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Title: Investigating issues of how extreme programming could be used in conjunction with an existing quality management framework

Course: BSCG4 Computing (Hons) With Specialist Streams

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Except where explicitly stated all work in this report, including appendices, is my own

Signed:

Date:

Abstract

It is widely assumed that gaining certification such as ISO is incompatible with Agile Methods, especially Extreme Programming. This dissertation is developed mainly to answer the question if Extreme Programming is compatible with the ISO 9001:2000 standard.

Although research has been done on Agile Methods like Extreme Programming this research offers a different objective as most research has been done with respect to Extreme Programming and comparing them to different traditional methods such as the Waterfall method, or comparing different Agile Methods with each other. This study is developed to discover how Extreme Programming is compatible with quality and therefore discover if it would be possible to achieve the ISO 9001:2000 standard by using Extreme Programming.

Acknowledgements

I would like to take this opportunity to extend my grateful thanks to all my friends and family, in particular my parents, who have helped and supported me throughout the course of this research, and the duration of my studies.

Furthermore, I would particularly like to acknowledge the assistance provided by Dr Richard Foley, and my work colleagues who have been extremely understanding and supportive over the past few months.

Without their direction and support, this research would not have been completed.

Glossary

ISO International Organisation for Standardisation

XP Extreme Programming

Contents

1. Introduction

The topic which this project will be covering is the investigation of how an existing method of Agile programming can be used best with an existing quality management framework. This study will examine the project area and find out if an agile method (Extreme Programming) can be used in conjunction with an existing quality management system. This project has been carried out due to a keen interest in Software Engineering and Agile Development Methods.

1.1 Background to Project

Agile methods are a new approach to software engineering and were first introduced in the late 90's (Fowler, 2005). Agile methods are seen as an alternative approach to building and managing software compared with traditional methods such as Waterfall model etc. More and more companies such as Nokia and Motorola (Lindvall and Muthig, 2004) are changing to Agile methods due to a number of factors, most notably the poor success rate of the traditional methods. Both companies gained positive results from using XP and are currently considering using agile methods for future projects. Research by The Standish Group shows a staggering 31.1% of projects will be cancelled before they are ever completed. Further results indicate 52.7% of projects will cost 189% of their original estimates. On the success side, the average is only 16.2% for software projects that are completed on-time and on-budget (The Standish Group, 1994). Although this report was carried out in 1994 the success rates have not improved and these results have been poor since around 1968 when Software Engineering began. These figures show that software projects cost the industry to waste vast sums of money.

Quality management systems are a set of standards that software engineers would follow in order to get the best quality end product (Simple Quality, 2005). In order for software to gain the quality that they require a framework for a quality management system needs to be in place in order to achieve a good quality standard. It is also a good initiative for companies to follow and achieve because many customers/clients look for quality certification such as ISO before they would consider using these companies. The ISO 9001:2000 system will be reviewed within this project in order to make sure that the software quality will be of a high standard. This will involve comparing the processes of the ISO 9001:2000 system and discovering how the processes of Extreme Programming can be adapted to meet the ISO 9001:2000 standard.

This subject is worth investigating because Agile methods are seen as a new approach for Software Engineering and therefore hope to offer an improvement on the poor results shown. It would be important for Software Engineers and companies as it would provide them with important information on how a particular Agile methods could be used with existing quality management systems and show an insight into the key issues involved such as the cost of change and how easily existing quality management systems could be adapted to meet the needs of agile methods. It could also be useful for companies who use or are considering using agile methods in conjunction with existing quality management systems or just using agile methods in

general. Massive companies such as Microsoft, Motorola and Nokia are looking into agile methods so the possible scope for this project is enormous.

1.2 Project Aims & Methodology

In this section the aims of the project will be explained as well as the research questions, hypothesis and the structure of the dissertation.

1.2.1 Aims

The aim of this study is to investigate what processes, practices and standards of Extreme Programming can be used in conjunction with the processes, practices and standards of a Quality Management Framework, in this case the ISO 9001:2000 standard. From this the processes, practices and standards which do not work well with the ISO 9001:2000 standard can also be discovered.

1.2.2 Research Questions & Hypothesis

The research questions that will be addressed in this report will be:
- What are the characteristics of Extreme Programming?
- What are Extreme Programming Quality Management System requirements?
- How can Extreme Programming be adapted to meet the requirements of ISO 9001:2000?

The hypothesis will be:
- The processes, practices and standards of Extreme Programming can be adapted to meet the processes, practices and standards of ISO 9001:2000.

In order to find the answers of the research questions and the hypothesis a literature review and a quasi-experiment will take place. The literature review will be used to find information on Extreme Programming and how Extreme Programming can be linked to quality issues as well as the ISO 9001:2000 Guidelines and how they are similar to Extreme Programming Practices. This method will allow the 2 research questions, what are the characteristics of Extreme Programming? and what are Extreme Programming Quality Management System requirements? to be answered.

The quasi-experiment will be used to discover if Extreme Programming can be used with ISO 9001:2000. This will be achieved by using Mapping Diagrams to map the ISO Guidelines with the Extreme Programming Practices and then drawing a table containing these results as well as displaying the results using bar graphs. This method can be used to answer the final research question as well as the hypothesis.

1.3 Structure of Dissertation

The dissertation has 5 chapters in total. The structure of the dissertation is as follows:

- Chapter 1 - The introduction will explain the background of the project as well as the project aims & methodology and the structure of the dissertation.
- Chapter 2 - Literature Review where the literature found on Extreme Programming (XP) and Quality Management Systems will be explained and discussed as well as the conclusions that have been found on each.
- Chapter 3 - The Development of the Research Method will then be explained and discussed where the chosen method itself will be explained and discussed as well as what the method consists of and how it was executed.
- Chapter 4 - The analysis of the results will be explained and discussed as well as the method of analysis.
- Chapter 5 - Finally there will be a conclusion where everything discussed will be summed up as well as the results found.

2. Literature Review

In this section the different XP Practices will be explained as well as how these practices relate to quality issues. Each of the thirteen XP Practices will be discussed and related to quality practices. Traditional Quality Management Systems will also be discussed and in particular the ISO 9001:2000 Guidelines as they are very important with respect to the project. Finally the key points and issues will be summed up in the conclusion.

2.1 Extreme Programming (XP) Practices

There are thirteen XP Practices and in this section all of the practices will be identified and explained. There will then be a discussion about how each practice can be related to quality issues.

2.1.1 Introduction to Extreme Programming

Extreme Programming was the chosen Agile method because through research it was the most commonly used Agile method and a lot of large companies such as Nokia and Motorola (Lindvall and Muthig, 2004) had already experienced using Extreme Programming to develop their projects.

Diagram 1 below shows the thirteen Core Practices involved in Extreme Programming. These practices will be explained and discussed in relation to quality issues.

Diagram 1 (http://www.xprogramming.com/images/circles.jpg)
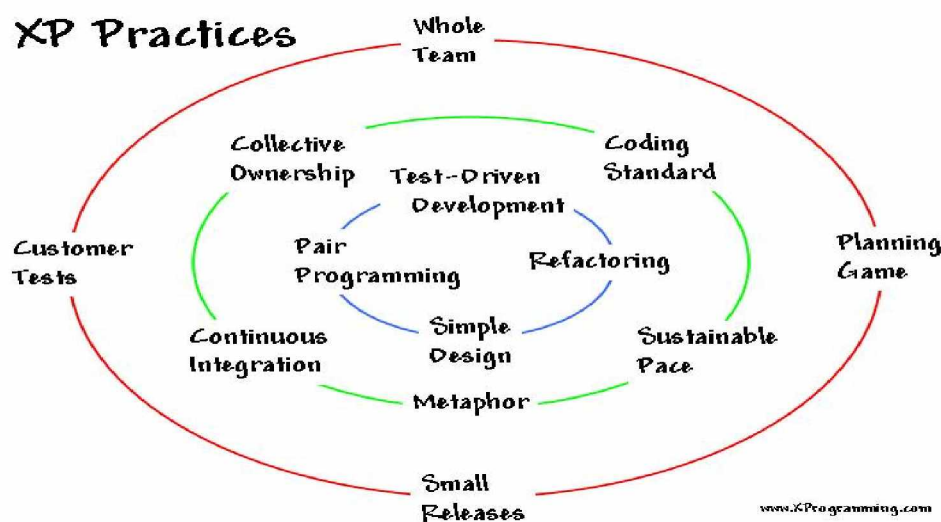
2.1.2 Extreme Programming & Quality Issues

This section will explain the thirteen Extreme Programming practices in diagram 1 and relate these Extreme Programming practices with quality issues.

2.1.2.1 Whole Team

The first core practice that will be looked at is called "Whole Team". Whole Team involves everyone within the project working together. This would include Testers, Programmers, Project Managers, Customer etc (Beck, 2005). The customer is very much involved here and is seen as being part of the team. Everyone would meet together and discuss their points and opinions about the project. There would normally be a coach or manager involved who would oversee the project and make sure the project is running on schedule (Jefferies, 2001).

From this Whole Team practice the customer is very much involved. This is good for relating to quality because most quality standards such as ISO highlight good customer communication. This is a great way of involving the customer because the customer defines and discusses their requirements with the "team" and therefore both the customer and the development team can get instant feedback thus improving the requirements and also having a positive effect on the project timescale.

2.1.2.2 Planning Game

Planning Game involves two key planning steps which are Release Planning and Iteration Planning. Release Planning is where the customer presents their desired features and a plan is laid out and Iteration Planning is where the development team meet approximately every 2 weeks and make any changes to the plan in accordance to difficulty, errors etc.

This practice can be linked to quality issues because quality standards emphasise the importance of establishing and improving plans. The XP Practice involves the same principle because in the Release Planning stage the features required are verified and validated between the customer and the programmers and in the Iteration Planning stage the product is reviewed with the customer after each iteration (usually 2 weeks) (Williams, 2003). This shows that a plan is established as well as improved due to the fact that the customer can view some form of running software after each iteration and therefore can make any changes to the project based on these iterations.

2.1.2.3 Customer Tests

Customer Tests involves the customer working with the team to define acceptance tests for the project (Martin, 2000). These tests are then run and are then kept running correctly throughout the project (Jefferies, 2001).

Customer Tests involves the customer a great deal due to the fact that they work with the testers to develop acceptance tests. This links well with quality because again

there is a lot of focus on the customer and testing is a major part of quality to make sure the software achieves what it is meant to achieve so creating these tests go "hand in hand" with quality.

2.1.2.4 Small Releases

Small Releases involves the release of running, tested software so that the customer can view the progress of the software and even release early to high end users if they wish to (Jefferies 2001).

This XP Practice links well with quality issues because it has an emphasis on the customer where they can see the running of the project and therefore make necessary changes. It also has emphasis on planning, design and development because the software is released early which improves design and development because functionality, usability can be reviewed early and therefore change according to the customers requirements this therefore also improves the planning of the project and improves the quality of the software.

2.1.2.5 Simple Design

Simple Design involves keeping the design as simple as possible and then investing in the design of the system every day. The design is done step by step and is built upon daily (Paulk, 2001).

Simple Design links to quality issues because the design is built upon daily and therefore shows progress with the design and the development of the project as the design is reviewed everyday. The quality issue of planning is also there because the design is keep simple therefore the required features are produced with the "simplest" design and the functionality, usability etc of the system can be further developed if required or if there is enough time and this therefore means that the system will meet requirements and be on time.

2.1.2.6 Pair Programming

Pair programming involves 2 programmers sitting together working on the same code. This results in better design, better code and better testing (Williams et al 2000).

In pair programming 2 programmers work together on the same code, this helps to reduce the number of bugs and errors within the code and therefore improves the quality of the system. The design and development of the system will improve as well as the communication. Communication is an important quality issue here because the 2 programmers can communicate together thus improving the code and helping each other to work out problems etc.

2.1.2.7 Test Driven Development

Test Driven Development involves testing every piece of code as its written. The code is then tested to see if the test and the code run correctly. The teams produce 100% test coverage which is good for design and for reducing errors (Jefferies, 2001).

Test Driven Development covers a lot of quality issues because each piece of code is tested as soon as it is written so this shows system improvement because if the code has errors etc it can be resolved there and then. Design and development is also involved here because the code is being constantly tested so this will therefore improve system design and make sure the system runs correctly.

2.1.2.8 Refactoring

Refactoring focuses on high cohesion and low coupling, achieving well designed code. Refactoring is also supported by comprehensive testing so the customer tests and programmer tests are critical (Jefferies, 2001).

Refactoring links well with quality issues because it focuses on good design with high cohesion and low coupling. Testing such as customer tests and programmer test are also supported by Refactoring so this links to planning issues as well as system improvement.

2.1.2.9 Continuous Integration

Continuous Integration involves XP teams performing multiple builds each day so the team knows if everything works together as soon as possible so there is not any confusion and problems (Fowler, 2005).

Continuous Integration links well with quality issues because there is multiple builds of the software everyday so this reduces the risk of large problems occurring and if any do occur the reason for the problem would be identified a lot quicker, this links well with system planning, design and development. With the daily builds the system is always being improved and analysed so these quality issues also occur here.

2.1.2.10 Collective Code Ownership

Collective Code Ownership means that any pair of programmers can improve any piece of code at anytime. This therefore helps to reduce defects and improves the code quality (Jefferies, 2001).

Collective Code Ownership links well to quality issues such as planning, improvement, design and development. Any pair of programmers can make changes to any piece of code this therefore involves planning and improvement because any pair of programmers can make changes so this will improve the project timescale as "certain" programmers are not required to change code as any pair can do it. As the

code is owned by everyone then this will improve design and development due to the fact that all of the code is written in the same style and can be developed by any pair.

2.1.2.11 Coding Standard

Coding Standard involves following the same code standard so that all of the code looks like it has been written by the one individual, this avoids confusion and means the code will be easier to follow and understand (Paulk, 2001).

Coding Standard is the practice where all of the code is written in the same style this means that unnecessary confusion wont occur with the code so this is good for planning, design and development purposes. Changes to the code can be followed easily therefore resulting in improvement of the system and the code.

2.1.2.12 Metaphor

Metaphor is a simple description of how the program works sometimes called "stories". These metaphors are usually are usually wrote on small index cards and placed on a wall or board (Jefferies, 2001).

Metaphors can be linked to quality issues because these simple descriptions are good for planning, design and development. By using these small cards as descriptions for the system the team are able to plan, design and develop the system based on the metaphors. They are kept simple and "imaginative" in most cases, like everything else in XP and the team then develop the system with the aid of the metaphors.

2.1.2.13 Sustainable Pace

Sustainable Pace means that the XP team work at a pace that can be sustained throughout (Jefferies, 2001). This means no overtime unless it is seen as beneficial and XP teams normally work to a 40 hour week (Grenning, 2001).

Sustainable Pace is more to do with the personal issues of the XP teams work arrangements so this practice will not be analysed in this study as it is not a practice or principle that can be directly associated with quality issues.

2.2 Traditional Quality Management Systems

In this section Quality Management Systems will be discussed in relation to Extreme Programming. A Quality Management System is a management system designed to direct and control an organisation with regards to quality (British Standards Institution, 2000). The Quality Management Framework that will be reviewed in this report will be the ISO (International Organisation for Standardisation) 9001:2000 because the ISO 9001:2000 is not only the most popular certification among companies (International Organisation for Standardisation, 2002) it also brings advantages such as improved work processes, established management systems and improved product/service quality (Lee, 2005).

2.2.1 Introduction to ISO 9001:2000

ISO 9001:2000 is the name given to a set of standards developed to provide a framework which a quality management system can be implemented around (British Standard Institute, 2006). The ISO 9001:2000 was chosen because it is the most popular standard used, especially in Europe.

The ISO 9001:2000 standard consists of these main sections (British Standard Institute, 2006):

1. Quality Management Systems
2. Management Responsibility
3. Resource Management
4. Product Realisation
5. Measurement, Analysis and Improvement.

The practices and principles involved in these sections will be explained and discussed. Only the relevant practices and principles will be discussed in relation to XP.

2.2.2 ISO 9001:2000 Requirements

The main sections of the ISO 9001:2000 will be explained and discussed in this section. This section covers Quality Management Systems, Management Responsibilities, Resource Management, Product Realisation and Measurement, Analysis and Improvement and what each element consists of (Dale, 2005).

Below (Diagram 2) is a diagram of the ISO 9001:2000 requirements though it is missing the Quality Management System Guidelines.

Diagram 2 (Bertram, 2003)
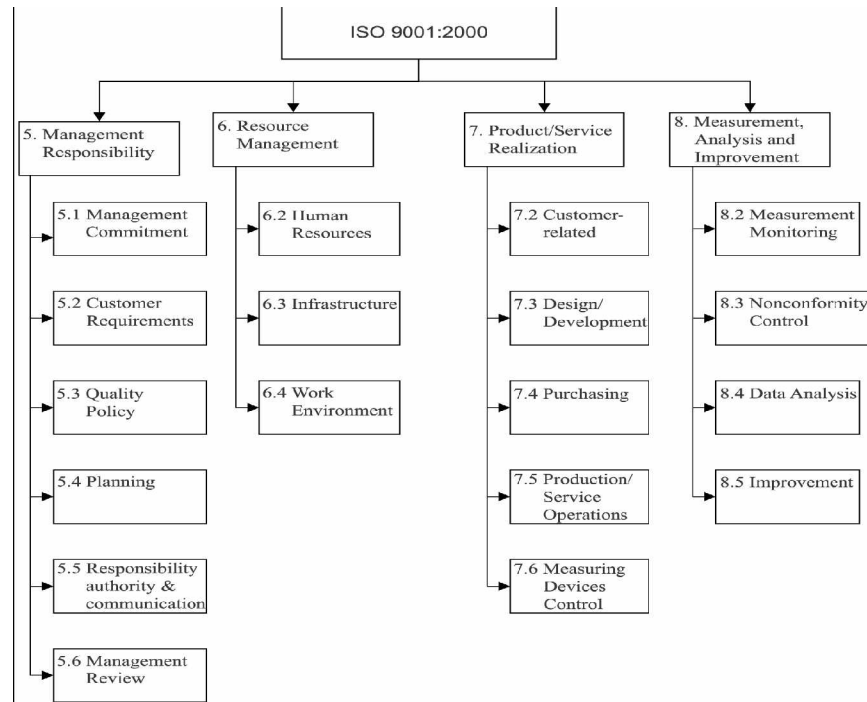
2.2.2.1 Quality Management Systems

Both the General Requirements and the Documentation Requirements will be reviewed and discussed in relation to Extreme Programming.

2.2.2.1.1 General Requirements

In the General Requirements section an organisation must define, document and update a QMS.

Definition of the methods used to guarantee effectiveness of the processes control and operation. The organisation will also insure that the processes can be monitored, measured and analysed.

Finally, the organisation shall establish the necessary actions in order to reach their planning results and follow a continuous processes improvement (Dale, 2005).

This can be related to Extreme Programming because in Extreme Programming the methods are all well defined and the processes are monitored, measured and analysed normally on a daily basis with practices such as Continuous Integration and Test

Driven Development etc. Continuous improvement is also well emphasised in Extreme Programming Practices.

2.2.2.1.2 Documentation Requirements

The documents that are necessary are: quality policy, quality objectives, quality manual, documents established by the company to control, plan and operate effectively their processes (e.g. test plans, project plans etc) and the record of each (e.g. test results etc). All of these documents must be defined, maintained and implemented (Vitoria, 2004).

This can be related to Extreme Programming because the documents such as test plans are written in the Extreme Programming practice Customer Tests and Test Driven Development where these test are developed and run within the system thus providing test results etc.

2.2.2.2 Management Responsibilities

In this section only the Management Responsibilities relevant to the study will be reviewed and discussed because Management Responsibilities such as Management Commitment, Quality Policy and Management Review all deal with management issues and this study is interested in the Practices and Principles rather than people/management skills.

2.2.2.2.1 Customer Focus

Develop customer focused quality objectives with the purpose to obtain customer satisfaction (Padhi, 2004).

This requirement links well with Extreme Programming because the whole "nature" of Extreme Programming is to involve the customer as much as possible with Extreme Programming Practices such as Customer Tests and Whole Team widely involve the customer.

2.2.2.2.2 Planning

The quality objectives should be established through all levels. The quality objectives should be used to measure quality and characteristics such as functionality, usability, efficiency, reliability etc. Quality of the policy should be taken into account such as cost, time, plan etc. Planning for an entire company as well as planning for a functional level and planning for improvements should take place (Munro-Faure et al 1993).

This ISO 9001:2000 requirement links well to Extreme Programming practices because there are a number of Extreme Programming Practices such as Small

Releases, Simple Design etc which relate well to this requirement due to the measurement of functionality, usability here as well as constant improvement.

2.2.2.2.3 Responsibility, Authority & Communication

Project responsibilities should be taken into consideration for reporting lines, interfacing with the customer, stakeholder communication etc. Defining responsibilities and authorities must also be done at the software release stage (Vitoria 2004).

There is a link here between Extreme Programming and the ISO 9001:2000 requirement because Extreme Programming Practices such as Customer Tests and Whole Team involve communicating with the customer and Pair Programming involves communication between programmers as well as responsibility and authority of the code been agreed.

2.2.2.3 Resource Management

Resource Management covers requirements such as Provision of Resources, Human Resources, Infrastructure and Work Environment. This section is about resources so it is not relevant to the study and therefore will not be reviewed as it does not concern the Practices and Principles involved with Extreme Programming.

2.2.2.4 Product Realisation

In this section only the relevant Product Realisation requirements will be reviewed and discussed in relation to Extreme Programming because Product Realisation requirements such as Planning of Product Realisation, Purchasing, Product & Service Provision and Control of Monitoring & Measuring Devices are not relevant to the study.

2.2.2.4.1 Customer-related Process

Customer requirements should be specified and reviewed with other process related requirement. They can then be communicated to the customer.

This ISO 9001:2000 requirement links well with Extreme Programming because Extreme Programming Practices such as Customer Tests, Small Releases and Whole Team all deal with customer issues such as customer requirements and customer communication so these Practices are similar to the ISO 9001:2000 requirement.

2.2.2.4.2 Design & Development

Product Development should be planned and controlled. Activities such as validation, verification and review should be defined. Records of the activities performed in the design and development should be defined and maintained.

This ISO 9001:2000 requirement links well with Extreme Programming because Extreme Programming Practices such as Planning Game, Simple Design, Test Driven Development, Refactoring etc all follow the same requirements as the ISO 9001:2000 requirement.

2.2.2.5 Measurement, Analysis & Improvement

In this section the Measurement, Analysis and Improvement requirements will be reviewed and discussed in relation to Extreme Programming. The requirement Control of Nonconforming Products will not be reviewed because it is not relevant to the study.

2.2.2.5.1 General

Monitoring, measuring, analysing and improvements should be planned and established (Dale, 2005).

2.2.2.5.2 Monitoring & Measuring

Customer satisfaction and dissatisfaction should be monitored and measured.

This ISO 9001:2000 requirement links well with Extreme Programming because Extreme Programming Practices such as Small Releases, Customer Tests etc all focus on these requirements.

2.2.2.5.3 Analysis of Data

Collection and analysis of adequate data should be done to determine the effectiveness and suitability of the QMS. It is then possible to evaluate what improvements can be made to the system. This should be related to customer satisfaction as well as the characteristics of processes (Vitoria 2004).

This ISO 9001:2000 requirement links well with Extreme Programming because Extreme Programming Practices such as Small Releases, Pair Programming etc all focus on improving and analysing the system the same as this ISO 9001:2000 requirement does.

2.2.2.5.4 Improvement

Continuous improvement should be defined as well as planned (Dale, 2003).

The ISO 9001:2000 requirement links well with Extreme Programming because Extreme Programming Practices such as Continuous Integration, Refactoring etc all focus on continually improving the system in one way or another whether it be the code or the system in general.

2.3 Conclusion

This first section of the literature review is on Extreme Programming (XP) Practices and gives an explanation of what each of the thirteen Extreme Programming Practices are and how they relate to quality issues. This is relevant to the study because it provides an insight into what the characteristics of Extreme Programming is as well as the quality issues involved. This information is relevant because Extreme Programming and quality issues are the basis for the study.

The second section of the literature review is on Traditional Quality Management Systems and they are discussed in relation to Extreme Programming. The ISO 9001:2000 Guidelines are explained and also related to Extreme Programming. This is also relevant to the study because it provides an insight into the different ISO 9001:2000 Guidelines as well as relating them to Extreme Programming Practices and this is an important area of the study.

In conclusion both of these sections can provide the desired knowledge required on each subject in order to carry out the investigation.

3. Development of the Research Method

This section contains a detailed discussion and critical evaluation of the research methods used. Aspects such as the design of the research method are covered as well as a justification as to why the selected research method was chosen.

3.1 The Research Method Adopted

As well as the literature review described in section 2 a quasi-experiment method was chosen in order to achieve the required results so questions could be answered and conclusions could be drawn.

The quasi-experiment consists of using the twelve Extreme Programming Practices and mapping them against the ISO 9001:2000 requirements. This will be explained further in the design section.

This method was chosen because it would allow the research questions to be answered as well as the hypothesis.

3.2 Design of Quasi-Experiment

This section will explain the design for the quasi-experiment and therefore show how the experiment was created.

The experiment was structured in a way that involves a table with each Extreme Programming Core Practice and in that table there would be the number of ISO 9001:2000 Guidelines that map with that particular Extreme Programming Practice. There would also be a section labelling whether the mapping was fully compatible, partially compatible or slightly compatible. This would then be repeated for all twelve Extreme Programming Practices.

In order to obtain the results that were entered into the table each Extreme Programming Practice had to be analysed as well as the ISO 9001:2000 Guidelines. Each Extreme Programming Practice was then compared with compatible ISO 9001:2000 Guidelines and Mapping Diagrams were created for each Extreme Programming Practice (see Appendices). The information obtained from these Mapping Diagrams was then used to create the final table.

Once each Extreme Programming Practice had been mapped with the ISO 9001:2000 Guidelines then all of the information was then entered into the table. Each Extreme Programming Practice was displayed in the same table but separated through different sections. The first Extreme Programming Practice that was mapped was the Whole Team practice and it would be mapped against the ISO 9001:2000 guidelines and information such as Number (the allocated number for that particular mapping result), Stage (the lifecycle stage of the particular mapped ISO 9001:2000 guideline), ISO 9001:2000 Guideline, Mapping Result and Standard of Mapping (Full, Part, Slight)

then every other Extreme Programming Practice would be mapped with the same conditions.

The quasi-experiment was structured in this way because it allows the Extreme Programming Practices to be compared with the ISO 9001:2000 in an easy to follow structured table. The results required can then be obtained from this table so the required answers for the research questions and the hypothesis can then be discovered.

There also has been similar methods to this used where different Agile methods were compared to one another (Stojanovic et al 2004). Different Agile method characteristics were listed in tables for each Agile method and then a comparison was done with each Agile method. Although in this project Agile methods will not be compared with one another, Extreme Programming Practices will be compared with ISO 9001:2000 guidelines so this experiment is relevant to this project and shows that others have had success when using this type of experiment method.

Once the mapping results for each Extreme Programming Practice was complete then came the decision of how to present the information shown. The decision was to create bar graphs to represent each ISO 9001:2000 Guideline and show the Extreme Programming Practice(s) that it mapped with. This was the best method to show the information because by using a bar graph to represent the information obtained from each ISO 9001:2000 Guideline it offered a more structured representation of the data. If the graph had been represented showing each Extreme Programming Practice it would then have appeared more congested and harder to understand. By using the one bar graph per ISO 9001:2000 Guideline it also showed the experiment results from an ISO perspective rather than just Extreme Programming and they can also be used for obtaining some conclusions as well as being visually attractive.

Bar graphs have already been successful for analysing results in other studies (Ceschi et al 2005) where traditional methods were compared to agile methods and the bar graphs were used to show and emphasise their results. In relation to this experiment their use of bar graphs can be adapted and be used to display and emphasise the experiment results.

3.3 Justification of Method

This method was chosen because it is the best possible way to achieve the required answers for the research questions as well as the hypothesis. There were other options such as questionnaires, surveys etc but these methods would not have given the results in order to answer the research questions and hypothesis so the quasi-experiment was deemed the best method choice.

Research was also done through various journals to gather information on the methods they used and how they could be adapted for use in this experiment. Most journals concerned with Agile Development Methods used to tables in order to record and analyse their results. In one journal (Holcombe et al 2003) they compared Extreme Programming with traditional methods and a table is used to record and

analyse the results. This method seemed popular and effective so this was taken into account when creating the table format used in this dissertation.

3.4 Conclusion

Through researching different kinds of methods such as Questionnaires, Experiments Surveys etc the best method, Experiment, was chosen because it was the best method to use in order to achieve the desired results. Therefore it would be the best method in order to allow for the research questions and hypothesis to be answered. Also through research different kinds of Experiment methods were analysed and the use of tables to record the results as well as the use of bar graphs to display and emphasise the results was a common feature of many experiments and these experiments were successful so this method was chosen for this project.

4. Analysis of Results

In this section the results of the experiment will be analysed and summarised and the Table and all of the graphs used will be shown and explained.

4.1 Mapping of Extreme Programming & ISO 9001:2000 Guidelines

In this section the Table and the graphs will be analysed and explained.

The following table was developed using the information obtained from the Mapping Diagrams and shows a comparison between Extreme Programming Practices and the ISO 9001:2000 Guidelines.

There are 5 main columns contained with in this table. The first column is headed Number and it contains a unique identifier for each different mapping result i.e. 1 – 44. The second column is headed Stage and shows the stage of the lifecycle in which the particular ISO 9001:2000 Guideline occurs i.e. Measurement, Analysis & Improvement stage. The third column is headed ISO 9001:2000 Guideline and shows the particular Guideline that has been mapped. The fourth column is headed Mapping Results and every column contains Yes otherwise it would not be represented in this table. The last column of the table (Mapping Standard) shows the standard of the mapping and is represented by Full, Part or Slightly. Full is where the Extreme Programming Practice maps between 100% - 76% with the ISO 9001:2000 Guideline. Part is where the Extreme Programming Practice maps between 75% – 50% with the ISO 9001:2000 Guideline and Slight is where the Extreme Programming Practice maps between 49% - 25%.

This table below shows that there are 44 different cases where Extreme Programming Practices map with ISO 9001:2000 Guidelines. This table shows what Extreme Programming Practices map with what ISO 9001:2000 Guidelines and how well they map with each other. See Appendices Results Obtained for an explanation of how each result seen in the table below was obtained. The results from this table are then used to create the bar graphs also shown below.

Table 1

XP Practice 1	Core Practise	Whole Team			
Number		Stage	ISO 9001:2000 Guideline	Mapping Result	Result Standard (Full, Part, Slight)
1		Management Responsibility	Customer Focus	Yes	Full
2		Management Responsibility	Responsibility, Authority and Communication	Yes	Full
3		Product Realisation	Customer Related Processes	Yes	Full

XP Practice 2	Core Practice	Planning Game			
Number		Stage			
4		Quality Management Systems	General Requirements	Yes	Part
5		Quality Management Systems	Documentation Requirements	Yes	Part
6		Product Realisation	Design and Development	Yes	Part
XP Practice 3	Core Practice	Customer Tests			
Number		Stage			
7		Quality Management Systems	Documentation Requirements	Yes	Full
8		Management Responsibility	Customer Focus	Yes	Full
9		Management Responsibility	Planning	Yes	Full
10		Management Responsibility	Responsibility, Authority and Communication	Yes	Full
11		Product Realisation	Customer Related Processes	Yes	Full
12		Measurement, Analysis & Improvement	Improvement	Yes	Full
13		Measurement, Analysis & Improvement	Monitoring And Measuring	Yes	Full
XP Practice 4	Core Practice	Small Releases			
Number		Stage			
14		Management Responsibility	Customer Focus	Yes	Full
15		Management	Planning	Yes	Full

Number		Stage			
			Responsibility		
16		Product Realisation	Customer Related Processes	Yes	Full
17		Measurement, Analysis & Improvement	Analysis of Data	Yes	Full
18		Measurement, Analysis & Improvement	Improvement	Yes	Full
19		Measurement, Analysis & Improvement	Monitoring And Measuring	Yes	Full
XP Practice 5	**Core Practice**	**Simple Design**			
Number		Stage			
20		Management Responsibility	Planning	Yes	Part
21		Product Realisation	Design And Development	Yes	Full
XP Practice 6	**Core Practice**	**Pair Programming**			
Number		Stage			
22		Management Responsibility	Responsibility, Authority and Communication	Yes	Full
23		Product Realisation	Design And Development	Yes	Full
24		Measurement, Analysis & Improvement	Analysis of Data	Yes	Full
XP Practice 7	**Core Practice**	**Test-Driven Development**			
Number		Stage			
25		Management Responsibility	Planning	Yes	Full
26		Product Realisation	Design And Development	Yes	Full
27		Measurement, Analysis & Improvement	Monitoring And Measuring	Yes	Full
28		Measurement, Analysis	Analysis of Data	Yes	Full

		& Improvement			
29		Measurement, Analysis & Improvement	Improvement	Yes	Full
XP Practice 8	**Core Practice**	**Refactoring**			
Number		Stage			
30		Management Responsibility	Planning	Yes	Slight
31		Product Realisation	Design And Development	Yes	Full
32		Measurement, Analysis & Improvement	Analysis of Data	Yes	Part
33		Measurement, Analysis & Improvement	Improvement	Yes	Full
XP Practice 9	**Core Practice**	**Continuous Integration**			
Number		Stage			
34		Product Realisation	Design And Development	Yes	Full
35		Measurement, Analysis & Improvement	Analysis of Data	Yes	Full
36		Measurement, Analysis & Improvement	Improvement	Yes	Full
XP Practice 10	**Core Practice**	**Collective Code Ownership**			
Number		Stage			
37		Management Responsibility	Planning	Yes	Part
38		Product Realisation	Design And Development	Yes	Full
39		Measurement, Analysis & Improvement	Improvement	Yes	Full
XP Practice 11	**Core Practice**	**Coding Standard**			

Number		Stage			
40		Management Responsibility	Planning	Yes	Part
41		Product Realisation	Design And Development	Yes	Full
42		Measurement, Analysis & Improvement	Improvement	Yes	Full
XP Practice 12	**Core Practice**	**Metaphor**			
Number		Stage			
43		Management Responsibility	Planning	Yes	Part
44		Product Realisation	Design And Development	Yes	Part

The conclusions that can be drawn from this table are that Extreme Programming Practices can be used in conjunction with ISO 9001:2000 Guidelines as there are 44 cases of this with the majority being the Result Standard Full. Conclusions can also be drawn about each practice such as Metaphor where it could be adapted in order to meet more ISO 9001:2000 Guidelines and relate more to quality issues.
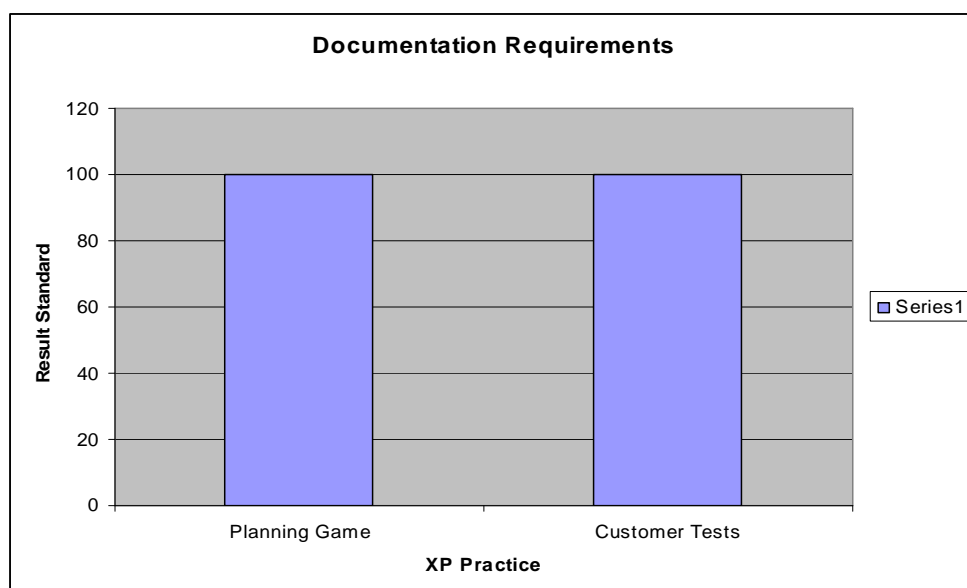
Graphs

In order to view the results from an ISO 9001:2000 point of view the bar graphs seen below were used to represent each ISO 9001:2000 Guideline and show how they mapped with the XP Practice(s). This also helps to emphasise the results and to show the results in a different way than Table1 above. Note that the title of the graphs show the ISO 9001:2000 Guideline, the X-axis show the XP Practice and the Y-axis show the Result Standard. If the XP Practice maps fully then it is represented by 100 on the Y-axis, if the XP Practice maps partly then it is represented by 50 on the Y-axis and if the XP Practice maps slightly then it is represented by 25 on the Y-axis.
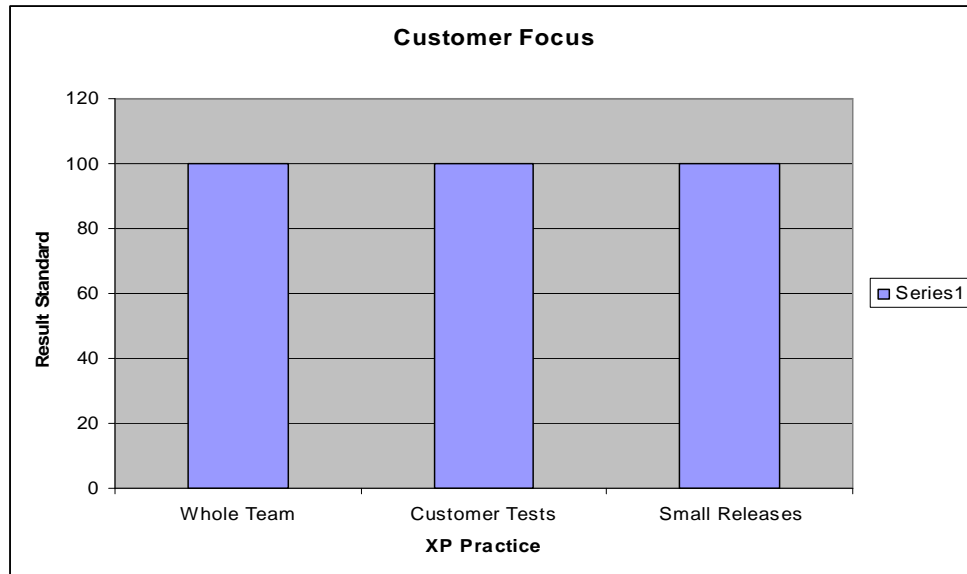
Graph 1 – General Requirements
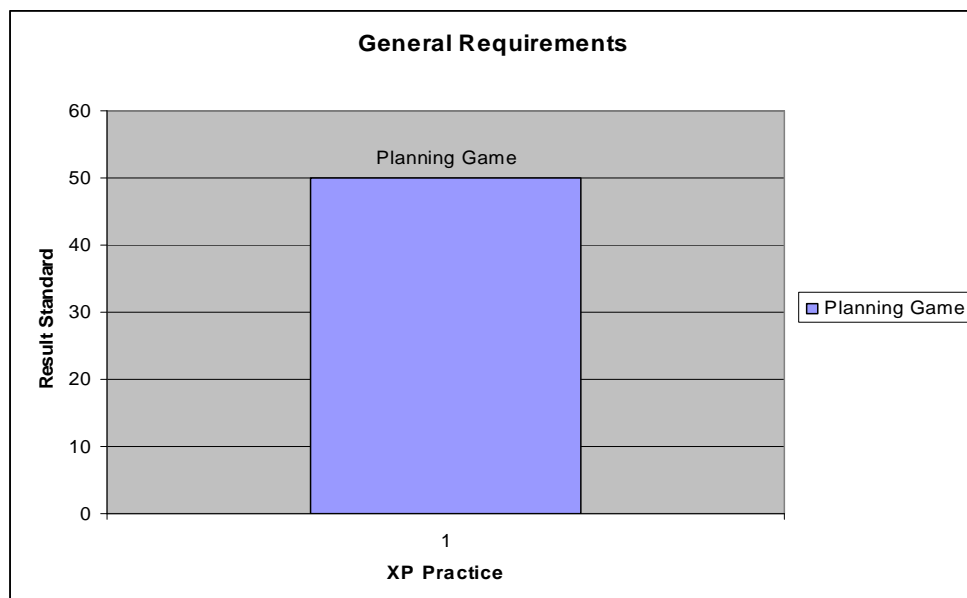
This graph represents the ISO 9001:2000 Guideline General Requirements and shows all of the Extreme Programming Practices that this Guideline maps with and the Result Standard i.e. Full, Part or Slight of that particular Extreme Programming Practice. In this case it shows only one Extreme Programming Practice, Planning Game because this is the only Extreme Programming Practice that this ISO 9001:2000 Guideline maps with. This highlights the fact that the ISO 9001:2000 Guideline only appears once in the quasi-experiment therefore this ISO 9001:2000 Guideline could be adopted more within XP.

Graph 2 – Documentation Requirements

This graph represents the ISO 9001:2000 Guideline Documentation Requirements and shows all of the Extreme Programming Practices that this Guideline maps with and the Result Standard. In this case it shows the two Extreme Programming Practices that it maps with (Planning Game and Customer Tests), both at Full level. This highlights the fact that the ISO 9001:2000 Guideline Documentation Requirements only appears twice and therefore more XP Practices could emphasise more documentation.

Graph 3 – Customer Focus

Customer Focus

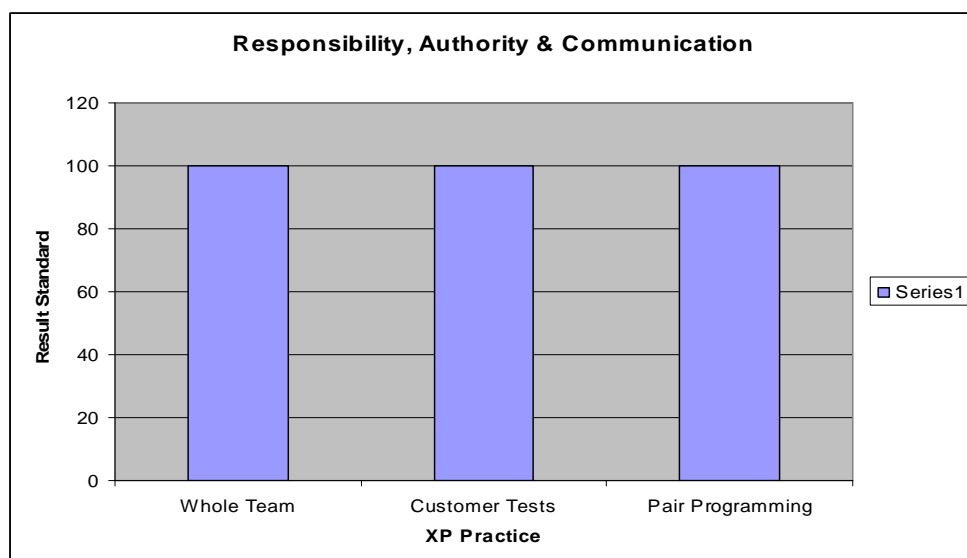| XP Practice	Result Standard
Whole Team	100
Customer Tests	100
Small Releases	100

(Series1)

This graph represents the ISO 9001:2000 Guideline Customer Focus and shows all of the Extreme Programming Practices that this Guideline maps with which are Whole Team, Customer Tests and Small Releases and are all of the Result Standard Full. This highlights the fact that the ISO 9001:2000 Guideline Customer Focus is used well within XP Practices and to a high level.

Graph 4 – Planning
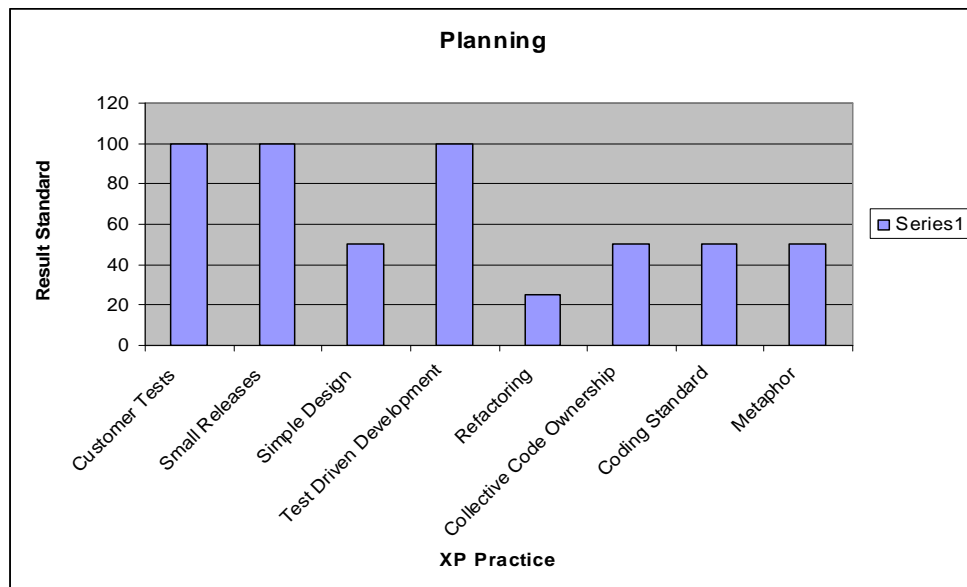
Planning

This graph represents the Planning ISO 9001:2000 Guideline as shows all of the XP Practices that it maps with, Customer Tests, Small Releases, Simple Design, Test Driven Development, Refactoring, Collective Code Ownership, Coding Standard and Metaphor as well as the Result Standard for each XP Practice. This emphasises the fact that the ISO 9001:2000 Guideline Planning maps well with the majority of XP Practices. This highlights the fact that the ISO 9001:2000 Guideline Planning is used frequently within XP Practices but not always to a high standard.

Graph 5 – Responsibility, Authority & Communication

Responsibility, Authority & Communication

This graph represents the ISO Guideline Responsibility, Authority & Communication and shows all of the XP Practices that it maps with, Whole Team, Customer Tests and
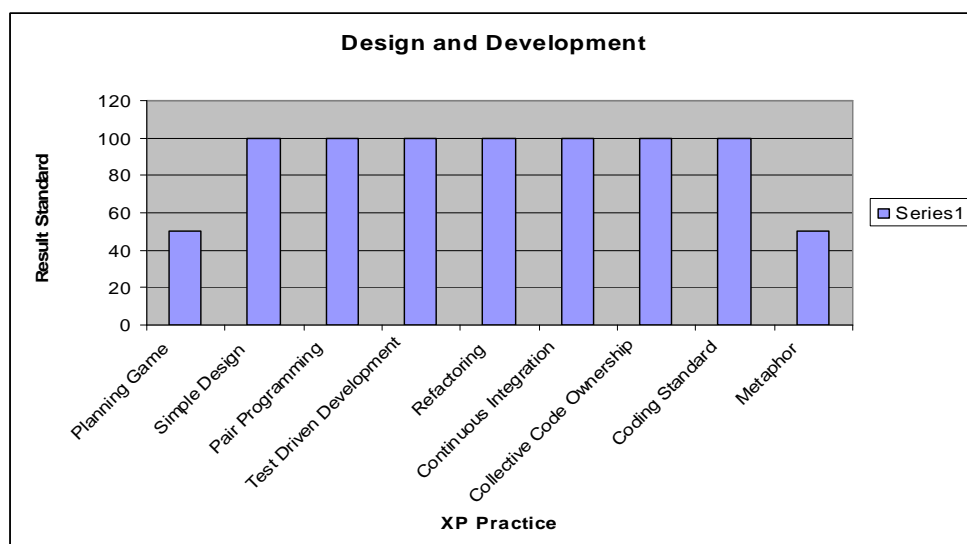
Pair Programming all to the Result Standard Full. This highlights the fact that the ISO 9001:2000 Guideline is used well within XP Practices and to a high level.

Graph 6 – Customer Related Processes

Customer Related Processes
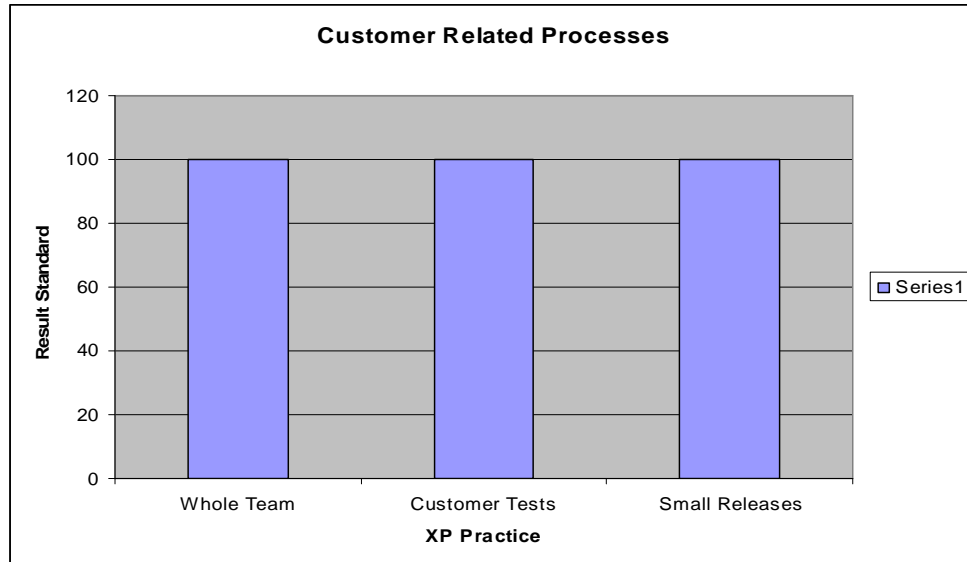
This graph represents the ISO Guideline Customer Related Processes and shows all of the XP Practices that it maps with, Whole Team, Customer Tests and Small Releases all to the Result Standard Full. This highlights the fact that the ISO 9001:2000 Guideline Customer Related Processes is used well within XP and to a high level.

Graph 7 – Design and Development

Design and Development

This graph represents the ISO Guideline Design and Development and shows all of the XP Practices that it maps with, Planning Game, Simple Design, Pair Programming, Test Driven Development, Refactoring, Continuous Integration, Collective Code Ownership, Coding Standard and Metaphor with the majority

mapping to the Result Standard Full. This highlights the fact that the ISO 9001:2000 Guideline Design and Development is used frequently within XP Practices normally to a high standard.

Graph 8 – Monitoring and Measuring

Monitoring & Measuring
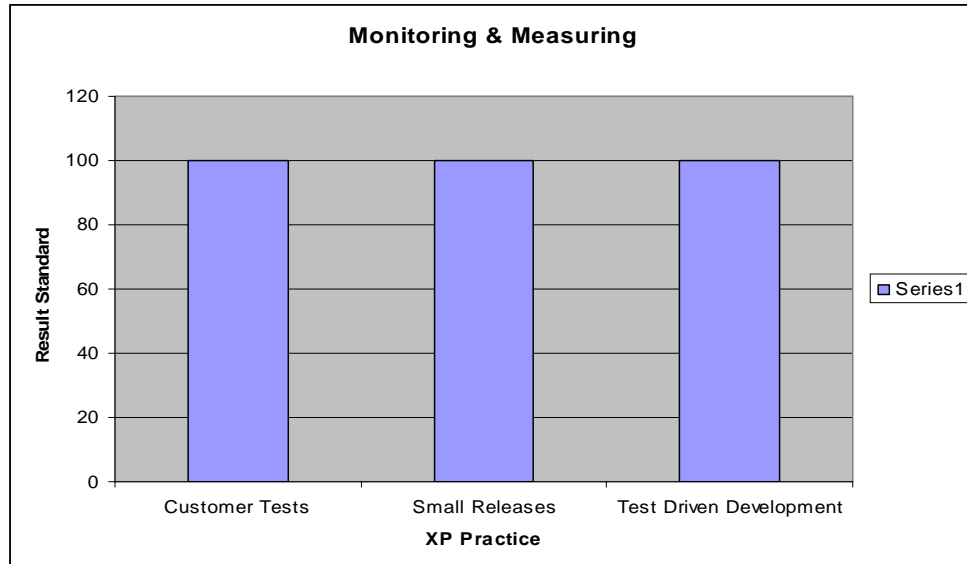
This graph represents the ISO Guideline Monitoring and Measuring and shows all of the XP Practices that it maps with, Customer Tests, Small Releases and Test Driven Development as well as the Result Standard which is Full in all cases here. This highlights the fact that the ISO 9001:2000 Guideline Monitoring and Measuring is used well within XP and to a high level.

Graph 9 – Analysis of Data
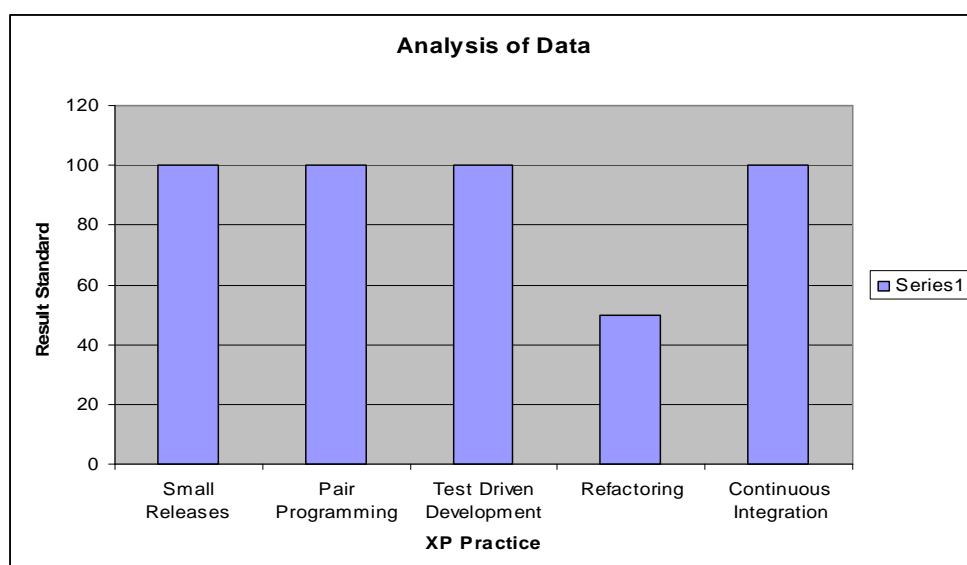
Analysis of Data

This graph represents the ISO Guideline Analysis of Data and shows all of the XP Practices that it maps with as well, Small Releases, Pair Programming, Test Driven

Development, Refactoring and Continuous Integration as the Result Standard for each. This highlights the fact that the ISO 9001:2000 Guideline Analysis of Data is used well within XP normally to high standard.

Graph 10 – Improvement

This graph represents the ISO Guideline Improvement and shows all of the XP Practices that it maps with, Customer Tests, Small Releases, Test Driven Development, Refactoring, Continuous Integration, Co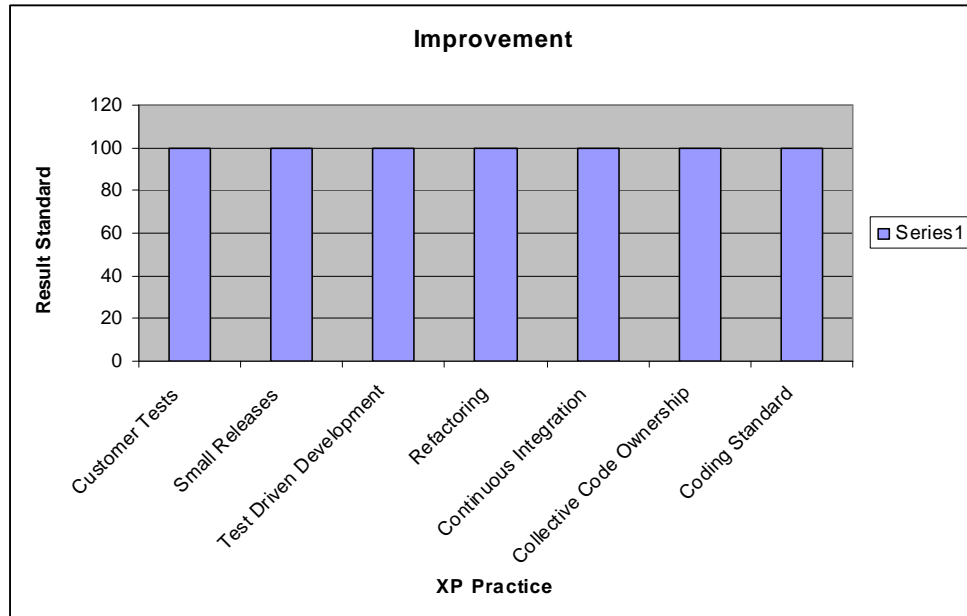llective Code Ownership and Coding Standard as well as the Result Standard which is Full in all cases here. This highlights the fact that the ISO 9001:2000 Guideline Improvement is used frequently within XP to a high standard.

4.2 Results Analysis

In this section the results from the above table will be analysed and discussed in relation to Extreme Programming and the ISO 9001:2000 Guidelines.

From the previous Table 1 it can be said that every Extreme Programming Practices maps in some way with at least 2 ISO 9001:2000 Guidelines and that every ISO 9001:2000 Guideline reviewed in this study is included at least once within the table. The majority of the ISO 9001:2000 Guidelines such as Design and Development, Improvement etc map with numerous Extreme Programming Practices while other such as General Requirements and Documentation Requirements only appear a few times. This would suggest that Extreme Programming could be used in conjunction with the ISO 9001:2000 system.

The bar graphs are used to show the results from an ISO 9001:2000 perspective where Table1 emphasises the results from an Extreme Programming perspective. The bar graphs help to emphasise the results as well as highlight what XP Practices map with the ISO 9001:2000 Guidelines and what the Result Standard of the mapping is.

5. Conclusion

In this section a discussion will take place where the results of the study will be discussed. There will be a review about what has been learned from the project, a critical appraisal of the work done as well as how successful the project was in relation to the original project aims, problems which arose and how those problems were solved, why these problems arose and what could be done differently if there was another chance to perform the same study. There will also be a section on what could be done in the future to further develop this study and a conclusion of the overall project.

5.1 Discussion

Agile Methods are relatively new to the computing industry and Extreme Programming is the most commonly used Agile Method and ISO 9001:2000 is the most popular quality certification among companies (International Organisation for Standardisation, 2002) so it seemed logical to compare both of their processes, practices and standards together as most companies seek ISO certification and Extreme Programming is becoming more popular with many companies (Lindvall 2004; Muthig 2004).

It can be said that the findings in this study indicate that Extreme Programming can be used successfully with ISO 9001:2000 Guidelines as most of the standards set in the ISO 9001:2000 Guidelines are reflected in Extreme Programming therefore companies using Extreme Programming Practices should be able to achieve ISO certification. This statement is supported by another company called Workshare (Wright, 2003) where this company achieved ISO 9001 certification and uses Extreme Programming for all of its development. They also believe that they are one of the first, if not the first, company to achieve ISO 9001 certification while using Extreme Programming for all of their development so this highlights the fact that companies using Extreme Programming can gain ISO certification. Other XP companies such as LogicaCMG (Grew, 2004) have also gained ISO certification.

Murru et al (2003) performed similar research where they also achieved positive results for using Extreme Programming with an ISO 9001 framework. However, they noted that in Extreme Programming they often fail to detail the steps required to produce documentation and this is also highlighted in this study where the ISO 9001:2000 Guideline Documentation Requirements maps with very little Extreme Programming Practices and there is a discussion on how the Extreme Programming Practice Planning Game could be adapted to include more documentation.

A case study performed by Coleman (2005) showed that 2 small XP companies had achieved ISO Certification also highlighting the fact that ISO certification can be achieved using Extreme Programming.

The majority of Extreme Programming Practices map fully with ISO 9001:2000 Guidelines. There are however a few Extreme Programming Practices that could be

adapted to meet the ISO 9001:2000 Guidelines. These Practices being Planning Game and Metaphor.

Planning Game could improve in relation to the ISO 9001:2000 Guideline Documentation Requirements as there is little documentation mentioned in the Extreme Programming Practice Planning Game apart from some testing documentation there could be more documentation requirements implemented here such as Quality Manuals and Quality Objectives this would therefore make Planning Game and Documentation Requirements much more compatible.

Although Metaphors are seen as a good practice because they include story like descriptions of how the program works, in relation to ISO 9001:2000 they offer very little. This is because these "stories" on cards cannot really be seen as formal documentation although they do offer some Planning and Design and Development qualities they lack in all other ISO 9001:2000 Guidelines.

This can therefore provide answers to the hypothesis of the study where the processes, practices and standards of Extreme Programming can be adapted to meet the processes, practices and standards set by ISO 9001:2000. The majority of Extreme Programming Practices meet at least 2 ISO 9001:2000 Guidelines therefore they could be adapted to meet ISO 9001:2000 Guidelines although most of them would not need to be adapted at all.

Extreme Programming Practices such as Customer Tests and Whole Team have a lot of focus on the customer and customer requirements so these practices would not need to be adapted at all since they very much follow a lot of ISO 9001:2000 Guidelines such as Customer Focus, Customer- related Processes etc.

The Extreme Programming Practices Small Releases and Test Driven Development offer good planning qualities as well as continuous improvement and good analysis so these Practices would need no or very little changes.

Continuous Integration, Coding Standard and Collective Code Ownership all involve continuous improvement as well as good design and development with Continuous Integration also offering good analysis qualities while Coding Standard and Collective Code Ownership involve good planning qualities.

Refactoring and Pair Programming also offer a range of good qualities such as design and development and analysis.

All in all every Extreme Programming Practice has something to offer in respect to ISO 9001:2000 Guidelines although Planning Game and Metaphor in particular could be improved with respect to ISO 9001:2000 Guidelines.

5.2 Project Critique

In this section I will demonstrate what I have learned about the process of research while the project was being carried out. I will also critically appraise my own work by saying how successful I was in achieving the project aims, what problems arose in the

course of the project that could not be resolved within the timescale available, why I thought these problems arose and what I would do differently if I had the chance to do it all again.

5.2.1 Appraisal of Achievement

The idea of studying Extreme Programming in relation to Quality Management Systems was appealing to me for a number of reasons. As I have an interest in Software Engineering and Agile Development Methods offer an alternative to traditional methods such as the Waterfall model etc I felt that this would be an interesting area to study. Due to the fact that through research Extreme Programming was the most popular Agile Method and very little studies had looked into Agile Methods and Quality Management Systems I felt that this study would be worthwhile and beneficial.

By carrying out this project I feel that the resulting table and research performed could potentially aid XP companies, companies considering using Extreme Programming or Agile Methods in general and Software Engineers. However, this study only looks into the ISO 9001:2000 system and should be noted that the results may differ if a company etc is using a different Quality Management System with a different set of standards and guidelines.

5.2.2 Critical Evaluation

From the beginning of the project it was clear that this project would involve a great deal of research as well as the design and implementation of the quasi-experiment. Due to the fact that I done sufficient research into the characteristics of each Extreme Programming Practice and how each practice could be related to different quality issues and research into the ISO 9001:2000 Guidelines and how each guideline could be related to Extreme Programming Practices then I felt I had gained sufficient knowledge for when it came to carrying out the experiment. The result was to produce a Table that mapped each Extreme Programming Practice with the ISO 9001:2000 Guidelines.

I believe I was successful in achieving the aims of the project because my first research question was what are the characteristics of Extreme Programming? I felt that I answered this question by reviewing and analysing each Extreme Programming Practice in the literature review. The second research question was what are Extreme Programming Quality Management System requirements? I felt that I answered this question by analysing each Extreme Programming Practice and discovering how they relate to quality issues. The third research question was how can Extreme Programming be adapted to meet the requirements of ISO 9001:2000? I felt that I answered this question in the experiment where I mapped each Extreme Programming Practice with the ISO 9001:2000 Guidelines and therefore discussed the conclusions from the table.

The problem that arose within the project was that originally I intended to contact a company and get access to the Quality Management System that they use but finding

a company that was willing to let me access their Quality Management System was more difficult than expected. I therefore decided to use the ISO 9001:2000 system as I could gain access to the system and there was a lot of information available on this system.

Overall I think the project as a whole ran as expected with a few minor setbacks along the way. If I had the opportunity to do it all again I would try and gain access to companies Quality Management Systems and I would do this by trying to make contact with companies earlier, although gaining access would never be guaranteed. This would offer me the opportunity to study their Quality Management System using the same methods as I used for the ISO 9001:2000 and producing a similar experiment.

5.3 Further Work

Work for the future could be:

- to study an individual Extreme Programming Practice and look into how it could be better developed in order to meet more quality standards. This could be done in depth for each Extreme Programming Practice. This could involve questions such as how can certain Extreme Programming Practices be better developed? What can be done to improve the practice in relation to quality?

- To look into Extreme Programming during the maintenance stage after ISO 9001:2000 certification had been granted. This could involve questions such as does documentation need to change? Do the Extreme Programming Practices need to change in any way?

- To look into other Agile Development Methods such as Scrum or Dynamic Software Development Method (DSDM) and follow similar research methods and hypothesis to this study.

- In the other hand research could be done with Extreme Programming and another Quality Management Standard such as Capability Maturity Model (CMM) and follow similar research methods and hypothesis to this study.

- It could also be used for other XP companies and see if they can achieve ISO 9001:2000 certification.

5.4 Conclusions

Overall the project has been a success. The fact that Extreme Programming can be used in conjunction with the ISO 9001:2000 has been discovered is a very significant part of the project as well as the fact that all of the Extreme Programming Practices have been reviewed and analysed in some way as well as all of the relevant ISO 9001:2000 Guidelines.

The quasi-experiment shows how each Extreme Programming Practices can be mapped with different ISO 9001:2000 Guidelines as well as giving an indication of how well they map. A table was used to show these results as well as bar graphs showing each ISO 9001:2000 Guideline and how they worked with Extreme Programming Practices. This experiment and the project as a whole could be used to potentially aid XP companies, companies considering using Extreme Programming or Agile Methods in general, Software Engineers and academics with an interest in the subject area.

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Appendices

A - Standish Report

For purposes of the study, projects were classified into three resolution types:

Resolution Type 1, or project success: The project is completed on-time and on-budget, with all features and functions as initially specified.

Resolution Type 2, or project challenged: The project is completed and operational but over-budget, over the time estimate, and offers fewer features and functions than originally specified.

Resolution Type 3, or project impaired: The project is cancelled at some point during the development cycle.

Overall, the success rate was only 16.2%, while challenged projects accounted for 52.7%, and impaired (cancelled) for 31.1%.
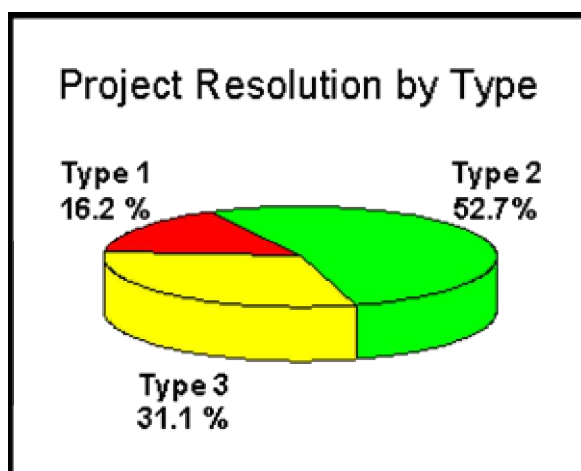
Cost Overruns	% of Responses
Under 20%	15.5%
21 - 50%	31.5%
51 - 100%	29.6%
101 - 200%	10.2%
201 - 400%	8.8%
Over 400%	4.4%

Time Overruns	% of Responses
Under 20%	13.9%
21 - 50%	18.3%
51 - 100%	20.0%

101 - 200%	35.5%
201 - 400%	11.2%
Over 400%	1.1%

% of Features/Functions	% of Responses
Less Than 25%	4.6%
25 - 49%	27.2%
50 - 74%	21.8%
75 - 99%	39.1%
100%	7.3%

Project Success Factors	% of Responses
1. User Involvement	15.9%
2. Executive Management Support	13.9%
3. Clear Statement of Requirements	13.0%
4. Proper Planning	9.6%
5. Realistic Expectations	8.2%
6. Smaller Project Milestones	7.7%
7. Competent Staff	7.2%
8. Ownership	5.3%
9. Clear Vision & Objectives	2.9%
10. Hard-Working, Focused Staff	2.4%
Other	13.9%

Project Impaired Factors	% of Responses
1. Incomplete Requirements	13.1%
2. Lack of User Involvement	12.4%
3. Lack of Resources	10.6%
4. Unrealistic Expectations	9.9%
5. Lack of Executive Support	9.3%
6. Changing Requirements & Specifications	8.7%
7. Lack of Planning	8.1%
8. Didn't Need It Any Longer	7.5%
9. Lack of IT Management	6.2%
10. Technology Illiteracy	4.3%
Other	9.9%

	Than 5 Years Ago	Than 10 Years Ago
Significantly More Failures	27%	17%
Somewhat More Failures	21%	29%
No Change	11%	23%
Somewhat Fewer Failures	19%	23%
Significantly Fewer Failures	22%	8%

B - Results Obtained

XP Practice 1 – Whole Team

1. The Result Standard 'Full' was achieved here because the processes and practises involved in the XP practise Whole Team mapped excellently with the ISO 9001:2000 Guideline Customer Focus.

Customer Focus involves determining and achieving good customer requirements in order to obtain customer satisfaction.

Whole team involves including the customer as part of the team where the customer would define the requirements and sets priorities as well as help to drive the project. Analysts help the customer to create their requirements and Testers also help the customers to define acceptance tests.

This result was obtained because there is no better way to achieve and determine good customer requirements other than to 'involve' the customer within the team. This means that the customer will be involved on a daily basis and can get their opinions across immediately as well as seeing how well the project is progressing. The XP practise and ISO practise have the same objectives so these practices 'map' well together.

2. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Whole Team mapped excellently with the ISO 9001:2000 Guideline Responsibility, Authority and Communication.

Responsibility, Authority and Communication involves management distributing different tasks and making sure everyone is aware of the customer requirements and needs. Everyone should also report back to the management with their findings.

Whole Team involves the Customer within the development team as well as a manager or coach to provide resources, sort all of the roles, keep the team on track and make sure everyone is aware of their task(s).

This result was obtained because the ISO practice involves using management to control the tasks and responsibilities as well as 'who does what', where XP would also use a manager or coach to do this. Both practices also involve reporting back to management with their findings. The ISO practice and XP practice have the same objective so they 'map' well together.

3. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Whole Team mapped excellently with the ISO 9001:2000 Guideline Customer Related Processes.

Customer Related Processes involve the Customer Requirements being specified and reviewed with other process related requirements. Once this is done the customer can then be informed.

Whole Team involves the customer throughout the project especially in the requirement stage and testing stage. The customer then knows the progress and details of the project so he is being communicated to constantly.

This result was obtained because the ISO practice involves using the customer where the XP practice Whole Team focuses 'heavily' on involving the customer. The ISO and XP practise therefore have the same objectives so they 'map' well together.

XP Practice 2 – Planning Game

4. The Result Standard 'Part' was achieved here because the practices and processes involved in the XP practice Planning Game mapped well with the ISO 9001:2000 Guideline General Requirements.

General Requirements involve planning and continuous improvement. It also involves other factors but these factors will not be taken into consideration here because they cannot be mapped with the Planning Game section.

Planning Game involves setting deadlines and what tasks to do after each deadline. The two key planning steps involved are Release Planning and Iteration Planning. Release Planning is where the customer presents their desired features and a plan is laid out and Iteration Planning is where the development team meet every 2 weeks and make any changes to the plan in accordance to difficulty, errors etc.

This result was obtained because part of the ISO practice involves establishing plans and improving them and these are also the key principles involved in the XP practice Planning Game.

5. The Result Standard 'Part' was achieved here because the practices and processes involved in the XP practice Planning Game mapped well with the ISO 9001:2000 Guideline Documentation Requirements.

Documentation Requirements involves defining, maintaining and implementing documents. These documents include test plans and test results as well as other documentation such as quality manuals, project specifications etc.

Planning game involves defining, maintaining, implementing and improving test plan documents for both the Release and Iteration testing.

This result was obtained because part of the ISO practice involves defining, maintaining and implementing test documents as does the XP practice Planning Game so they map well in this part.

6. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Planning Game mapped well with the ISO 9001:2000 Guideline Design And Development.

Design And Development involves planning and controlling the development of the product. Activities such as validation, verification and a review of the product are

defined. All records of the results and outcomes of these activities are defined and maintained.

Planning Game involves Release Planning where the customer presents their desired features and Iteration Planning which involves 2 week iterations to review the 'working' product.

The result was obtained because the ISO practice involves verifying, validating and reviewing the product. The XP Practice involves the same principle because in the Release Planning stage the features required are verified and validated between the customer and the programmers and in the Iteration Planning stage the product is reviewed with the customer after every iteration (usually 2 weeks) therefore the XP practice and the ISO practice map well together.

XP Practice 3 – Customer Tests

7. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Customer Tests mapped excellently with the ISO 9001:2000 Guideline Documentation Requirements.

Documentation Requirements involves defining, maintaining and implementing documents. These documents include test plans and test results as well as other documentation such as quality manuals, project specifications etc.

Customer Tests involves the customer working with the 'team' to define acceptance tests for the project. These tests are then run it is the then kept running correctly throughout the project.

The result was obtained because the ISO practice involves documenting test plans and recording the test results and the XP practice involves writing the customer tests and recording the results of the tests.

8. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Customer Tests mapped excellently with the ISO 9001:2000 Guideline Customer Focus.

Customer Focus involves determining and achieving good customer requirements in order to obtain customer satisfaction.

Customer Tests involves the customer working with the 'team' to define acceptance tests for the project. These tests are then run it is the then kept running correctly throughout the project.

The result was obtained because the XP practice involves the customer in great detail where they actually write the tests with the help of the programmers. The tests are then reviewed until the customer and the 'team' are satisfied. The ISO practice Customer Focus also uses the principle of involving the customer and making sure they are satisfied and the XP practice 'mirrors' this principle therefore both of these practice map well together.

9. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Customer Tests mapped excellently with the ISO 9001:2000 Guideline Planning.

Planning involves establishing quality objectives and these objectives should follow the quality policy and be measurable. Quality objectives should be used to measure the characteristics such as functionality, usability etc

Customer Tests involves the customer working with the 'team' to define acceptance tests for the project. These tests are then run it is the then kept running correctly throughout the project.

The result was obtained because the XP Practice Customer Tests involves creating and using the acceptance tests to determine whether the feature is functional, has good usability etc so the XP Practice therefore maps well with the ISO Guideline Planning because it involves the same principles for measuring quality.

10. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Customer Tests mapped excellently with the ISO 9001:2000 Guideline Responsibility, Authority and Communication.

Responsibility, Authority and Communication involves management distributing different tasks and making sure everyone is aware of the customer requirements and needs. Everyone should also report back to the management with their findings.

Customer Tests involves the customer working with the 'team' to define acceptance tests for the project. These tests are then run it is the then kept running correctly throughout the project.

The result was obtained because the XP Practice Customer Tests involves working with the customer to establish the acceptance tests and this maps well with the ISO Guideline Responsibility, Authority and Communication because it involves communicating with the customer in order to establish requirements and needs.

11. The Result Standard 'Yes' was achieved here because the practices and processes involved in the XP practice Customer Tests mapped excellently with the ISO 9001:2000 Guideline Customer Related Processes.

Customer Tests involves the customer working with the 'team' to define acceptance tests for the project. These tests are then run and it is then kept running correctly throughout the project.

Customer Related Processes involve the Customer Requirements being specified and reviewed with other process related requirements. Once this is done the customer can then be informed.

The result was obtained because communication to the customer is constant using the XP Practice and the customer plays a big part in the developing the Customer Tests as well as in the Customer Related Processes so they map well together.

12. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Customer Tests mapped excellently with the ISO 9001:2000 Guideline Improvement.

Improvement involves continuous improvement by defining a plan and stating opportunities where improvement could be applied.

Customer Tests involves the customer working with the 'team' to define acceptance tests for the project. These tests are then run and it is then kept running correctly throughout the project.

The result was obtained because by involving the customer to define acceptance tests this means that the requirements will improve once the testing has been done. These tests are run throughout the project so the product will continually improve. Therefore the XP practice maps well with the ISO Guideline.

13. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Customer Tests mapped excellently with the ISO 9001:2000 Guideline Monitoring and Measuring.

Monitoring and Measuring customer satisfaction takes place so that the organisation knows how well the product works.

Customer Tests involves the customer working with the 'team' to define acceptance tests for the project. These tests are then run and it is then kept running correctly throughout the project.

This result was obtained because the customer helps to write the acceptance tests and this is a good way of achieving customer satisfaction by directly involving the customer so that the customer knows exactly what is going on and therefore customer satisfaction can be monitored and measured easily therefore the XP practice maps well with the ISO Guideline.

XP Practice 4 – Small Releases

14. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Small Releases mapped excellently with the ISO 9001:2000 Guideline Customer Focus.

Small Releases involves the release of running, tested software so that the customer can view the progress of the software and even release early if the wish to.

Customer Focus involves determining and achieving good customer requirements in order to obtain customer satisfaction.

This result was obtained because with Small Releases the customer can see directly how well the product is improving and how good the functionality is etc. This involves good Customer Focus where the customer can change their requirements based on the progress of the Small Releases thus improving the product and the customer satisfaction. Therefore the XP Practice maps well with the ISO Guideline.

15. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Small Releases mapped excellently with the ISO 9001:2000 Guideline Planning.

Planning involves establishing quality objectives and these objectives should follow the quality policy and be measurable. Quality objectives should be used to measure the characteristics such as functionality, usability etc

Small Releases involves the release of running, tested software so that the customer can view the progress of the software and even release early if the wish to.

This result was obtained because with Small Releases the customer has the chance to view the progress of the system and can therefore release the product early etc so this ties in well with Planning where the customer can view characteristics such as functionality etc and the team can therefore change any of the project plans due to the customer feedback therefore the XP Practice maps well with the ISO Guideline.

16. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Small Releases mapped excellently with the ISO 9001:2000 Guideline Customer Related Processes.

Customer Related Processes involve the Customer Requirements being specified and reviewed with other process related requirements. Once this is done the customer can then be informed.

Small Releases involves the release of running, tested software so that the customer can view the progress of the software and even release early if the wish to.

This result was obtained because Small Releases involves the customer a great deal and they can change their requirements according to the Small Release and the Customer Related Processes is all about customer requirements and making changes to them etc so therefore this XP Practice maps well with the ISO Guideline.

17. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Small Releases mapped excellently with the ISO 9001:2000 Guideline Analysis of Data.

Analysis of Data involves collecting and analysing data and therefore finding what improvements could be made to the system. This should be related to customer satisfaction, processes and products etc.

Small Releases involves the release of running, tested software so that the customer can view the progress of the software and even release early if the wish to.

This result was obtained because Small Releases is all about the team and the customer analysing the system so far and trying to find improvements etc and Analysis of Data is all about analysing and improving the system and should be related to the customer therefore this XP Practice maps well with the ISO Guideline.

18. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Small Releases mapped excellently with the ISO 9001:2000 Guideline Improvement.

Improvement involves continuous improvement by defining a plan and stating opportunities where improvement could be applied.

Small Releases involves the release of running, tested software so that the customer can view the progress of the software and even release early if the wish to.

This result was achieved because Small Releases involves the team and customer reviewing the system in its current state at a particular time, this allows the team and customer to suggest and make improvements to the system based on the Small Releases. Improvement is all about continuously improving the system and Small Releases allows for continuous improvement therefore this XP Practice maps well with the ISO Guideline.

19. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Small Releases mapped excellently with the ISO 9001:2000 Guideline Measuring and Monitoring.

Monitoring and Measuring customer satisfaction takes place so that the organisation knows how well the product works.

Small Releases involves the release of running, tested software so that the customer can view the progress of the software and even release early if the wish to.

This result was achieved because Small Releases involves releasing the product to the customer in order to gain feedback. This allows the team to then monitor and measure the customer satisfaction thus relating well with the ISO Guideline Monitoring and Measuring which involves monitoring and measuring customer satisfaction therefore the XP Practice maps well with the ISO Guideline.

XP Practice 5 – Simple Design

20. The Result Standard 'Part' was achieved here because the practices and processes involved in the XP practice Simple Design mapped well with the ISO 9001:2000 Guideline Planning

Planning involves establishing quality objectives and these objectives should follow the quality policy and be measurable. Quality objectives should be used to measure the characteristics such as functionality, usability etc

Simple Design involves keeping the design as simple as possible and then investing in the design of the system every day. The design is done step by step and is built upon daily.

This result was achieved because Simple Design involves keeping the design as simple as possible then building on that design daily, this links well with planning because it means that the design is continually improved on and this allows the

planning of the design to progress and keep improving therefore the XP Practice maps well with the ISO Guideline.

21. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Simple Design mapped excellently with the ISO 9001:2000 Guideline Design and Development.

Design And Development involves planning and controlling the development of the product. Activities such as validation, verification and a review of the product are defined. All records of the results and outcomes of these activities are defined and maintained.

Simple Design involves keeping the design as simple as possible and then investing in the design of the system every day. The design is done step by step and is built upon daily.

This result was achieved because Simple Design involves keeping the design simple then expanding the design every day and this links well with the ISO Guideline because by keeping the design simple and building upon it regularly this therefore links well with the ISO Guideline due to the fact that there is good design as well as continuous development.

XP Practice 6 – Pair Programming

22. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Pair Programming mapped excellently with the ISO 9001:2000 Guideline Responsibility, Authority and Communication.

Responsibility, Authority and Communication involves management distributing different tasks and making sure everyone is aware of the customer requirements and needs. Everyone should also report back to the management with their findings.

Pair programming involves 2 programmers sitting together working on the same code. This results in better design, better code and better testing.

This result was achieved because in Pair Programming two programmers work on the same code, this means that they know who is responsible for the code and there is continuous communication between the programmers thus resulting in better design, better code and better testing therefore the XP Practice maps well with the ISO Guideline.

23. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Pair Programming mapped excellently with the ISO 9001:2000 Guideline Design and Development.

Design And Development involves planning and controlling the development of the product. Activities such as validation, verification and a review of the product are defined. All records of the results and outcomes of these activities are defined and maintained.

Pair programming involves 2 programmers sitting together working on the same code. This results in better design, better code and better testing.

This result was achieved because in Pair Programming the two programmers work together thus planning and reviewing the development of the code constantly therefore the XP Practice maps well with the ISO Guideline.

24. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Pair Programming mapped excellently with the ISO 9001:2000 Guideline Analysis of Data.

Analysis of Data involves collecting and analysing data and therefore finding what improvements could be made to the system. This should be related to customer satisfaction, processes and products etc.

Pair programming involves 2 programmers sitting together working on the same code. This results in better design, better code and better testing.

This result was achieved because there are 2 programmers constantly looking over the code in Pair Programming. Due to the fact there is 2 programmers where in other development methods it would normally be one, this therefore improves the analysis of the code and improving the code in general thus resulting in a better system and in most cases better customer satisfaction therefore the XP Practice maps well with the ISO Guideline.

XP Practice 7 – Test-Driven Development

25. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Test-Driven Development mapped excellently with the ISO 9001:2000 Guideline Planning.

Planning involves establishing quality objectives and these objectives should follow the quality policy and be measurable. Quality objectives should be used to measure the characteristics such as functionality, usability etc

Test Driven Development involves testing every piece of code as its written. The code is then tested to see if the test and the code run correctly. The teams produce 100% test coverage which is good for design and for reducing errors.

This result was achieved because Test Driven Development involves constantly testing the code, this is good for planning because it means that any errors, bugs etc can be dealt with immediately so this should reduce the errors that would be found closer to the release of the system, therefore Test Driven Development maps well with the ISO Guideline.

26. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Test-Driven Development mapped excellently with the ISO 9001:2000 Guideline Design and Development.

Design And Development involves planning and controlling the development of the product. Activities such as validation, verification and a review of the product are defined. All records of the results and outcomes of these activities are defined and maintained.

Test Driven Development involves testing every piece of code as its written. The code is then tested to see if the test and the code run correctly. The teams produce 100% test coverage which is good for design and for reducing errors.

This result was achieved because Test Driven Development involves constantly testing the code, this is good for design because it means that the code will be as bug and error free as possible and the code is constantly being validated, verified and reviewed therefore this XP Practice maps well with the ISO Guideline.

27. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Test-Driven Development mapped excellently with the ISO 9001:2000 Guideline Monitoring and Measuring.

Monitoring and Measuring customer satisfaction takes place so that the organisation knows how well the product works.

Test Driven Development involves testing every piece of code as its written. The code is then tested to see if the test and the code run correctly. The teams produce 100% test coverage which is good for design and for reducing errors.

This result was achieved because Test Driven Development involves constantly testing the code therefore constant monitoring and measuring takes place to make sure the code is bug/error free thus improving code as well as the overall system which in turn would improve customer satisfaction. Therefore this XP Practice maps well with the ISO 9001:2000 Guideline.

28. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Test-Driven Development mapped excellently with the ISO 9001:2000 Guideline Analysis of Data.

Analysis of Data involves collecting and analysing data and therefore finding what improvements could be made to the system. This should be related to customer satisfaction, processes and products etc.

Test Driven Development involves testing every piece of code as its written. The code is then tested to see if the test and the code run correctly. The teams produce 100% test coverage which is good for design and for reducing errors.

This result was achieved because Test Driven Development involves constantly testing the code therefore constant analysis is taken place and improvements to the code and therefore the system can take place. Therefore the XP Practice maps well with the ISO Guideline.

29. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Test-Driven Development mapped excellently with the ISO 9001:2000 Guideline Improvement.

Improvement involves continuous improvement by defining a plan and stating opportunities where improvement could be applied.

Test Driven Development involves testing every piece of code as its written. The code is then tested to see if the test and the code run correctly. The teams produce 100% test coverage which is good for design and for reducing errors.

This result was achieved because Test Driven Development involves constantly testing the code therefore errors, bugs etc will be found as soon as possible thus continually removing these bugs, errors etc as soon as they are found in the code will continuously improve the code therefore the XP Practice maps well with the ISO Guideline.

XP Practice 8 – Refactoring

30. The Result Standard 'Slight' was achieved here because the practices and processes involved in the XP practice Refactoring mapped well in parts with the ISO 9001:2000 Guideline Planning.

Planning involves establishing quality objectives and these objectives should follow the quality policy and be measurable. Quality objectives should be used to measure the characteristics such as functionality, usability etc

Refactoring focuses on high cohesion and low coupling, achieving well designed code. Refactoring is also supported by comprehensive testing so the customer tests and programmer tests are critical.

This result was achieved because Refactoring involves having good quality objectives as the code quality is high although it does not really follow a particular plan and cant really be used to measure characteristics just through refactoring so this XP Practice map well in parts with the ISO 9001:2000 Guideline.

31. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Refactoring mapped excellently with the ISO 9001:2000 Guideline Design and Development.

Design And Development involves planning and controlling the development of the product. Activities such as validation, verification and a review of the product are defined. All records of the results and outcomes of these activities are defined and maintained.

Refactoring focuses on high cohesion and low coupling, achieving well designed code. Refactoring is also supported by comprehensive testing so the customer tests and programmer tests are critical.

This result was achieved because Refactoring involves good code design with high cohesion and low coupling and as the code continually gets developed the refactoring will also improve and develop therefore this XP Practice maps well with the ISO 9001:2000 Guideline.

32. The Result Standard 'Part' was achieved here because the practices and processes involved in the XP practice Refactoring mapped well with the ISO 9001:2000 Guideline Analysis of Data.

Analysis of Data involves collecting and analysing data and therefore finding what improvements could be made to the system. This should be related to customer satisfaction, processes and products etc.

Refactoring focuses on high cohesion and low coupling, achieving well designed code. Refactoring is also supported by comprehensive testing so the customer tests and programmer tests are critical.

This result was achieved because Refactoring is related to analysing the code and making improvement to the code having high cohesion and low coupling therefore this XP Practice maps well with the ISO 9001:2000 Guideline.

33. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Refactoring mapped excellently with the ISO 9001:2000 Guideline Improvement.

Improvement involves continuous improvement by defining a plan and stating opportunities where improvement could be applied.

Refactoring focuses on high cohesion and low coupling, achieving well designed code. Refactoring is also supported by comprehensive testing so the customer tests and programmer tests are critical.

This result was achieved because Refactoring involves improving the quality of the code by focusing on high cohesion and low coupling and as the code progresses the refactoring will also progress therefore this XP Practice maps well with the ISO 9001:2000 Guideline.

XP Practice 9 – Continuous Integration

34. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Continuous Integration mapped excellently with the ISO 9001:2000 Guideline Design and Development.

Design And Development involves planning and controlling the development of the product. Activities such as validation, verification and a review of the product are defined. All records of the results and outcomes of these activities are defined and maintained.

Continuous Integration involves XP teams performing multiple builds each day so the team knows if everything works together as soon as possible so there isn't any confusion and problems.

This result was achieved because Continuous Integration involves good design and development because the code is built upon each day and therefore improving on the development of the code by constantly reviewing it and improving the design therefore this XP Practice maps well with the ISO 9001:2000 Guideline.

35. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Continuous Integration mapped excellently with the ISO 9001:2000 Guideline Analysis of Data.

Analysis of Data involves collecting and analysing data and therefore finding what improvements could be made to the system. This should be related to customer satisfaction, processes and products etc.

Continuous Integration involves XP teams performing multiple builds each day so the team knows if everything works together as soon as possible so there isn't any confusion and problems.

This result was achieved because Continuous Integration involves constantly analysing the code and integrating it and therefore can discuss and solve any problems which they encounter therefore improving the system thus improving customer satisfaction as a result. Therefore the XP Practice maps well with the ISO 9001:2000 Guideline.

36. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Continuous Integration mapped excellently with the ISO 9001:2000 Guideline Improvement.

Improvement involves continuous improvement by defining a plan and stating opportunities where improvement could be applied.

Continuous Integration involves XP teams performing multiple builds each day so the team knows if everything works together as soon as possible so there isn't any confusion and problems.

This result was achieved because Continuous Integration involves constant integration of the system so that the any problems can be found and then solved therefore offering continuous improvement as the system has multiple builds on a daily basis. This therefore shows that the XP Practice maps well with the ISO 9001:2000 Guideline.

XP Practice 10 – Collective Code Ownership

37. The Result Standard 'Part' was achieved here because the practices and processes involved in the XP practice Collective Code Ownership mapped well with the ISO 9001:2000 Guideline Planning.

Planning involves establishing quality objectives and these objectives should follow the quality policy and be measurable. Quality objectives should be used to measure the characteristics such as functionality, usability etc

Collective Code Ownership means that any pair of programmers can improve any piece of code at anytime. This therefore helps to reduce defects and improves the code quality.

This result was achieved because Collective Code Ownership shows that there is a plan in place in order for each pair of programmers to alter any piece of code this therefore shows good planning and quality therefore the XP Practice maps well with the ISO 9001:2000 Guideline.

38. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Collective Code Ownership mapped excellently with the ISO 9001:2000 Guideline Design and Development.

Design And Development involves planning and controlling the development of the product. Activities such as validation, verification and a review of the product are defined. All records of the results and outcomes of these activities are defined and maintained.

Collective Code Ownership means that any pair of programmers can improve any piece of code at anytime. This therefore helps to reduce defects and improves the code quality.

This result was achieved because Collective Code Ownership involves any pair of programmers altering the any piece of code therefore this means that the programmers can improve on any of the code thus improving the codes design. This therefore shows that the XP Practice maps well with the ISO 9001:2000 Guideline.

39. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Collective Code Ownership mapped excellently with the ISO 9001:2000 Guideline Improvement.

Improvement involves continuous improvement by defining a plan and stating opportunities where improvement could be applied.

Collective Code Ownership means that any pair of programmers can improve any piece of code at anytime. This therefore helps to reduce defects and improves the code quality.

This result was achieved because Collective Code Ownership involves any pair of programmers being able to alter the code at any time thus offering continuous code improvement therefore the XP Practice maps well with the ISO 9001:2000 Guideline.

XP Practice 11 – Coding Standard

40. The Result Standard 'Part' was achieved here because the practices and processes involved in the XP practice Coding Standard mapped well with the ISO 9001:2000 Guideline Planning.

Planning involves establishing quality objectives and these objectives should follow the quality policy and be measurable. Quality objectives should be used to measure the characteristics such as functionality, usability etc

Coding Standard involves following the same code standard so that all of the code looks like it has been written by the one individual, this avoids confusion and means the code will be easier to follow and understand.

This result was achieved because Coding Standard has good planning principles with good quality objectives as this would make the code easier to understand, avoiding confusion etc therefore this XP Practice maps well with the ISO 9001:2000 Guideline.

41. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Coding Standard mapped excellently with the ISO 9001:2000 Guideline Design and Development.

Design And Development involves planning and controlling the development of the product. Activities such as validation, verification and a review of the product are defined. All records of the results and outcomes of these activities are defined and maintained.

Coding Standard involves following the same code standard so that all of the code looks like it has been written by the one individual, this avoids confusion and means the code will be easier to follow and understand.

This result was achieved because Coding Standard involves good code design as the code is written in the same format therefore avoiding any unnecessary confusion etc thus making it easier to develop the code. This therefore shows that the XP Practice maps well with the ISO 9001:2000 Guideline.

42. The Result Standard 'Full' was achieved here because the practices and processes involved in the XP practice Coding Standard mapped excellently with the ISO 9001:2000 Guideline Improvement.

Improvement involves continuous improvement by defining a plan and stating opportunities where improvement could be applied.

Coding Standard involves following the same code standard so that all of the code looks like it has been written by the one individual, this avoids confusion and means the code will be easier to follow and understand.

This result was achieved because Coding Standard involves the code being written in the same format this making it easier for the programmers to alter and therefore improve the code. This therefore shows that the XP Practice maps well with the ISO 9001:2000 Guideline.

XP Practice 12 - Metaphor

43. The Result Standard 'Part' was achieved here because the practices and processes involved in the XP practice Metaphor mapped well with the ISO 9001:2000 Guideline Planning.

Planning involves establishing quality objectives and these objectives should follow the quality policy and be measurable. Quality objectives should be used to measure the characteristics such as functionality, usability etc

Metaphor is a simple description of how the program works sometimes called "stories". These metaphors are usually are usually wrote on small index cards and placed on a wall or board.

This result was achieved because Metaphor involves using descriptive stories to give a description of how the program works therefore planning of the project can be done in line with the metaphor. This therefore shows that the XP Practice maps well with the ISO 9001:2000 Guideline.

44. The Result Standard 'Part' was achieved here because the practices and processes involved in the XP practice Metaphor mapped well with the ISO 9001:2000 Guideline Design and Development

Design And Development involves planning and controlling the development of the product. Activities such as validation, verification and a review of the product are defined. All records of the results and outcomes of these activities are defined and maintained.

Metaphor is a simple description of how the program works sometimes called "stories". These metaphors are usually are usually wrote on small index cards and placed on a wall or board.

This result was achieved because Metaphor offers a description of how the project works therefore a design for the project can be developed using the "stories". This therefore shows that this XP Practice maps well with the ISO 9001:2000 Guidline.

C - Mapping Diagrams

Below shows the mapping diagrams which were used to help me achieve the results required to be entered into the table.

Whole Team Map

ISO 9001:2000 Guidelines	Whole Team Practice	Full/Part/Slight
General Requirements	Involves customer in the 'team' to set the requirements etc	
Documentation Requirements		
Customer Focus	Everyone is made aware of their tasks in hand. There is also a manager/coach who oversees the project.	Full
Planning		
Responsibility, Authority & Communication		Full
Customer-Related Processes	Team meet regularly and everyone communicates there points and issues etc	Full
Design & Development		
General		
Monitoring & Measuring		
Analysis of Data		
Improvement		

Planning Game Mapping

ISO 9001:2000 Guidelines	Planning Game Practice	Full/Part/Slight
General Requirements	Involves Planning, Release Planning & Iteration Planning	Part
Documentation Requirements		Part
Customer Focus	Documentation (test plans, results etc)	
Planning		
Responsibility, Authority & Communication	Product reviewed after each iteration.	
Customer-Related Processes		
Design & Development		Part
General		
Monitoring & Measuring		
Analysis of Data		
Improvement		

This process was then repeated for the ten other Extreme Programming Practices and the information was then entered into the table using the results from these Mapping Diagrams.