MANUFACTURING ENGINEERS' UNDERSTANDING ON THE VALUE OF RISK MANAGEMENT TO PROJECT SUCCESS IN THE PHARMACEUTICAL INDUSTRY

Jean Livingston

1765620 MBA Project Management

Manufacturing engineer's understanding on the value of risk management to project success in the pharmaceutical industry of Ireland.

Dublin Business School/Liverpool John Moore's University

Dissertation submitted in part fulfilment of the requirement for the degree of Master's in Business Administration (MBA) at Liverpool John Moore's University in conjunction with Dublin Business School.

Jean Livingston

Student number:
1765620

16 August 2013

Word Count: 20,920 words

Table of Contents

Table of Figures

Table of Tables

Declaration

I, Jean Livingston, declare that this research report is my own, unaided work, except as indicated in the acknowledgments, the text and the references.

This report is being submitted in partial fulfilment of the requirements for the degree of 'Master of Business Administration Project Management' at Dublin Business School, Dublin.

It has not been submitted before, in whole, or in part for any degree or examination at any other institution.

Jean Livingston

Signed ………..……………………………… on the day of 16/08/2013.

Acknowledgement

The completion of this master's dissertation owes much help, understanding and support to many people. First I would like to thank Dublin Business School and the Liverpool John Moore University for allowing me to undertake this master's degree in Project Management. This year was extremely influential and a great learning experience for me.

I would also like to greatly thank my supervisor, Mr Patrick Mongey. Patrick made his support available in a number of different and insightful ways. He provided me with advice and guidance without which this dissertation would never have been completed.

I would also like to thank my friends and family for helping me through this stressful time and by helping me any way they could. Without their love and support this dissertation would never have been completed.

Abstract

The primary objective of this study was to comprehend the understanding manufacturing engineer's had of the value of risk management to project success in the pharmaceutical industry in Ireland. The adoption of manufacturing engineers to lead projects instead of traditional project managemers has increased during the economic downturn. Risk management has been developed over the last fifty years and has significant impact on project success. The objective was to discover if manufacturing engineers understood this value.

Projects have always been a critical part of the pharmaceutical industry as the majority of its research and development is undertaken in the form of research and development projects. This research found that it is true that engineers are taking on more of a project management role in these pharmaceutical projects. The research also proved that manufacturing engineers understand that risk management is important to project success and the different stages of risk management are individually and collectively important to project success.

Chapter 1
Introduction

Chapter 1 – Introduction

"Pharmaceutical projects are like fresh fruit – they depreciate if they are not tended to, and they do poorly if sitting on the shelf with long periods of inactivity" (Burns, 2013). As the pharmaceutical industry in Ireland grows and leans towards an increase in research and development projects, the need for good project management for the pharmaceutical industry increases. The manufacturing engineers that are involved with these projects are increasingly becoming project leaders despite having no formal project management experience. Organisations are employing manufacturing engineers as project managers as a cost saving measure during the economic downturn. Organisations are not focusing on the cost of project failure in their budgets at the early stages of the projects, which is why they are saving the cost of employing a project manager by using an existing engineer. The majority of manufacturing engineers in the pharmaceutical industry understand the need for proper risk management in order to improve the likelihood of project success but they are unable to implement correct risk management plans and procedures due to lack of formal knowledge and training.

In response to this growing trend of employing manufacturing engineers as project managers for costly pharmaceutical projects, it might be worthwhile for manufacturing engineers to undergo formal project management training. A correctly implemented risk management plan can increase project success. The importance of risk management will be explored throughout this research project.

This research project explores the three main stages of the risk management process, risk identification, risk analysis and risk response. The researcher also explores the tools and techniques used for each of the stages of risk management to help increase the likelihood of project success. This research project also explores the preference that manufacturing engineers have with the common tools and techniques used in the risk management process.

There is a large amount of literature available on project success and risk management, including the models of the risk management process and the debate on the definition of project success. However there is a gap in the literature which can be the difference between understanding risk management and project success. The majority of the literature focuses on a project managers understanding on project success whereas there is no literature of manufacturing engineer's ideas of project success. The literature does not explore what tools and techniques are the most commonly used by manufacturing engineers for each of the three stages of risk management. There is also a literature gap when risk management is looked at for pharmaceutical projects, especially when focusing on the pharmaceutical industry in Ireland.

1.1 Research Area

How does project risk management affect project success?

Do manufacturing engineers undertake the role of project manager during pharmaceutical projects?

What are the risk management tool that are most commonly used in the pharmaceutical industry?

1.2 Research Objectives

Research objects are the clear and precise statements that identify what the researcher will accomplish during his or her research project (Saunders, Lewis and Thornhill, 2012, p.32). Research objectives provide the focus and the direction for the researcher to ensure a clear and concentrated research project.

The following research objectives are the objectives that are concentrated on during this research project:

- To determine the most common risk identification tool used by manufacturing engineers and if this tool, along with the practice of risk identification helps improve project success.
- To discover if the practice of risk analysis helps improve overall project success and to discover what is the most common risk analysis tool used in the pharmaceutical industry.
- To uncover what the most common risk response strategy used by manufacturing engineers in the pharmaceutical industry is and if the technique of risk response helps improves project success.
- To detect the value of risk management to project success as understood by manufacturing engineers in the pharmaceutical industry.

The research focuses on the influence risk management has on project success. The objectives of this research are closely related to the scope of the research and therefore no separate discussion on research scope is necessary for this research project.

1.3 Research Questions

Question 1: What is the most common risk identification technique used in pharmaceutical projects?

Rationale: The literature would suggest that either checklists or risk breakdown structure creation are the most popular techniques in the identification of risks (Hassanein and Afify, 2007) (Stosic, Isljamovic and Mihic, 2013) (Larson and Gray, 2011, p.214). These only apply to the construction and new product innovation and there is no information on techniques used in the pharmaceutical industry.

Question 2: Is qualitative risk analysis more commonly used that quantitative risk analysis?

Rationale: According to Kerzner (2013, p.766) qualitative risk analysis is the most commonly used method, however Larson and Gray (2011, p.216) states that the most commonly used technique is scenario analysis, which according to Rezakhani (2012) is usually a quantitative technique.

Question 3: What is the most popular risk strategy used in the pharmaceutical industry?

Rationale: According to Tworek (2012), building contractors in the United States preferred method of risk strategy is risk retention and in Poland it is risk avoidance. There is little evidence on which risk strategy is most commonly used in Ireland or by the pharmaceutical industry in Ireland.

Question 4: Does risk management have any impact on the success of a project?

Rationale: According to Pretorius, Steyn and Jordaan (2012) risk management has no impact on the outcome of a project. Conversely the PMI (2013, p.310) states that a correctly implemented risk management policy can greatly improve the chances that a project meets their objectives and succeeds.

1.4 Research Hypothesis

Hypothesis 1: The most commonly used risk identification technique used by manufacturing engineers are checklists.

Rationale: The most commonly used technique used by contractors and civil engineers for risk identification is the checklist (Hassanein and Afify, 2007), it is reasonable to assume that manufacturing engineers working in the pharmaceutical industry would also use similar techniques in their risk identification.

Hypothesis 2: Manufacturing engineers use probability and statistical analysis which would indicate that they would use a quantitative method for risk analysis.

Rationale: According to Nicholas and Steyn (2008, p.373) engineers use statistical and probability techniques to implement the risk analysis technique of scenario analysis for their project.

Hypothesis 3: The least used strategy for risk response is the risk mitigation strategy.

Rationale: According to Larson and Gray (2011, pp.219-220) and Melnic (2010) risk mitigation or reduction may be expensive especially if it is required to attempt to reduce the impact the event may have on the project. For this reason it is reasonable that project managers might seek a less expensive risk strategy to implement.

Hypothesis 4: Correctly implemented risk management does impact on the outcome of a project.

Rationale: Larson and Gray (2011, p.211), Lock (2008, p.99) and PMI (2013, p.310) state that correctly implemented risk management affects the outcome of the project in a positive way. In opposition however, Pretorius, Steyn and Jordaan (2012) state that it does not have an impact, with the majority of the literature agreeing that it does impact the outcome, it is reasonable to assume that manufacturing engineers will agree.

1.5 Researcher Suitability

The researcher holds a degree in biomedical engineering from Dublin City University. The researcher has successfully completed all the relevant modules in the MBA Project Management program at Dublin Business School and will use the information gained from these modules, especially the two project management modules: project management tools and techniques and project management planning and control, to aid in this research project. The researcher will also use her work experience in the pharmaceutical industry as a backdrop to this research project.

The researcher has knowledge and enthusiasm towards project management especially the risk management process as well as an interest in the pharmaceutical industry, the researcher is self-assured and suitable to undertake this research project.

1.6 Recipient of Research

This research project is intended to perform a detailed investigation to understand manufacturing engineer's understanding on the value of the risk management process to project success in the pharmaceutical industry in Ireland. Many of the respondents of the self-administered web based surveys have shown interest in the results of this research project. A copy of the results of this survey will be available to any respondents who request the results.

This dissertation is submitted as part of the Masters in Business Administration Project Management curriculum in Dublin Business School in association with Liverpool's John Moore University. The primary recipient of this research project is Dublin Business School and Liverpool's John Moore University staff and students, especially Mr Patrick Mongey.

1.7 Research Limitations

There is a time limit placed on the research project which limits the amount of manufacturing engineers being targeted to ninety. This is only a tiny proportion of the sample size however this will have to be representative of the total population due to this time limitation.

Using a quantitative method for the research project, the researcher faces many limitations to her research this research method. The rigidity of the quantitative method doesn't allow for many fluctuations when applied to the social sciences. Subjects respond based on their past experiences and the expectations that are placed on them (Burns and Burns, 2008, p.17).

Another limitation with the quantitative method is that there is no definitive way in which participants will react when asked to complete a survey. Some of the participants might find the content boring or too personal which will limit the response rate. To overcome this the researcher is planning to distribute between 180 and 200 surveys to possible participants. (Burns and Burns, 2008, p.17)

1.8 Organisation of Dissertation

The organisation of this dissertation is divided into nine separate chapters each dealing with a separate area of study for this research project.

Chapter 1 is an introduction to the dissertation including several parts of the research project including the research area, research objectives, research questions and research hypotheses.

Chapter 2 is the literature review which contains the academic materials read and critiqued by the researcher about this dissertation topic. The literature review chapter is divided into four sections, the first being a brief background into why the literature review was undertaken. The second section deals with the pharmaceutical industry in Ireland. The third section deals with the problems surrounding defining project success. The final section deals with the different stages of risk management; risk identification, risk analysis and risk response and the impact that they has on project success.

Chapter 3 comprises of the research methodology. This section detains how and why the researcher is going to carry out her research project in order to obtain answers to her research questions, determine the validity of her research hypotheses and meet her research objectives.

Chapter 4 is the data analysis and findings section. In this section the results and findings of the data collected are recorded on paper.

Chapter 5 contain the conclusions, which provides conclusions to her research project and research area.

Chapter 6 are the recommendations, which provides the recommendations the researcher has made in relation to this topic.

Chapter 7 deals with the researcher's reflection about her experience in conducting this research project at Dublin Business School.

Chapter 8 and 9 deal with the appendices and bibliography related to the research undertaken for this project.

Chapter 2
Literature Review

Chapter 2 – Literature Review

Background of Literature Review

The three main aims of a literature review are (Aveyard, 2010, pp.5-6):

- To demonstrate research skills, both primary research skills and secondary research skills which the researcher has.
- To demonstrate the researcher's deep understanding of the research subject.
- To demonstrate a knowledge of existing literature that relates to the research topic, research objectives and research methodology.

The literature review for this research is not a simple summary of previous published works, it is a critical literature discussion. This shows understanding and appreciation of the theories and arguments that are presented in the literature by numerous different authors.

Oliver (2012, pp.7-20) states there are five steps to a successful literature review which include identifying the main subjects and themes, reviewing previous research, and summarising key ideas in the related subject areas.

The researcher has searched and carefully selected the literature on project success, the Irish pharmaceutical industry and the risk management process which are relevant to this research topic. The researcher is interested in the project management and risk management area, which leads to increased motivation and enjoyment while doing the areas of literature review on the risk management and the debate on project success. The future of a pharmaceutical project's success depends on the project manager's ability to fully comprehend the value of risk management to the project success. This will create a future demand for project managers who focus on the areas of risk management and project success.

Project managers working on projects in the pharmaceutical industry are continuously challenged by increased regulatory restrictions due to being involved in the highly regulated pharmaceutical industry. The definition of project success not being uniform is the greatest challenge the project managers in any industry face, especially the pharmaceutical industry.

There is a surplus of books, journals, articles and other documentation available in the areas of risk management, project success and the pharmaceutical industry. Narrowing down the literature to have a significant focus area was a fundamental issue for this literature review, and was the first element to be done.

2.1 Pharmaceutical Industry

The pharmaceutical industry includes ethical drugs only and does not include consumer or animal health care (MarketLine, 2012a). Ethical drugs are considered to be all manufactured prescription drugs, and does not include over the counter medication (WHO, 2013). The Irish pharmaceutical industry can be divided into four different sectors; primary, secondary, diagnostics and biopharmaceuticals (Enterprise Europe Ireland, 2010). Primary pharmaceuticals involve the mass manufacture of the chemical drugs while secondary pharmaceuticals include the production of the final drug dosage form as well as the packaging (Enterprise Europe Ireland, 2010). Diagnostics pharmaceuticals sector is the development and production of products that enable medical diagnosis and the biopharmaceutical sector involves the research and development of new drugs (Enterprise Europe Ireland, 2010).

Ireland is one of the leading locations for the pharmaceutical industry in Europe. The Irish pharmaceutical industry is worth €40 billion to the Irish economy and has had over €4.3 billion invested in it over the past six years (IPHA, 2012). The Irish pharmaceutical industry is worth an addition €3 billion in taxes directly to the Irish government and is responsible for a yearly external expenditure €4.3 billion (IPHA, 2012). The pharmaceutical industry accounts for 45% of Ireland's manufactured exports, which is equivalent to 20% of Ireland's overall total exports (IPHA, 2012). The Irish pharmaceutical exports are the seventh largest in the world (PharmaChemical Ireland, 2013). There are 24,000 people directly employed in the pharmaceutical industry in Ireland while another 24,000 are employed in services which provide supporting services to the pharmaceutical industry. Of the new pharmaceutical jobs created in the pharmaceutical industry, 20% were created in Ireland (Enterprise Europe Ireland, 2010). The pharmaceutical industry in Europe has had decelerating growth for the past five years, Figure 1, which may provide a shrinking in the pharmaceutical industry in Ireland in the years to come.

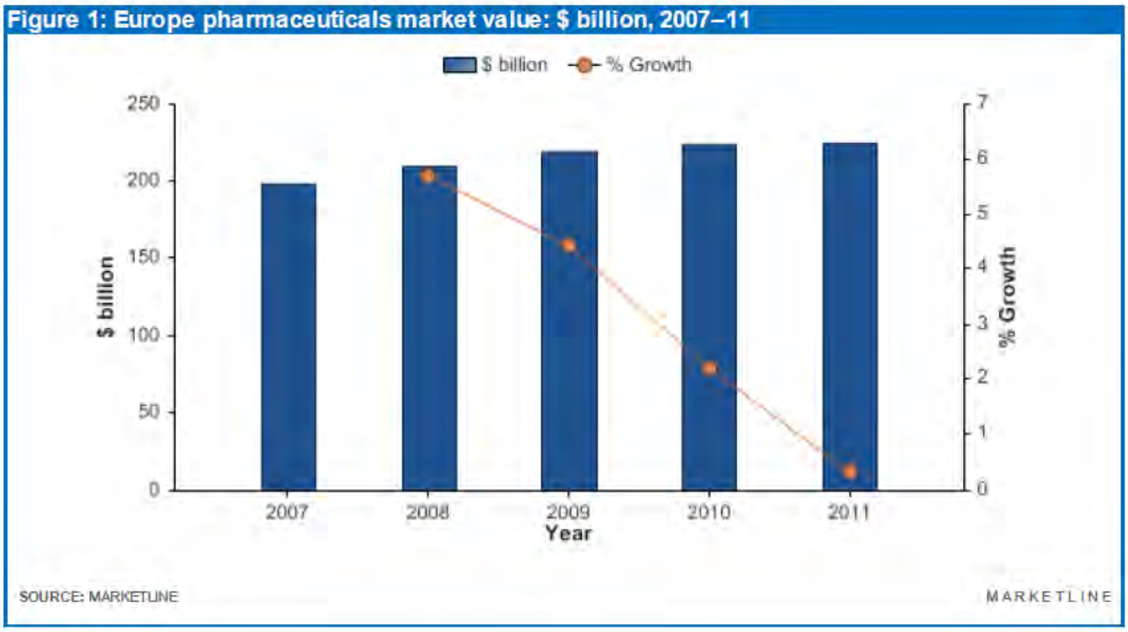


Figure 1: European Pharmaceutical Growth (MarketLine, 2012a)

Ireland is attractive location for the pharmaceutical industry for a number of reasons. Ireland has one of the lowest corporation tax rates in Europe at 12.5% (Ernst and Young, 2012). Ireland is also the only English speaking country in the Eurozone which allows for dealings with Europe and the United States with ease (IPHA, 2012). Ireland has political and economic stability and a large number of government incentives to assist with start-up costs for the manufacturing facilities (IPHA, 2012). The pharmaceutical industry needs a highly skilled and educated workforce, as approximately 40% of pharmaceutical employees will need a third level degree. In Ireland, 45% of 25-34 year olds have a third level degree (PharmChemical Ireland, 2013). All these factors contribute to make Ireland an attractive location for the pharmaceutical industry.

Ireland is the leading European country for pharmaceutical investment (Enterprise Europe Ireland, 2010). There are over 120 pharmaceutical plants by overseas companies in Ireland. 14 of the top 15 pharmaceutical companies have plants in Ireland (IPHA, 2012) and 7 out of 10 of the top selling drugs in the world are produced in Ireland (Enterprise Europe Ireland, 2010). Pfizer, the world's largest pharmaceutical company and the eighth largest company in the world has its European headquarters in Ireland (Irish Times, 2013). GlascoSmithKline and AstraZeneca also have large production plants located in Ireland. These three companies account for 98% of the European pharmaceutical market, Figure 2. The three top global pharmaceutical companies, Pfizer, Merck Sharpe and Dohme, and GlaxoSmithKline still account for

18.5% of the global pharmaceutical market (MarketLine, 2012b). These companies often have gross profit margins in the region of 70-80% (Corporate Watch, no date).

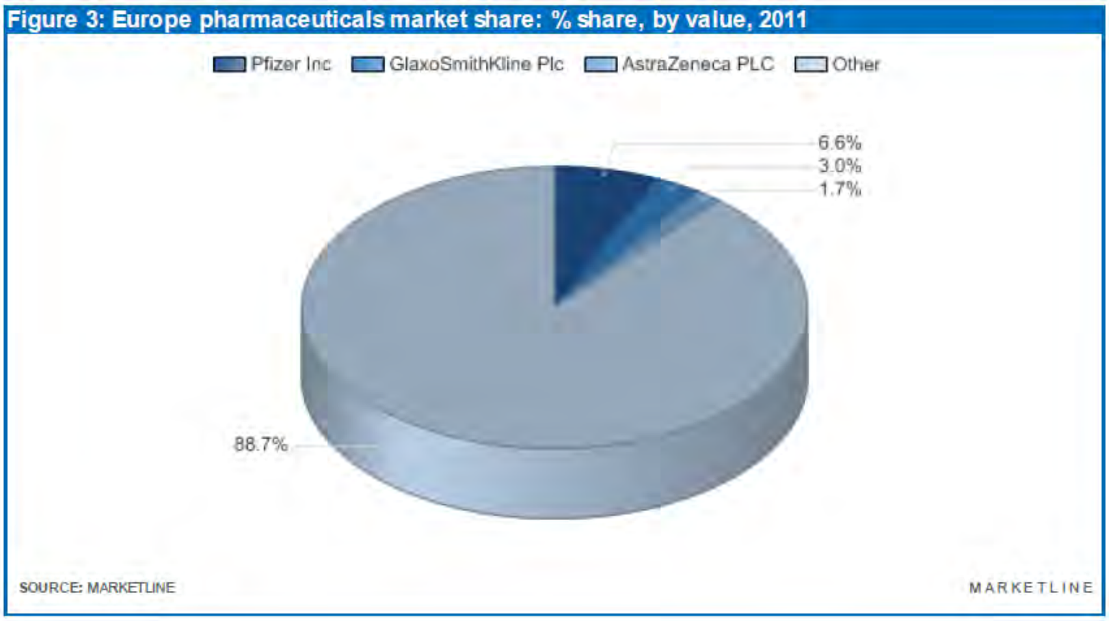


Figure 2: Pharmaceutical Companies European Market Share (MarketLine, 2012a)

2.2 Project Success

According to the Project Management Institute (PMI) "a project is a temporary endeavour undertaken to create a unique product, service or result" (2013, p.3). This definition of a project is universally accepted, however a definition on when a project is deemed a success is non-existent. Hans et al. (2012) state that this lack of definition is the reason for project failure. Sai Nandeswara Roa and Jigeesh (2012) state that a project is successful when the project is completed on time and in budget while also satisfying the customer. Lock (2007, pp.5-6) also agrees that a project is successful when it is completed within budget, with customer satisfaction and delivered to the customer on time. Kerzner (2013, p.7) states that a project is successful when it is completed "within the constraints of time, cost and performance".

Although completing the project on time, within budget and with customer satisfaction appear in most definitions of project success, the definition has been expanded to include more specifications. The PMI (2013, p.35) states that the project should be completed with the constraints of scope, resources and risk as well as with time, cost and quality. Pinto and Slevin (1987) says that as well as the time, budget and quality constraints, in order that for a project to be successful it has to achieve all the goals set for it. Kerzner (2013, pp.7-8) states that project success needs to be redefined to include minimum scope changes, little work disturbance and without changing corporate culture. The literature cannot agree on a definition of project success with some authors believing that project success does not exist in project management (Ika, 2009). For this research project, a successful project is one where all project objectives are successfully completed on time, within budget and with satisfied customers.

The probability that a project is successful can be increased by a number of different factors. Sai Nandeswara Roa and Jigeesh (2012) state that project success can be improved by increasing training, quality assurance techniques and by continually to develop techniques for project success. Lock (2007, p.6) states good project definition and strategy, competence, organisational structure and project communications are some of the factors that help increase project success. Wideman and Shenhar (2001) state that there are four key indicators that help project success; project efficiency, impact on customers, business success and future preparation. Didrago (2013) states that it is stakeholders such as management, customers and suppliers, more than the conventional factors that affect project success. The literature agrees that there are many different factors that affect project success, however they all also agree that there is a definitive list of project success factors developed by Pinto and Slevin (1987), Figure 3. Pinto and Slevin (1987) state that there are ten critical success factors that project success depends on. These critical success factors are time sequenced and interdependent.

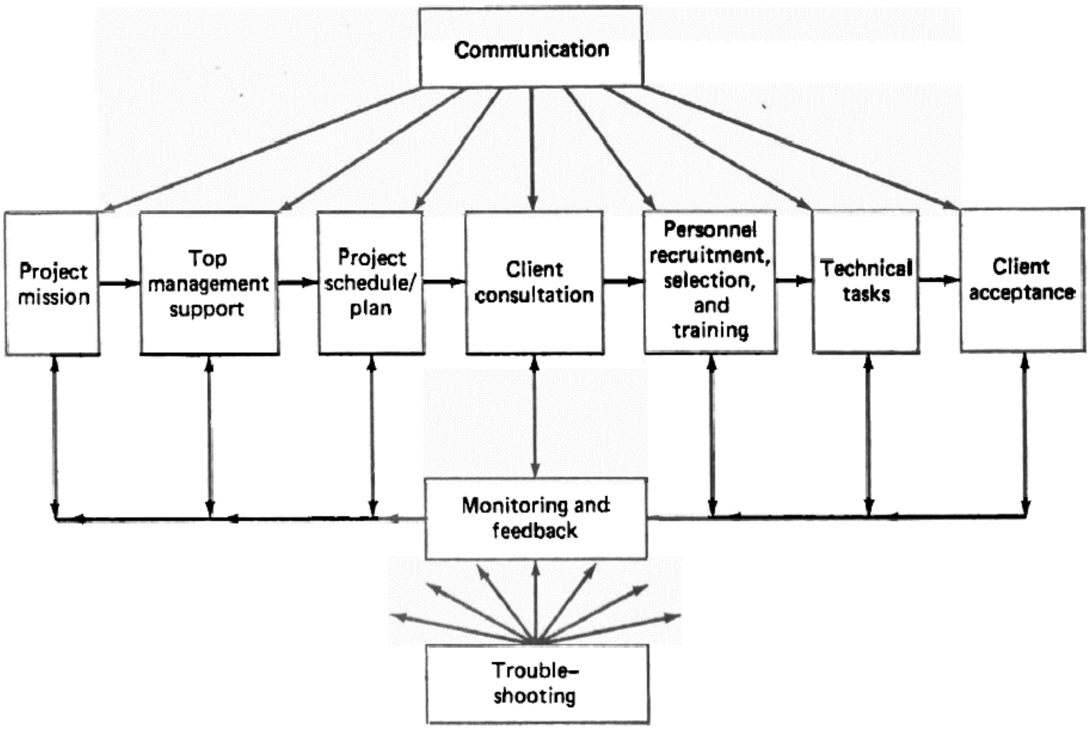


Figure 3: Project Success Factors (Pinto and Slevin, 1988)

Pretorius, Steyn and Jordaan (2012) also state that there is no procedure in place to measure the outcome of project success, which disputes Pinter and Psunder (2011). Pinter and Psunder's (2011) article states that their M-TOPSIS method will measure project success only if the procedure is duplicated for every project which is not possible. Despite the M-TOPSIS method being developed in the area of project success, there is little information on if this method will improve project success or if it will reduce the project cost.

Projects fail because of the occurrence of unforeseen events (Hillson, 2009). The lack of definition of project success has prevented there being an accurate method of how to measure project success being developed (Hans et al., 2012). Simmons (2001) states

that projects fail due to lack of definition, missing information and crawling requirements. In contrast Sai Nandeswara Rao and Jigeesh (2012) state that projects are delayed due to the availability of materials, plants and persons as well as issues caused by performance. Didrago (2009) states that projects fail due to stakeholders, managers, contractors, customers and suppliers involvement and not due to project definition or lack of it. In contrast to the authors above, Pretorius, Steyn and Jordaan (2012) state that in the engineering, construction, petrochemical and mining industries, risk management has no effect on project outcome.

In determining how to define project success there has been both qualitative and quantitative research done. Sai Nandeswara Roa and Jigeesh (2012) and Pretorius, Steyn and Jordaan (2012) undertook quantitative research, however neither surveyed exclusively the engineers responsible for undertaking the steps to ensure project success. The researcher for this project will undertake quantitative research amongst manufacturing engineers to determine their perspective of risk management to project success. There also has been a large amount of research in the construction, petrochemical and mining industries, with little research being done for the pharmaceutical industry, especially focusing exclusively on the Irish pharmaceutical industry. The researcher will focus exclusively on the Irish pharmaceutical industry for this researcher due to the gap in the literature for this section of the pharmaceutical industry.

2.3 Risk Management

The PMI (2013, p.310) defines risk as "an uncertain event or condition that if it occurs, has a positive or negative effect on one or more project objectives" while Kerzner (2013 p.873) defines risk as "a measure of the probability and consequence of not achieving a defined project goal". Larson and Gray (2011, p.211) defines risk management as "attempt[ing] to recognize and manage potential and unforeseen trouble spots that may occur when the project is implemented" while the PMI (2013, p.309) states risk management is "the process of conducting risk management planning, identification, analysis, response, planning and controlling risk on a project". The definition of risk and risk management is uniform throughout most authors, however the process of risk management is not as easy to define. The definitions used for this research project, for both risk and risk management will be the PMI definitions

The main objective of risk management is to reduce the impact a risk can have on a project through correct planning (Nicholas and Steyn, 2008, p.363). As Portney (2007, p.150) and Hillson (2009, pp.12-13) state risk management can increase the chances of a project being completed successfully. The PMI (2013, p.311) also agree that risk management when done proactively and consistently can help an organisation be successful. The literature all agrees that correctly implemented risk management helps increase the likelihood that a project will succeed. The aim of this research is to ensure that this view is consistent with manufacturing engineers' perspective on project success.

According to Lock (2007, p.99) a risk can occur at any time during the project life cycle and the later that a risk occurs in a project the higher the likelihood that the success of the project will be affected. Kerzner (2013, p.883) states the importance of establishing risk management early in a project and risks should be continuously monitored to prevent project failure. The consensus among the literature is that risk management is a continuous process and should commence the moment the project is initiated and finish when the project is officially handed off.

The project manager usually tries to assemble a dedicated risk management team consisting of core team members and relevant stakeholders for each project (Larson and Gray, 2011, p.213). Kerzner (2013, p.883) also suggests that a devoted risk management team is important to ensure project success. Larson and Gray (2011, p.213) mention that unless the risk management team can keep an open mind it is likely that the risk management process will not be successful.

Maylor (2010, pp.193-195) states that there are three steps to the risk management process, identification of risks, quantification of risks and controlling of the risks. In contrast the PMI (2013, p.309) states there is an additional three steps to the process; planning risk management, the risk response management and they divide the quantification process into qualitative risk analysis and quantitative risk analysis. Lock (2007, pp.100-113) has six similar steps to his risk management process;

identification, appraisal, register, dealing with risks, planning for a crisis and insurance. Larson and

Gray (2011, p.213) has the most encompassing risk management plan, despite only having four steps, it includes all the steps that the authors above have stated. Larson and Gray's (2011, p.213) risk management plan states their four steps to risk management which are; risk identification, risk assessment, risk response development and risk response control. The literature has varying differences in the risk management process, however the three most common steps in the risk management process will be examined in this research. These risk management steps are: risk identification, risk analysis and risk control.

2.3.1 Risk Identification

Risk identification is the first step in the risk management process according to the PMI (2013, p.319). Identification of risks "is the process of determining which risks may affect the project and documenting their characteristics" (PMI, 2013, p.319). Cooper et al. (2005, p.35) states that risk identification determines the important factors that may affect the project and how these risks may surface. In contrast to these views, Portney (2007, p.155) states that risk identification is the process of identifying risks that result from risk factors and the classification of risk comes in later risk management process. Hassanein and Afify (2007) states that the most practiced form of risk management is risk identification. According to Tadayan, Jaafar and Nasri (2012) risk identification is an iterative process which has five different levels. Each level follows on from the previous level and they are all equally important to the risk identification process. Xu

et al. (2011) states that risk identification takes its process from real life events and projects fail due to lack of real risks being identified for the project.

Risk identification is a key part of the risk management process. Xu et al. (2011) and Skorupko (2008) both agree that risk identification is fundamental to project success. Stosic, Isljamovic and Mihic (2013) state that risk identification is important as it helps identify risks before they surface and have the opportunity to affect the project negatively. Lock (2007, p.100) states that no risk identification will result in project failure. Stosic, Isljamovic and Mihic (2013) state that risk identification is key for the success of innovation. As the majority of pharmaceutical projects are research and development projects, it is clear that risk identification would contribute significantly using Stostic, Isljamovic and Mihic's (2013) research.

The definition of risk identification has small differences between the different literatures. The basic definition risk identification is of a procedure of identifying all the unforeseen events and the impact they could have on a project, is consistent. This is the definition used for this research project. The importance of risk identification is not known, there is very little data on whether risk identification impacts on project success. This research project will attempt to help find a link between risk identification and project success. The use of Stostic, Isljamovic and Mihic's (2013) research with innovation projects determined that risk identification is important for project success. The pharmaceutical industry does have a large number of innovation projects so this

research project will help determine if the employees in the pharmaceutical industry agree that risk identification is key for project success.

According to the PMI (2013, p.319) there are seven main tools that could be used to identify risks from documentation reviews to expert judgment. Larson and Gray (2011, pp.214-216) states the two most common risk identification techniques used in projects are, the risk breakdown structures (RBS) and risk profiles. Risk breakdown structures are based of the work breakdown structure (WBS) and help identify risk from the individual activities that need to be accomplished (Larson and Gray, 2011, p.214). Stosic, Isljamovic and Mihic (2013) agree that the risk breakdown structures can be used to identify potential risk events. By using a hierarchical system based off the work breakdown structure and using different risk categories, management, technology, and market for example, the risk breakdown structure could be successfully used to identify risk in innovation projects (Stosic, Isljamovic and Mihic, 2013). Kerzner (2013, p.887) and Nicholas and Steyn (2008, pp.405-409) agrees that work breakdown structures are important tools for helping identify project risks however they do not mention risk breakdown structures, which may dispute the need to develop a risk breakdown structure for a risk identification purpose.

Risk profiles which are comparable to checklists, address traditional areas of risks associated with the project and are risk profiles defined from previous projects (Larson and Gray, 2011, p.214). Larson and Gray (2011, p.214) are the only authors who state

that risk profiles can be used in identifying risks, the majority of authors choosing to use checklists. For this reason risk profiles are determined to be too similar to checklists so in the research project checklists are the risk identification tool that is used.

Hassanein and Afify (2007) state that checklists are the most popular method of risk identification as they are based off intuition, judgment and experience. Risk checklists are created by identifying possible risks under different risk categories (Hassanein and Afify, 2007). In contrast, Eybpoosh, Dikmen and Birgonul (2011) state there are two main problem areas with checklists, being used as a risk identification technique. Risk checklists ignore the interdependencies between the different risks and risk checklists it ignores repeating risks. Lock (2007, p.100) states that checklists are an important starting point to helping identify the different risk that may affect a project. Checklists are critical to a company as the project grows in size and checklists from previous projects should be used to help with the identification of risks (Lock, 2007, p.100).

To combat these problems with risk checklists, the use of structural equation modelling (SME) should be used to identify risks (Eybpoosh, Dikmen and Birgonul, 2011). The problem with structural equation modelling is that it is expensive to implement and requires specialist operators (Eybpoosh, Dikmen and Birgonul, 2011). Eybpoosh, Dikmen and Birgonul (2011) developed the structural equation model for projects in the construction industry and it is difficult to know if this model could be used for projects in the pharmaceutical industry. Xu et al. (2011) and Skorupko (2008) state that

risks can be identified from observing risks from past projects through different risk categories, from political risk to financial risk. It is agreed usually, to use past project data to help identify risks, so it is unknown if risk categories will be useful in the pharmaceutical industry.

The most efficient and effective tool for risk identification is still under discussion. There has been little evidence on which is the most popular technique used in risk identification process with multiple authors claiming their method is the most popular. The researcher will attempt to discover what the most popular risk identification technique used by manufacturing engineers in the pharmaceutical industry is. There has been no indication of which risk identification tool is used in pharmaceutical projects to help project success, as checklists may only be successful in "fast track" projects

(Hassanein and Afify, 2007). While the risk breakdown structure has been achieving good results with its use in innovation projects (Stosic, Isljamovic and Mihic, 2013). The majority of research into risk identification techniques has been in the construction industry and with new product development. This lack of information shows a gap in the literature for the researcher to fill with her research project by focusing on the pharmaceutical industry in Ireland and observing if there is any correlation with common risk identification techniques in the construction industry and with new product development.

2.3.2 Risk Analysis

The PMI (2013, p.329) defines project risk analysis as "the process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact". Kerzner (2013, p.892) states that risk analysis is an organized method of estimation of the level of risk a project has. Kerzner (2013, p.892) states that risk analysis should be done for only identified and relevant risks. In contrast, Lock (2007, p.100) states that all identified risks should be analysed. The importance of risk analysis is that it helps with the prioritization of risks that may impact the project and helps determines which risks should be dealt with first and with what priority (Kerzner, 2013, p.896).

The process of risk analysis is divided into qualitative and quantitative methods (PMI, 2013, p.329). The qualitative risk analysis approach is the most common approach according to Kerzner (2013, p.892). Some qualitative risk analysis methods include risk probability and impact assessment, risk categorization, interviews and probability impact matrix (PMI, 2013, p.329). In contrast Lock (2007, pp.100-102) states the most common qualitative methods are fault trees, fishbone diagrams, failure mode and effect analysis (FMEA) and classification matrices. The qualitative method of measuring risk impact involves defining the risks as either high impact, medium impact or low impact. High risk involves a high impact on the project and continuous monitoring is needed in contrast low impact is the opposite where the impact on the project is low and minimal monitoring is needed (Kerzner, 2013, p.896).

Kerzner (2013, p.898) states that risk probability and impact assessment and a probability impact assessment are the most common techniques and are amongst the easiest risk analysis tools to implement. Garvey and Lansdowne (1998) state that impact assessments matrices, a branch of the risk probability and impact assessment tool, provides a methodology to assess and respond to identified risks. Mahmoudi et al. (2013) states that it is becoming increasingly common to combine risk assessment with risk impact assessment for a project, this allows for more of the impacts of risky projects to be analysed. Mahmoudi et al. (2013) stated that large risky projects may benefit from their risk assessment model. However, it declares nuclear and natural disasters as risky projects, so it is unknown if this model would be able to be transferred to the pharmaceutical industry.

Immel (2013) states that engineers do not frequently undertake the practice of risk assessment. Immel (2013) states that when engineers do undertake risk assessment, fishbone diagrams or cause and effect diagrams are the most commonly used technique. Dong et al. (2013) also used cause and effect diagrams for risk analysis in their research of construction projects. Dong et al. (2013) state that the main disadvantage in cause and effect diagrams is that for each stage of the project a new diagram needed to be drawn which time is consuming. There is little research done on cause and effect diagrams use in the pharmaceutical industry and although a common risk assessment technique (PMI, 2013, p. 328) it is unclear the extent of use in the pharmaceutical industry.

The qualitative method of risk classification involves defining the risks as either high impact, medium impact or low impact. High risk involves a high impact on the project and continuous monitoring is needed and in contrast low impact is the low impact on a project and minimal monitoring is needed (Kerzner, 2013, p.896). With risk classifications it is important to note there is a need for clear and concise definitions on high, medium and low impact otherwise confusion and misclassification of risks can occur (Kerzner, 2013, p.895).

Quantitative risk analysis uses numerical values placed on risk in order to accurately determine risk impact on a project (PMI, 2013, p.335). The quantitative method of identifying risks uses statistical probabilities of the risk occurrence and determines the impact on the project using statistical methods (Nicholas and Steyn, 2008, p. 373). The quantitative method has analysis techniques such as decision analysis, expected values and the Monte Carlo process (Kerzner, 2009, pp.771-772). Rezakhani (2012) states that the quantitative method of risk analysis can only be used when there is high quality empirical data available. If there is no high quality data, the small improvement in accuracy that the quantitative method has over the qualitative method will be diminished (Rezakhani, 2012).

The qualitative approach may be the most common method, however the most common technique used to analyse risk is scenario or sensitivity analysis (Larson and Gray, 2011, p.216). Larson and Gray (2011, p.216) state that scenario or sensitivity analysis,

which involves assessing the probability of an event and the impact of the event, is also the easiest to implement. In contrast, Rezakhani (2012) states that scenario or sensitivity analysis is an advanced method and needs high quality data in order to be completed accurately. Nicholas and Steyn (2008, p.373) state that scenario or sensitivity analysis falls into either the qualitative method or the quantitative method depending on the method used to identify the risk impact. There is little research done on the use of scenario or sensitivity analysis in pharmaceutical projects. Despite it being the most commonly used risk analysis technique, it is unknown if it is the technique of choice for manufacturing engineers when undertaking risk analysis, this research project will attempt to determine if this is the case.

The Monte Carlo method is the most popular probability distribution technique (Kerzner, 2013, p.906). The Monte Carlo process is "an attempt to create a series of probability distributions for potential risks" (Kerzner, 2013, p.906). Kerzner (2013, p.906) states that the Monte Carlo process is most commonly used for when simulating large scale risks for large projects. Liang et al. (2013) states that the Monte Carlo method for obtaining probability distributions is extremely effective when used in the risk analysis process. The Monte Carlo process is most commonly used in the technology industry (Kerzner, 2013, p.906) as they can devote a large number of dedicated computer hours to it. There is little information on the effectiveness of probability distributions for pharmaceutical projects. According to Nicholas and Steyn (2008, p.373) engineers use statistical and probability techniques to implement the risk

analysis so the aim of this research is to determine if probability distribution is used by manufacturing engineers undertaking risk analysis for pharmaceutical projects.

The literature is clear on the differences between the two different risk analysis methods, qualitative and quantitative. There is very little clear literature on the methods used in projects in any industry, especially in the pharmaceutical industry. It is common for project managers to create their own method of risk analysis (Subramanyan, Sawant, and Bhatt, 2012) but there is little evidence of a correct method or the impact on project success that the risk analysis process may have. This research will attempt to gather information on which type of method for risk analysis, qualitative or quantitative, is the most commonly used in the pharmaceutical industry by manufacturing engineers practising risk management.

2.3.3 Risk Response

Risk response "is the process of developing options and actions to enhance opportunities and to reduce threats to project objectives" (PMI, 2013, p.342). Kerzner (2013, p.913) states that risk response is the methods and techniques used to deal with known risks and opportunities. Risk response also provides estimations of the resources that will be needed to ensure project success and reduce project risk (Kerzner, 2013, p.913).

Kerzner (2013, pp.913-914) states that there are five factors that influence risk response:

- Quantity and value of information,
- Benefit to project manager,
- Risk to project manager,
- Cost of alternatives,
- Exposure to risk.

There are four main strategies for developing a risk response, acceptance, avoidance, transference and reduction (PMI, 2013, p.342).

Risk avoidance is when "the project team acts to eliminate the threat or protect the project from [risk] impact" (PMI, 2013, p.344). However Melnic (2010) states that risk avoidance is the complete eradication of the risk to the project. This complete removal of the risk may have to be done by giving up on the project completely (Melnic, 2010). According to Tworek (2012) risk avoidance brings the most tangible benefits and contractors in Poland, as he believes this to be the best risk strategy. Larson and Gray (2011, p.220) state that avoiding risk is impossible, as completely eliminating all risks from a project is unfeasible and impracticable.

Avoiding risks is useful for critical risks which have low impacts (PMI, 2013, p.344). The most commonly used techniques to avoiding risks are extending the project

schedule, changing the scope or changing the project strategy (PMI, 2013, p.344). The avoidance technique is the most widely used to manage risks that have a small impact on the project and that arise early in the project (PMI, 2013, p.344). Larson and Gray (2011, pp.220-221) agree that avoidance techniques can be easily implemented for small risks and becomes problematic for larger risks. There has been no research done on risk avoidance for pharmaceutical projects. The main areas of risk avoidance research has been in the construction industry. In previous literature there has been correlation between the construction industry and the pharmaceutical industry so the research in this project will try to identify the use of avoidance in risk response for this industry.

According to the PMI (2013, p.344) transferring risk is a risk strategy where the risk impact is moved to a different party. Risk transference is the most common type of risk strategy according to Larson and Gray (2011, pp.221-222). Transferring the risk is usually achieved by using insurance. However it is important to note that transferring the risk does not eliminate the risk impact should the risk occur (Larson and Gray, 2011, pp.221-222). Though risk transference through insurance is the most common type of risk response, Lock (2007, p.111) states that there are several examples of risks that cannot be insured:

- When the loss is too high,
- When it is impossible to determine the future of the risk,
- When the insurer gains from the risk.

The ability to transfer a risk to another party through insurance is important and needs to be taken with care or the future of the entire project is in jeopardy (Lock, 2007, p.107).

Risks can be transferred to another party through insurance and this is one of the most common forms of risk response used in any industry (Tworek, 2012). According to Tworek's (2012) research, 11.4% of contractors think transferring risk is the best way to respond to risk. The pharmaceutical industry undertakes insuring of its products but there is no data to see if transference would be the main risk response strategy used. The aim of this research is to understand if manufacturing engineers would choose risk transference as commonly as contractors in Poland (Tworek, 2012).

Risk reduction or mitigation is the process of reducing the risks, by either reducing the impact of the risk on the project or reducing the probability that the risk will occur

(Larson and Gray, 2011, pp.219-220). According to the PMI (2013, p.345) risk mitigation is reducing the project risks by reducing the impact or probability to acceptable limits. Melnic (2012) states that risk mitigation might be the most desirable option, however it may be extremely expensive to implement, but this expense would be miniscule when compared to the financial impact that an occurrence of a risk would have on the project. Larson and Gray (2011, pp.219-220) state that it is less expensive if the probability of the event occurring is reduced than if its impact of the risk is reduced.

Risk mitigation is the most commonly used technique amongst contractors in the United States (Tworek, 2012). Lock (2007, p.105) agrees with Tworek (2012) that it is a commonly used technique, he also states that risk mitigation is the most important part of the risk management process. Lock (2007, p.105) also states that risk mitigation is one of the hardest to implement as it requires "active participation of all managers and staff". Larson and Gray (2011, p.220) in contrast state that risk mitigation is easy to implement when testing and prototyping are frequently used. Larson and Gray (2011, p.220) also agree with Lock (2007, p.105) by stating that it is commonly managers that undertake risk mitigation.

Accepting risk is when "the project team decide to acknowledge the risk and not take any action unless the risk occurs" (PMI, 2013, p.345). Larson and Gray (2011, p.222) also state that accepting a risk needs to be a conscious decision by all team members in order to be successful. Accepting the risk is usually undertaken when the risk is too great to consider another strategy (Larson and Gray, 2011, p.222). Also it is common to accept a risk when the probability of the risk occurring is low (Larson and Gray, 2011, p.222). Lock (2007, p.106) agrees that the risk would either be too large to avoid or the probability of occurrence low for it to be accepted.

A contingency plan is usually developed to combat the risk in this case, so if the risk does occur there are alternate options available (Melnic, 2010). The literature is in agreement over the definitions of the different risk strategies and when it is acceptable

to use them. As can be seen from Tworek's (2012) research different cultures may have to be considered in the decision on risk strategy. There is a lack of literature with empirical data on which risk strategy is the most accurate and most widely used. There is no quantitative data on risk strategies in the pharmaceutical industry, only in the construction industry.

Chapter 3
Research Methodology

Chapter 3 – Research Methodology

3.1 Introduction

The purpose of this study is to explore manufacturing engineers' understanding on the value of risk management to project success in the pharmaceutical industry. Risk management is a tool generally adopted by project managers in helping a project succeed in the organisations definition of project success. Plenty of literature is available on risk management and how it impacts the project's chances of success with some authors developing their own methods and techniques to respond to each stage of the risk management process. However, the majority of the existing literature for risk management and project success is for the construction industry. The majority of the literature excludes the opinion of the manufacturing engineers who have to implement the risk management techniques. This research project investigates the area of the manufacturing engineer's understanding of the value of risk management to project success in the pharmaceutical industry.

The Guide to the Project Management Body of Knowledge (PMBOK) (PMI, 2013) is a collection of the processes and knowledge areas with the best practices for the project management field. The PMBOK guide has as one of its nine project areas including risk management as one of the critical success factors for a project. This research project uses the PMBOK guide's critical success factors to help evaluate manufacturing engineer's understanding of the value of risk management to project success.

3.2 Research Methodology

According to Saunders, Lewis and Thornhill (2012, p.5) research methodology is "the theory of how research should be undertaken including the theoretical and philosophical assumptions upon which research is based and the implications of these for the method or methods adopted." Research methodology is a systematic way of solving problems and is how researchers go about the process of research according Rajeskar, Philominathan and Chinnathombi (2006). The rationale of research methodology is to assist the researcher in answering their research questions and research hypotheses. There are numerous different research methods each with its own unique advantages and disadvantages, the method chosen, by the researcher will influence the type of data being collected (Saunders, Lewis and Thornhill, 2012, p.126)

The research process is comparable to an onion, different interconnecting layers which all need to be completed for the research to be undertaken successfully (Saunders, Lewis, Thornhill, 2012, p.126). The research onion, Figure 4, has six different layers:

- Research philosophy,
- Research approach,
- Research strategies,
- Research choices,
- Time horizons,
- Techniques and procedures.

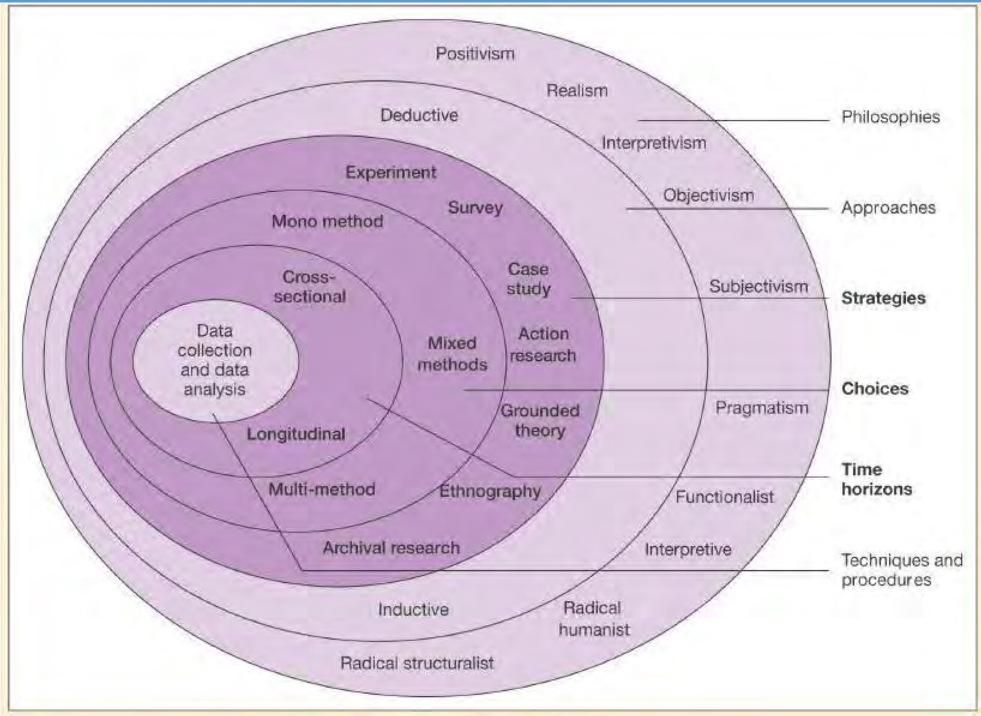


Figure 4: Research Onion (Saunders, Lewis and Thornhill, 2012, p.128)

3.3 Research Philosophy

Research philosophy is an "overarching term relat[ing] to the development of knowledge and the nature of that knowledge" (Saunders, Lewis and Thornhill, 2012, p.127). Research philosophy is more simply stated, as the assumptions that shape the way the world is viewed by the researcher (Saunders, Lewis and Thornhill, 2012, p.128). There are three main philosophical research positions, ontology, epistemology and axiology available to researchers and it is important to note that none are worthier than the other as they are all suited to different research styles.

According to Saunders, Lewis and Thornhill (2012, p.676) "ontology is a branch of philosophy that studies the nature of reality or being." Epistemology is a philosophical

position that is concerned with if the social sciences can be studied using similar methods that are used in the study of the natural sciences (Bryman and Bell, 2011, pp.15-16). Axiology is a philosophical position "that studies judgement about value" (Saunders, Lewis and Thornhill, 2012, p.137).

There are two main characteristics of ontology: objectivism and subjectivism. Objectivism supports the suggestion that social experiences and their consequence are independent of the individuals who undertaken them (Bryman and Bell, 2011, p.716). Subjectivism states on the other hand, that the objects created by actions of the individuals, who are then responsible for these actions (Saunders, Lewis and Thornhill, 2012, p. 132). Saunders, Lewis and Thornhill (2012, p.132) believe that ontology is not suitable for business research and the research philosophies that are suitable to business research are positivism, realism and interpretivism which are encompassed by epistemology position.

There are three main branches of epistemology: positivism, interpretivism and realism (Saunders, Lewis and Thornhill, 2012, p.134). Positivists believe that the social world exists superficially and can be viewed impartially by a researcher who is independent of the research (Blumberg, Cooper and Schindler, 2011, p.17). Positivism allows research methods that are in line with the natural sciences. Positivists normally develop research hypotheses from the secondary research that they have undertaken and this remove the researcher from the data collection process.

Interpretivism states that the world is constructed by the people, and with that the research undertaken is achieved by the interest of the people and the researcher cannot separate themselves from the research process (Blumberg, Cooper and Schindler, 2011, p.17). Interpretivists focus on the details of a situation and the meaning behind these details by using two intellectual traditions; phenomenology and symbolic interaction (Saunders, Lewis and Thornhill, 2012, pp.137-140). Interpretivists use observational techniques by observing the world surrounding them, they do not develop research hypotheses as it would involve being independent from the research.

Realism believes "an objective reality exists and could be known about" (Cameron and Price, 2009, pp. 53-54). Realism can be broken into two areas, direct and critical. Direct realism believes that what human senses represents, are an accurate representation of the world while critical realism believes that humans only experience sensations (Saunders, Lewis and Thornhill, 2012, p.136). Realism is similar to positivism as it believes that a scientific approach can be used in data collection in the social sciences.

The paradigm that the researcher finds reflects her study the most is that of the functionalist. The problem solving aspect of the functionalist paradigm, is the principle reason that it was chosen by the researcher over the others, interpretative, radical humanist or radical structuralist. (Bryman and Bell, 2011, p.24)

The predominant epistemological position utilized in this research project is positivism. This is due to the researcher developing research hypotheses which will need to be tested with methods similar to methods used in the natural sciences. The researcher chose positivism over realism because of the researcher's belief that the world cannot be simplified.

3.4 Research Approach

Research approach is a "general term for inductive, deductive or abductive research approach" (Saunders, Lewis and Thornhill, 2012, p.680). Deductive research begins with a "theory and proceeds by testing hypotheses derived from the theory" (Cameron and Price, 2009, p.74). Deduction is the dominant research approach used in the natural sciences as it allows a greater degree of control (Saunders, Lewis and Thornhill, 2012, p.145). Deduction has a tendency to not tolerate alternate theories that may arise (Cooper and Schindler, 2008, p.72-74).

Blaikie (2010, cited in Saunders, Lewis and Thornhill, 2012, p.145) states there are six steps for a deductive approach to research:

- Proposal of hypothesis,
- Using existing literature, determine a testable position,
- Examining the logic of the argument and if there is an advantage of knowing the answer to the argument,
- Test the position,
- Analyse the results, if the results do not back up the position, either reject or reconsider the position,
- Analyse the results, if they are consistent the position is corroborated.

In an inductive research approach, data is collected and a theory is developed as a result of the data analysis (Saunders, Lewis and Thornhill, 2012, p.147). Induction is useful for theory generation and formulation (Saunders, Lewis and Thornhill, 2012, p.147). The abductive approach is a research approach that involves "the collection of data to explore a phenomena, identify themes and explain patterns to generate a new – or modify an existing theory which is subsequently tested" (Saunders, Lewis and Thornhill, 2012, p.665).

The research approach that is used for this project is deductive. The researcher chose the deductive approach because it is a highly structure method and it is able to be operationalized. The deductive approach allows the researcher to generalise which is

not given in either the inductive or abductive approaches, which is necessary for her research hypotheses.

3.5 Research Strategy

The third layer of the research onion, Figure 4, details the different research strategies available to the researcher (Saunders, Lewis and Thornhill, 2012, p.173). Research strategy is how the research questions are going to be answered (Saunders, Lewis and Thornhill, 2012, p.173). There are three main types of research strategy used in correlation with the deductive research approach; experiments, case studies and surveys (Saunders, Lewis and Thornhill, 2012, p.173). In this research, the research questions and research hypotheses revolve around what manufacturing engineers understand about the value risk management and the value risk management has on project success. It is important when choosing the research strategy for a project to consider that there should be a link between the data collection process and the research strategy (Marschan-Piekkari and Welch, 2004, p.114)

Experiments are "studies involving intervention by the researcher beyond that required for measurement to determine the effect on another variable" (Blumberg, Cooper and Schindler, 2011, p.492). There are numerous advantages to using experiments, the major advantage is the imitability of repeating experiments (Cooper and Schindler, 2008, p.245). Experiments can generate a sterile controlled environment which may limit the interaction of participants in some situations (Cooper and Schindler, 2008,

p.245). Experiments although would be suitable for this research were not chosen to be used due to the short time period in which the data needs to be gathered. Experiments need careful planning and need to be reproduced over a period of time for the data gather to be considered valid.

Case studies are a "social survey … on a single case with a view to revealing important features about its nature" (Bryman and Bell, 2011, p.68). Case studies are helpful when the participants in the study cannot be separated from the organisation and when the researcher has to gather research from different sources (Cameron and Price, 2009, p.306). Case studies are not appropriate for the researcher's project as there would need for events to be generalised for the research questions to be fully answered. The researcher would have considered a multiple-case study if the time constraint was not applicable in this research project.

A survey is a method of questioning participants by using questions and instructions for the participants involved (Blumberg, Cooper and Schindler, 2008, p.492). A survey is useful for generating large quantities of data from large group of people. Surveys generate quantitative data which can directly answer the research questions and confirm research hypotheses (Cameron and Price, 2009, p.359). A weakly designed survey could lead to misleading information which can misinform the researcher (Cameron and Price, 2009, p.359). Based on the researcher's research questions and research hypotheses, the researcher is seeking to find facts by asking a representative sample

questions to determine opinions to identify and explain the manufacturing engineers' understanding of the value of risk management in project success. Therefore, the researcher has selected the survey strategy because it is most suitable research strategy for this research study.

3.6 Research Choice

Research design is the plan of how the research will be undertaken and all research question answered (Saunders, Lewis and Thornhill, 2012, p.159). The first choice that the researcher has to undertake is to decide whether they will follow a single research design (mono method) or a multiple message research design (multi method) (Saunders, Lewis and Thornhill, 2012, p.160). The research methodological choice can be easily broken down into different stages, Figure 5.

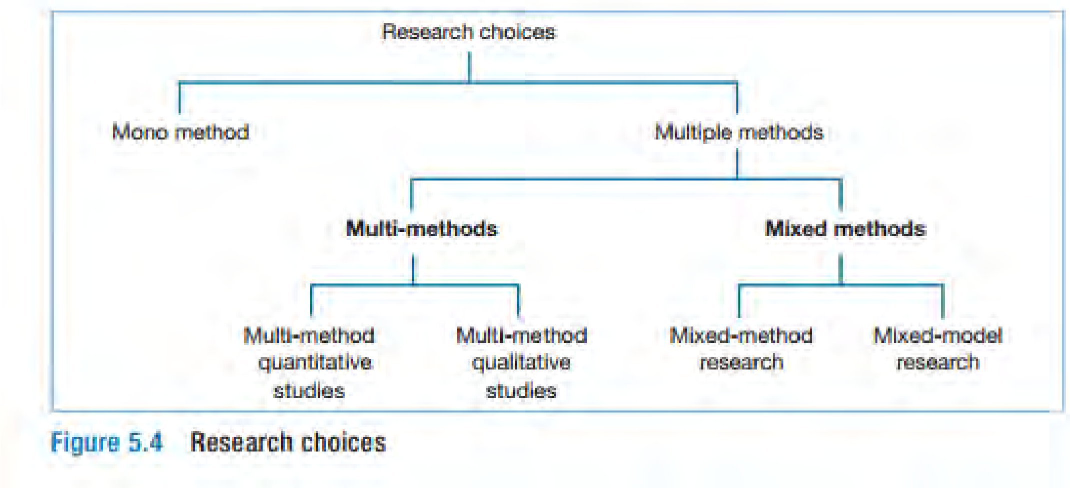


Figure 5: Methodological Choice (Saunders, Lewis and Thornhill, 2006, p.146)

The mono method is the most suitable method for testing developed research hypotheses to determine the validity of a proposed theory (Cameron and Price, 2009, p.256). The mono method has two main branches, qualitative and quantitative. Qualitative data is non-numeric data such as descriptions and opinions. Whereas, in contrast, quantitative data is numeric data such as numbers and units (Saunders, Lewis and Thornhill, 2012, p.161, Cameron and Price, 2009, p.212).

Multiple research design can be broken into multi-method and mixed methods. Multi-method research design is when more than one data collection technique is used, however it is restricted to either qualitative or quantitative (Tashakkori and Teddlie, 2003, p.17). Using both a qualitative and quantitative data collection techniques in combination with each other is a mixed method research design (Saunders, Lewis and Thornhill. 2012, p.166).

In this research project, a mono method for data collection and analysis technique is applied. The researcher's choice is to use a quantitative data collection technique and there is one stage of this data collection. A self-administered web based survey was carried out to collect responses and views from manufacturing engineers in the pharmaceutical industry. This provides quantitative data which the researcher analysed to determine the understanding manufacturing engineers have of the impact of risk management on project success. The benefit of using a mono method for this research project is that when the subject is complex, as in this research project, it is easier to plan

and carry out the research necessary for completion (Saunders, Lewis and Thornhill, 2012, pp.162-163).

3.7 Time Horizons

There are two identifiable time horizons, that of longitudinal study (long-term study) and cross-sectional study ('snapshot' study) (Saunders, Lewis and Thornhill, 2012, p.190, Bryman and Bell, 2011, pp.53-57). When the research is conducted over a period of time and all details recorded it is a longitudinal study (Saunders, Lewis and Thornhill, 2012, p.190). In contrast, cross-sectional research is conducted for one moment in time and all data recorded from that moment.

Cross sectional time horizon is a time horizon that is "conducted only once and reveals a snapshot of one point in time" (Blumberg, Cooper and Schindler, 2011, p.490). Cross-sectional time horizons usually employ a survey strategy as they provide a snapshot of events at a particular time (Saunders, Lewis and Thornhill, 2012, p.190). A longitudinal study is "repeated over an extended period of time, tracking changes in variables over time" (Blumberg, Cooper and Schindler, 2011, p.495). Due to the time and cost that longitudinal study uses there are rarely used in business research or management research (Bryman and Bell, 2011, p.57)

The researcher utilised cross-sectional research for this research. The research is based on a survey strategy by using a self-administered web based survey for the data collection process. The researcher's use of this data collection method, at a particular moment in time, has led to a cross sectional time horizon being used in this research project.

3.8 Data Collection

A survey can be either interviewer administered (face to face) or self-completion (web based). There are numerous advantages to self-completion surveys that were used in this research project. Self-completion or self-administered surveys are less expensive than interviews (Cameron and Price, 2009, pp.358-359). The self-administered survey is anonymous and there is little interviewer bias on the respondent (Cameron and Price, 2009, p.359). The disadvantages of self-completion surveys are that there is a loss of researcher control and it can be a slow process to get the data returned (Cameron and Price, 2009, p.359).

Interviewer administered surveys have instant feedback associate and a higher correctly administered rate, however there is a large bias present due to the interviewer being present in the interview (Cameron and Price, 2009, p.359). For this research project, the researcher decided that web based self-administered surveys were appropriate due to the large number of respondents needed.

"A questionnaire is a predetermined set of questions designed to capture data from respondents" (Hair et al, 2003, p.419). In this research project, part of the self-administered web based survey is a written questionnaire. It is suggested that the design of the questionnaire is consistent to avoid confusion and generate confidence in the respondents (Cameron and Price, 2009, p.358).

Consequently the majority of the questions in the survey were either closed questions or statements which the respondents were asked to indicate their opinion on a five point scale: "very often", "often", "neutral", "sometimes" or "never". The researcher administered the survey to a trial group, as well as referring it to the dissertation supervisor to ensure complete clarification and to minimise response errors. To avoid non-responses, loss of control and slow responses, it is suggested that the researcher should maintain contact with survey respondents to ensure follow up contact is allowed (Hair et al, 2003, p.133).

3.8.1 Primary Data Collection

Self-administered web based surveys are used as the primary data collection technique for this research project. The self-administered web based surveys are used as they allow the largest amount of anonymity for the participants and it will be the easiest method to distribute the surveys to the sample population and gather the results.

3.8.2 Secondary Data Collection

Secondary data is a tool used to help compare the primary data findings to a general context to help triangulate the data (Saunders, Lewis and Thornhill, 2012, p.307). The literature review was compiled using secondary data collection by books and journals. These were used as a secondary source of information considered for this research project.

3.8.3 Techniques for Data Analysis

The way in which data is analysed is extremely important for every research project. This research project will involve the investigation of the returned web based surveys. In order to analyse the responses from the self-administered web based surveys, the researcher will use the PASW Statistic package (formally SPSS Statistics). The reason behind using the PASW package, over other alternatives available is due to the researcher's previous experience with this software package and the knowledge the researcher has that this software is used in the pharmaceutical industry. The survey questions were designed for the purpose of this research, there were no open questions in order for all questions to be able to be analysed by the PASW Statistical software package.

According to Waters (2007, p.18) there are three main areas of quantitative data analysis, deciding on the quantitative tools that will be used, collecting the data and displaying the data. The data collection was mainly achieved by the online survey hosting website that the research used for this research project. SurveyMonkey.com

collects all the results and converts them to the numerical format needed for the PASW Statistical software to perform detailed analysis with.

The choice of data display was the final major activity of the data analysis chapter. This data display involved generating appropriate diagrammatic representation of the responses for each of the questions in the surveys. With the charts and diagrams, the researcher was able to reduce and represent the data collected in an appropriate and clear method.

3.9 Population and Sample

According to Bryman and Bell (2011, p.175) sampling is used in research when it is not possible to survey the entire population due to limited resources and time constraints. In the majority of cases, conclusions about the entire population, can be drawn from the particular sample. The most important part of sampling is ensuring the sample is representative of the entire population otherwise the findings cannot be generalised (Bryman and Bell, 2011, p.176). In this research project, the researcher is unable to sample the entire population due to time and resource limitations, therefore sampling was necessary.

The sampling process described by Hair et al. (2003, p.209) has five main steps:

1. Defining the population,
2. Choosing the sampling frame,
3. Selecting the sampling method,
4. Determine the sampling size,
5. Implementing the sample plan.

In order to correctly define the target population, it is essential that the research objectives and scope of the project are carefully considered (Hair et al, 2003, pp.209-210). The target population are "those people … that contain the desired information for the study that determine whether a sample or census should be selected (Cooper and Schindler, 2008, p.713). The criteria used to select the target population for this research were manufacturing engineers in the pharmaceutical industry in Ireland that had experience with working with projects.

"A sampling frame is the listing of all units in the population from which the sample will be selected" (Bryman and Bell, 2011, p.176). The sampling frame for this research project is a list of the pharmaceutical companies in Ireland. This list was compiled by using the list from the IDA (2013) and BioPharmaGuy (2013). This list generated the sampling unit, as the self-administered web based survey was distributed to every company on the list. The sampling unit is "elements or objects available for selection during the sampling process" (Hair et al, 2003, p.420).

Bryman and Bell (2011, p.179) state that the sampling method that is selected is based off a number of external factors. These external factors are, but are not limited to, the scope, objectives, time and budget of the study. There are two classes of sampling, probability sampling and non-probability sampling. Probability sampling is when the sample is randomly selected and each unit in the population has an equal probability of being selected (Bryman and Bell, 2011, p.717). Non-probability sampling is when the sample is not randomly selected so a units probability of being selected compared to another is not equal (Bryman and Bell, 2011, p.716).

The sampling stance for this project is non-probability random sampling, as this best suits the exploratory methodological stance used in this research project (Burns and Burns, 2008, p.198). Considering the research strategy used is a quantitative data collection in the form of a self-administered web based survey, the sampling technique used for this research project is snowball sampling.

Snowball sampling is a sampling procedure where initial respondents provide additional respondents (Bryman and Bell, 2011, p.682). In snowball sampling, the initial respondents are used by the researcher to gain additional respondents. This sampling process is repeated until the sample size is reached (Saunders, Lewis and Thornhill, 2012, p.289). In this project, the initial contacts were identified and research access was achieved through direct personal contact. These initial contacts were then asked to pass the self-administered web based survey to other manufacturing engineers in their organisation. This method was found by the researcher to be an effective and inexpensive way to collect the data required for this research project.

For this research project, it was impractical to collect data from the entire population as it was too large. The sample size of 90 manufacturing engineers who work with projects in the pharmaceutical industry in Ireland was selected. This sample was selected from the population of manufacturing engineers working on projects in different pharmaceutical organisations in Ireland. The researcher requested completed surveys off respondents who are working in the pharmaceutical industry and have experience working on projects. The self-administered web based survey is distributed by the contacts with a direct link to the survey. The majority of respondents will be recently graduated manufacturing engineers that have worked or are currently working on projects in the pharmaceutical industry.

3.10 Research Ethics

The researcher's stance on research ethics is a combination of universalism and situational ethics. This is due to the researcher having strong moral principles that ethical guidelines should not be broken the researcher understands that she might be

placed in a situation where this may be unavoidable and in these situations a more situational stance may be used (Bryman and Bell, 2011, pp.124).

Ethical issues may occur throughout the dissertation. The researcher has examined a number of the major stages of her dissertation and will determine the major issues that might arise for each stage. In the development of the research topic, the ethical issue which may arise is the researcher's rights to quality research. The anonymity and privacy of the contributors are ethical issues that occur throughout many stages of the research project. They occur in the research design, the data collection and processing phases of the project. The main ethical issue that may occur throughout this process is the situation surrounding data protection. The data collected will be highly sensitive and could cause reputation damage to all parties involved if not stored correctly. (Saunders, Lewis and Thornhill, 2012, p. 236).

3.11 Research Limitations

There is a limit placed on the research which limits the amount of engineers being targeted to ninety. This is only a tiny proportion of the sample size, however it will have to be a representation of the total population due to this limitation.

Using a quantitative method for the research, the researcher faces many limitations to this method. The rigidity of the quantitative method doesn't allow for many fluctuations

when applied to the social sciences. Subjects respond based on their past experiences and the expectations that are placed on them (Burns and Burns, 2008, p.17).

Another limitation with the quantitative method is that there is no definitive way in which participants will react when asked to complete a survey. Some of the participants might find the content boring or too personal which will limit their response rate. To overcome this the researcher is planning to distribute between 180 and 200 surveys to potential participants. (Burns and Burns, 2008, p.17)

Chapter 4
Data Analysis and Findings

Chapter 4 – Data Analysis and Findings

4.1 Overview

This chapter outlines the data analysis and significant findings of the research project. The data analysis considers all data from both main sources, primary and secondary. The literature review, Chapter 2, illustrates the secondary data. The secondary data gathered is used with the primary sources of data collected to corroborate the findings. A quantitative research method is used for this research project.

The questionnaire results were analysed using frequency analysis for each of the 21 questions. A total of 135 respondents took part in the survey, however only 90 completed the survey. Only the 90 completed surveys will be used in this analysis. All respondents were manufacturing engineers that had worked in the pharmaceutical industries for different time periods. Comparisons were also made to understand the impact of risk management to project success in the pharmaceutical industry.

4.2 Demographic Data

When respondents were asked about their gender out of the 90 respondents, 28 (31.1%) were female and the remaining 62 (68.8%) were male. This corresponds with the convention that more males are engineers than females (The Telegraph, 2013).

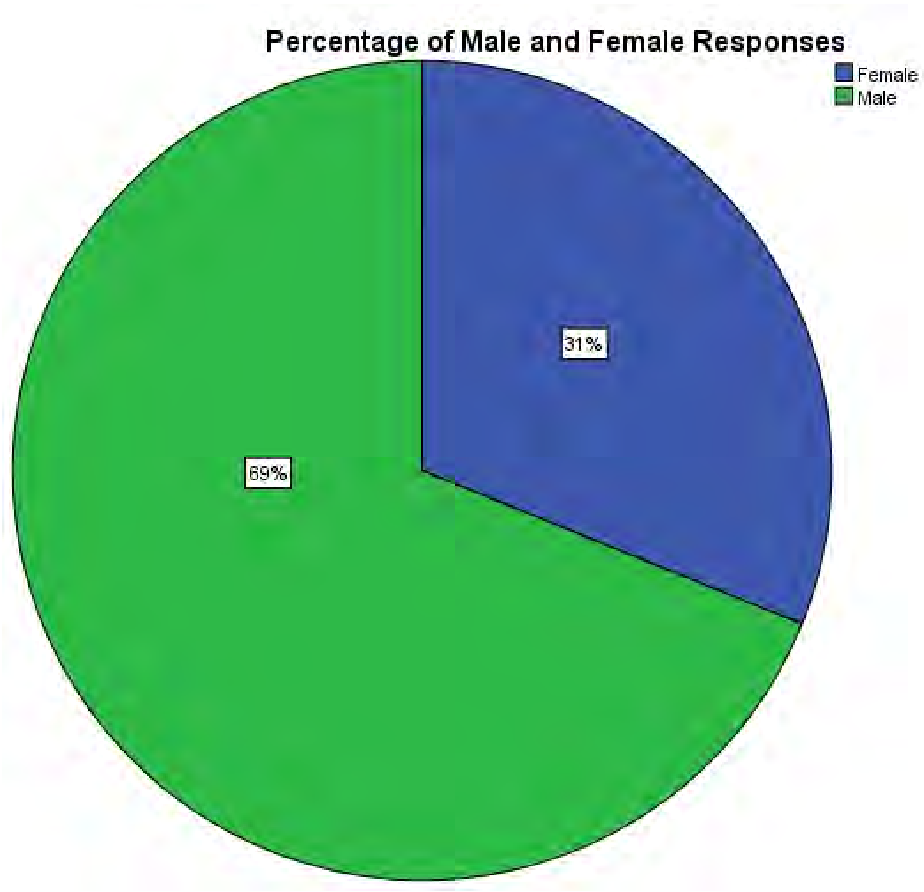


Figure 6: Gender graph

According to Figure 7, the majority of the respondents were in the age range "18 to 24". The age range is used to provide an insight into the average age of the respondents. 49 respondents (54.4%) are between "18 and 24" years old, 14 respondents (15.6%) are "25 to 34" years old and 12 (13.3%) respondents are between "35 and 44" years old. With over 24,000 people directly employed in the pharmaceutical industry in Ireland, (Enterprise Europe Ireland, 2012) and 40% of pharmaceutical employees will need a third level degree (PharmChemical Ireland, 2013) the majority of respondents being under 44 years old it correlates with this data. The remaining 15 respondents are either in the "45-54" age bracket (10%) or the "above 55" age bracket. The remaining 6.7% (6 respondents) are above 55.

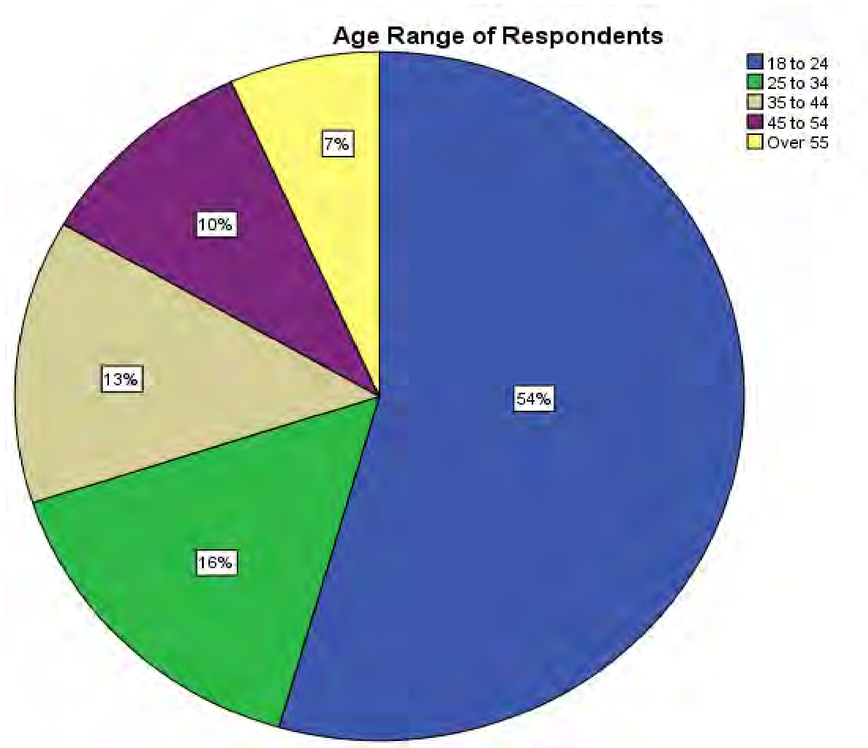


Figure 7: Age Range of Respondents

When the respondents were asked how long they worked in the pharmaceutical industry the majority, 43 respondents (47.8%), had been working in the industry for under a year. This correlates with the age of respondents as 49 (54.4%) respondents were between 18 and 24 which would place them in a recent graduate position. With 20% of pharmaceutical jobs being for recent graduates (PharmaChem Ireland, 2012) the majority of respondents working in the pharmaceutical industry for less than a year associates with this statistics. 19 (21.1%) respondents have worked in the pharmaceutical industry for 1 to 3 years, 8 (8.9%) of respondents have worked for between 4 to 6 years in the pharmaceutical industry while 20 (22.2%) have worked for more than six years. The length of time working in the pharmaceutical industry correlates with the number of projects that are overseen by the respondents.

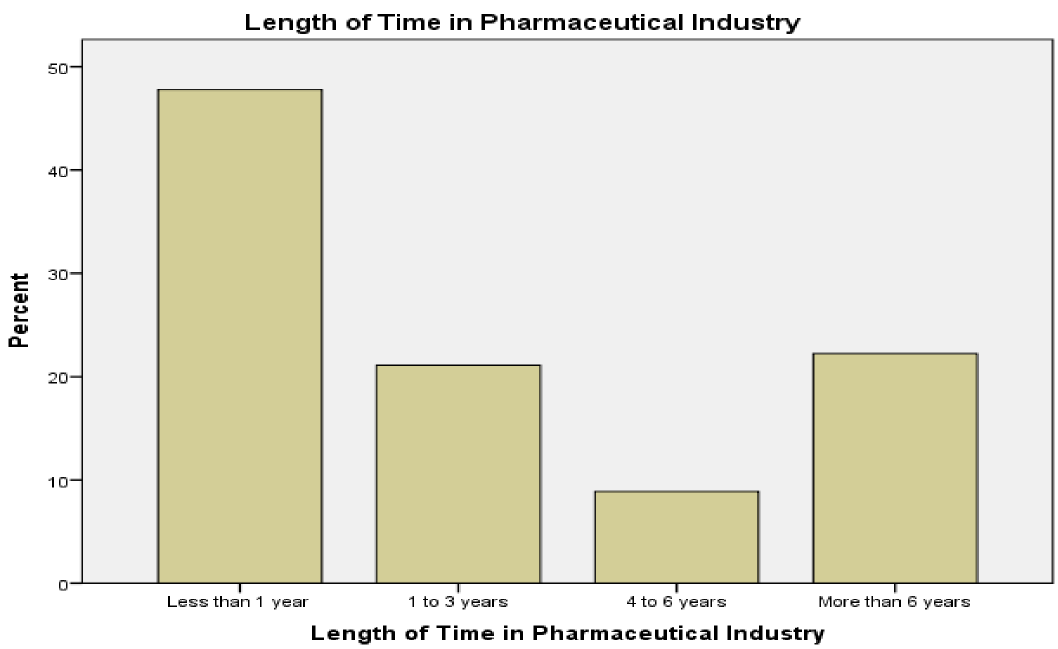


Figure 8: Length of Time in Pharmaceutical Industry

When the manufacturing engineers surveyed in this research were asked if they had ever overseen a project, an overwhelming majority of the respondents, 66 respondents, (73.3%) said they had overseen a project. This shows that there is a need for manufacturing engineers to have an understanding of projects, project management and how the likelihood of the project being a success can be helped by using risk management. 16 (17.8%) have never overseen a project while 8 (8.9%) respondents are unsure if they have overseen a project. This shows that there needs to be greater project communications to ensure that manufacturing engineers understand if they lead a project or not.

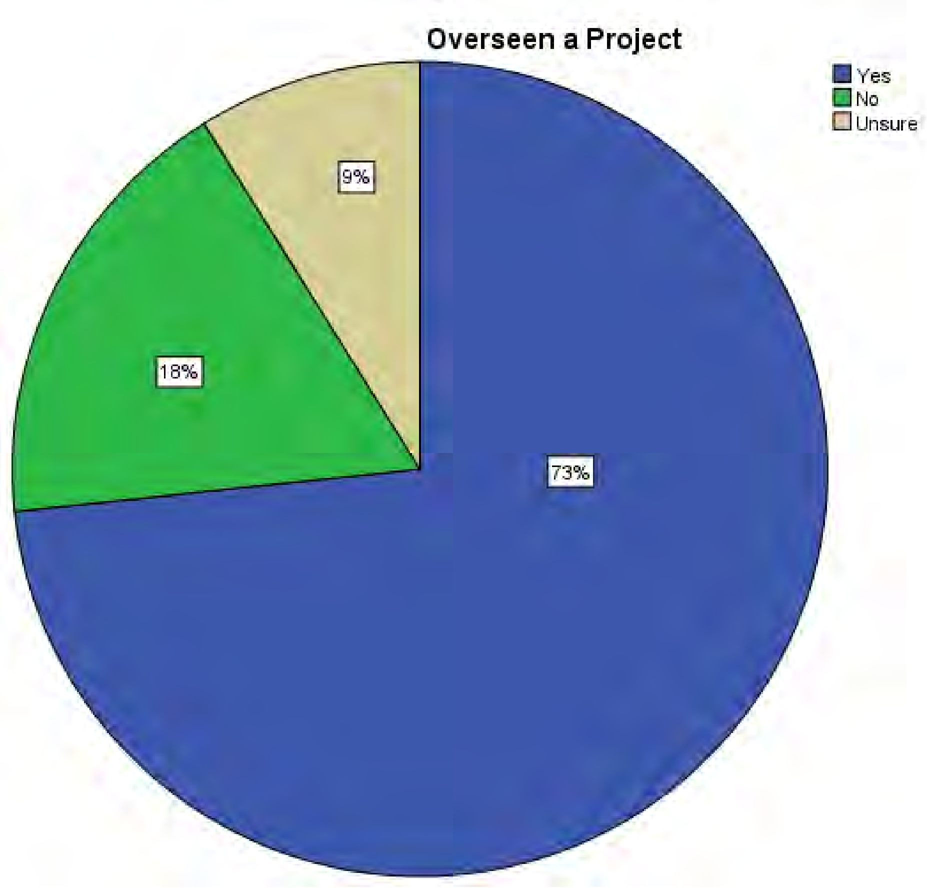


Figure 9: Overseen a Project

When determining whether that the projects manufacturing engineers had overseen had been successful, the question was only posed to the 66 respondents who had answered yes to the question on overseeing a project. The definition of success the respondents were required to base their responses on was the PMI (2013, p.3) and Sai Nandeswara Roa and Jigeesh (2012) definition. The definition used in this research project was "A successful project for this survey will be one where all project objectives were successfully completed on time and within budget." When asked on their project's success, 43 (65.2%) respondents stated that their project was successful, 9 (13.6%) respondents said that their project was unsuccessful and 9 (13.6%) where unsure of its success. 5 (7.6%) responded that project success was not applicable due to the project not being completed.

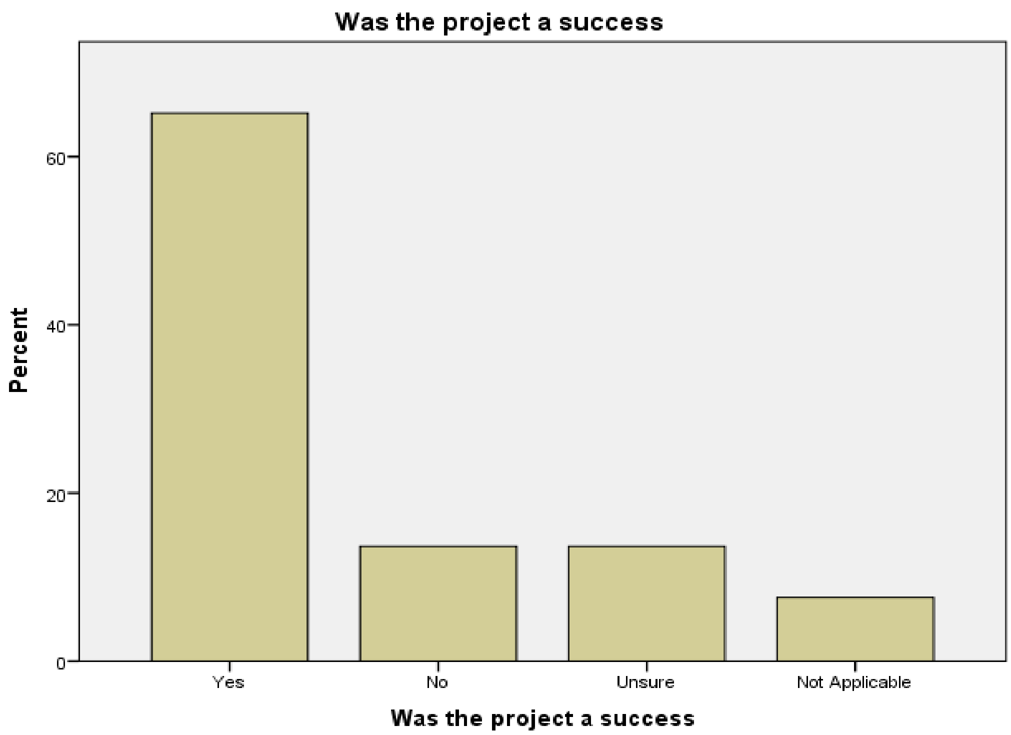


Figure 10: Project Success

4.3 Risk Identification

Risk identification is the first step in the risk management process (PMI, 2013, p.319). Identification of risks "is the process of determining which risks may affect the project and documenting their characteristics" (PMI, 2013, p.319). Risk identification should be the first step used when identifying risks for a project but only 71 (78.9%) respondents said they have been involved in identifying risks. Of the remaining 19 respondents, 14 (15.6%) respondents said no and 5 (5.6%) respondents were unsure if they have ever identified risks. With 21.2% (19 respondents) of respondents having done no risk identification techniques it leads to questions on how successful projects can be if comprehensive risk identification is not undertaken. Xu et al. (2011) and Skorupko (2008) both agree that risk identification is fundamental to project success, which when only 71 (78.9%) of respondents had undertaken risk identification it shows a big area of concern where projects can fail.

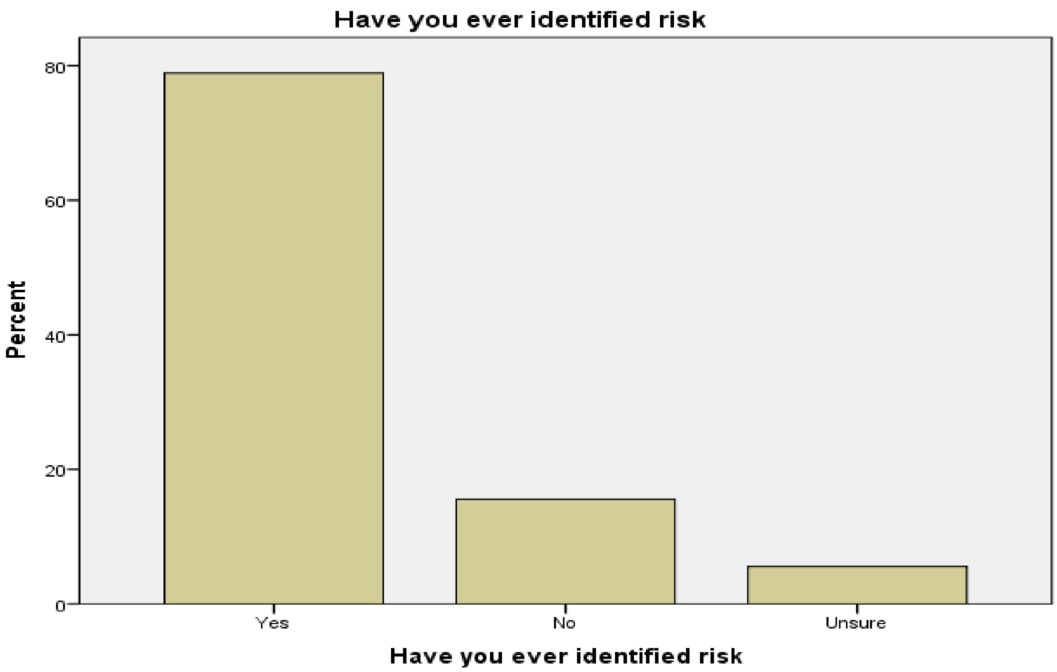


Figure 11: Identification of Risk

When respondents were asked to determine if they have ever used a selection of risk identification techniques, the respondents were asked to determine the usage of these tools by determining if they use these tools: "very often", "often", "sometimes" or "never". The most commonly used technique used by contractors and civil engineers for risk identification is the checklist (Hassanein and Afify, 2007). It is reasonable to assume that manufacturing engineers working in the pharmaceutical industry would also use similar techniques in their risk identification.

Brainstorming was the tool used most often by manufacturing engineers in the pharmaceutical industry with 38 (42.2%) respondents choosing brainstorming as their most commonly used technique. Checklists which was previously predicted to be the most commonly used tool, was the second most commonly used technique with 36 (40.0%) respondents choosing checklists as a commonly used technique.

Cause and effect diagrams or fishbone diagrams were found to be the tool that was often used. 38 (42.2%) respondents chose this tool, only 10 (11.1%) respondents would use this tool more often than the other respondents. Interviewing and assumption analysis were chosen as the top tool when usage was described as "sometimes". 26 (28.9%) respondents chose interviewing and assumption analysis tools as being used sometimes.

The risk identification technique that was never used by manufacturing engineers in the pharmaceutical industry was the Delphi technique. 55 (61.1%) respondents replied saying they have never used the Delphi technique in risk identification. When comparing the most commonly used technique, brainstorming, no respondents said that they had never used the brainstorming risk identification technique.

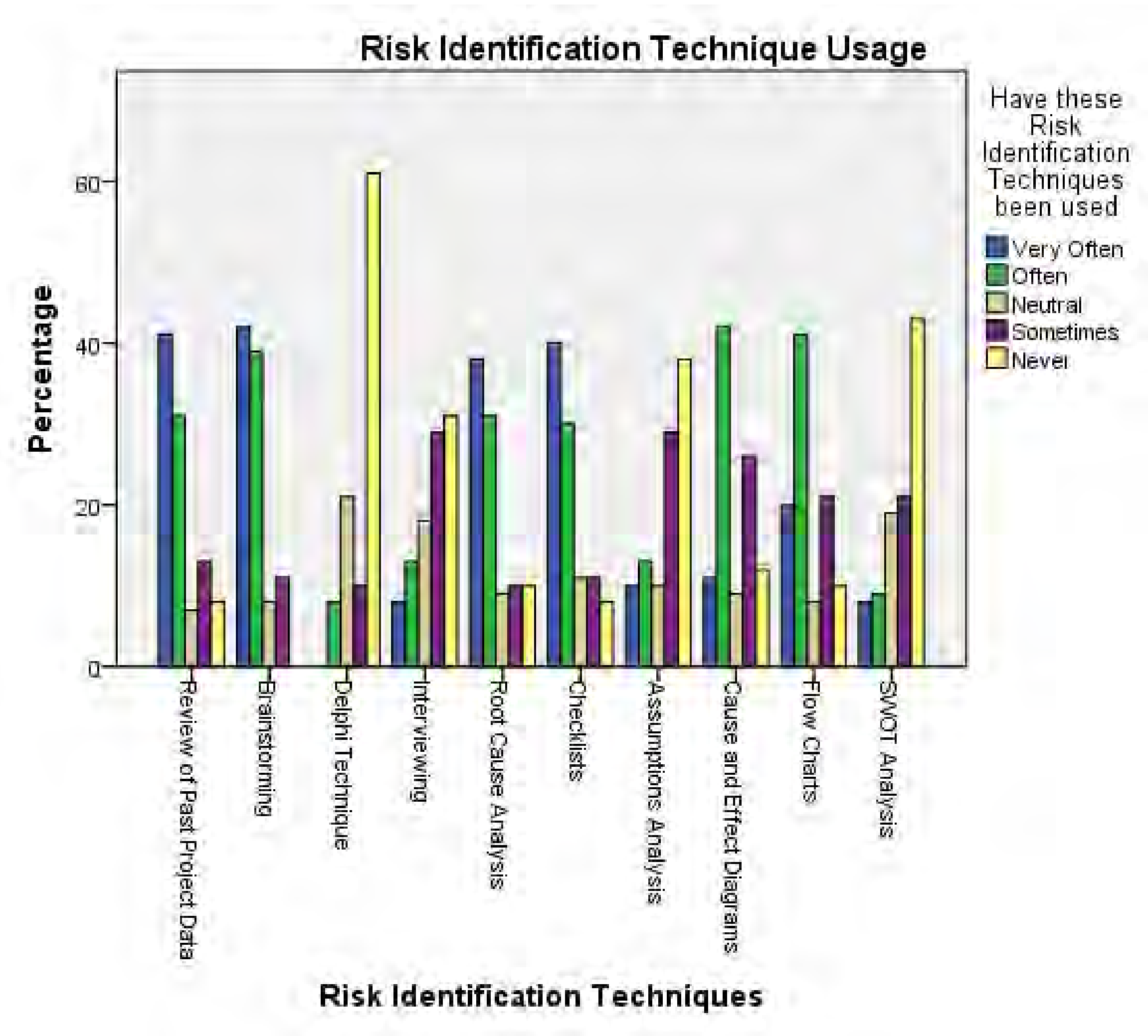


Figure 12: Use of Risk Identification Techniques

Respondents were asked how likely they would be to use the same techniques in different projects. Again it was assumed that the most commonly used technique would be checklists as they are the most commonly used technique used by civil and structural engineers in construction projects (Hassanein and Afify, 2007).

The risk identification technique that was most likely to be used in future pharmaceutical projects by manufacturing engineers was reviewing past project data. 54 (60.0%) respondents said they would use this technique for future risk identification. Checklists which was thought to be the most commonly used technique was in fact only chosen by 30 (33.3%) respondents. Brainstorming was a more popular choice for use again as it was chosen by 37 (41.1%) of respondents.

Brainstorming was the most commonly chosen technique under the "often label". 37 (41.1%) of respondents said they would likely use brainstorming again. This is in contrast to brainstorming being the most popular risk identification technique used by manufacturing engineers in previous projects. Assumptions analysis would be used in future pharmaceutical projects as a risk analysis technique "sometimes". 35 (38.9%) said they would "sometimes" use assumption analysis, this correlates with the previous question where 26 (28.9%) of respondents had used this technique in previous pharmaceutical projects.

The risk identification technique that was the least likely to be ever used again by manufacturing engineers in the pharmaceutical industry was the Delphi technique. 28 (31.1%) respondents said they would never use the Delphi technique for risk identification techniques in the pharmaceutical industry. This correlates directly with the Delphi technique being the least used risk identification tool in previous pharmaceutical projects.

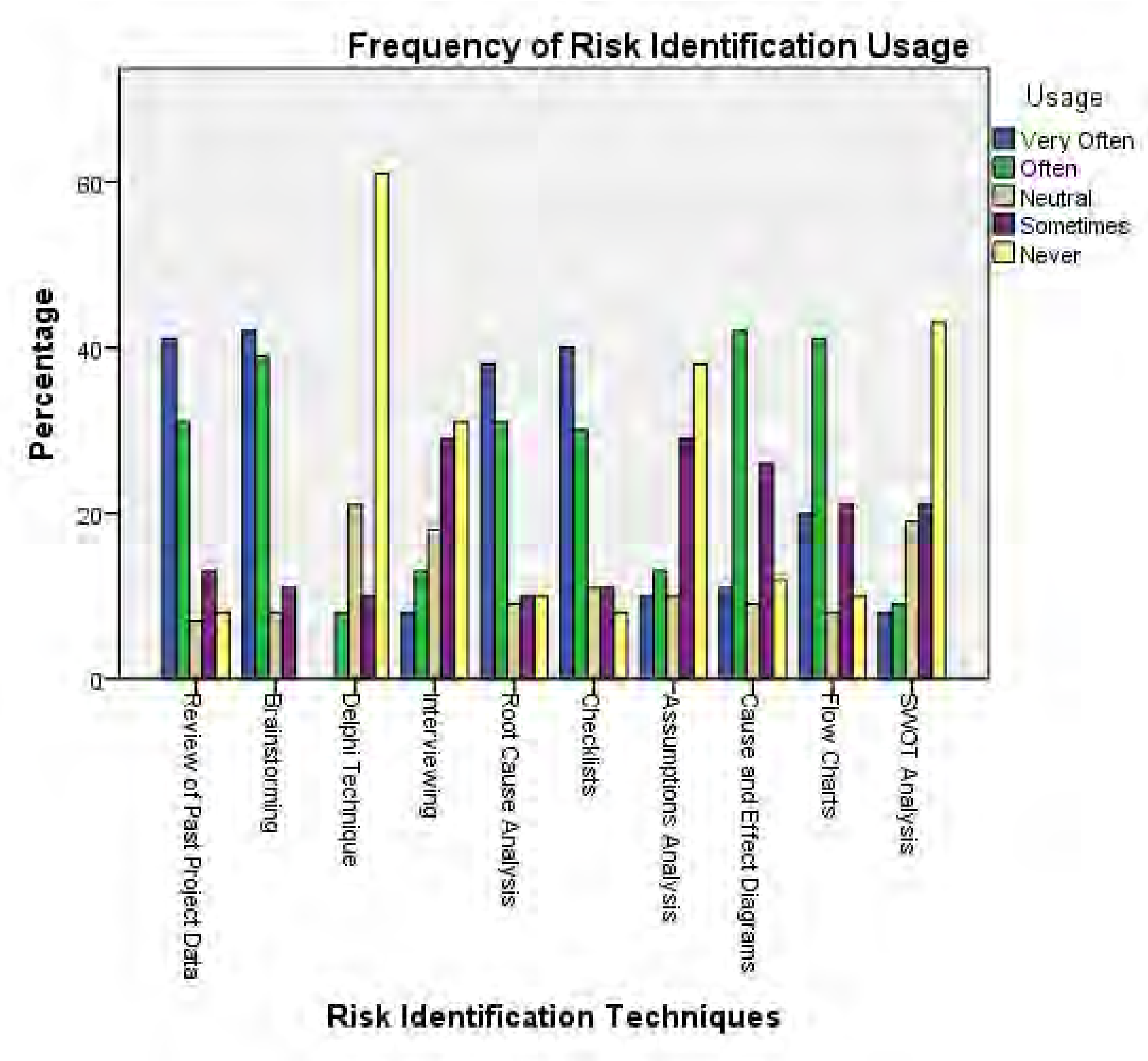


Figure 13: Risk Identification Tools Future Usage

Respondents were asked to determine which of the most commonly used risk identification technique was the easiest to implement. On a scale from one to ten the respondents were asked to rank the techniques, with one being the easiest to implement and ten being the hardest to implement.

The easiest technique to implement according to manufacturing engineers in the pharmaceutical industry was reviewing past project techniques. 38 (42.2%) respondents said that reviewing past project techniques was the easiest technique to implement. The second easiest risk identification technique to implement was checklists. 19 (21.1%) answered that checklists were the second easiest tool to implement.

The Delphi technique was determined to be the most difficult tool to implement. 28 (31.1%) respondents responded that the Delphi technique was the most difficult risk identification technique to be implemented. This compares with the Delphi technique being the least used risk identification technique and the least likely risk identification technique to be used in future pharmaceutical projects.

Brainstorming was a tool which was determined to be easy to implement. 30 (33.3%) respondents said that it was the easiest technique to implement and 18 (20.0%0 respondents said that it was the second easiest to implement. This correlates with brainstorming being the most commonly used risk identification technique. The easier a technique is to implement the higher usage the tool will have.

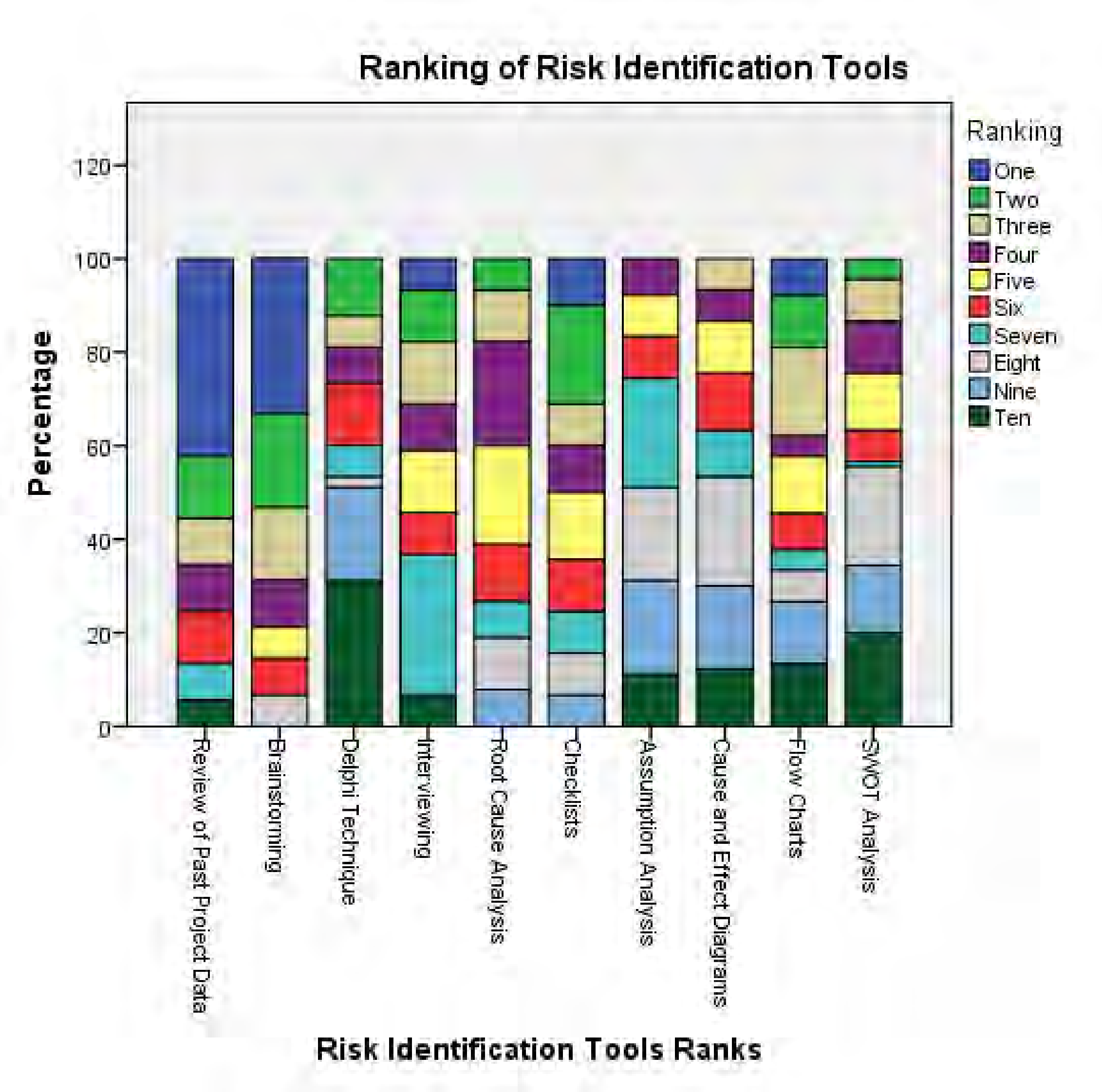


Figure 14: Risk Identification Tools Ranking

Risk identification was almost unanimously agree prevents project failure. When the respondents were asked if risk identification helps prevent project failure, 84 (93.3%) respondents responded with yes. No respondents replied with that risk identification does not prevent project failure, however 6 (6.7%) respondents said they were unsure if risk identification did affect project success. This data agrees with the literature, it was all agreed that risk identification does improve the chances of a project succeeding.

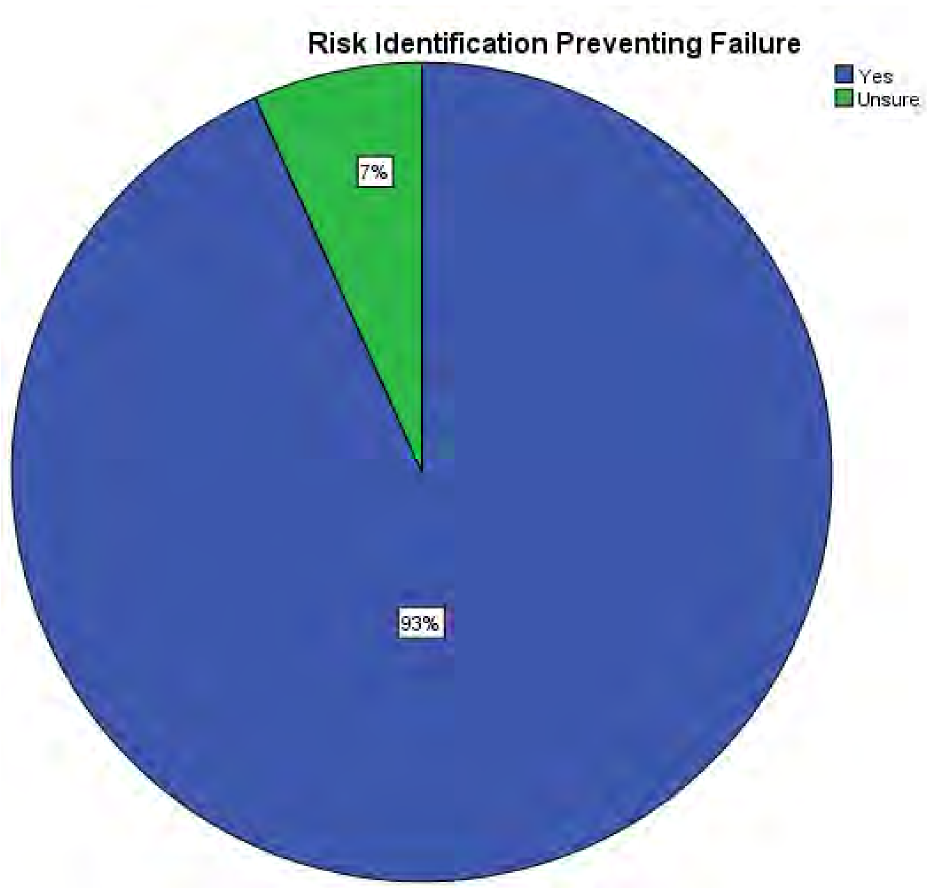


Figure 15: Risk Identification Preventing Failure

4.4 Risk Analysis

The PMI (2013, p.329) defines project risk analysis as "the process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact". According to Nicholas and Steyn (2008, p.373) engineers use statistical and probability techniques to implement the risk analysis technique of scenario analysis for their project. When respondents were asked if they preferred to analyse risks using statistics, 57 (63.3%) of respondents agreed that they preferred to analyse risks using statistical methods, 17 (18.9%) respondents said they preferred using qualitative analytical methods. Surprisingly 16 (17.8%) respondents responded with being unsure if they prefer statistical tools to qualitative tools.

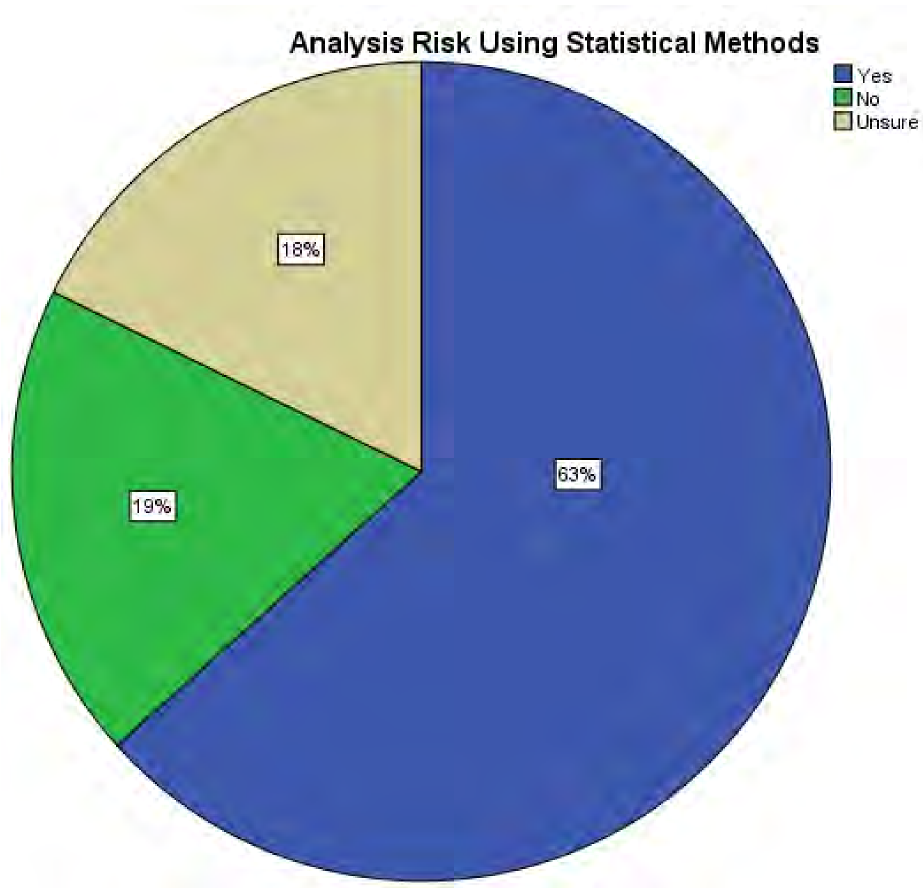


Figure 16: Analysing Risks Using Statistics

When the respondents were asked if they have ever analysed risks using either of the two methods, qualitative or statistical (quantitative), no respondent said they were unsure if they had ever analysed risks. 73 (81.1%) respondents said they had analysed risks before in pharmaceutical projects. 17 (18.9%) manufacturing engineers responded that they had never analysed risks. As risk analysis is the second step of the majority of risk management plans, it is unusual that risk analysis is not more common practiced.

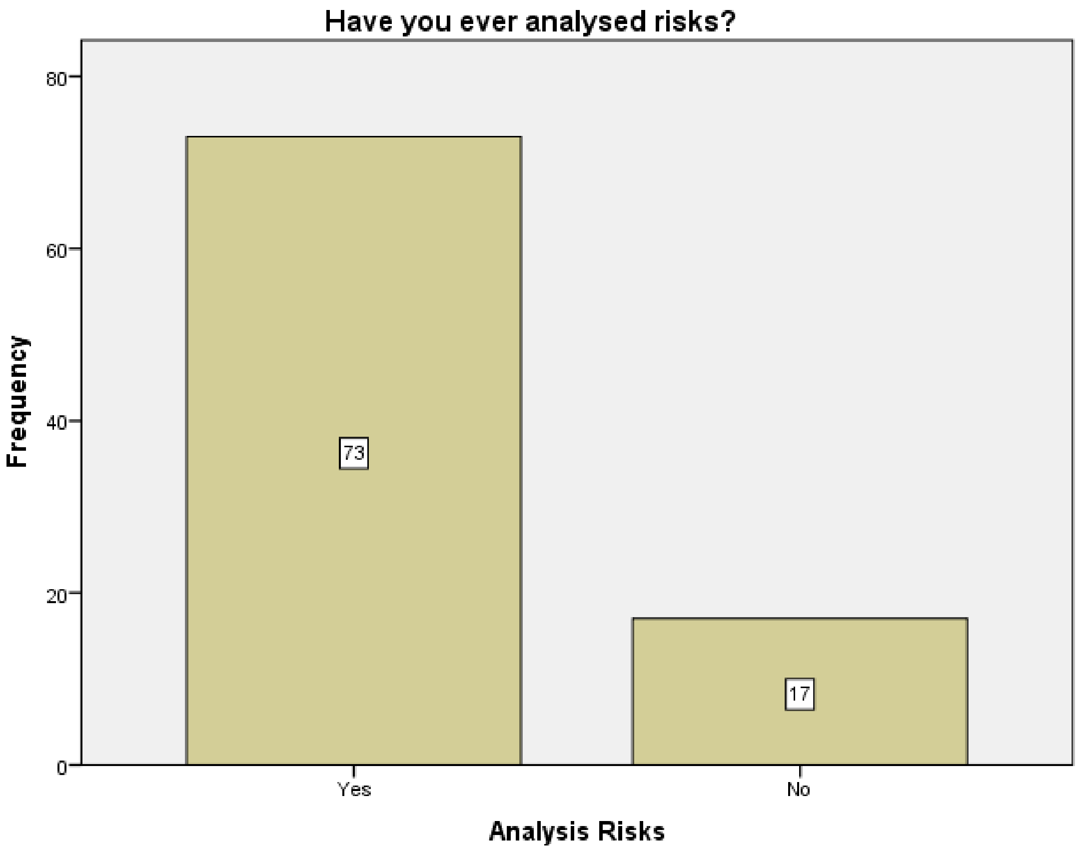


Figure 17: Analysing Risks

According to Nicholas and Steyn (2008, p.373) engineers use statistical and probability techniques to implement the risk analysis technique of scenario analysis for their project. It has already been seen that manufacturing engineers prefer to analyse risks using statistical methods. It is therefore assumed that the most commonly used technique would be a statistical tool.

The most commonly used risk analysis tool is expert judgement. 26 (28.9%) respondents said that expert judgement is the most commonly used risk analysis technique used in the pharmaceutical industry by manufacturing engineers. Expert judgement according to PMI (2013, p.333, 341) can be both a qualitative tool and a statistical tool.

The second most commonly used risk analysis tool used by manufacturing engineers in the pharmaceutical industry is risk probability and assessment. 42 (46.7%) respondents stated that they often use risk probability and assessment as a tool for risk analysis. Risk probability and assessment is a qualitative tool, which again suggests that even though engineers prefer using statistics the most commonly used tools are qualitative.

The tool that was described as "sometimes" used is modelling and simulation. 28 (31.1%) respondents responded that they sometimes use modelling and simulation as a risk analysis tool for pharmaceutical projects. Modelling and simulation is a statistical analysis tool so again contradicts the information given by previous questions.

The tool that is most commonly never used by manufacturing engineers is sensitivity analysis. 34 (37.8%) manufacturing engineers have never used sensitivity analysis in risk analysis for pharmaceutical projects. This is a statistical tool which again opposes the view that manufacturing engineers prefer analysing risks using statistics.

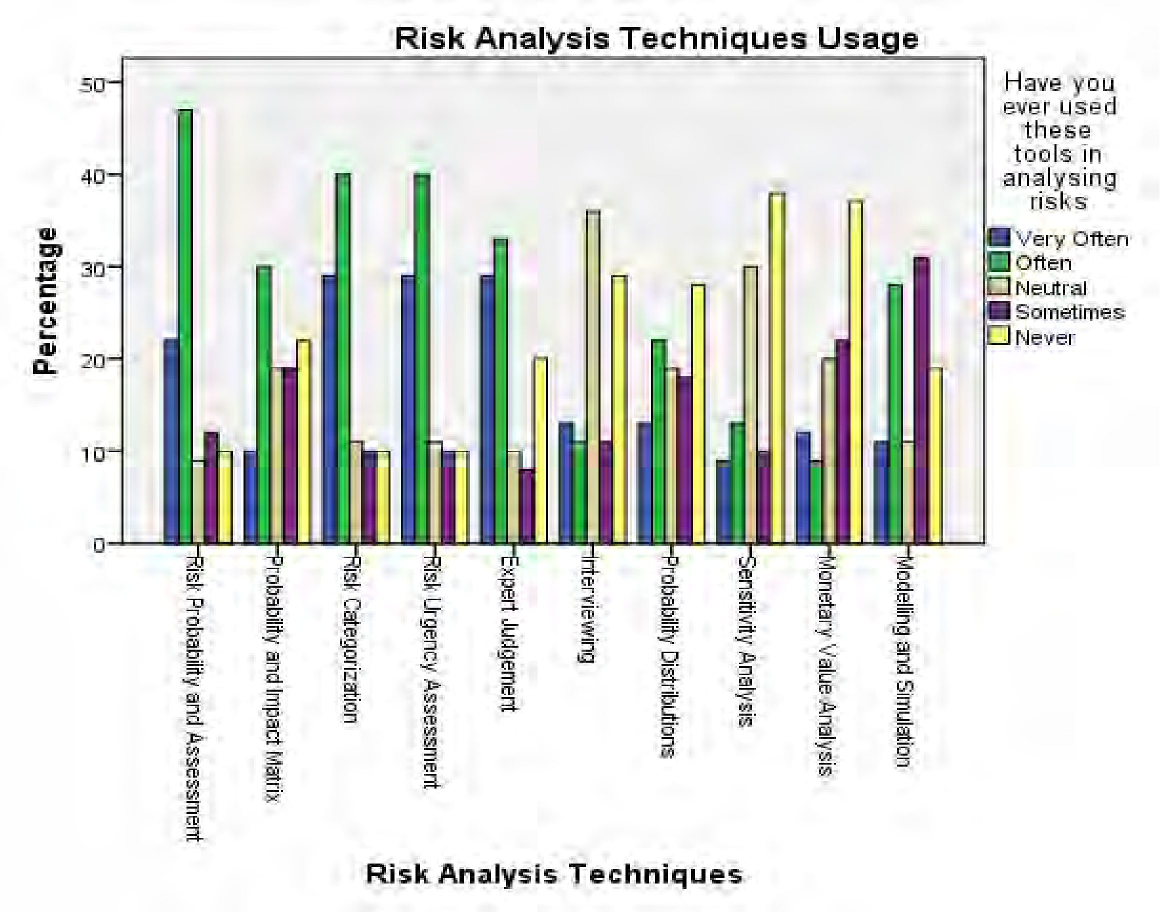


Figure 18: Risk Analysis Tools Usage

Respondents were asked to determine which of the most commonly used risk analysis techniques was the easiest to implement. On a scale from one to ten the respondents were asked to rank the technique, with one being the easiest to implement and ten being the hardest to implement.

The easiest risk analysis tool to implement, according to manufacturing engineers in the pharmaceutical industry is risk probability and assessment. 28 (31.1%) respondent replied with risk probability and assessment technique is the easiest to implement for pharmaceutical projects. This again challenges Nicholas and Steyn's (2008) belief that engineers prefer to analyse risk using statistical methods as the risk probability and assessment technique is a qualitative technique.

The second easiest risk analysis tool to implement is risk categorization. 20 (22.2%) respondents when asked to rank the commonly used risk analyses technique placed this in second place. This refutes the commonly held belief that the statistical tools would be the most commonly used, however this strengthens the belief that it is the easy to implement tools that are the most widely used.

The most difficult technique to implement according to manufacturing engineers is the modelling and simulation technique. Over half of respondents, 47 (52.2%)

responded that this technique was the most difficult to implement. This again contradicts the

Nicholas and Steyn (2008) belief that statistical tools would be the most commonly used among engineers.

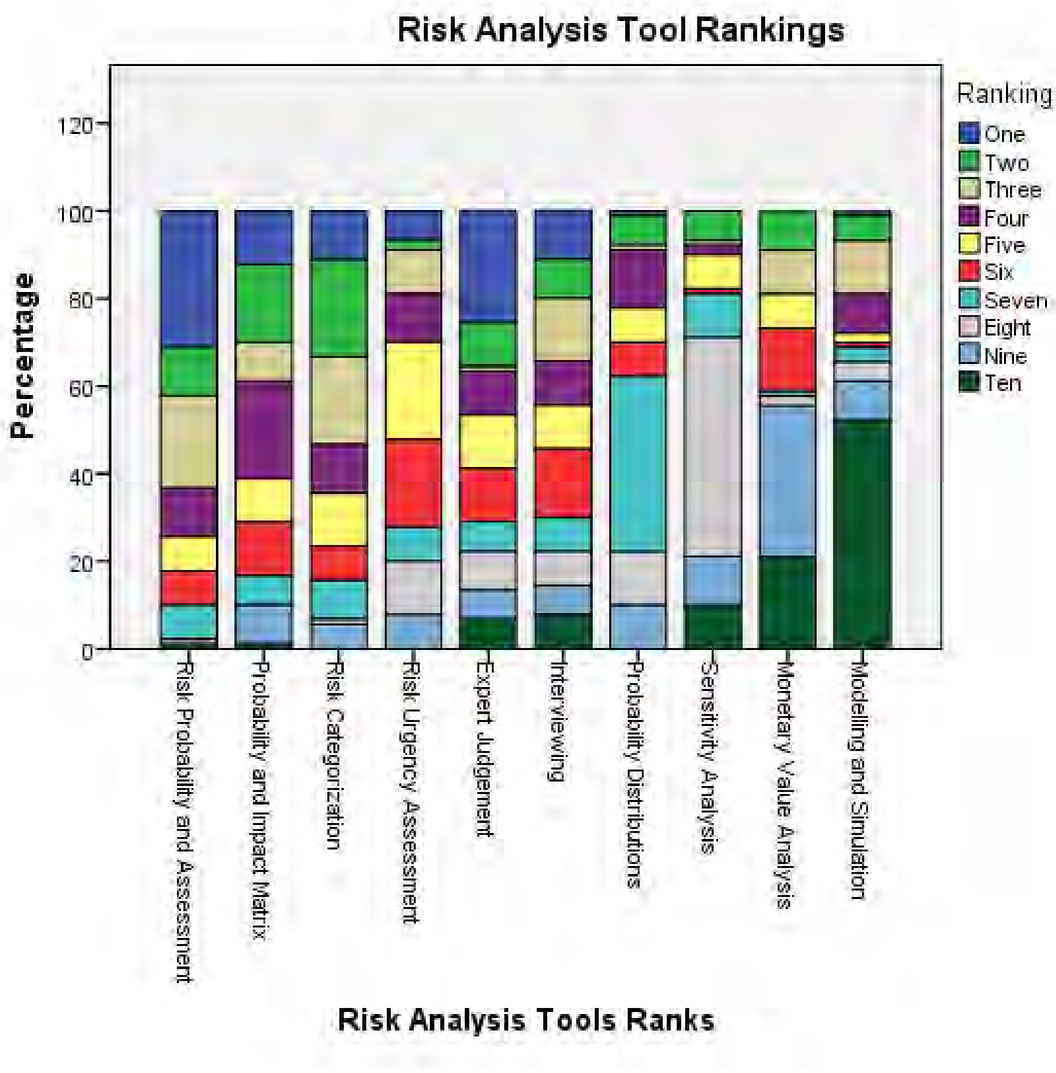


Figure 19: Risk Analysis Tool Rankings

Risk analysis was almost unanimously agreed as the preferred method to prevent project failure. When the respondents were asked if risk analysis helps prevent project failure, 75 (83.3%) respondents responded with yes. 8 (8.9%) respondents replied with that risk identification does not prevent project failure, however 7 (7.8%) respondents said they were unsure if risk analysis did affect project success. This data agrees with the literature and it was agreed that risk analysis does improve the chances of a project succeeding.

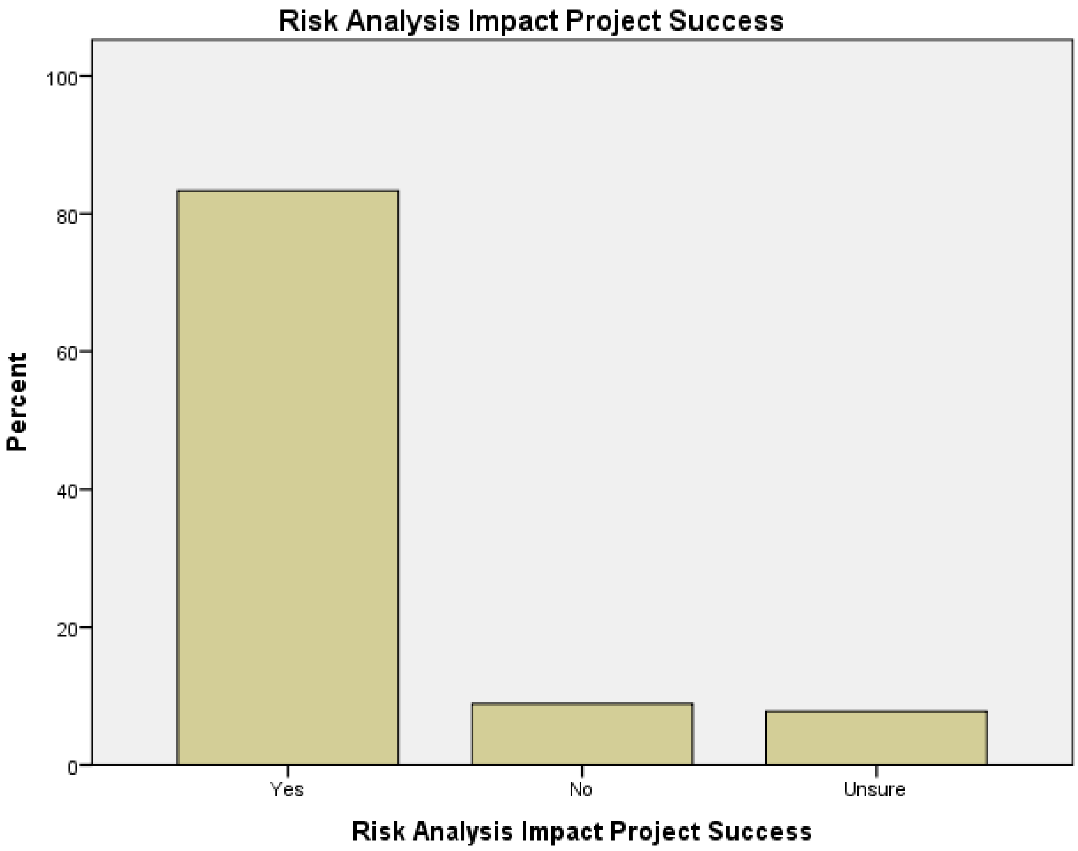


Figure 20: Risk Analysis & Project Success

4.5 Risk Response

Risk response "is the process of developing options and actions to enhance opportunities and to reduce threats to project objectives" (PMI, 2013, p.342). There are four main strategies for developing a risk response: risk acceptance, risk avoidance, risk transference and risk reduction (PMI, 2013, p.342). Risk response is one of the final stages of risk management. When respondents were asked had they ever developed a risk strategy, 6 (6.7%) were unsure if they had ever responded to a risk and 28 (31.1%) had never developed a risk strategy or response to any risk. The majority of manufacturing engineers working in the pharmaceutical industry have developed risk response, 56 (62.2%) respondents had developed risk responses.

Figure 21: Developed Risk Response

The respondents were asked to determine the usage of the four risk response strategies by determining if they use these tools: "very often", "often", "sometimes" or "never". According to Larson and Gray (2011, pp.219-220) and Melnic (2010) risk mitigation or reduction may be expensive especially if it is required to attempt to reduce the impact the event may have on the project. For this reason it is reasonable that project managers might seek a less expensive risk strategy to implement.

The most commonly used technique in risk response is the risk avoidance technique. 35 (38.9%) respondents responded that the risk response tool they most use is the avoidance response tool. This confirms that the mitigation technique is not the most used risk response technique.

The second most common risk response technique despite literature contradictions is mitigation. Mitigation was used "often" by 36 (40.0%) respondents stating that they commonly used mitigation as a risk response technique. This disagrees with Larson and Gray (2011, pp.219-220) and Melnic (2010) as despite the expense of risk mitigation it is the second most commonly used technique.

The least used risk response technique is either risk avoidance or risk transference. For both risk avoidance and risk transference, 12 (13.3%) used these techniques. This is a stark difference between some manufacturing engineers using risk avoidance as the most common technique and the manufacturing engineers that use it the least.

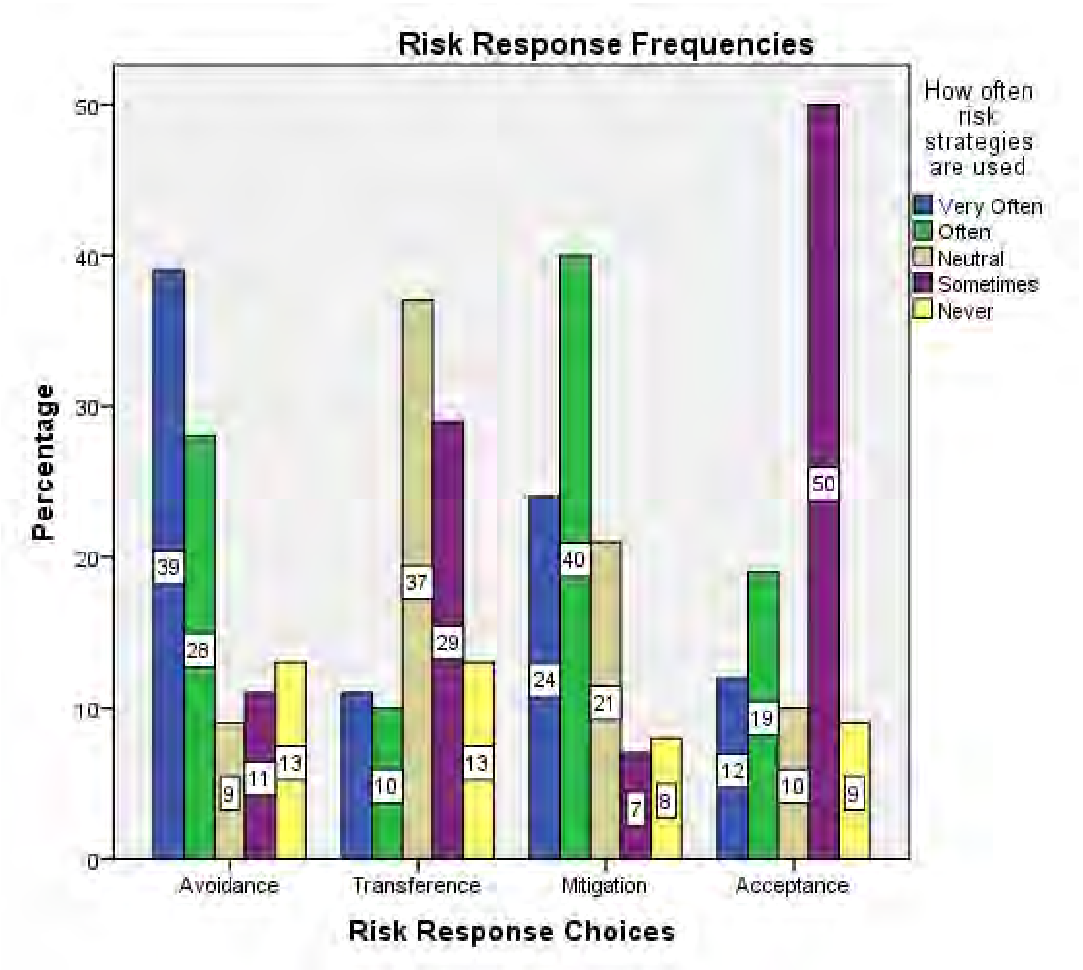


Figure 22: Risk Response Usage Frequency

Respondents were asked to determine which of the most commonly used risk response techniques was the easiest to implement. On a scale from one to ten the respondents were asked to rank the techniques, with one being the easiest to implement and ten being the hardest to implement.

The easiest risk response to implement according to manufacturing engineers in the pharmaceutical industry is risk avoidance. 41 (45.6%) respondents stated that the easiest to implement risk response strategy is risk avoidance. This correlates with existing literature that mitigation as a risk response strategy is not commonly used as it is too expensive.

The second easiest risk response strategy to implement is risk transference. 29 (32.2%) manufacturing engineers working in the pharmaceutical industry stated that risk transference is the risk response that is the second easiest to implement. This also directly correlates with the existing literature as both Larson and Gray (2011, pp.219-220) and Melnic (2010) state that mitigation is not used due to its expense.

The hardest strategy to implement according to the respondents is risk acceptance. 35 (38.9%) respondents stated that they would rank this risk strategy as the hardest to implement. This doesn't comply with the literature as it was thought that mitigation would be the hardest risk strategy to implement but it has a tendency to be the third easiest to implement.

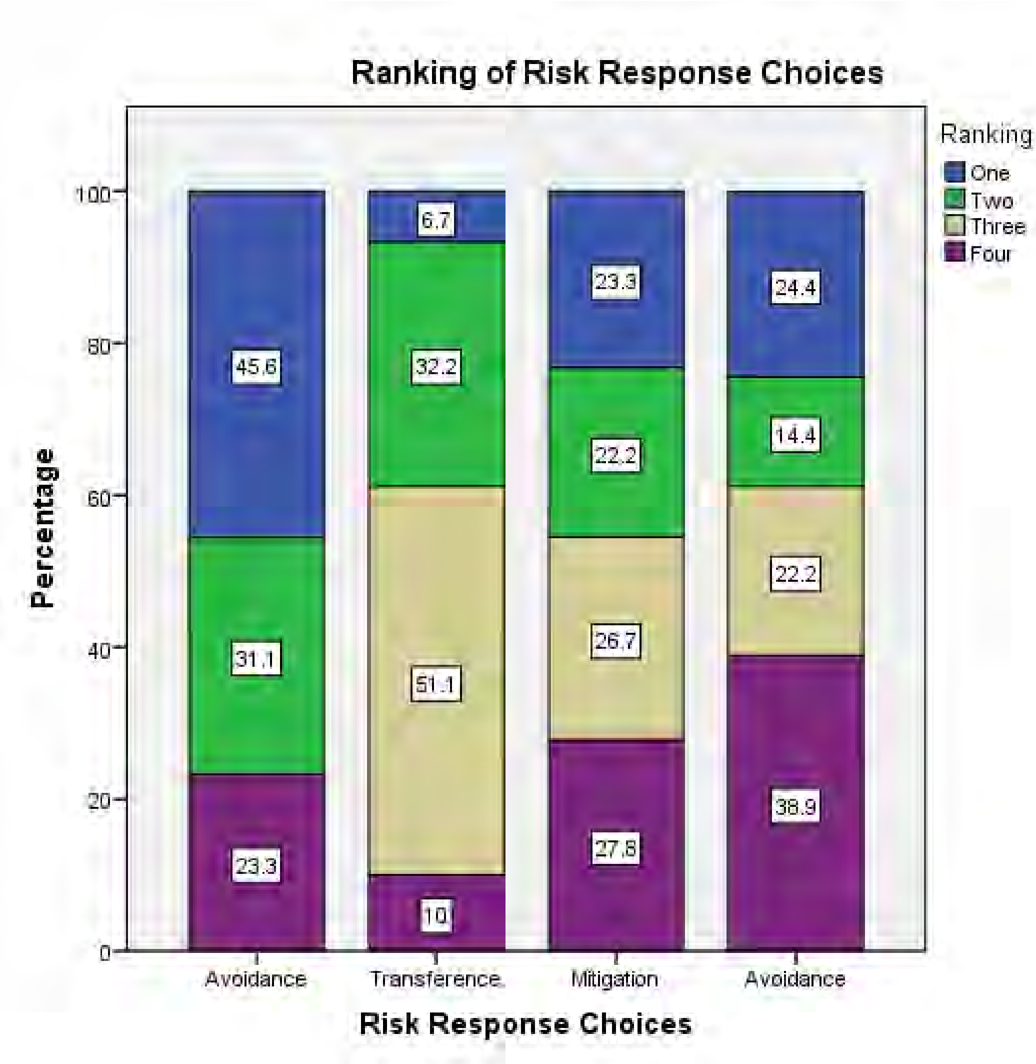


Figure 23: Ranking of Risk Response

When respondents were asked if they ever been involved in developing risk strategies for pharmaceutical projects the majority said they had been involved. 54 (60.0%) respondents, when asked if they had been involved in developing risk strategies said they had been involved. 27 (30.0%) respondents said they had never developed risk strategies, and 9 (10.0%) respondents said they were unsure if they had ever been involved in developed risk strategies for if a risk arose during a project.

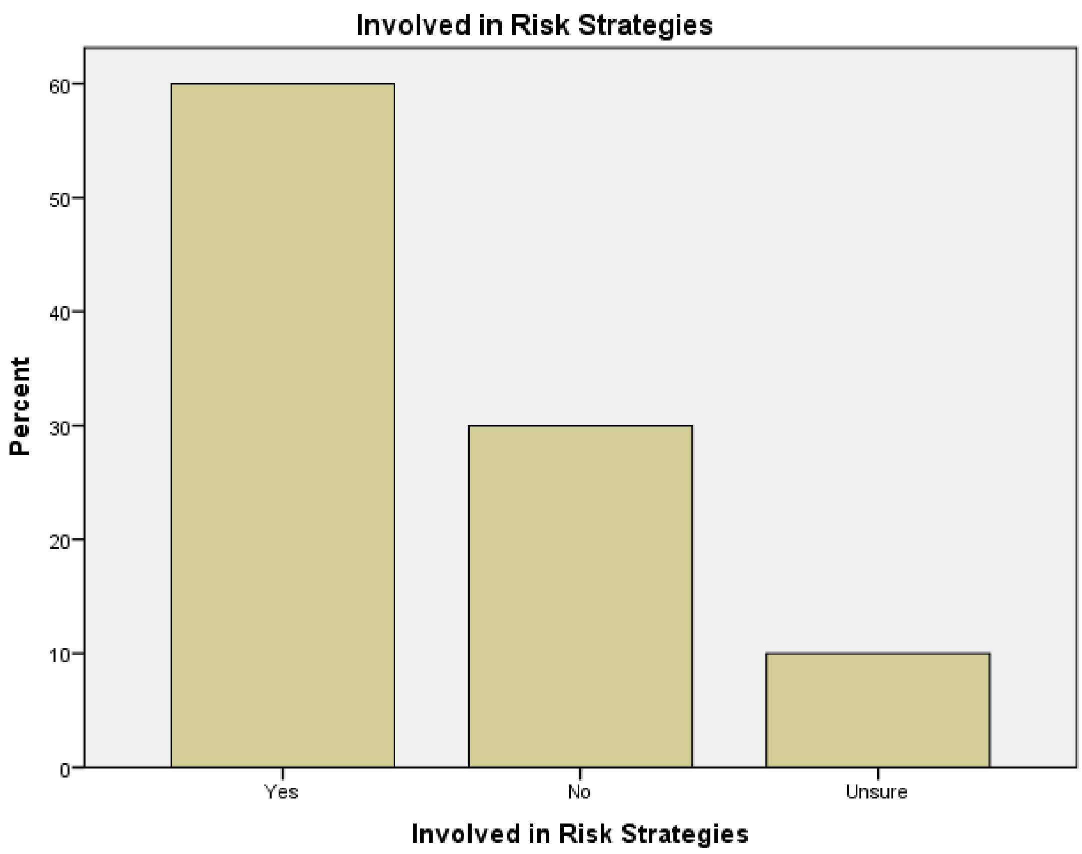


Figure 24: Risk Strategies Involvement

Risk response was almost unanimously agreed upon to prevent project failure. When the respondents were asked if risk response helped prevent project failure, 74 (82.2%) respondents responded with yes. 14 (15.6%) respondents replied with risk response does not prevent project failure. 2 (2.2%) respondents said they were unsure if risk identification did affect project success. This data agrees with the literature that risk identification does improve the chances of a project succeeding.

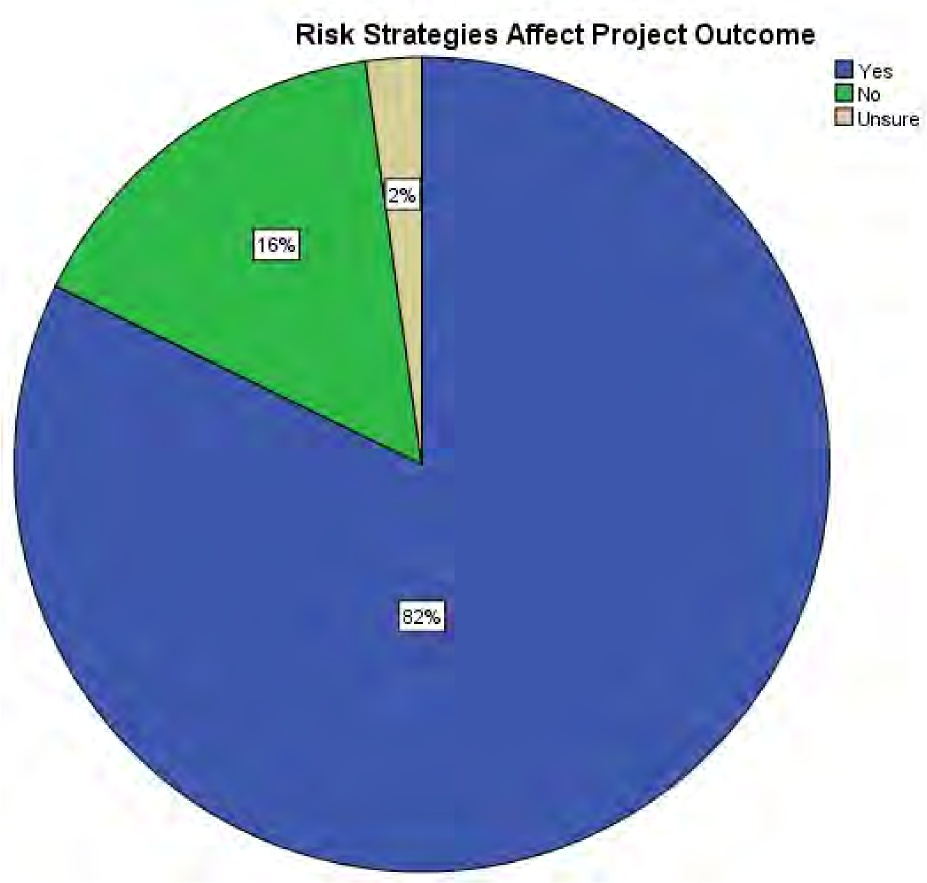


Figure 25: Risk Strategies and Project Outcome

4.6 Risk Management and Project Success

The PMI (2013, p.309) states that risk management is "the process of conducting risk management planning, identification, analysis, response, planning and controlling risk on a project". The data has so far agreed that risk identification, risk analysis and risk response all affect project success, so overall it can be seen that the majority of manufacturing engineers in the pharmaceutical industry agree that risk management helps prevent project failure. No respondents did not think risk management didn't affect project success. 9 (10.0%) respondents stated they were unsure of the affect risk management had on project success. 81 (90.0%) engineers stated that risk management directly affects project success.

Figure 26: Risk Management and Project Success

Chapter 5
Conclusions

Chapter 5 – Conclusions

5.1 Conclusions

This chapter contains the conclusions on the findings for this research study. The purpose of this study is to condense the theoretical implications that were deduced from the literature and the data findings which directly relate to the four research questions and research hypotheses. The implications of risk management to project success is well documented, with arguments for both sides being well documented. There was a strong belief that it was only experienced project managers who had previously led projects and could manage projects in the regulated pharmaceutical industry while it was actually in recent years the majority of projects are being led by the core engineering team. This suggests that manufacturing engineers are leading important projects with no specialised training which may lead to an increase in the number of projects failing.

The objective of this research project was to gain a better understanding of manufacturing engineer's perspective on the value of risk management to project success in the pharmaceutical industry. This research objective has been achieved by answering the research questions and proving or disproving the research hypotheses.

5.1.1 Risk Identification

Hassanein and Afify (2007) state that the most commonly used risk identification technique used by contractors and civil engineers is checklists. The research hypothesis stated that manufacturing engineers would also use checklists as the most commonly used risk identification technique in the pharmaceutical industry.

Checklists were never selected as the most common used risk identification tool. The tool that is most commonly used by manufacturing engineers for risk identification in the pharmaceutical industry is brainstorming. This contradicts the research hypothesis as the civil and construction engineers may use checklists commonly as a risk identification technique, so would engineers in the pharmaceutical industry. Checklists were not selected as the most common tool for future usage from the respondents. Checklists were also selected as the second easiest risk identification technique to implement.

In general, many manufacturing engineers chose the easiest risk identification tool as the most common. Reviewing past project data was ranked the easiest tool to implement and was the top tool that manufacturing engineers will use in the future. This shows that it is common to assume that the easier a tool is to implement, the more common it can and will be implemented.

This theory is also true for the other end of the spectrum, the hardest of the ten most common risk identification tool to implement, according to manufacturing engineers in the pharmaceutical industry, is the Delphi technique. The Delphi technique is the least used risk identification technique and the risk identification technique that will not be used in future identification technique.

It is also assumed that risk identification when implemented correctly does impact the likelihood of project success. Stostic, Isljamovic and Mihic (2013) states that risk identification is key for project success in innovation projects, the majority of manufacturing engineers agree with Stostic, Isljamovic and Mihic (2013) stating that risk identification affects project management. Despite the agreement that there is correlation with risk identification and project success, it not the most commonly implemented risk management step.

Despite the importance of the first risk management step, risk identification, it is interesting that it is not the most commonly undertaken risk management step. It leads to the belief that manufacturing engineers skip or ignore this step due to the belief that it is an easy step and the other risk management steps are more important.

5.1.2 Risk Analysis

According to Nicholas and Steyn (2008, p.373) engineers use statistical and probability techniques to implement the risk analysis technique of scenario analysis for their project. This hypothesis should include manufacturing engineers in the pharmaceutical industry.

It was agreed by a large amount of the manufacturing engineers surveyed that the preferred method of analysing risks being a statistical method. This was contradicted when asked which the easiest technique to implement was and which technique was most commonly used. When these questions were asked, the techniques selected were qualitative techniques and not a quantitative technique.

The most commonly used technique was expert judgement. According to Kerzner (2013, p.892) the qualitative risk analysis approach was the most common approach used when analysing risks. The data in this research project corresponds with Kerzner (2013, p.892), with the top three risk analysis techniques used in the pharmaceutical industry being qualitative approaches. This data again corresponds with the manufacturing engineers using the easiest to implement tool the most while the more difficult the tool is to implement, the less likely it is that the tool will be used.

This assumption that the easiest to implement tool is the most commonly used correlates with the data found with this research project. The least used risk analysis tool used by the manufacturing engineers in the pharmaceutical industry is sensitivity analysis. Sensitivity analysis as a tool for risk analysis was ranked the eight easiest tool to use by the manufacturing engineers. The general assumption that the harder the tool is to implement the less likely it is to be implemented is true.

Risk analysis was the most commonly implemented stage of the risk management technique. There is a large amount of the manufacturing engineers surveyed that have been involved in the analysing risk process. This is promising as there is a large amount of supporting literature that shows the importance of analysing risk correctly. Kerzner, (2013, p.896) states that risk analysis helps with the prioritization of the risks that may affect the project.

Risk analysis is the most commonly implemented risk management technique according to the manufacturing engineers that were surveyed. The value of risk analysis to project success is clear amongst the engineers and helps provide strength to the argument that manufacturing engineers will use the easiest to implement tools over harder to implement and more accurate tools.

5.1.3 Risk Response

According to Larson and Gray (2011, pp.219-220) and Melnic (2010) risk mitigation or reduction may be expensive especially if it is required to attempt to reduce the impact the event may have on the project. For this reason it is reasonable that project managers might seek a less expensive risk strategy to implement.

The risk response technique that is most commonly used amongst the manufacturing engineers in the pharmaceutical industry is the risk avoidance technique. This agrees with the research hypothesis as risk mitigation was used but not commonly. The risk avoidance technique is the easiest risk response technique to implement according to the manufacturing engineers in the pharmaceutical industry. This substantiates the claim that the easier tools are the most commonly used.

The risk analysis tool that is the most difficult to implement is the risk acceptance technique, according to manufacturing engineers in the pharmaceutical industry. Risk acceptance is the hardest to implement risk analysis technique. This again correlates the assumption that the easier the tool is to implement the more frequently it is used.

Risk response is the least used risk management technique according to manufacturing engineers in the pharmaceutical industry. Less than one third of manufacturing engineers use this technique in the risk management process. Kerzner (2013, p.913)

states that risk response is important to gather an understanding of how a risk occurs and formulate a response.

Risk response may be the least implemented stage of risk management but it does not impact the value that the risk response has on the manufacturing engineer's perspective on project success. Complying with the literature, risk response is crucial to project success, it just needs to be implemented more by manufacturing engineers.

5.1.4 Risk Management and Project Success

Larson and Gray (2011, p.211), Lock (2008, p.99) and PMI (2013, p.310) state that correctly implemented risk management affects the outcome of the project in a positive way. In opposition however, Pretorius, Steyn and Jordaan (2012) state that it does not have an impact on project success. With the majority of the literature agreeing that it does impact the outcome, it is reasonable to assume that manufacturing engineers will agree.

When manufacturing engineers were asked if risk management affects project success, the overwhelming majority of respondents agreed that risk management affects project success. This agrees with Larson and Gray (2011, p.211), Lock (2008, p.99) and PMI (2013, p.310). Due to the large number of respondents it is agreed that risk management affects project success. The respondents who didn't think that risk management affects

project success claimed they were unsure of the affect risk management has on project success.

It is also assumed that risk identification when implemented correctly does impact the likelihood of project success. Mihic (2013) state that risk identification is key for project success in innovation projects, the majority of manufacturing engineers agree with Mihic (2013) stating that risk identification affects project management. Despite the agreement that there is correlation between risk identification and project success, it not the most commonly implemented risk management step.

Risk analysis is a commonly implemented technique and it is, the most commonly implemented risk management technique according to the manufacturing engineers that were surveyed. The value of risk analysis to project success is clear amongst the manufacturing engineers and helps provide strength to the argument that manufacturing engineers will use the easiest to implement tools over harder to implement more accurate tools.

Risk response does affect project success according to manufacturing engineers in the pharmaceutical industry. The respondents that were not in agreement that risk response does affect project success, shows the lack of definitive definition of project success.

5.2 Limitations of the research

This study finds some interesting facts about risk management in the pharmaceutical industry, however it becomes apparent that there are a few limitations to the research study that was undertaken.

This research study was undertaken by manufacturing engineers in the pharmaceutical industry, so the respondents of the survey were exclusively from the pharmaceutical industry. The data collected from this research project was partial to this portion of the population. The population can only be accurately represented by a complete proportional sample (Burns and Burns, 2008, p.17). This is a limitation to this type of research project and not to the research methodology that was used. A large scale research project covering the entire population would be more representative and would increase the value of the study.

Using a quantitative method, the self-administered web based surveys for the research, the rigidity of the surveys is the primary limitation. The rigidity of the quantitative method doesn't allow for many fluctuations when applied to the social sciences. Subjects responded based on their past experiences and the expectations that are placed on them (Burns and Burns, 2008, p.17). Also work place interference and fear may influence the surveys. A completely unrigged survey would help to overcome this limitation.

The researcher has taken every conceivable possible precaution to help increase the accuracy and precision of the data. These limitations to this study can be included in the project management field.

Chapter 6
Recommendations

Chapter 6 – Recommendations

There is no uniform definition on project success due to the fact that each project is unique and has different project variables. The size of the population that was surveyed is very limited, it would be recommended that the research project is repeated for a larger population sample from the pharmaceutical industry. This would greatly improve the consistency of the survey and improve the generalisation of the findings overall.

Another approach to this research project would be to survey manufacturing engineers across a broad number of industries to observe if there is correlations between manufacturing engineers in different industries. This would allow direct comparisons between the industries and improve the quality of this research project. It is recommended that a deeper investigation in this topic by using a larger population is undertaken due to high level of detail in this research project.

Although this study is based on risk management techniques in the pharmaceutical industry, there should be a study undertaken on risk management techniques in other manufacturing industries from food to consumer goods.

It is agreed that risk management increases the likelihood of projects success. This is accepted by the large majority of manufacturing engineers in the pharmaceutical industry. The success also depends on other project factors such as the environment, communication, planning and management.

The main observation that was found in this survey was that the majority of the techniques used in the risk management process were the easiest to implement. There should be further study done on the easier a risk management technique is to implement does that mean the likelihood of the technique being used is increased, as the basic findings from this survey suggest that this is the case.

Chapter 7
Self-reflection

Chapter 7 – Self-Reflections

Kolb (1984) states that the learning process must be reinforced with shared human experiences and interpreted dialogue with one another. For example, when learning to swim, the mistakes you make at the beginning will be practiced until they are not made again in the future.

This chapter focuses on how the Masters in Business Administration focusing on Project Management course has added value to my knowledge and how it has improved my personal development and transferable skills which can be applied in today's volatile work environment. This chapter will also detail the new skills and techniques developed over the completion of this master's dissertation.

6.1 Learning Styles

Kolb (1984) discovered that there are four combinations of observing and processing which determine the four learning styles. According to Kolb (1984), the learning cycle involves four separate processes that must be present for learning to occur. The experiment observer takes a hands-on direction to observe if their concepts will work while reflective observers prefer to observe and work things out rather than diving straight in to the problem.

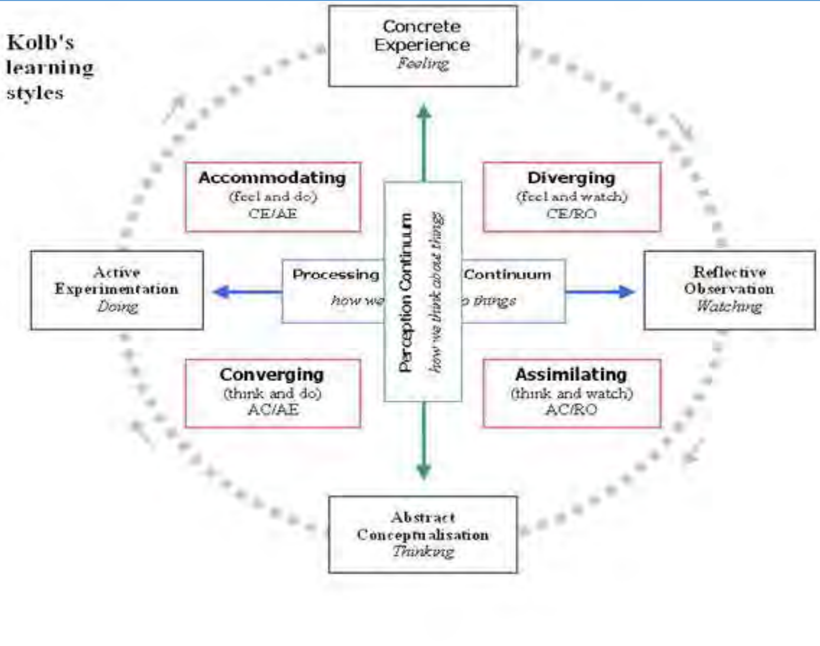


Figure 27: Kolb's Learning Styles (Source: Concept David Kolb, adaptation and design Alan Chapman (2006))

6.1.1. Convergers

Convergers are between the abstract conceptualisation and active experimenter learning styles. Convergers contemplate situations and then try to see if their ideas work when put into practice in the real world. They like to ask how and want to understand how things work. They like small changes which improves efficiency by observing the facts and making the necessary changes.

Convergers prefer to work independently, thinking carefully and acting by themselves. Convergers learn through interaction and collaboration. Computer-based learning is the most effective type of learning for convergers over other methods of learning.

6.1.2. Accommodators

Accommodators are between the concrete experience and active experimenter learning experience. The most hands on learning approach is the accommodating approach. Accommodators tend to not think on a situation but act on instinct. They have an action-first response which is based on a do and ask questions later mentality. Accommodators dislike a rigid routine and take risks to see what happens in the environment.

Accommodators explore intricacy directly and they learn better individually than in a group setting. Accommodators dislike lectures and prefer to learn with a hands-on method with practical lecturing.

6.1.3. Divergers

Divergers are between concrete experience and reflective observer learning styles. Divergers think deeply about experiences that affect them. They receive their name from their ability to take a single experience and diverge it into multiple possible meanings. Divergers like to understand why things are the way they are and what they can gain from the smallest detail to fully understand the complete picture.

Divergers dislike conflict and enjoy working with others as they enjoy their feedback. Divergers can be influenced by others and enjoy receiving constructive criticism. Divergers like to learn with logic and exploration that leads to conversation and discovery.

6.1.4. Assimilators

Assimilators are between the abstract conceptualiser and reflective observer learning styles. Assimilators have the most intellectual approach to learning. Assimilators prefer to think on situations rather than act. Assimilators prefer organisation and structured understanding. Assimilators prefer learning from lectures which include demonstrations. Assimilators also learn primarily through logical and thoughtful conversations.

Assimilators need strong control and dislike unpredictability of models to external influences. Assimilators learn best through lectures that give all details to a certain concept. Assimilators prefer to maintain serious concentration and do not have a large amount of down time.

6.2 Self-Assessment

By identifying the attributes of the different learning styles I realise that my learning style is that of converger (converging).

Fascinated by how things worked from a young age, my ambition was to be a manufacturing engineer. With my parental background the medical field also held interest to me, so by planning and completing my goals I obtained my Bachelor of Engineering in Biomedical Engineering from Dublin City University, where I graduated with a second class honours degree.

During my time in Dublin City University I completed a six month internship in a manufacturing company which had some pharmaceutical products. This internship gave me a first-hand look at how the manufacturing industry and pharmaceutical industry work in tandem with each other. In order to earn money to support myself through both my degrees I worked part time at a medical centre, which provided me an insight into how these pharmaceutical products impact people's daily lives.

My work experience has given me a general idea of the actual work environment of business. It has given me the knowledge of real work and first-hand experience in fixing problems in actual business scenario. The part-time job quickly gave me managerial exposure which included management, writing, communication and decision making skills. Despite experience in this area I lacked the technical knowledge which would help me progress further in this field. In order to further my skills in this managerial area I decided to complete my MBA.

There are lots of institutions in Ireland who provide an MBA program, however with my background in Biomedical Engineering and my wish to work in the pharmaceutical industry I decided I wanted to focus on a Project Management MBA. Since I knew I would have to self-fund my MBA I knew that it would have to be a Dublin based institutions and I found that DBS and its values suited my convergent learning style best.

The MBA in Project Management has given me knowledge to apply to real world situations in the work environment and has been a great addition to my learning base.

Modules like international management, international business and trade and strategic management has helped me develop and improve many skills that are crucial to work experience. The main skills that have been developed through these modules are management skills, problem solving skills, communication skills and decision making skills. These skills are extremely useful both professionally and personally. This master's dissertation stage has been an extremely valuable learning experience to me.

Decision making is a critical skill for career and leadership success. The MBA program in project management has helped develop my decision making skills. The MBA helped me to learn that you need to make well-considered decisions in a timely manner which contributes to overall success. If you make poor decisions the project you are working on risks failure.

My decision making skills have been developed from case studies and group presentations that occurred during my modules in my MBA. The modules that contained the case studies and group presentations which contributed to my decision making skills are project management tools and techniques, strategic management, international business and trade and project management planning and control. These

.

modules involved case study work which placed me in the business situations where these critical business decisions need to be made and these decisions were then presented to the class in the form of group presentations. These skills will help me in the future when I start my career as a project manager in the pharmaceutical industry.

Another important element of the MBA in Project Management was the group presentations. There were times where there were groups assigned by the lecturer and groups where we got to choose our own teams. The most challenging and interesting group work was when we didn't know the team members before we had to work together. This provided the most real world like situations where in business the team may be full of members which have never worked together before. The presentations helped me to develop my team working skills. The presentations also help grow my confidence and made me more employable for my future careers.

For an effective and prosperous career, time management both is extremely important. Using time management skills correctly helps an individual to effectively cope with intense pressure. During my MBA, time management was extremely important. There were numerous assignment deadlines, class assignments and research activities that forced a deadline onto you. I implemented a checklist and planer technique to help me ensure that all assignments and exercises were completed and to a high standard. This increased my organisational skills and helped me to meet all the deadlines.

The completion of this master's dissertation has also added value to both my personal and professional learning styles. The master's dissertation requires substantial work in all areas including reviewing literature, planning and distributing primary research data, primary and secondary data analysis and compiling all these sections into a written report. It was the most time consuming part of the MBA curriculum and needed detailed and expansive time management and organisational skills.

I have written my dissertation on manufacturing engineer's understanding on the value of risk management to project success in the pharmaceutical industry. Since the economic downturn there have been numerous cases where to save money an engineer is placed in charge of a project in the pharmaceutical industry instead of an experienced project manager. While completing my literature review I developed skills in numerous areas; collection and finding of relevant information, planning, decision making and logical thinking. I gained experience with learning to research within numerous different online catalogues of information. During my primary data collection I have developed more confidence in my interpersonal skills, by having to interact with numerous people in order to get my administered web based surveys completed.

6.3 Future Application

I believe that this MBA in project management has added value to my knowledge base. I have acquired numerous new skills and developed skills that I already had. I believe these skills will play a significant role in my future professional and personal life. My goal of working as the head of the quality department for a pharmaceutical plant for a large multinational pharmaceutical company has been brought closer to me through the skills I have learnt this year undertaking my MBA. I hope to continue to be challenged and continue to develop my skills and learn more to help grow and contribute to any organisation that I may be involved in.

Chapter 8
Appendix

Chapter 8 – Appendix

8.1 Appendix 1: Survey

Introduction

Dear Respondents,

I am a post graduate student of Dublin Business School. As a part of my studies, I am conducting a survey research into the risk management of pharmaceutical projects.

The survey is design to collect information to evaluate an engineer's perspective into the benefits of risk management to pharmaceutical projects. In order to full fill my research I need to obtain the viewpoint of manufacturing engineers working in the pharmaceutical industry. For this survey a project is defined as a temporary endeavour undertaken to create a unique product, service or result. A successful project for this survey will be one where all project objectives were successfully completed on time and within budget.

There are 21 questions which will take approx. 10 minutes to complete. The information collected in this survey will be treated in the strict confidence and will be used only to produce statistical tables. It will not be possible to identify the responses of any individual from the result produced. There will be no reference to you or your information in any part of my dissertation. For the sake of anonymity, your web responses will be automatically decoded and exported into a database.

Thank you for participating in this survey.

Yours sincerely,

Jean Livingston

MBA Student

Dublin Business School

MANUFACTURING ENGINEERS' UNDERSTANDING ON THE VALUE OF RISK MANAGEMENT TO PROJECT SUCCESS IN THE PHARMACEUTICAL INDUSTRY OF IRELAND.

1. What is your gender?

- Female
- Male

2. What is your age?

- 18 to 24
- 25 to 34
- 35 to 44
- 45 to 54
- Over 55.

3. How long have you worked in the pharmaceutical industry?

- Less than 1 year
- 1 to 3 years
- 4 to 6 years
- More than 6 years

4. Have you ever overseen a project of any kind during your employment?

- Yes
- No
- Unsure

5. Would you consider this project a success?

A successful project for this survey will be one where all project objectives were successfully comple on time and within budget.

- Yes
- No
- Unsure
- Not applicable

6. Have you ever been involved in identifying risks for a project?

- Yes
- No
- Unsure

7. Have you ever used these tools in identifying risks that may affect the project outcome?

	Very Often	Often	Neutral	Sometimes	Never
Review of past project data					
Brainstorming					
Delphi Technique					
Interviewing					
Root Cause Analysis					
Checklists					
Assumptions Analysis					
Cause and Effect Diagrams					
Flow Charts					
SWOT Analysis					

8. Would you ever use these techniques for future risk identification?

	Very Often	Often	Neutral	Sometimes	Never
Review of past project data					
Brainstorming					
Delphi Technique					
Interviewing					
Root Cause Analysis					
Checklists					
Assumptions Analysis					
Cause and Effect Diagrams					
Flow Charts					
SWOT Analysis					

9. Which technique do you find easiest to implement?

Please rank the following from 1 to 10, with 1 being the easiest to implement and 10 being the hardest to implement.

- Review of past project data
- Brainstorming
- Delphi Technique
- Interviewing
- Root Cause Analysis
- Checklists
- Assumptions Analysis
- Cause and Effect Diagrams
- Flow Charts
- SWOT Analysis

10. Do you think risk identification helps prevent project failure?

- Yes
- No
- Unsure

11. Do you prefer to analyse risks using statistics?

- Yes
- No
- Unsure

12. Have you ever analysed risks?

- Yes
- No
- Unsure

13. Have you ever used these tools in identifying risks that may affect the project outcome?

MANUFACTURING ENGINEERS' UNDERSTANDING ON THE VALUE OF RISK MANAGEMENT TO PROJECT SUCCESS IN THE PHARMACEUTICAL INDUSTRY OF IRELAND.					
	Very Often	Often	Neutral	Sometimes	Never
Risk probability and assessment					
Probability and impact matrix					
Risk categorization					
Risk urgency assessment					
Expert judgement					
Interviewing					
Probability distributions					
Sensitivity analysis					
Monetary value analysis					
Modelling and simulation					

14. Which technique do you find easiest to implement?

Please rank the following from 1 to 10, with 1 being the easiest and 10 being the hardest to implement.

Risk probability and assessment
Probability and impact matrix
Risk categorization
Risk urgency assessment
Expert judgement
Interviewing
Probability distributions
Sensitivity analysis
Monetary value analysis
Modelling and simulation

15. Do you think analysing risks would impact on project success?

Yes

No
Unsure

16. Have you ever developed a strategy on how to respond to a risk?
Yes
No
Unsure

17. Have you ever used these strategies for responding to potential risks?

	Very Often	Often	Neutral	Sometimes	Never
Avoidance					
Transference					
Mitigation					
Acceptance					

18. Which strategy do you think is the easiest to implement?

Please rank the following from 1 to 4, with 1 being the easiest to implement and 4 being the hardest to implement.
Avoidance
Transference
Mitigation
Acceptance

19. Have you ever been involved in developing risk strategies?
Yes
No
Unsure

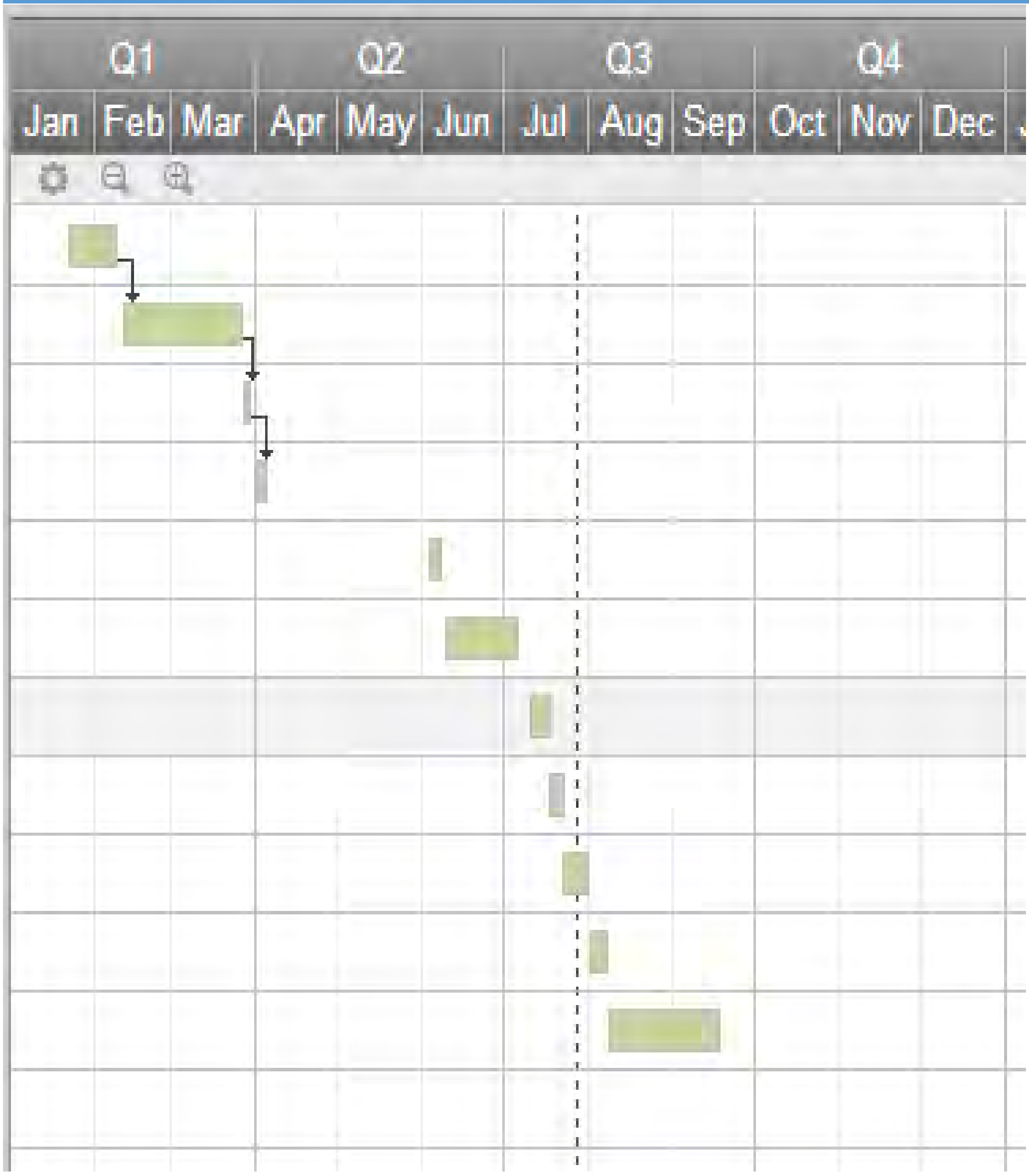
20. Do you think correctly developed risks strategies affect project success?
Yes
No
Unsure

21. Do you think the chance of a project being successful can be increased by developing and implementing a risk management plan for a project?
Yes

- ○ No
- ○ Unsure

8.2 Appendix 2: Dissertation Gantt Chart

Activity	Start Date	Finish Date
Searching for secondary data	22 February 2013	8 February 2013
Reading secondary data	8 February 2013	25 March 2013
Creating surveys	10 April 2013	13 April 2013
Running sample surveys	27 May 2013	30 May 2013
Administrating surveys	3 June 2013	9 June 2013
Analysis primary data	9 June 2013	15 July 2013
Writing early draft	10 July 2013	17 July 2013
Analysing comments of drafts	17 July 2013	22 July 2013
Revision of drafts	22 July 2013	31 July 2013
Proofing	1 August 2013	7 August 2013
Printing and binding	8 August 2013	15 August 2013


Q1
Q2
Q3
Q4
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

8.3 Appendix 3: Frequency Tables

Gender Question

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	28	31.1	31.1	31.1
	Male	62	68.9	68.9	100.0
	Total	90	100.0	100.0	

Table 1: Frequency Table Question 1

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 to 24	49	54.4	54.4	54.4
	25 to 34	14	15.6	15.6	70.0
	35 to 44	12	13.3	13.3	83.3
	45 to 54	9	10.0	10.0	93.3
	Over 55	6	6.7	6.7	100.0
	Total	90	100.0	100.0	

Table 2: Frequency Table Question 2

Length of Time in Pharmaceutical Industry

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	43	47.8	47.8	47.8
	1 to 3 years	19	21.1	21.1	68.9
	4 to 6 years	8	8.9	8.9	77.8
	More than 6 years	20	22.2	22.2	100.0
	Total	90	100.0	100.0	

Table 3: Frequency Table Question 3

Overseen a Project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	66	73.3	73.3	73.3
	No	16	17.8	17.8	91.1
	Unsure	8	8.9	8.9	100.0
	Total	90	100.0	100.0	

Table 4: Frequency Table Question 4

Was the project a success

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	43	47.8	65.2	65.2
	No	9	10.0	13.6	78.8
	Unsure	9	10.0	13.6	92.4
	Not Applicable	5	5.6	7.6	100.0
	Total	66	73.3	100.0	
Missing	System	24	26.7		
Total		90	100.0		

Table 5: Frequency Table Question 5

Have you ever identified risk

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	71	78.9	78.9	78.9
	No	14	15.6	15.6	94.4
	Unsure	5	5.6	5.6	100.0
	Total	90	100.0	100.0	

Table 6: Frequency Table Question 6

Risk Identification Techniques * Usage Cross tabulation

Count

		Usage					Total
		Very Often	Often	Neutral	Sometimes	Never	
Risk Identification Techniques	Review of Past Project Data	41	31	7	13	8	100
	Brainstorming	42	39	8	11	0	100
	Delphi Technique	0	8	21	10	61	100
	Interviewing	8	13	18	29	31	99
	Root Cause Analysis	38	31	9	10	10	98
	Checklists	40	30	11	11	8	100
	Assumptions Analysis	10	13	10	29	38	100
	Cause and Effect Diagrams	11	42	9	26	12	100
	Flow Charts	20	41	8	21	10	100
	SWOT Analysis	8	9	19	21	43	100
Total		218	257	120	181	221	997

Table 7: Frequency Table Question 7

Risk Identification Techniques * Usage Cross tabulation

Count

		Usage					Total
		Very Often	Often	Neutral	Sometimes	Never	
Risk Identification Techniques	Review of Past Project Data	41	31	7	13	8	100
	Brainstorming	42	39	8	11	0	100
	Delphi Technique	0	8	21	10	61	100
	Interviewing	8	13	18	29	31	99
	Root Cause Analysis	38	31	9	10	10	98
	Checklists	40	30	11	11	8	100
	Assumptions Analysis	10	13	10	29	38	100
	Cause and Effect Diagrams	11	42	9	26	12	100
	Flow Charts	20	41	8	21	10	100
	SWOT Analysis	8	9	19	21	43	100
Total		218	257	120	181	221	997

Table 8: Frequency Table Question 8

Risk Identification Tools Ranks * Ranking Cross tabulation

Count

		Ranking										Total
		One	Two	Three	Four	Five	Six	Seven	Eight	Nine	Ten	
Risk Identification Tools Ranks	Review of Past Project Data	42	13	10	10	0	11	8	0	0	6	100
	Brainstorming	33	20	16	10	7	8	0	7	0	0	101
	Delphi Technique	0	12	7	8	0	13	7	2	20	31	100
	Interviewing	7	11	13	10	13	9	30	0	0	7	100
	Root Cause Analysis	0	7	11	22	21	12	8	11	8	0	100
	Checklists	10	21	9	10	14	11	9	9	7	0	100
	Assumption Analysis	0	0	0	8	9	9	23	20	20	11	100
	Cause and Effect Diagrams	0	0	7	7	11	12	10	23	18	12	100
	Flow Charts	8	11	19	4	12	8	4	7	13	13	99
	SWOT Analysis	0	4	9	11	12	7	1	21	14	20	99
Total		100	99	101	100	99	100	100	100	100	100	999

Table 9: Frequency Table Question 9

RI prevent failure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	84	93.3	93.3	93.3
	Unsure	6	6.7	6.7	100.0
	Total	90	100.0	100.0	

Table 10: Frequency Table Question 10

Analysis Risk Using Statistics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	57	63.3	63.3	63.3
	No	17	18.9	18.9	82.2
	Unsure	16	17.8	17.8	100.0
	Total	90	100.0	100.0	

Table 11: Frequency Table Question 11

Analysis Risks At All

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	73	81.1	81.1	81.1
	No	17	18.9	18.9	100.0
	Total	90	100.0	100.0	

Table 12: Frequency Table Question 12

Risk Analysis Techniques * Have you ever used these tools in analysing risks Cross tabulation

Count

		Have you ever used these tools in analysing risks					Total
		Very Often	Often	Neutral	Sometimes	Never	
Risk Analysis Techniques	Risk Probability and Assessment	22	47	9	12	10	100
	Probability and Impact Matrix	10	30	19	19	22	100
	Risk Categorization	29	40	11	10	10	100
	Risk Urgency Assessment	29	40	11	10	10	100
	Expert Judgement	29	33	10	8	20	100
	Interviewing	13	11	36	11	29	100
	Probability Distributions	13	22	19	18	28	100
	Sensitivity Analysis	9	13	30	10	38	100
	Monetary Value Analysis	12	9	20	22	37	100
	Modelling and Simulation	11	28	11	31	19	100
Total		177	273	176	151	223	1000

Table 13: Frequency Table Question 13

Risk Identification Tools Ranks * Ranking Cross tabulation

Count

		Ranking										Total
		One	Two	Three	Four	Five	Six	Seven	Eight	Nine	Ten	
Risk Identification Tools Ranks	Risk Probability and Assessment	31	11	21	11	8	8	8	1	0	1	100
	Probability and Impact Matrix	12	18	9	22	10	12	7	0	9	1	100
	Risk Categorization	11	22	20	11	12	8	9	1	6	0	100
	Risk Urgency Assessment	7	2	10	11	22	20	8	12	8	0	100
	Expert Judgement	26	10	1	10	12	12	7	9	7	7	101
	Interviewing	11	9	14	10	10	16	8	8	7	8	101
	Probability Distributions	1	7	1	13	8	8	40	12	10	0	100
	Sensitivity Analysis	0	7	1	2	8	1	10	50	11	10	100
	Monetary Value Analysis	0	9	10	0	8	14	1	2	34	21	99
	Modelling and Simulation	1	6	12	9	2	1	3	4	9	52	99
Total		100	101	99	99	100	100	101	99	101	100	1000

Table 14: Frequency Table Question 14

Risk_Analysis_Impact

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	75	83.3	83.3	83.3
	No	8	8.9	8.9	92.2
	Unsure	7	7.8	7.8	100.0
	Total	90	100.0	100.0	

Table 15: Frequency Table Question 15

Developed_Risk_Strategy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	56	62.2	62.2	62.2
	No	28	31.1	31.1	93.3
	Unsure	6	6.7	6.7	100.0
	Total	90	100.0	100.0	

Table 16: Frequency Table Question 16

Risk Response * How often risk strategies are used Cross tabulation

			How often risk strategies are used					Total
			Very Often	Often	Neutral	Sometimes	Never	
Risk Response	Avoidance	Count	39	28	9	11	13	100
		% within How often risk strategies are used	45.3%	28.9%	11.7%	11.3%	30.2%	25.0%
	Transference	Count	11	10	37	29	13	100
		% within How often risk strategies are used	12.8%	10.3%	48.1%	29.9%	30.2%	25.0%
	Mitigation	Count	24	40	21	7	8	100
		% within How often risk strategies are used	27.9%	41.2%	27.3%	7.2%	18.6%	25.0%
	Acceptance	Count	12	19	10	50	9	100
		% within How often risk strategies are used	14.0%	19.6%	13.0%	51.5%	20.9%	25.0%
Total		Count	86	97	77	97	43	400
		% within How often risk strategies are used	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 17: Frequency Table Question 17

Risk Response Choices * Ranking Cross tabulation

Count

		Ranking				Total
		One	Two	Three	Four	
Risk Response Choices	Avoidance	46	31	0	23	100
	Transference	7	32	51	10	100
	Mitigation	23	22	27	28	100
	Avoidance	24	14	22	39	99
Total		100	99	100	100	399

Table 18: Frequency Table Question 18

Involved in Risk Strategies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	54	60.0	60.0	60.0
	No	27	30.0	30.0	90.0
	Unsure	9	10.0	10.0	100.0
	Total	90	100.0	100.0	

Table 19: Frequency Table Question 19

Risk Strategies Affect Project Outcome

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	74	82.2	82.2	82.2
	No	14	15.6	15.6	97.8
	Unsure	2	2.2	2.2	100.0
	Total	90	100.0	100.0	

Table 20: Frequency Table Question 20

Risk Management and Project Success

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	81	90.0	90.0	90.0
	Unsure	9	10.0	10.0	100.0
	Total	90	100.0	100.0	

Table 21: Frequency Table Question 21

Chapter 9
Bibliography

Chapter 9 – Bibliography

Abdul-Rahman, H, Loo, S, & Wang, C (2012), 'Risk identification and mitigation for architectural, engineering, and construction firms operating in the Gulf region', *Canadian Journal of Civil Engineering*, 39, (1), pp. 55-71, Computers & Applied Sciences Complete, EBSCOhost, (Accessed: 1 July 2013).

Aveyard, H. (2010). *Doing a Literature Review in Health and Social Care*. 2nd ed. Glasgow: Open University Press. Dawsonera [Online]. Available at: https://www.dawsonera.com/abstract/9780335238866 (Accessed: 24 July 2013).

BioPharmaGuy (2013) 'Ireland Biotech, Pharma & Life Science Company Career Pages'. Available at: http://biopharmguy.com/links/country-ireland.php (Accessed: 17 May 2013).

Blumberg, B., Cooper, D.R. and Schindler, P.S. (2011) *Business research methods*. 3rd European edn. London: McGraw-Hill.

Burns, R (2013) 'Project Management Quotes' *Project Auditors*. Available at: http://www.projectauditors.com/Company/Project_Management_Quotes.php. (Accessed: 29 July 2013).

Burns, R.B and Burns, R.A (2008) *Business Research Methods and Statistics Using SPSS. London: Sage Publications Ltd.*

Brandas, C, Didraga, O, & Bibu, N (2012), 'Study on Risk Approaches in Software Development Project', *Informatica Economica*, 16, (3), pp. 148-157, Business Source Complete, EBSCOhost, (Accessed: 1 July 2013).

Bryman, A. and Bell, E. (2011) *Business research methods*. 3rd edn. Oxford: Oxford University Press.

Cameron, S. and Price, D. (2009) *Business research methods: a practical approach*. London: CIPD.

Chan, A, Yeung, J, Yu, C, Wang, S, & Ke, Y (2011), 'Empirical Study of Risk Assessment and Allocation of Public-Private Partnership Projects in China', *Journal Of Management In Engineering*, 27, (3), pp. 136-148, Academic Search Complete, EBSCOhost, (Accessed: 1 July 2013).

Connolly, D. (2012) *Irish pharmaceutical sector overview.* Available at: http://www.morganmckinley.ie/article/irish-pharmaceutical-sector-overview. (Accessed 14 March 2013).

Cooper, D., Grey, S., Raymond, G., and Walker, P. (2005) *Project Management Guidelines. Managing Risk in Large Projects and Complex Procurements*. 1st ed. Hoboken, NJ: John Wiley & Sons

Cooper, D.R. and Schindler, P.S. (2008) *Business research methods*. 10th edn. Berkshire: McGraw-Hill.

Corporate Watch. (no date) 'Pharmaceutical Industry: Sector Overview'. Available at: http://www.corporatewatch.org/?lid=312. (Accessed: 9th April 2013).

Davy Research (2012) 'Ireland and the Pharma Patent Cliff.' Available at: http://www.davy.ie/content/pubarticles/patentcliff20121128.pdf. (Accessed: 20 Jun 2013).

Department of Jobs, Enterprise and Innovation (2012) 'Pharmaceutical Industry'. Available at: http://www.djei.ie/press/2012/20120223b.htm. (Accessed: 20 Jun 2013).

Didraga, O. (2013) 'The Role and the Effects of Risk Management in IT Projects Success', Informatica Economica, 17, (1), pp. 86-98, Business Source Complete, EBSCOhost [Online]. (Accessed: 25 June 2013).

Enterprise Ireland. (2010) 'Pharmaceuticals'. Available at: http://www.enterprise-ireland.com/en/Source-a-Product-or-Service-from-Ireland/Sector-and-Company-Directories/Pharmaceutical-Sector-Profile.pdf. (Accessed: 9th April 2013).

Enterprise Europe Ireland. (2010) 'Pharmaceuticals in Ireland'. Available at: http://www.een-ireland.ie/eei/assets/documents/uploaded/general/Pharmaceuticals%20Fact%20sheet.pdf. (Accessed: 9th April 2013).

Egeraat, C.V, and Barry, F. (2008) 'The Irish Pharmaceutical Industry over the Boom Period and Beyond'. Available at: http://www.tcd.ie/business/staff/fbarry/papers/The%20Irish%20Pharmaceutical%20Industry%20over%20the%20Boom%20Period%20and%20Beyond.pdf (Accessed: 20 Jun 2013).

Ernst and Young. (2012) 'What Europe has to offer Biotechnology companies'. Available at: http://www.ey.com/Publication/vwLUAssetsPI/What_Europe_has_to_offer_biotechnology_companies/$FILE/Biotech%20report%202012%20-%20What%20Europe%20has%20to%20offer%20biotechnology%20companies.pdf. (Accessed: 9th April 2013).

Eybpoosh, M., Dikmen, I. and Birgonul, M.T. (2011) 'Identification of Risk Paths in International Construction Projects Using Structural Equation Modelling' *Journal of Construction Engineering and Management,* 137 (12), pp. 1164-1175. Business Source Complete, EBSCOhost, (Accessed: 10 April 2013).

Fortunato, B, Hallowell, M, Behm, M, & Dewlaney, K 2012, 'Identification of Safety Risks for High-Performance Sustainable Construction Projects', Journal Of Construction Engineering & Management, 138, (4), pp. 499-508, Academic Search Complete, EBSCOhost. (Accessed: 10 April 2013).

Garvey, P.R. and Lansdown Z.F. (1998). Risk Matrix: An Approach for Identifying, Assessing and Ranking Program Risks. *Air Force Journal of Logisitics*. 22 (1), pp. 18-24.

GradIreland (no date) 'Pharmaceutical and biotechnology'. Available at: http://gradireland.com/career-sectors/science-research-and-development/pharmaceutical-and-biotechnology. (Accessed: 20 Jun 2013).

Hair, F. J. J.R., Babin, B., Money, H.A. and Samuel, P. (2003) *Essentials of business research methods*. 1st edn. Hoboken, NJ: John Wiley & Sons

Han, W.S., Yusof, A.M., Ismail, S. and Aun, N.C. (2012) 'Reviewing the Notions of Construction Project Success', International Journal of Business and Management, 7 (1), pp. 90-101. Business Source Complete, EBSCOhost [Online]. (Accessed: 9th April 2013).

Hassanein, A.A.G and Afify, H.M.F (2007) 'A risk identification procedure for construction contracts – a case study of power stations projects in Egypt' *Civil Engineering and Environmental Systems,* 24 (1), pp. 3-14. Business Source Complete, EBSCOhost [Online]. (Accessed: 10th April 2013).

Hillson, D. (2009) Managing Risk in Projects. 1st edn. UK: MPG Books.

Ika, L.A. (2009). 'Project success as a topic in project management journals.' Project Management Journal, 40(4), pp. 6-19. Business Source Complete, EBSCOhost [Online]. (Accessed: 9th April 2013).

Immel, J. (2013). Root Cause Analysis for Young Engineers. Available: http://www.sciencemag.org/content/340/6131/444.full. (Accessed 1 July 2013).

Industrial Development Authority (IDA) (2013) 'Pharmaceutical Companies'. Available at: http://www.idaireland.com/search-companies.xml (Accessed: 17 May 2013).

InterSearch (2013) 'Ireland and the US Pharmaceutical Industry'. Available at: http://intersearch.ie/en/component/content/article/3-news/114-ireland-and-the-us-pharmaceutical-industry. (Accessed: 20 Jun 2013).

Irish Pharmaceutical Healthcare Association (IPHA). (2012) 'Contribution to the Irish Economy'. Available at: http://www.ipha.ie/alist/contribution-to-the-irish-economy.aspx. (Accessed: 20 Jun 2013)

Irish Pharmaceutical Healthcare Association (IPHA). (no date) 'The Pharmaceutical Industry in Ireland'. Available at: http://www.medicinesandyou.ie/pdf/Unit7_student_info.pdf. (Accessed: 9th April 2013).

Irish Times (2013) 'Top Pharmaceutical Companies'. Available at: http://www.top1000.ie/industries/pharma. (Accessed: 20 Jun 2013).

Jaskowski, P, and Biruk, S (2011), 'the Conceptual Framework for Construction Project Risk Assessment', *Reliability: Theory & Applications*, 6, (3), pp. 27-35, Academic Search Complete, EBSCOhost, (Accessed: 1 July 2013).

Kerzner, H.R (2013) 'Project Management a Systems Approach to Planning, Scheduling and Controlling.'11th edn. USA: Wiley

Kolb, D.A (1984). Experiential learning: experience as the source of learning and development. New Jersey: USA: Prentice Hall.

Larson, E.W. and Gray, C.F (2011) *Project Management: The Managerial Process*.5th ed. New York: McGraw Hill

Lock, D (2007) 'The Essentials of Project Management.' 3rd edn. Cornwall: TJ International Ltd.

Mahmoudi, H., Renn, O., Vanclay, F., Hoffmann, V and Karai, E. (2013). A Framework for combining social impact assessment and risk assessment. *Environmental Impact Assessment Review*. 43 (1), pp. 1-8.

MarketLine (2012a) 'Pharmaceuticals in Europe' *MarketLine reports platform*, Irish series [Online]. (Accessed: 9th April 2013).

MarketLine (2012b) 'Global Pharmaceuticals' *MarketLine reports platform*, Irish series [Online]. (Accessed: 9th April 2013).

MarketLine (2012c) 'Pharmaceuticals in the United States' *MarketLine reports platform*, Irish series [Online]. (Accessed: 9th April 2013).

Marschan-Piekkari, R. and Welch, C (2004) *Handbook of Qualitative Research Methods for International Business*. 1st edn. Cheltenham: Edward Elgar Publishing Inc. GoogleBooks [Online]. Available: http://books.google.ie/books?id=r5oYx6NPJJ4C&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false (Accessed: 18 Jun 2013).

Maylor, H. (2010) *Project Management*. 4th edn. Gosport, England: Prentice Hall

Melnic, A. (2010) 'Risk Response Strategies in Project Management', *Metalurgia International*, 15 (8), pp. 74-78, Business Source Complete, EBSCO*host* [Online]. (Accessed: 9th April 2013).

Nicholas, J.M. and Steyn, H. (2008) Project management for business, engineering, and technology: principles and practice. 3rd ed. Oxford: Butterworth-Heinemann.

Oliver, P. (2012). *Succeeding with your Literature Review*. New York: McGraw-Hill. Dawsonera [Online]. Available at: https://www.dawsonera.com/abstract/9780335243693 (Accessed: 24 July 2013).

Peacock, L. (2013). Shell UK boss: My industry has a 'girl problem' and we've got to fix it. Available: http://www.telegraph.co.uk/women/womens-business/9947001/Shell-UK-Engineering-has-a-girl-problem-and-weve-got-to-fix-it.html. (Accessed 5 July 2013).

Perry, J. (2012). 'Ireland is largest net exporter of pharmaceuticals, valued at €55 billion, accounting for 50% of exports. Available: http://www.djei.ie/press/2012/20120223b.htm. (Accessed 20 June 2013).

Pinter, U. and Psunder, I. (2011) 'Project Management Maturity and Project Management Success in the Engineering and Construction Industry in Southern African', Journal of Civil Engineering and Management, 19 (1), pp. 16-23. Business Source Complete, EBSCOhost [Online]. (Accessed: 9th April 2013).

Pinto, J.K. and Slevin, D.P. (1987) 'Critical Factors in Successful Project Implementation.' IEEE Transactions on Engineering Management, 3 (1), pp.22-27). Graduate School of Public Administration [Online]. Available at: http://gspa.grade.nida.ac.th/pdf/PA%20780%20(Pakorn)/8.Critical%20Success%20Factors%20in%20Effective%20Project%20Implementati.pdf. (Accessed: 24 Jun 2013).

PharmaChemical Ireland (2013) 'The Pharmaceutical Industry' Available at: http://www.pharmachemicalireland.ie/Sectors/PCI/PCI.nsf/vPages/About_us~industry-profile?OpenDocument. (Accessed: 20 Jun 2013).

PMI (2012) 'A Guide to the Project Management Body of Knowledge (PMBOK Guide).' 12th edn. Pennsylvania: PMI.

Portney, S.E. (2007) Project Management for Dummies. 2nd edn. Hoboken, NJ: Wiley

Pretorius, S., Steyn, H. and Jordaan, J.C. (2012) 'A Study of Reasons Behind Delays in Pharmaceutical Projects', South African Journal of Industrial Engineering, 23 (3), pp. 1-12. Business Source Complete, EBSCOhost [Online]. (Accessed: 9th April 2013).

Rajeskar, S., Philominathan, P. and Chinnathombi, C. (2006). *Research Methodology*. Available: http://arxiv.org/pdf/physics/0601009.pdf. (Accessed: 13 Jun 2013).

Recruit Ireland (no date) 'Pharmaceutical Industry Remains Robust in Recent Downturn'. Available at: http://www.recruitireland.com/careercentre/sciencepharma/Pharma-Industry-Remains-Robust/2826. (Accessed: 20 Jun 2013).

Rezakhani, P. (2012) 'Current state of existing project risk modelling and analysis methods with focus on fuzzy risk assessment – Literature Review' Frattura E Integrita Strutturale, 20 (1), pp. 17-21. Business Source Complete, EBSCOhost, (Accessed: 10 April 2013).

Sai Nandeswara Rao, N, & Jigeesh, N (2012), 'A Study of Reasons Behind Delays in Pharmaceutical Projects', the IUP Journal of Operations Management, 21 (2), pp. 19-29. Business Source Complete, EBSCOhost [Online]. (Accessed: 9th April 2013).

Saunders, M., Lewis, P. and Thornhill, A. (2012) *Research methods for business students.* 6th edn. Harlow: Pearson Education.

Saunders, M., Lewis, P. and Thornhill, A. (2012) *Research methods for business students.* 4th edn. Harlow: Pearson Education. Dawsonera [Online]. Available at: https://www.dawsonera.com/abstract/9781408212653 (Accessed: 24 July 2013).

Shutb, A., Bard, J.F. and Globerson, S. (2005) Project Management Processes, Methodologies and Economics.2nd edn. Upper Saddle River, NJ: Pearson Education.

Silicon Republic (2012) 'Ireland is world's largest net exporter of pharmaceuticals.' Available at: http://www.siliconrepublic.com/innovation/item/25929-ireland-is-worlds-largest. (Accessed: 20 Jun 2013).

Simmons, T. (2001) 'Reducing Risk in Pharmaceutical Automation Projects.' Pharmaceutical Technology Europe, 13 (12), pp.22-27. Business Source Complete, EBSCOhost [Online]. (Accessed: 9th April 2013).

Skorupko, D. (2008) 'Identification and Initial Risk Assessment of Construction Projects in Poland' *Journal of Management in Engineering,* 24 (3), pp. 120 – 127. Business Source Complete, EBSCOhost, (Accessed: 10 April 2013).

Stosic, B., Isljamovic, S. and Mihic, M.M. (2013) 'Improvement of Innovation Project Risk Identification by Applying RBS Method', Metalurgia International, 18 (2), pp. 161-166. Business Source Complete, EBSCOhost, (Accessed: 10 April 2013).

Subramanyan, H., Sawant, P.H. and Bhatt, V. (2012) 'Construction Project Risk Assessment: Development of Model Based on Investigation of Opinion of Construction Project Experts from India' *Journal of Construction Engineering and Management,* 138 (3), pp. 409–421. Business Source Complete, EBSCOhost, (Accessed: 10 April 2013).

Tadayan, M, Jaafar, M, & Nasri, E 2012, 'An Assessment of Risk Identification in Large Construction Projects in Iran', *Journal Of Construction In Developing Countries*, 17, (1), pp. 57-69, Academic Search Complete, EBSCOhost, (Accessed: 1 July 2013).

Tariq, M, & Khan, M 2012, 'Six Sigma based Risk Identification and Mitigation Framework for Projects Execution', *Information Management & Business Review*, 4, (2), pp. 79-85, Business Source Complete, EBSCO*host*, (Accessed: 1 July 2013).

Tashakkori, A. and Teddlie, C. (2003) *the Sage Handbook of Mixed Methods in Social and Behavioural Research.* 1st edn. Thousand Oaks, CA: Sage. GoogleBooks [Online]. Available: http://books.google.ie/books?id=F8BFOM8DCKoC&printsec=frontcover#v=onepage&q&f=false (Accessed: 18 Jun 2013).

Tworek, P (2012) 'Plan Risk Response as a Stage of Risk Management in Investment Projects in Polish and U.S. Construction - Methods, Research', *Scientific Annals of the 'Alexandru Ioan Cuza' University Of Iasi*, 59 (1), pp. 201-212, Business Source Complete, EBSCOhost, (Accessed: 10 April 2013).

Wall, M. (2012) 'Pharma sector leveraged role in economy to get deal' *Irish Times.* Available at: http://www.irishtimes.com/news/pharma-sector-leveraged-role-in-economy-to-get-deal-1.1946. (Accessed: 20 Jun 2013).

Waters, J (2008). Quantitative Methods for Business. 4th ed. Harlow: Pearson Education. Dawsonera [Online] Available at: https://www.dawsonera.com/abstract/9781408250280 (Accessed: 25 July 2013).

Wideman, R.M. and Shenhar, A.J. (2001) 'Organizational Deployment of Project Management: The Next Big "Aha" for Corporate Project Leaders' in Knutson, J (eds.) Project Management for Business Professionals A Comprehensive Guide. USA: Wiley.

World Health Organisation (WHO) (2013), 'Ethical Criteria for Medical Drug Promotion'. Available at: http://apps.who.int/medicinedocs/documents/whozip08e/whozip08e.pdf (Accessed: 2 July 2013)

Xu, Y, Yang, Y, Chan, A, Yeung, J, & Cheng, H. (2011) 'Identification and Allocation of Risks Associated with PPP Water Projects in China', *International Journal Of Strategic Property Management,* 15 (3), pp. 275-294. Business Source Complete, EBSCOhost, (Accessed: 10 April 2013).

Zizhi, X, Jinpeng, L, and Xin, L (2012), 'Study on the Whole Process Risk Management System of Power Grid Construction Projects', Asian Social Science, 8, (8), pp. 69-73, Academic Search Complete, EBSCOhost. (Accessed 10 April 2013).

Zou, P, and Jie, L (2010), 'Risk identification and assessment in subway projects: case study of Nanjing Subway Line 2', *Construction Management & Economics*, 28, (12), pp. 1219-1238, Business Source Complete, EBSCOhost. (Accessed 10 April 2013).

Zizhi, X, Jinpeng, L, & Xin, L 2012, 'Study on the Whole Process Risk Management System of Power Grid Construction Projects', *Asian Social Science*, 8, (8), pp. 69-73, Academic Search Complete, EBSCOhost, (Accessed: 1 July 2013).