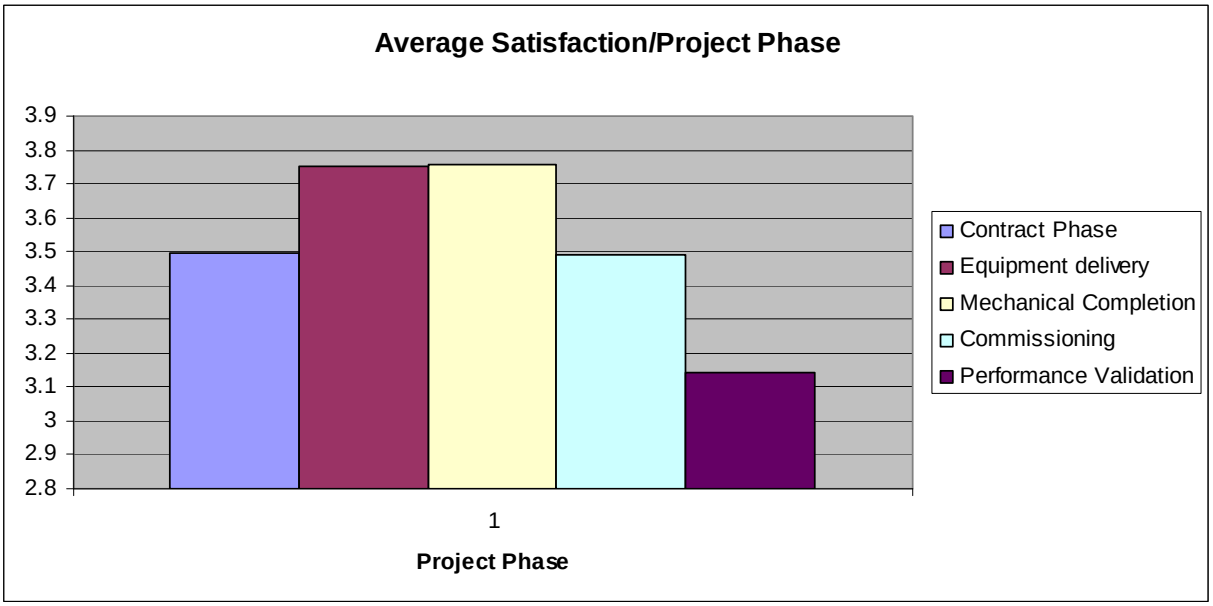
In the survey there is a separate part of questions regarding the project's team behaviour during the project life cycle. The customer expects fast handling of the claims and availability of the project team.

5.2.3 Measurement of the customer satisfaction

In the following two graphs I made a comparison based on the grades that the customers assigned for every project phase. Table 13 is a typical average measurement of the customer satisfaction for every project phase. The conclusion is that the customer is more satisfied with the equipment delivery and mechanical completion phase. In table 14 I have made a comparison between the project phases based on the project hours spend during every project phase. The assumption I made is that every project lasts for approximately one thousand hours which are divided in the following way:

- Contract phase:190 hours
- Equipment delivery phase:60 hours
- Mechanical completion: 380 hours
- Commissioning phase: 150 hours
- Performance validation: 220 hours

Table 13: Average customer satisfaction



Based on the above hour distribution for every project phase I have calculated the weighted satisfaction for every project phase which can be found in table 14. The conclusion is that the mechanical completion has the biggest average satisfaction while the equipment delivery the smallest.

Table 14: Weighted customer satisfaction

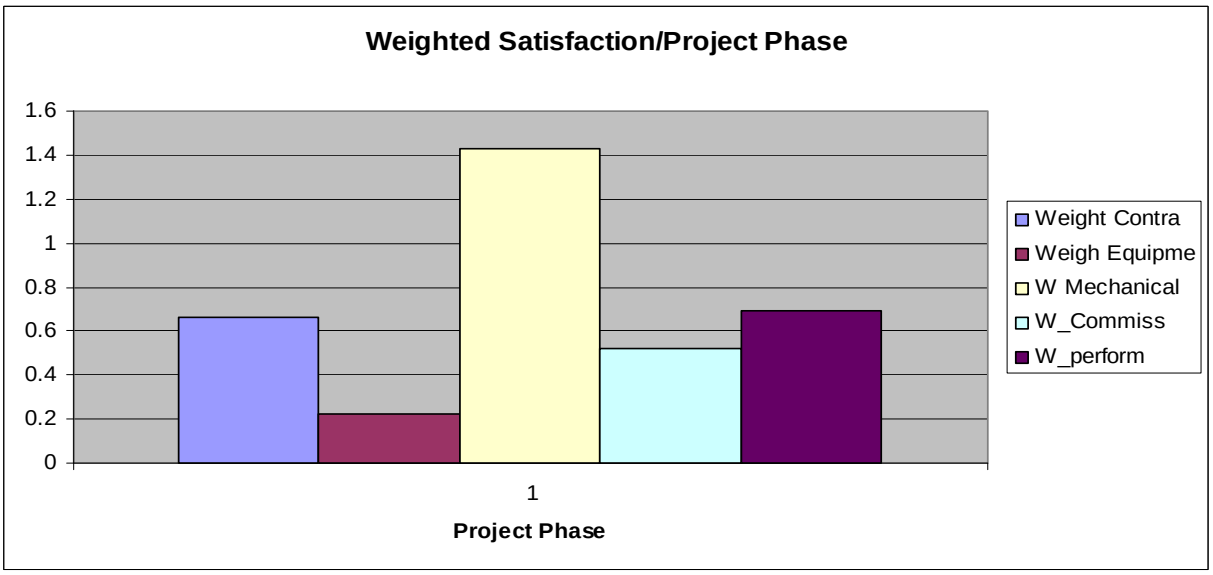
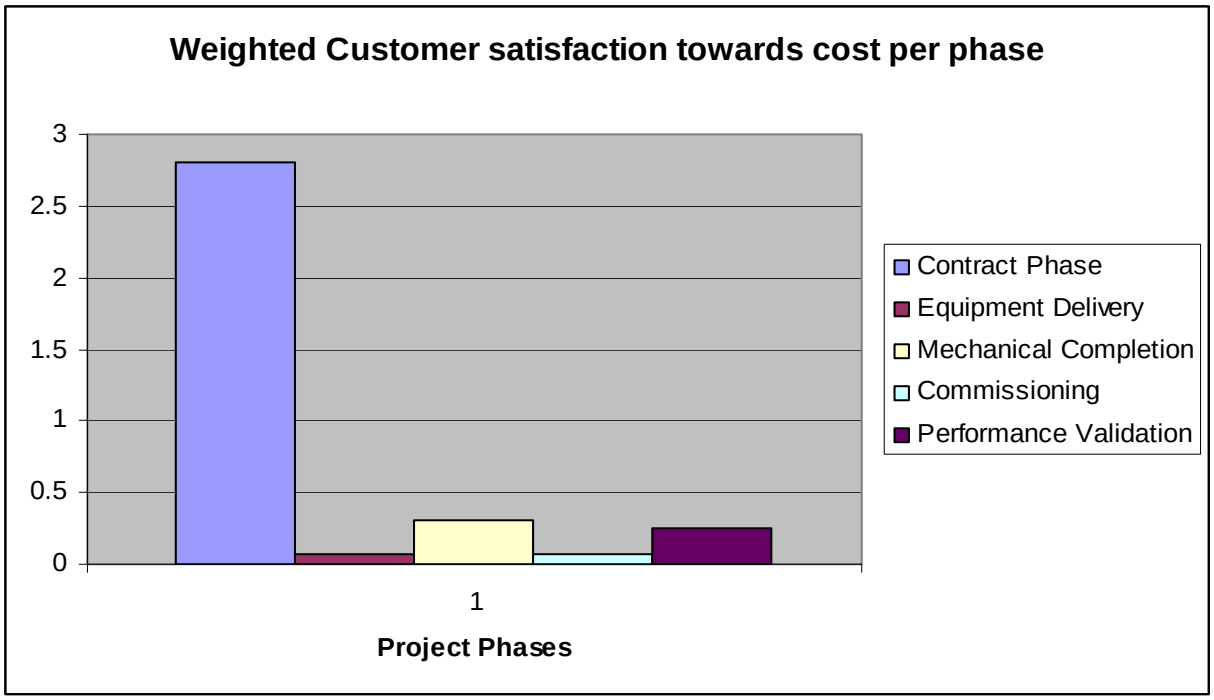


Table 15: Weighted customer per cost



In table 15 I have calculated the weighted customer satisfaction based on the cost of every project phase. The assumption that I made is that all projects has the same cost of 1.000.000 € which is distributed in the following way:

- Contract phase: 780.000 €
- Equipment delivery: 20.000 €
- Mechanical completion: 80.000 €
- Commissioning: 40.000 €
- Performance validation 80.000 €

Chapter 6 - Conclusions and Recommendations

The average customer satisfaction from all projects is approximately 3.5 based on the customer input. That means that there is area for improvement in the following categories.

6.1. Organization Structure

The projects in the company I am working for are conducted under a weak matrix organization structure. This type of organization combines functional and project departmentalization. That means that the projects are executed in parallel with the other activities of the functional departments which requires continuous cooperation and collaboration. The disadvantage of this organizational structure is the lack of autonomy that occurs in the segment of projects due to the interaction between the various activities of the organization.

The solution which will provide the autonomy that is mandatory for a project is the creation of a separate department which will handle all projects. By doing this there will be the following significant benefits for the projects:

- For the employees, direct involvement in the project from the preparation phase because so far the engineers were involved directly in the project execution without any prior knowledge of the project objectives.
- Strengthening of the project manager role in the project team because now there is direct influence from the functional manager during the project activities. Theoretically project and functional managers have equal authority within the company but this dual authority during the project execution can be frustrating for the shared resources.
- Less conflicts between project and functional manager regarding the resources allocation. Resource allocation during the project requires a lot of discussions between the two sides in order to obtain the right number of resources with the right skills.

- Less conflicts during the decision making process.
- Creation of better working environment for the employees because they will work as a permanent staff focused on the project activities and not on the temporary environment of a project where many of them have to report to at least two managers.

6.2. Project Management improve

Project Management is the discipline of planning and executing a project within a certain time, cost and with the required quality. In order to have an effective project management process we must have the right organization structure and the right person as a project manager.

The skills that are necessary for a project manager cover a wide area of the human personality. It requires strong personal, technical and management skills. Most of the times project managers are promoted in this position due to their technical ability but they lack the right management skills and profile. Then it is expected from them to learn during the job without any type of management training provided in advance.

The best approach in order to secure the performance of the project manager is to follow the right training course based on the competences that are required for a successful project management. Of course on the job training is recognised as the best teacher but is has to be accomplished by a formal project management training.

Another factor that is essential in order to have effective project management is the structure and the culture of the organization. The organization should show the right commitment and support for the implementation of the project management tools and techniques otherwise it will fail to provide quality projects.

Except from the project manager also for the project team there is area of improvement. The project manager has to do the following things in order to create an effective project team:

- Encourage teamwork
- Find a way to use conflict constructively
- Focus on team's development
- Have an open door policy and be accessible for all project team members
- Always perform an open analysis regarding the project objectives
- Follow up team's progress continuously
- Encourage free flow of communication between team members
- Invest on technology and keep the team update
- Keep the members in close relation in order to have a better cooperation

6.3. Problem solving

One of the risks that appear more is the problem solving capability. It is one of the major risks that occur in all phases during the project execution. It refers to the knowledge, skills and strategies of the technical staff to solve technical issues. The customer expects from the technical staff fast diagnose and repair of any mechanical or electrical problem which is not always possible due to the following reasons:

- Lack of technical competence
- Lack of proper training
- New systems are continually released without being tested properly
- Application of latest technology

Technical staff need to have detailed and in-depth understanding of complicated mechanical and electrical systems. In order to improve technical staff's performance the following things have to be done:

- Professional training
- On the job training together with more experienced personnel
- Creation of separate departments in order to increase the specialized knowledge which is necessary in order to solve difficult problems.
- Provide technical staff with special utilities and instruments that are necessary for efficient problem solving
- Investment on the development of technical staff because it takes some years to create an efficient engineer.
- Recruit personnel with technical proficiency in certain technological area.
- Go about to solve the problem using a systematic approach.

In conclusion I would like to note that the technical department should of course be profitable but the main goal should be to create competent staff which will be able to handle the technical problems that arise in the most efficient way and thus to keep customer satisfaction at a very good level because, after all, the technical staff is in continuous contact with the customer more than everyone else in the company.

6.4. Focus on system wide value

Focus on system wide value according to the customer's opinion is one of the most important characteristics of a successful project because it shows the benefit that was obtained in contrast with the money spent.

Improvement in that area is not very easy to be achieved. It has to do with the way the company is doing things, with the culture of the company. It takes many years to change the attitude and special emphasis has to be given in order to keep the quality at a very good level and at the same time reduce the cost. In today's competitive environment the company should focus on improving the provided services, the efficiency of the equipment and of course ensure that issues of quality are properly addressed without increasing the cost of the equipment.

In order to achieve the above the following things has to be done:

- Run operational cost reduction programs
- Improve the efficiency of the equipment through a new robust design
- Provide greater output with improved quality
- Reduce labour cost for the same output.
- Integration of value for money principles in the organization's decision making policies.

6.5. Amount of training provided

One of the survey results that are very important for the customer is the training that is provided to their employees. The customers believe that their employees are not proper trained and developed by the contractor. They expect that after a large investment their employees will be capable of handling the new equipment without significant issues occur. For them the correct amount and the quality of the training provided, has direct impact on their employee's performance and therefore positive consequence on the financial and operational indicators for the customer. In order to improve the training that is provided to the customer the following things has to be done:

- Institute a person responsible for training who will be authorized for organizing the appropriate training course.

- Use the official training material that is provided from the training centre that exists in the headquarters.
- The trainers should follow a special training program on how to perform a professional training course.
- The training course should be performed in the correct training environment using the proper training facilities.

6.6. Understanding customer's requirements

The sales manager has a central role in managing and developing the customer. In order to succeed in this role he must do the following things:

- Ability to create an atmosphere of trust and respect with the customer
- Build a relationship with the customer or the potential customer by spending as much as possible time with him.
- Divide the customers into groups, focus on them and create the correct strategy for each one.
- Perform a customer analysis in order to identify the strengths and weaknesses and plan accordingly.
- Propose products that meet customer's needs.
- Study the market trends and prepare their strategy
- Perform a competitor's analysis in order to identify the strengths and weaknesses of their products compared with ours.

6.7. Conclusions from the statistical analysis of the results

6.7.1. Comparison between phases

According to the statistical analysis (table 6) the phases that scored higher than the average based on the customer input, is the equipment delivery and the mechanical completion, while the phase with the lower score is the performance validation.

That is because the accuracy of the equipment delivery has been improved during the last years although there is still area of improvement because the initial estimate time of arrival differs from the final by two or three weeks.

Furthermore the mechanical completion has scored with a good grade because if there is no delay with the equipment delivery, then runs smoothly and the customer is satisfied with the installation of the new equipment. This result is also verified from table 14 where we have measure the customer satisfaction based on the distribution of hours for each project.

Regarding the performance validation which is the most significant phase because the commercial production has started and the customer expects quick ramp up of the equipment performance and also because after this phase the customer takes the full responsibility of running the equipment. Therefore under these conditions the customer is extremely demanding and all upcoming problems must be solved in the most efficient way.

The above results can be justified also from table 6 where we can see the risks that appear in each project phase. Most of the risks occur in contract and performance validation phase which according to me are the most critical phases during the project life cycle. The contract phase because in that phase we have the agreement with the customer and the preparation of the project and the performance validation because in that phase the customer acquires the objectives of the project.

One characteristic that is observed during the contract phase is the diversity of risks. This can be explained from the fact that during this phase people with different background are involved, commercial technical and legal. Under these circumstances the project manager must have central role in coordinating all the different activities for the benefit of the project.

6.7.2. Analysis of risks per project phase

Tables 7, 8, 9, 10 and 11 depict the various risk events that occurred according to the customer during the different phases of a project. In the above mentioned tables there is one risk event “problem solving/ Issue resolution” which can be seen in all project phases. The customer expects from the contractor to solve the problem in a way that is convenient, cost effective and timely which requires from the contractor’s staff a lot of skills. If that is not possible then customer loses time and money and the contractor’s staff lose their credibility.

The contract phase is the phase with the biggest range of risk events. The risk events that appear more frequently are the time to conclude the agreement and the focus on system wide value. The first one is related with the discussions regarding the agreement between the two sides while the second is related with the perception the customer has that the invested money will not bring back the requested benefits.

In the equipment delivery phase the issue that appears more frequently is the on time delivery of the equipment. Very frequently the estimated time of arrival for the equipment changes due to various reasons which cause a lot of problems in the time schedule of the project. The consequences are very bad especially if the delivery of the project is connected with liquated damages.

During the commissioning phase according to the customer the most critical issue is the training that is provided to the customer before the equipment starts commercial production. This is important for the customer because after the finalization of the project, the customer's technical staff has to be able to take full responsibility of running the equipment which is not easy if they have not reached a certain level of competence.

Another issue which according to the customer is critical is problem solving capability. During this phase the start up of the equipment is performed, and a lot of technical problems usually occur. The customer expects a smooth and easy start up procedure which is not happening frequently.

During the performance validation period according to the customer the most critical issue is the way the performance of the equipment is measured. This is because according to the contract, in order for the contractor to deliver the equipment to the customer, the performance of the equipment must reach a specified in the contract value. The issue is that the customer some times has his own performance measurement system or he does not trust our performance measurement system although it follows international standards. In order to solve the above issue the project manager has to explain from the beginning of the project in detail the measurement system and how it works.

Another issue related with the one above is the performance of the equipment to meet customer expectations. This is a general approach because for the contractor it is enough to reach the specified performance issues for one week of production but the customer expects that the equipment will perform like this for a longer period of time. The project manager has to combine the two different approaches. He has to fulfil the contract and achieve the performance figures and at the same time support the customer in order to keep or even improve the performance.

Regarding the performance of the project team the ranking of the results showed that project team is in the third position regarding the total number of risks appeared. Issues that are connected with the project teams performance is their availability and the fast reaction to the customer's requirements. The customer expects that the project team will follow the project as close as possible and also to solve all issues that occur as fast as possible.

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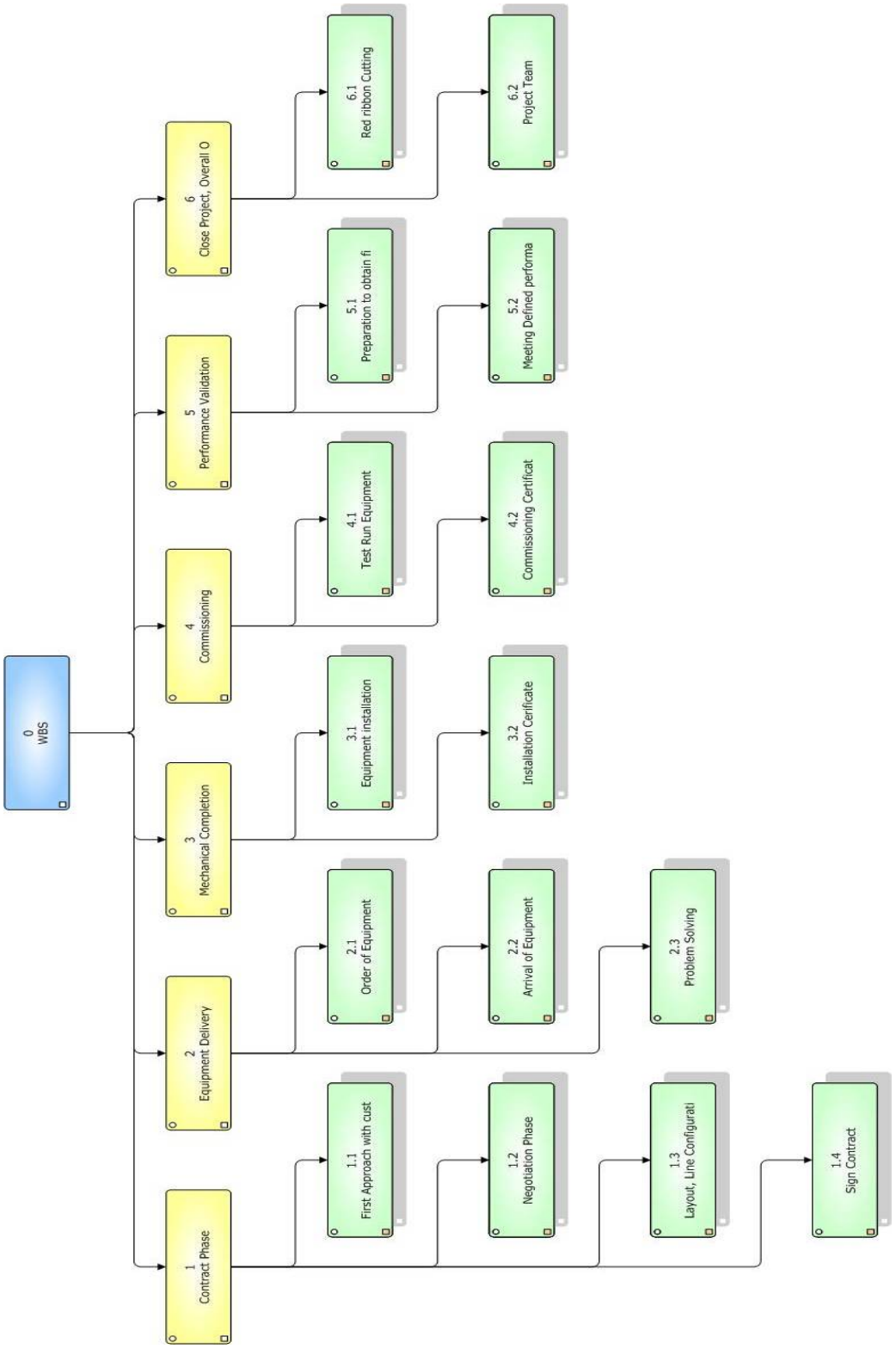
Appendix A – WBS for an installation project



Appendix C - Survey for my thesis proposal

2008 EQUIPMENT INSTALLATION SURVEY

Introduction

Thank you for taking the time to complete this questionnaire. The purpose of this survey is to identify areas that are important to you regarding equipment installation, and to help my company learn how it can better meet your critical business needs. Your valuable input will help drive both strategic and tactical priorities. A representative will be in contact with you soon after the survey is complete.
This survey covers questions about the various aspects of the equipment installation recently conducted a company. The Company Pak is interested in your perceptions and opinions on all aspects of the installation. **However, if you feel you cannot answer a question, please feel free to enter "Don't Know" and move to the next question.**

Overview of Sections in Survey:

- Overall Evaluations
- Contract Phase
- Equipment Delivery
- Mechanical Completion
- Commissioning
- Performance Validation
- Project Team
- Survey Evaluation

Overall Evaluations

Please think about your most recent experience of the installation of equipment.

1. Thinking ONLY about the installation so far, how would you rate that experience overall?

Excellent	Very Good	Good	Fair	Poor
❍	❍	❍	❍	❍
(5)	**(4)**	**(3)**	**(2)**	**(1)**

110. Please tell us why you rated your overall experience for this installation as

_____

_____

_____

108. How would you rate the overall quality of the equipment installed?

Excellent	Very Good	Good	Fair	Poor	Don't Know
❍	❍	❍	❍	❍	❍
(5)	**(4)**	**(3)**	**(2)**	**(1)**	**(9)**

109. Why did you rate the overall quality of the equipment installed as? Please add comments to highlight any significant differences for Filling and Processing Equipment, if applicable to this installation.

_____

_____

_____

108. During this installation, have you had any quality issues equipment?

❍ Yes (1)
❍ No (2)

109. Did we meet your timing expectation in this project?

❍ Yes (1)
❍ No (2)
❍ Don't Know (9) _____

110. Please explain why your timing expectations were not met and the impact of your expectations not being met.

_____

_____

_____

111. Based on the installation of this project, what is the likelihood that you would recommend this type of equipment and services to your business partners?

Extremely Likely	Very Likely	Somewhat Likely	Not Very Likely	Not at All Likely	Don't Know
❍	❍	❍	❍	❍	❍
(5)	**(4)**	**(3)**	**(2)**	**(1)**	**(9)**

Contract Phase

Now, we would like to get your overall impressions of the Contract phase during the recent equipment installation. This would cover all aspects from the request for a quotation to the signing of a contract and the ordering of this equipment.

10. How would you rate the overall experience of the Contract phase?

Excellent	Very Good	Good	Fair	Poor	Don't Know
❍	❍	❍	❍	❍	❍
(5)	**(4)**	**(3)**	**(2)**	**(1)**	**(9)**

11. More specifically, how would you rate the following aspects of this Contract?

	Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)	Don't Know (9)
e. Company's understanding of your requirements	❍	❍	❍	❍	❍	❍
a. Clearly stating the deliverables	❍	❍	❍	❍	❍	❍
f. Clearly communicating your role and responsibilities	❍	❍	❍	❍	❍	❍
g. The specified performance targets meeting your requirements	❍	❍	❍	❍	❍	❍
d. Focus on providing you with system-wide value for the money	❍	❍	❍	❍	❍	❍
b. The time taken to conclude the agreement	❍	❍	❍	❍	❍	❍

10_1. What comments or suggestions for improvement do you have on Contract phase? Please add comments to highlight any significant differences for Filling and Processing Equipment, if applicable to this installation.

_____

_____

_____

120_HD. Please tell us why you rated this/these aspect(s) of the Contract Phase as either 'Fair' or 'Poor'.

120E. Understanding of your requirements

120A. Clearly stating the deliverables

120F. Clearly communicating your role and responsibilities

120G.The specified performance targets meeting your requirements

120D. Focus on providing you with system-wide value for the money

120B. The time taken to conclude the agreement

Equipment Delivery

Now, please think more about the Delivery of your equipment.

20. How would you rate the overall Delivery of the equipment?

Excellent	Very Good	Good	Fair	Poor	Don't Know
❍	❍	❍	❍	❍	❍
(5)	**(4)**	**(3)**	**(2)**	**(1)**	**(9)**

21. More specifically, how would you rate the following aspects of Equipment Delivery?

	Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)	Don't Know (9)
a. The on-time arrival of your equipment	❍	❍	❍	❍	❍	❍
b. The condition of your equipment upon arrival	❍	❍	❍	❍	❍	❍
c. The completeness of the delivery (all parts and components delivered)	❍	❍	❍	❍	❍	❍
d. Problem solving and issue resolution	❍	❍	❍	❍	❍	❍

20_1. What comments or suggestions for improvement do you have on Delivery of your equipment? Please add comments to highlight any significant differences for Filling and Processing Equipment, if applicable to this installation.

_____

_____

_____

130_HD. Please tell us why you rated this/these aspect(s) of Equipment Delivery as either 'Fair' or 'Poor'.

130A. The on-time arrival of your equipment

130B. The condition of your equipment upon arrival

130C. The completeness of the delivery (all parts and components delivered)

130D. Problem solving and issue resolution

Mechanical Completion

Now we would like for you to consider the Mechanical Completion of the installed equipment. This would include the box opening, positioning, assembling, connection and verification of the layout of the equipment in your facilities.

30. How would you rate the overall Mechanical Completion of your equipment?

Excellent	Very Good	Good	Fair	Poor	Don't Know
❍	❍	❍	❍	❍	❍
(5)	**(4)**	**(3)**	**(2)**	**(1)**	**(9)**

31. More specifically, how would you rate on the following aspects of the Mechanical Completion of your equipment?

	Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)	Don't Know (9)
a. Meeting their commitments	❍	❍	❍	❍	❍	❍
b. Layout of packaging Line meeting your requirements	❍	❍	❍	❍	❍	❍
c. The quality of workmanship	❍	❍	❍	❍	❍	❍
d. Problem solving and issue resolution	❍	❍	❍	❍	❍	❍

30_1. What comments or suggestions for improvement do you have on the Mechanical Completion of your equipment? Please add comments to highlight any significant differences for Filling and Processing Equipment, if applicable to this installation.

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140_HD. Please tell us why you rated this/these aspect(s) of Mechanical Completion as either 'Fair' or 'Poor'.

140D. Meeting their commitments

140G. Layout of packaging line meeting your requirements

140F. The quality of workmanship

140E. Problem solving and issue resolution

Commissioning

Now, we would like for you to think specifically about the Commissioning of your equipment, including the functional testing with water and product, and microbiological validation.

40. How would you rate the overall Commissioning of your equipment?

Excellent	Very Good	Good	Fair	Poor	Don't Know
❍	❍	❍	❍	❍	❍
(5)	**(4)**	**(3)**	**(2)**	**(1)**	**(9)**

41. More specifically, how would you rate on the following aspects of the Commissioning of your equipment?

	Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)	Don't Know (9)
e. Meeting their commitments	❍	❍	❍	❍	❍	❍
d. Testing with water and product	❍	❍	❍	❍	❍	❍
f. Package quality and appearance	❍	❍	❍	❍	❍	❍

g. Amount of training provided	❍	❍	❍	❍	❍	❍
h. Quality of training provided	❍	❍	❍	❍	❍	❍
i. Problem solving and issue resolution	❍	❍	❍	❍	❍	❍

40_1. What comments or suggestions for improvement do you have on the Commissioning of your equipment? Please add comments to highlight any significant differences for Filling and Processing Equipment, if applicable to this installation.

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_____

150_HD. Please tell us why you rated this/these aspect(s) of Commissioning as either 'Fair' or 'Poor'.

150E. Meeting their commitments

150D. Testing with water and product

150F. Package quality and appearance

150G. Amount of training provided

150H. Quality of training provided

150I. Problem solving and issue resolution

Performance Validation

Now, please focus your thoughts on validating the performance of your equipment, which is the measurement and verification against agreed performance targets during commercial production.

50. How would you rate the company on overall Performance Validation of your equipment?

Excellent Very Good Good Fair Poor Don't Know

❍	❍	❍	❍	❍	❍
(5)	**(4)**	**(3)**	**(2)**	**(1)**	**(9)**

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51. More specifically, how would you rate it these aspects of Performance Validation of your equipment?

	Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)	Don't Know (9)
Meeting their commitments	❍	❍	❍	❍	❍	❍
h. Definition of how performance is measured	❍	❍	❍	❍	❍	❍
g. Achieving agreed performance targets	❍	❍	❍	❍	❍	❍
j. Technical support and coaching	❍	❍	❍	❍	❍	❍
k. Problem solving and issue resolution	❍	❍	❍	❍	❍	❍

50_1. What comments or suggestions for improvement do you have on the Performance Validation of your equipment? Please add comments to highlight any significant differences for Filling and Processing Equipment, if applicable to this installation.

_____

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_____

160_HD. Please tell us why you rated this/these aspect(s) of Performance Validation as either 'Fair' or 'Poor'.

160H. Meeting their commitments

160I. Definition of how performance is measured

160G. Achieving agreed performance targets

160J. Technical support and coaching

160K. Problem solving and issue resolution

Project Team

Now, we would like for you to think specifically about the Project Team during the installation project.

60. How would you rate the overall on the Project Team during this installation?

Excellent	Very Good	Good	Fair	Poor	Don't Know
❍	❍	❍	❍	❍	❍
(5)	**(4)**	**(3)**	**(2)**	**(1)**	**(9)**

61. More specifically, how would you rate company's Project Team on these aspects?

	Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)	Don't Know (9)
m. Project management	❍	❍	❍	❍	❍	❍
l. Contact persons being clearly defined	❍	❍	❍	❍	❍	❍
h. Communication and coordination with your staff	❍	❍	❍	❍	❍	❍
a. Understanding your needs	❍	❍	❍	❍	❍	❍
n. Decision making ability	❍	❍	❍	❍	❍	❍
f. Meeting time commitments	❍	❍	❍	❍	❍	❍
e. Being available when needed	❍	❍	❍	❍	❍	❍
d. Having professional, knowledgeable and competent staff	❍	❍	❍	❍	❍	❍
g. Handling and resolution of issues and claims	❍	❍	❍	❍	❍	❍

60_1. What comments or suggestions for improvement do you have on the Project Team? Please add comments to highlight any significant differences for Filling and Processing Equipment, if applicable to this installation.

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_____

_____

170_HD. Please tell us why you rated this/these aspect(s) of the Project Team as either 'Fair' or 'Poor'.

170M. Project management

170L. Contact persons being clearly defined

170H. Communication and coordination with your staff

170A. Understanding your needs

170N. Decision making ability

170F. Meeting time commitments

170E. Being available when needed

170D. Having professional, knowledgeable and competent staff

170G. Handling and resolution of issues and claims

Overall Opinions

69. Based on this project, have your opinions toward the company?

Improved Greatly	Improved Somewhat	Stayed the Same	Declined Somewhat	Declined Greatly	Don't Know

❍	❍	❍	❍	❍	❍
(5)	**(4)**	**(3)**	**(2)**	**(1)**	**(9)**

70_1. Why have your opinions toward the company based on this project?
Please add comments to highlight any significant differences for Filling and Processing Equipment, if applicable to this installation.

_____

_____

_____

70_2. Taking this into account, as well as what you have read and heard, how would you rate the overall quality of all the products, services and support provided?

Excellent	Very Good	Good	Fair	Poor	Don't Know
5	4	3	2	1	9
❍	❍	❍	❍	❍	❍

72. Are there any unresolved issues related to your installation?

❍ Yes (1)
❍ No (2)
❍ Don't Know (9)

72_1. Have any of these unresolved issues been raised during previous installations?

❍ Yes (1)
❍ No (2)
❍ Don't Know (9)

73. Please describe the unresolved issues and explain the impact of these issues.

_____

_____

_____

112_HD. For the next few questions, please consider your overall installation experiences over the past 12 – 18 months.

How would you rate the company on …?

	Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)	Don't Know/Not Applicable (9)
112a. Making improvements to the overall installation process based on your feedback	❍	❍	❍	❍	❍	❍
112b. Taking action on issues you report	❍	❍	❍	❍	❍	❍

113. Please provide examples on how the company hasn't used your feedback appropriately and what could be done differently in the future.

_____

_____

_____

105. If you have any other suggestions on how the company can improve their installation of equipment, please enter them here.

_____

_____

_____

Survey Evaluation

107. What comments or suggestions for improvement do you have on this survey?

_____

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