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The use and effectiveness of project management methodologies in virtual and distributed projects

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Abstract

Problem statement: Virtual and distributed projects are now fast replacing collocated projects as they bring up more skills needed for projects. There are various problems that have been encountered while working on virtual and distributed projects which include lack of face-to-face communication, different geographical locations and culture. Project management, through the use of project management methodologies, is becoming more crucial to ensure the problems are removed or minimized. The aim of this study is to look at the use and effectiveness of project management methodologies in virtual and distributed projects.

Research method: The positivistic research paradigm was used in this study since it allowed the researcher to quantify and analyse the data received from the survey. As part of the positivistic research a survey was conducted for the research method while a questionnaire was used for data collection purposes. The collected data was then tested and analysed using the quantitative data analysis which included descriptive statistics, t-tests, factor analysis, KMO and Bartlett's test, Cronbach's alpha test, spearman's rho, Levene's test for equality of variance and non-parametric correlations.

Main findings: While companies apply different project management methodologies to virtual and distributed projects, it is other factors (which include lack of face-to-face communication, different geographical locations and different cultures) which influence the use and effectiveness of the project management methodologies as well as the success of the virtual and distributed projects. In some cases it is how the project management methodology is used as some only apply certain parts of it while others report not having enough time to apply the project management methodology.

Principal conclusion: Project management methodologies are useful and effective in virtual and distributed projects when they are effectively applied and followed. Issues caused by lack of face to face communication, different geographical areas and different cultures also have to be addressed as they influence the results on the virtual and distributed projects' success. This is further discussed in this study and proposed solutions are given to the issues caused when using project management methodologies in virtual and distributed projects.

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Keywords: project management, project management methodology, virtual and distributed projects, virtual and distributed teams, PMBOK, PRINCE 2

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Samevatting

Probleem stelling: Virtueel en verspreide projekte is vinning besig om gerangskikte projekte te vervang omdat dit meer vaardighede beskikbaar stel vir projekte. Daar is verskeie probleme van toepassing op verspreide projekte en dit sluit in ‘n tekort van persoon tot persoon kommunikasie, verskillende geografiese plasings en kultuur. Projek bestuur, deur die gebruik van projek bestuursmetodologie, word meer krities tot die verwydering of minimisering van probleme. Die doel van hierdie navorsing is om te kyk na die gebruik en effektiwiteit van projekbestuur metodologie by virtueel en verspreide projekte.

Navorsingsmetode: Die positivistiese navorsings paradigma is gebruik vir hierdie navorsing want dit het dit moonlik gemaak vir die navorser om die data, uitkomstig uit die opname, te kwantifiseer en te analiseer. As deel van die positivistiese navorsing, is ‘n opname gedoen vir die navorsingsmetode en is gebruik gemaak van ‘n vraelys vir die kolleksie van data, Die data is toe getoets en analiseer met behulp van kwantitatiewe data analise wat beskrywende data statistiek, t-toetse, faktor analise, KMO en Bartlett se toets, Cronbach se alpha toets, Spearman se rho, Levene se toets vir gelykheid van variansie en nie parametriese korrelasies.

Hoof Bevindings: Alhoewel maatskappye verskillende projek bestuursmetodolgieë toepas op virtueel en verspreide projekte, is dit ander faktore (insluitende ‘n tekort aan persoon tot persoon kommunikasie, verskillende geografiese plasings en kultuur) wat die gebruik en effektiwieteite van die projek bestuursmetodologie sowel as die sukses van die virtueel en verspreide projekte beïnvloed, In sekere gevalle is dit hoe die projek bestuursmetodologie gebruik is, want sommige pas sekere gedeeltes daarvan toe, terwyl andere rapporteer dat hulle nie genoegsame tyd het om die projek bestuursmetodologie toe te pas nie.

Hoof gevolgtrekkings: Projek bestuursmetodologieë is bruikbaar en effektief in virtueel en verspreide projekte wanneer hulle effektief toegepas en gevolg word. Faktore veroorsaak deur ‘n tekort van persoon tot persoon kommunikasie, verskillende geografiese plasings en verskillende kulture moet ook aangespreek word, want hul beïnvloed die uitslag van die virtueel en verspreide projekte se sukses. Hierdie is verder bespreek in die studie en oplossings is voorgestel vir die

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probleme veroorsaak wanneer projek bestuursmetodoligieë in virtuele en verspreide projekte gebruik word.

Sleutelwoorde: projek bestuur, projek bestuursmetodologie, virtueel en verspreide projekte, PMBOK, PRINCE 2

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Chapter 1

In this chapter we are going to look at the introduction of the research, the research objectives, the research method and the outline of the study. This chapter has been structured as follows:

1.1 Introduction

1.2 Research objectives

1.3 Research method

1.4 Outline

1.1 Introduction

Project management addresses effective leadership, conducive organizational climate, technologically realistic requirements, realistic schedule and effort estimates, sufficient software personnel and other necessary resources, and a diverse and synergistic team, (Linberg, 1999). Project management includes project planning, project control, information management, document management, communication management, project cost and budgeting, and scheduling (Skibniewski and Vecino, 2012). The project manager makes use of different skills and techniques to ensure that the project objectives have been met. The value of project management to stakeholders, that is the enterprise, customers, suppliers and community, is to turn resources into project outputs and allow value realisation for all stakeholders through cost saving and improvement in performance (Zhai et al., 2009). While the aim is to address all project requirements, stakeholders also have to obtain value from the whole process.

Being a knowledge-centric and experience-driven activity, project management is supported by the use of the project management information system, (Berzisa and Grabis, 2011). There are different kinds of project management methodologies that have been developed that explain and show project management activities in an organization, the standards as well as the guidelines followed and best practices (Bērziša, 2009). Project management has evolved from the use of project management methodologies like PMBOK (Pons, 2008), to the use of other project management methodologies like PRINCE 2 (Hope, 2011), and agile project management methodologies. McAvoy and Butler (2009) highlights how traditional project management attempts to control the negative impacts of the developers' traits by imposing a standardized structure which relies less on the developers' skills and abilities, whereas with agile project management, developers are empowered and their traits have a huge impact on the project.

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On the other hand, projects and applications development have also changed from the traditional collocated development to a virtual and distributed development style due to a lack of skills within the same area and thereby searching for more skills in different locations. Virtual teams are usually organized by a project manager and are a group of people who share common objectives and interact with each other to meet specific objectives mainly in an online environment (O'Keefe and Chen, 2011). Distributed projects are defined as the implementation of a related set of projects across two or more locations. The projects are related in that they share or pass data between them (Felix and Harrison, 1984).

One reason for virtual and distributed projects is because of outsourcing. For outsourcing to happen, people in different locations form one software development team and work together to address the project objectives or goals (Guzman et al., 2010). This allows for better skills to be found and at times it is at a cheaper rate. Some companies are moving to outsourcing as it helps them reduce the issues associated with managing their own projects. Even though virtual and distributed projects also aid in getting better skills at a lower cost, there are a few threats and weaknesses that need to be looked out for. One of these was cited by Chinowsky et al. (2003), that as more multinational, interdisciplinary, and multi-organizational partnerships are utilized, there is need for greater and more efficient communication alternatives to make sure that teams at different locations were on the same level at all times.

Due to communication, cultural and technological issues faced in virtual and distributed projects, many companies are now experiencing backlogs and are also pressured into producing better quality projects as compared to their rivals. Even though the resources are available in terms of skilled labour at different locations and the latest technology at the project teams disposal, little guidance currently exists to assist in the successful implementation and management of the virtual and distributed teams as well as the projects (Chinowsky et al. 2003).

This research will focus on the current available guidance on project management methodologies and virtual teams. Focus will also be given to project management methodologies that are currently in use and their effectiveness in virtual and distributed projects based on the responses from the survey. The opportunities and weaknesses of the current project management methodologies are reviewed and recommendations are given on ways of improving on the use of

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project management methodologies in virtual and distributed projects to ensure that they are effective.

The next section, section 1.2, looks at the research objectives or aims of this study.

1.2 Research Objectives

The main aim of this research is to study the use and effectiveness of Project Management Methodologies in virtual and distributed projects. In order to reach this aim the following objectives will be addressed:

- Review background of individual respondent
- Describe characteristics of virtual and distributed teams
- Describe the characteristics of virtual and distributed projects
- Identify the challenges faced by project managers who have worked in virtual teams.
- Identify the opportunities experienced by project managers who have worked in virtual teams.
- Determine the use of project management methodologies in virtual and distributed projects.
- Determine the effectiveness of PMM in virtual and distributed teams
- Determine the relationship between PMM and the success of virtual and distributed projects

This section looked at the aims of the research. Section 1.3 focuses on the research method that was used in this study.

1.3Research Method

For this research the positivistic approach will be used as its characteristics are most suitable for this study. These characteristics are listed as: the world exists independently of humans, measurement and modelling, objectivity, hypothesis testing, quantitative data analysis and universal laws and are further explained in chapter 3 of this research. The research paradigm will allow the researcher to find out patterns and regularities between:

- The use of project management methodologies in virtual and distributed projects
- The effectiveness of project management methodologies in virtual and distributed projects

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When using this approach, a multiple respondent survey will be used. Surveys are done to systematically collect the same data from a large group of people. A purposive selected sample of project managers, developers and other information technology specialists will be used for this survey. For data collection questionnaires based on the research objectives will be used to collect data for the survey. These will be sent to the selected sample, who have experience in using project management methodologies and working on virtual and distributed projects, in the form of electronic emails and drop off questionnaires. The results will be collected and different statistical tests which include descriptive statistics, factor analysis, reliability analysis, non-parametric correlations and regression analysis will be applied to the data.

From the research method that was used we go on to section 1.4 which shows the outline of study. It shows the chapters and content covered in the research.

1.4 Outline of study

Chapter 1: Introduction/Problem Statement

- This will focus on the purpose of the research (aims)
- Problem description
- Research goals

Chapter 2: Literature review

- This chapter will look at the research and literature that has been covered so far, when it comes to:
- Project Management and project management methodologies
- Virtual and distributed projects

Chapter 3: Research Design

: Research Approach - Positivistic

: Research Method - Survey

: Data Collection - Questionnaires

: Data analysis - Statistical

Chapter 4: Results

- Report the findings on the different tests applied on the data.
- Tests applied include:

: Descriptive Statistics

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: Factor Analysis

: Reliability Analysis

: Non-parametric correlations

: Regression Analysis

Chapter 5: Discussion conclusions

: Discussion of results

: Additional Results

: Lessons learnt

: Limitations

: Recommendations

: Conclusion

Chapter 1 gave an introduction to the research being done, the aim of the study, the research method used and the outline of the different chapters covered by the study. The next chapter, Chapter 2 focuses on the literature review for project management, project management methodologies, virtual and distributed projects plus the teams and the use and effectiveness of project management methodologies in virtual and distributed projects.

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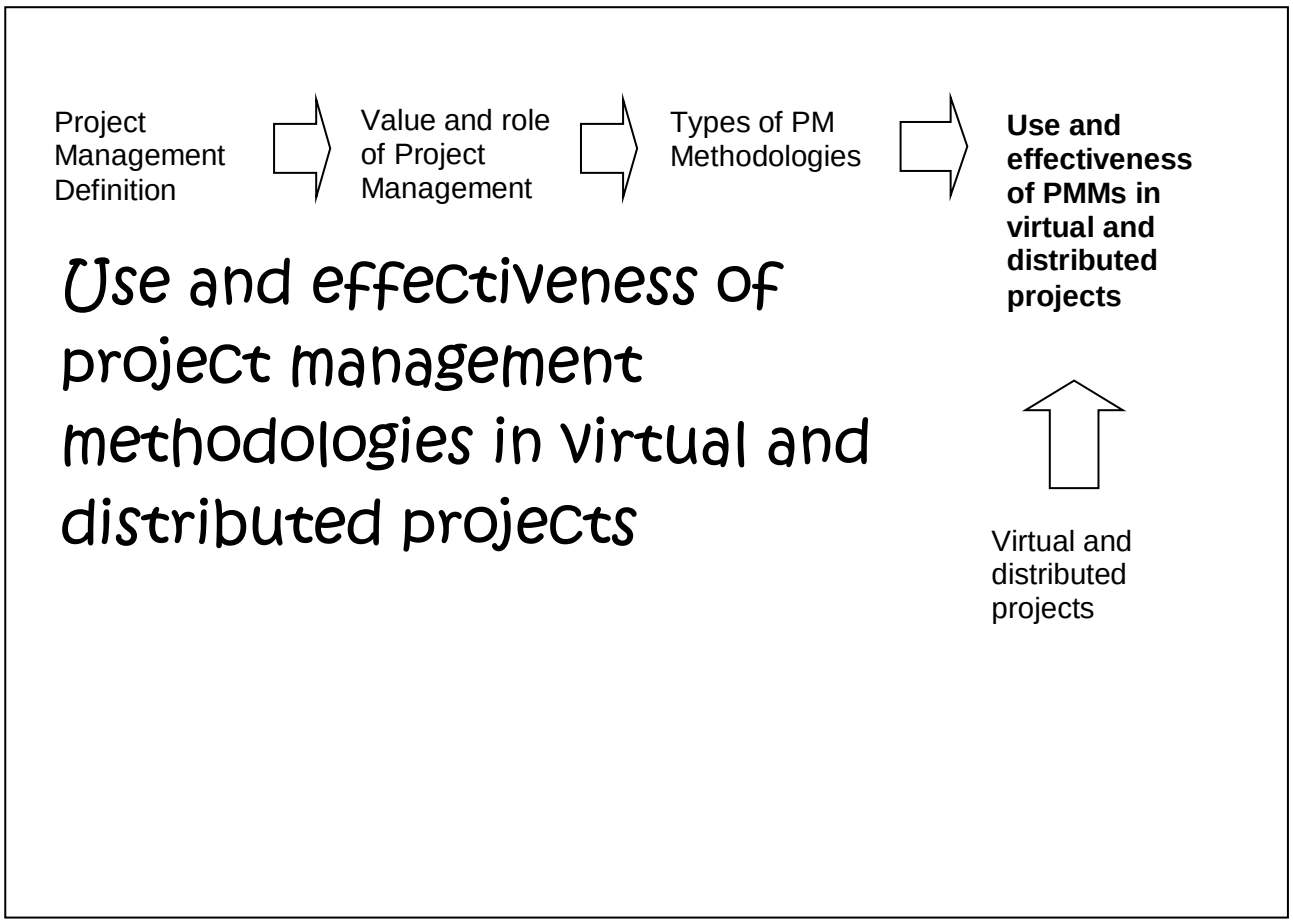
Chapter 2: Literature Review

In this chapter we are going to look at the definition of Project Management, the value and role of Project Management, different types of Project Management Methodologies, their use and effectiveness, then virtual and distributed projects, how Project Management Methodologies are used in virtual and distributed projects and finally the conceptual framework. This chapter has been structured as follows in the layout depicted in Fig. 2.1:

Fig 2.1: Chapter 2 layout



2.1 Definitions of Project Management

Project Management (PM) has been defined from different angles by a variety of authors. Some of the definitions are explained in the following paragraphs. From these definitions comparisons were made and the similarities and differences were noted.

Project management for Systems Development (S) is a framework concerned with planning, organising, directing and controlling the efforts of an application development team into creating an efficient and cost effective computer application (Felix and Harrison, 1984). To create efficient and cost effective computer applications within stipulated times, project management techniques

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are used to develop computer applications within the constraints of budget and time. In their study, project management was seen to be more effective in creation of centralised applications as compared to distributed processing systems where standard techniques could not be applied. The main points included in the definition of project management by Felix and Harrison (1984) were planning, organising, directing and controlling.

Project management can also be viewed as a way of tracking and organising a project (Curlee, 2008). This would be achieved by combining the knowledge and skills of the project manager with the tools and techniques of project management to come up with the requested product. For project management to be fruitful, a suggestion was made in their research: that is, for project management to include new ways of measuring a project's success and for the community to be flexible when using technologies in a changing environment. In the definition given by Curlee (2008) for project management, tracking and organising brought about by tools and techniques were important factors that contributed to the managing projects.

Project management is a process which includes project planning, project control, information management, document management, communication management, project cost and budgeting, and scheduling (Skibniewski and Vecino, 2012). This was another angle to project management which came from Skibniewski and Vecino (2012), who explained it in the context of web-based applications. Just like the definition given by Felix and Harrison (1984), Skibniewski and Vecino (2012) also highlighted the important parts of project management as project planning and project control. They, however, also included other factors such as information management, document management, communication management, project cost and budgeting as well as scheduling.

From the U.S Department of Defence (DoD) perspective, project management is the use of critical path methods which involved management of cost, schedule and performance (*Cantwell et al*. 2013). An insight on how the DoD used the same tools and methods to manage simple and repetitive projects even though the Dod projects were technologically advanced was provided by *Cantwell et al*. (2013). An argument was brought into play by the authors, where they highlighted the use of any two of the three elements of cost, schedule and performance as the reason to why traditional approaches to project management failed. *Cantwell et al*. (2013) specified the use of critical path methods, which are critical steps that had to be followed when managing projects. These included cost management, schedule and performance.

Project management is focused on classical functions such as planning, organising and controlling processes (Anantatmula, 2010). The classical functions help use resources in the projects

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efficiently and effectively. Anantatmula (2010) also included planning, organising and controlling processes as being functions of project management just as had been highlighted by Felix and Harrison (1984) and Skibniewski and Vecino (2012).

Similarities in definitions of Project Management

The authors explained similar aspects that were looked at when focusing on project management. No matter how big, small or complex the project is, planning, organising, directing and controlling are important aspects of project management that help achieve the goals of a project efficiently and effectively.

In the different studies done, (*Cantwell et al*. (2013); Skibniewski and Vecino (2012); Felix and Harrison (1984)) explained the importance of sticking to the budget and stipulated time frames. For the project to be a success it had to meet both the budgeted costs as well as be completed within the scheduled time. These are important factors to be included as it links with planning, controlling and organising to address the project goals or objectives. After coming up with the estimated cost of the project and scheduled completion time of different tasks (planning), it is necessary to organise the available resources and lead them to achieve the goals of the project. When there are issues arising, control is applied to make sure the different set milestones are achieved while sticking to the scheduled times and cost.

Differences in Project Management definitions

While Felix and Harrison (1984) went on to highlight how project management was easier in centralised as compared to distributed projects were standard techniques were not applicable, Curlee (2008) suggested that for project management to be successful in distributed projects, the teams had to be flexible and had to apply newer technology as compared to the one used in centralised projects. The two basically looked at the same point from different angles. In 1984, focus was mainly on collocated or centralised projects where managing the project was easier since the project was based in one location. Applying the standards used in centralised projects to distributed projects was difficult as it was more of a venture that had not been extensively explored. Nowadays there are different techniques and tools that have been developed that allow easier management of distributed projects, which is why Curlee (2008) was advising project teams to be flexible, in other words, to adapt to changes in the projects requirements.

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Felix and Harrison (1984) explained project management as being a technique, whereas *Cantwell et al*. (2013) saw it as a combination of tools and techniques. While both authors viewed project management as a technique, *Cantwell et al*. (2013) went on to highlight the use of different tools to aid in managing projects. Various tools are made available to different project management techniques to ensure that project goals are met.

Project Management Framework

Hewagamage and Hewagamage (2011) came up with the generic project management framework shown in fig 2.1. In this framework (fig 2.1), project success is achieved by combining different factors which are, knowledge for project management, project management skills, tools and techniques in the starting, planning, executing and closing stages of a project. A combination of different factors is needed to guide and manage a project to successful completion. Most factors included in the generic project management framework were also covered in the definitions of project management given by the different authors in the paragraphs above.

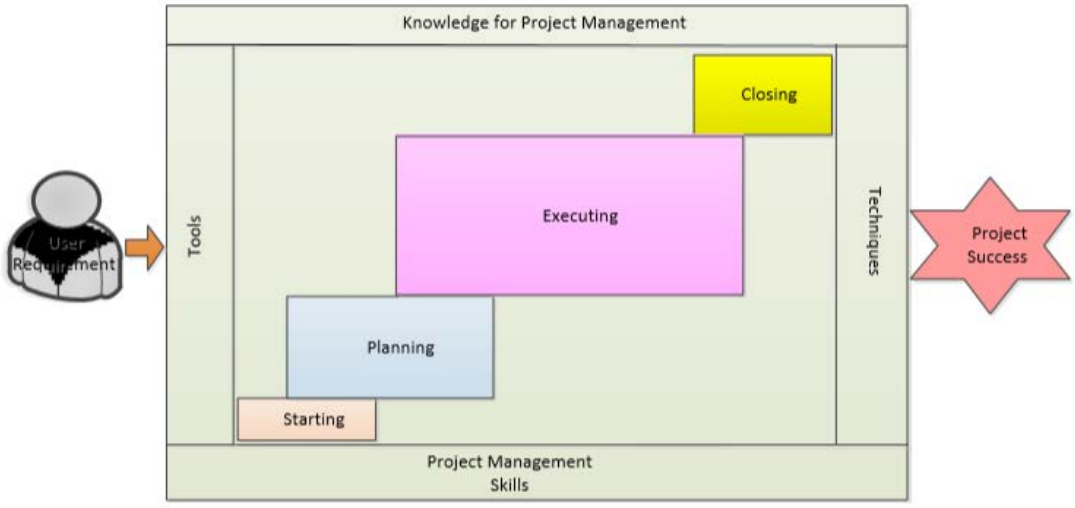

Fig 2.1: Generic project management framework (Hewagamage and Hewagamage, 2011)

From the definitions given by these different authors, project management can be said to involve planning, organising and controlling resources like time, money and individuals to produce an efficient and cost effective computer application. This involves looking at what wants to be achieved, in terms of product to be produced, and then schedule the time and resources to meet

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the necessary requirements within the stipulated time and budget. This definition of project management will be used for the purposes of this research.

After looking at the definitions of project management in this section, section 2.2 looks at the value and role of project management.

2.2 Value and Role of Project Management

In section 2.1 the focus was on the definition of project management, where the objective is to realise the value of a project by meeting the specified project requirements. In this section we look at the value and role of project management were focus is given to the following areas:

2.2.1 Value of project management to stakeholders

2.2.2 The role of project management in achieving project success

This sub sections are explained in detail in the paragraphs that follow.

2.2.1 Value of project management to stakeholders

From the research and studies done, strong evidence of the actual value of investing in project management has been hard to produce and measure (Thomas and Mullaly, 2007). The aim of this section , however,is to identify and explain the value of project management to stakeholders.

The value of project management to stakeholders can be viewed from two angles where:

1. it is obtained by turning resources into project outputs, and
2. it comprises the sum of incremental values (which includes cost saving and improvement in performance) for all stakeholders through value realisation (Zhai et al., 2009). The sum of incremental values had to be for all stakeholders as different stakeholders have different goals in terms of time, cost and quality. The goals of the stakeholders are also dynamic, that is, they are not revealed at the same time, but come up at different stages of the project.

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To better explain the value of project management to stakeholders (Zhai et al., 2009) came up with a value framework for project management in mega-projects, Figure 2.2, where their focus was on a company called SHRBC. In this framework they took into consideration that implementating project management effectively had an impact on the success of the project, which in turn had allowed stakeholders to realise the value of a project. Through the use of the value framework, the project manager aims to keep a balance between different stakeholders who define their value expectations or requirements in a project (Zhai et al., 2009)

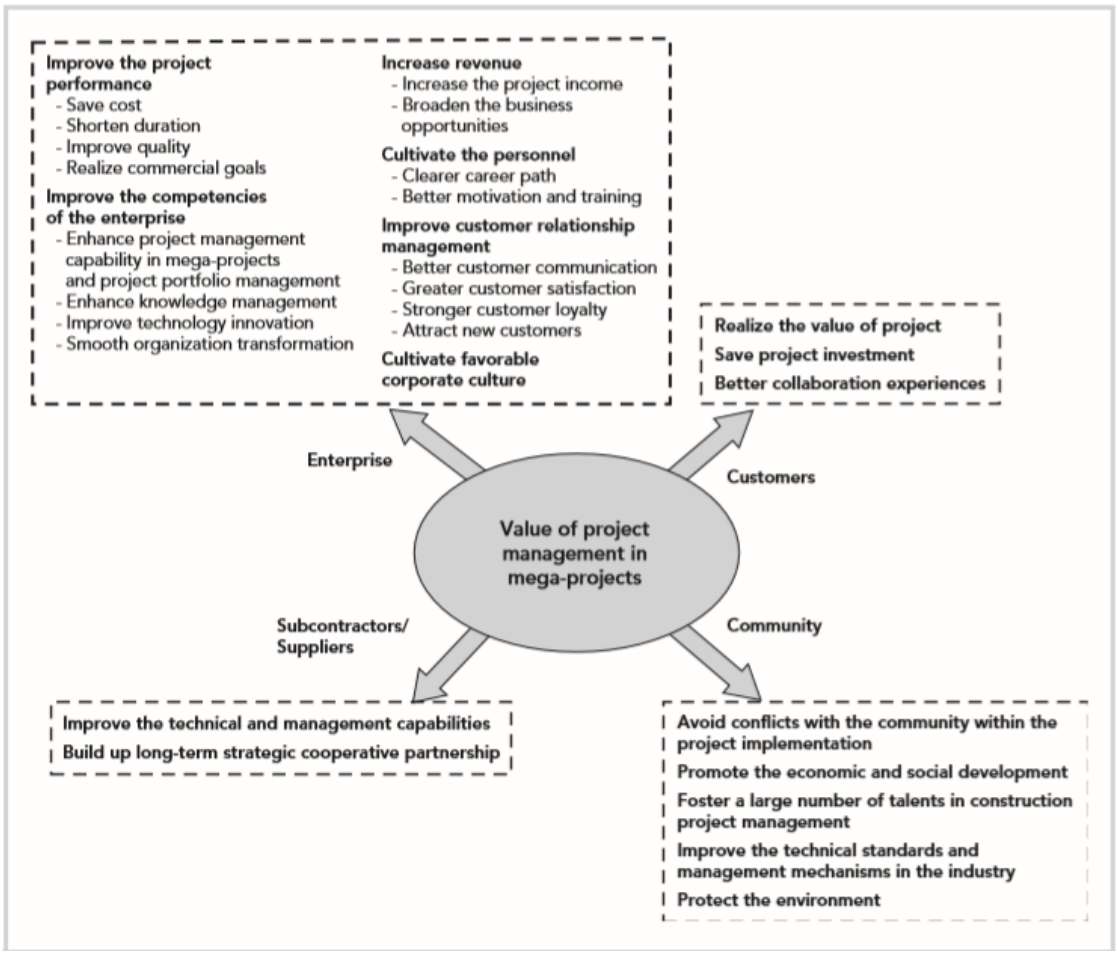

Figure 2.2: Value framework of project management in mega-projects (Zhai et al., 2009).

In Figure 2.2, Zhai *et al.* (2009) identified the key stakeholders of mega-projects as the enterprise, the customers, the subcontractors/suppliers, and the community as these had the most power, greatest legitimacy, and urgent demand on the implementation of the mega-project as well as the results. From there, they explain the value of project management from each of the stakeholders' perspectives shown by the different arrows in Figure 1. These are further explained in the paragraphs that follow:

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Enterprise

The value of project management has attracted a lot of different companies into using different project management techniques on their projects. Under enterprise, Zhai et al. (2009) highlighted six values of project management which are explained below:

- Improving the projects performance

  Improving the projects performance is measured by how much costs have been saved, how much project duration is shortened, the improvement in quality, and realisation of commercial goals. If all the factors mentioned are favourable, there is improved project performance. From the definition of project management discussed in section 2.1, the aim is to guide a project to successful completion by sticking to the budgeted cost and time while meeting all the project requirements.

- Improve the competencies of the enterprise

  An important factor for companies is to always maintain a competitive advantage over its' rivals. Project management allows for enhanced knowledge management, improved technology innovation and smooth organization transformation in both huge and small projects.

- Increase revenue

  An increase in revenue usually comes up when project management has offered all other stated benefits, for instance, with the first benefit, where we improve the projects efficiency. This results in a reduction in costs as well as project duration which in turn increases the project income and broadens the business opportunities.

- Cultivate the personnel

  For the staff it helps with a clearer career path. Opportunities are offered to the company's' employees which results in better motivation. In some cases training is offered to the project team members so that they possess the relevant project management skills needed for certain projects.

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- Customer relationship management

  If applied effectively, project management results in better customer communication. Good communication between the project team and customers helps understand and carry out the project requirements effectively resulting in greater customer satisfaction, stronger customer loyalty and in most cases new customers.

- Cultivate favorable corporate culture

  An additional value brought about by project management to companies is a favourable corporate culture. This helps attract business to the company. If known for having high standards in the industry, customers are more than willing to be associated with the company. For projects, customers look for companies with a certain reputation to assist them in these projects.

Customers

Project management makes customers realize the value of project by giving them a preview of what intends to be done. At times projects fail because customers fail to visualize what needs to be done and the importance. Once they know how they benefit from the project they assist in all ways, bringing about better collaboration experiences.

Sub-contractors/suppliers

In terms of sub-contractors or suppliers, project management helps improve their, technical and management capabilities. It also helps build up long-term strategic cooperative partnership between the company and these suppliers. From previous experiences, the most reliable sub-contractors and suppliers are known before hand and given a schedule of when they are expected to assist. The company also has an idea of how much they charge for their services, which allows for better planning.

Community

As much as project management adds value to the enterprise and customers, it also helps avoid conflicts with the community within the project implementation. Notification of what needs to be done, the benefits and reasons can be communicated to the community beforehand. This

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promotes the economic and social development of the community while protecting the environment as well.

As much as Zhai et al. (2009) included saving costs as some of the value gained from project management, Thomas and Mullaly (2007) argued that implementing project management did not bring about tangible revenue and cost impacts most of the times. They explained how project management brought about benefits in the less tangible aspects of the project that is, meeting stakeholder expectations around cost, timing, quality, and process. This in-turn brought about other benefits like preparing the organisation for other future activities.

2.2.2 The Role of project management in achieving project success

The role of project management is closely related to the value of project management explained in section 2.2.1. Project management has a role it plays in bringing value to projects. Some of these roles are explained in this section.

Guide a project to successful completion

Project management is important in guiding a project to successful completion while keeping costs under control. As discussed by Hewagamage and Hewagamage (2011) in section 2.1, the main aim of project management is to combine different tools and techniques, project management skills and knowledge of project management to the different stages of a project to ensure that all the project goals are successfully achieved within the budgeted cost and scheduled time.

Assist in meeting project objectives

Project management is done to ensure that the goals of the project which include performance, meeting the budgeted cost and sticking to scheduled time are addressed. Leaving out any of the three factors usually results in project failure. In section 2.1 *Cantwell et al.* (2013) explained why traditional projects had failed. This had been because project managers and teams had mainly focused on only two of the three elements of cost, schedule and performance being used by the project managers as well as teams while leaving out the third element. In other traditional projects which failed focus had only been on the cost and schedule, while in others it was schedule and

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performance and others cost and performance. Project management allows planning, organising and controlling to ensure none of the factors are left out to avoid any chances of project failure.

The definitions in section 2.1 show how certain factors are critical to the success of projects. There should be a framework or technique to guide project managers when they work on projects so that they include all the critical success factors. The main factors included in section 2.1 for the definition of project management were planning, organising and directing. These factors play different roles in a project each of which is explained. Planning is important for all projects as there is need to know what needs to be done and by whom. Organising is also crucial as the right resources need to be allocated to the right places. For example when planning as the project manager you know how much is available for the project team, you therefore know how many developers or testers to hire or to assign duties to. Directing is an ongoing process in which the project manager monitors how the team is performing and if things are not going according to plan the manager has tools and techniques at his disposable to control.

After focusing on the value and role of project management methodologies an example of two types of project management methodologies, PMBOK and PRINCE 2 are explained in section 2.3.

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2.3 Types of Project Management Methodologies

Project management techniques have been utilized for many years to develop centralized applications within the constraints of budgets and time (Felix and Harrison 1984). Project Management Methodologies (PMM) have been developed to assist project teams in developing successful projects, that is, those that are within budget and that are delivered on time. There are different kinds of project management methodologies that have been developed that explain and show project management activities in an organisation, the standards as well as the guidelines followed and best practices (Bērziša, 2009). Some of the project management methodologies include Project Management Body of Knowledge (PMBOK), Projects in Controlled Environments (PRINCE2), and agile project management. In this research only two will be explained in detail, that is, PMBOK and PRINCE 2 as they are the most popular ones and regularly used as shown in chapter 4.

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PMBOK

"PMBOK is a standard which presents techniques and tools for effective project management" Rdiouat et al. (2012); *Sukhoo et al.* (2005); Hewagamage and Hewagamage (2011) and Bērziša (2009) describe PMBOK as showing 42 overlapping and interacting processes divided into five process groups and nine knowledge areas in project management shown in fig 2.3.1, with each area described with management processes that include inputs (documents or documentable artifacts), tools (mechanisms applied to the inputs to produce outputs), techniques (mechanisms applied to the inputs to produce outputs) and outputs (documents or documentable artifacts).

Nine Knowledge Areas: Integration, Scope, Time, Cost, Quality, Human Resources, Communications, Risk, and Procurement are included in The *PMBOK® Guide* (Zwikael, 2009). The nine knowledge areas and processes where summarized in the PMBOK guide 2000 as shown below.

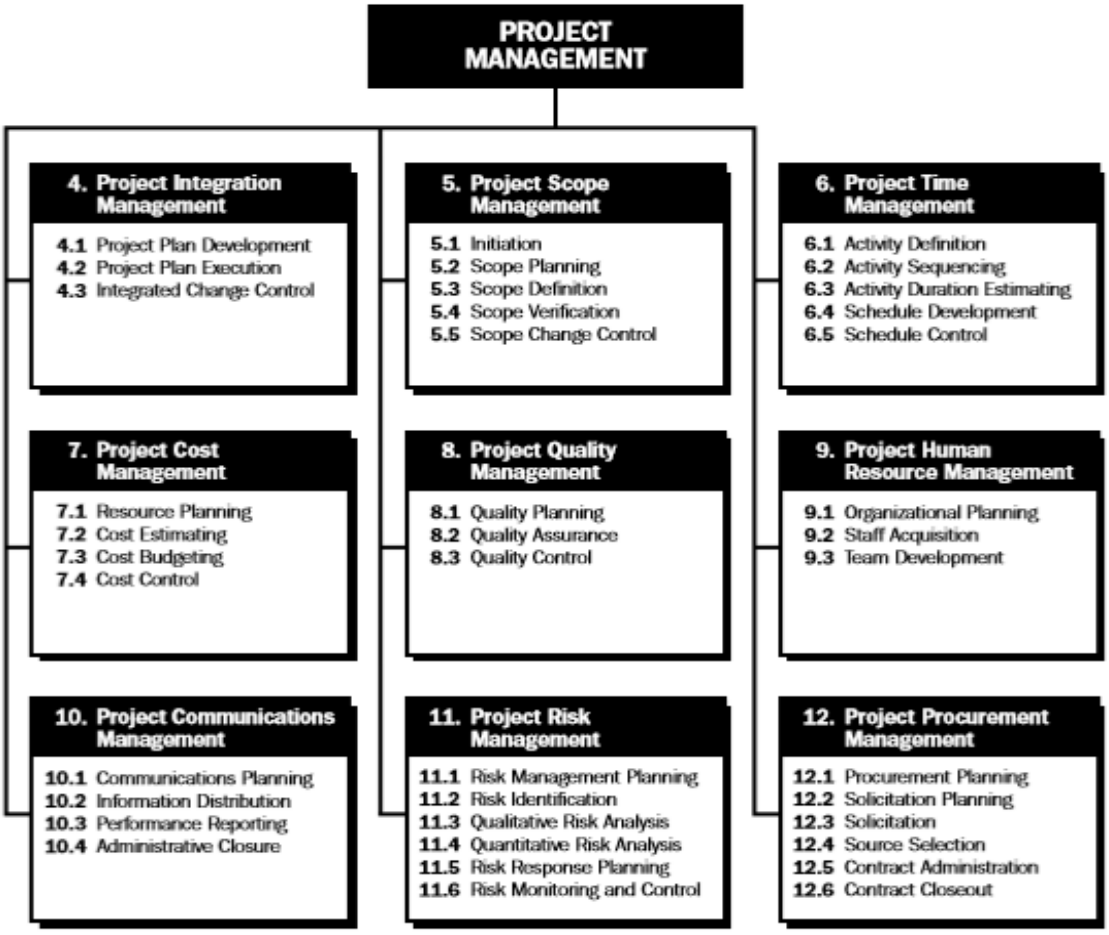

Fig 2.3.1: Overview of project management areas and project management processes (PMBOK Guide 2000)

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Each of the nine knowledge areas is briefly explained below with reference to the PMBOK Guide 2000:

Project Integration Management

This knowledge area includes the project plan development (combining all project plans to create one consistent document), project plan execution (executing the activities specified in the project plan) and integration change control (aligning all changes in the entire project) which are needed to coordinate the various elements of a project. The project team is involved in one or more of the stated processes

Project Scope Management

This is the second knowledge area which includes the following processes: initiation, scope planning, scope definition, scope verification and scope change control. These processes are used to ensure that the project includes all work required to successfully complete the project. Just like with the project integration management, these processes interact with each other and with those in other knowledge areas.

Project Time Management

This knowledge area houses all processes needed to ensure timely completion of the project and the processes included are: activity definition, activity sequencing, activity duration estimating, schedule development and schedule control. In smaller projects some of the processes can be grouped into one process for example with activity sequencing, activity duration estimating and schedule development.

Project Cost Management

Sticking to the budget is a necessity when working on projects. This knowledge area ensures that the project is completed within the approved budget by focusing on the following processes: resource planning, cost estimating, cost budgeting and cost control. Focus is primarily given to cost of the resources needed to complete the specified project activities.

Project Quality Management

Project quality management uses quality planning, quality assurance and quality control to ensure the project meets the requirements for which it was undertaken. The requirements include management of the project and the product of the project.

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Project Human Resource Management

The people working on a project need to be managed to obtain the best results from them. This knowledge area includes organisational planning, staff acquisition and team development to assist in making the most effective use of the human resources involved with the project. Activities in the mentioned processes include leading, communicating, negotiating, motivating, coaching, performance appraisal and team building.

Project Communications Management

This knowledge area uses the communications planning, information distribution, performance reporting and administrative closure processes to ensure timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information.

Project Risk Management

Six processes, that is, risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, risk monitoring and control assist in identifying, analysing and responding to project risk. Unexpected events can occur and cause a negative impact on a project and therefore there is need to make a plan to either avoid or minimise risk as much as possible.

Project Procurement management

This is the last knowledge area which includes procurement planning, solicitation planning, solicitation, source selection, contract administration and contract closeout to acquire goods and services, and to attain project scope from outside the company.

PMBOK divides the project management process into 5 groups each containing one or more processes (Rdiouat et al., 2012). The nine knowledge areas explained above, are applied in these 5 process groups.

Initiating process:

This is when the project kicks off or starts where the initial scope can be used at the beginning of the project or a phase if necessary. The goals of the project should be clearly understood at this stage.

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Planning process:

This process includes the project scope definition as well as planning, with the goal of preparing the structure for project execution and control (Zwikael, 2009). The activities needed to achieve the objectives are described in this process. Estimation of budgets and time schedules should be estimated as well and execution of the project should be planned.

Executing process

This process makes use of the tools for quality assurance, communicating progress, plus developing and managing the project team, stakeholders and sponsors to meet the project specifications.

Monitoring and control process

It is necessary to monitor progress and performance in a project while also reviewing the content and quality. This is done in this process to be able to meet the specified project cost, schedule, quality, risk and scope of the project.

Closing process

This is the final process associated with all activities across all process groups used to gain customer acceptance of the project and formally close it.

Project managers do not usually have sufficient time to apply all processes as is required by the *PMBOK® Guide* and therefore choose to perform the easier processes or the ones they are most familiar with. This might have a serious impact on the success of the project especially in cases where they give lower priority to Knowledge Areas that have higher impact on project success (Zwikael, 2009).

We also look at PRINCE 2 below.

.**PRINCE 2**

Another project management methodology is PRrojects IN Controlled Environments (PRINCE 2) created by Simpact Systems Ltd in 1975 and originally based on PROMPT (*Ghosh et al.* 2012), which is mainly used as a standard for IT projects in the United Kingdom and provides a framework covering the wide variety of disciplines and activities required within a project (Hewagamage and Hewagamage, 2011; *Ghosh et al.* 2012). These standards can also be applied to non-IT projects (*Ghosh et al.* 2012).

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PRINCE 2 is a process-based method which focuses on a business case which describes the rationale and business justification for the project. Just as mentioned above PRINCE2 is also said to be applicable to any size or type of project (Hewagamage and Hewagamage, 2011).

Hewagamage and Hewagamage (2011) highlighted some of the weaknesses of PRINCE2 as not focusing on software engineering practices in general, being difficult to interpret the terminology and approach with respect to practices in the software engineering, not having a proper approach in guiding the project and not supporting human resource and procurement management.

(*Ghosh et al.* 2012; Kruger and Rudman, 2013) explained PRINCE2 as being made up of 4 elements which are, 7 Principles (guiding obligations and good practices determining whether the project is being managed using PRINCE 2), 7 Themes (aspects to be addressed continually throughout the project), 7 Processes (steps in the project) and Tailoring (project environment). This was done to suit the specific needs of the project. The 7 Processes are in-turn divided into 40 Activities. (Turley, 2010) gives an insight into the 7 principles, 7 themes, 7 processes and tailoring each of which is briefly explained in the paragraphs that follow.

The **7 Principles**, look at the good project characteristics or best practices and are highlighted below: If any of these are missing it is not considered a PRINCE 2 project.

1. Continued business justification – all projects should have a business case or continued business justification. This includes reasons why the project should be done as well as costs, benefits and timescales.

2. Learn from experience – Even though this principle acknowledges that projects are unique, it encourages the PRINCE 2 project team to learn from past projects to help avoid or minimise risks.

3. Defined roles and responsibilities – The PRINCE 2 project team members should know what needs to be done and by which human resource. These roles should be clearly defined and agreed on.

4. Manage by stages – Projects are broken down into manageable tasks which are known as stages in PRINCE 2. Planning, monitoring and controlling are done on a stage by stage basis.

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A review of the previous stage is done and a decision is made on whether to move onto the next one or not.

5. Manage by exception – This principle focuses on execution of the previous stage. If there are any issues in that stage it raises a notification to the above management layer.

6. Focus on products – A detailed product description is given and this guides the project as well as builds correct expectations and delivers the stated products.

7. Tailor to suit the project environment – Whether it be a small project or large one, PRINCE 2 aims to tailor the project to suit that environment.

The **7 themes** focus on the items that must be continually addressed and are highlighted below:

1. Business Case – business reasons for carrying out the project

2. Organisation – people involved, sponsors, person responsible for the business case, user and supplier representatives, roles and responsibilities involved, project manager

3. Quality – level of product quality, checks to be done to ensure product quality is met

4. Plans – how the project product will be created, steps involved, levels of quality to be attained, costs involved, detail required for each plan, people involved from the organisation, timelines

5. Risk – risks involved, what to do if they happen, how to identify analyse and document the risks, how they can be mitigated, how to manage and monitor risks throughout the project.

6. Change – how changes should be controlled, tools to be used,

7. Progress – how will project be controlled, when will reporting be done, is the project still viable.

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The 7 processes address the activities and the individuals they are allocated to.

PRINCE2 divides a project into a number of management stages which are driven by a sequence of seven processes, or smaller activities (Kruger and Rudman, 2013). The activities are briefly explained below:

1. **Starting Up A Project**

   All the prerequisites for initiating the project, including justification for the project and the requirements, are checked to see if they are in place.

2. **Directing A Project**

   This includes monitoring through the use of reports, controlling of decision points done by the managerial decision-makers also referred to as the project board.

3. **Initiating A Project**

   Initiating a project involves planning and costing the projects and reviewing the business case. This is done to provide the baseline for decision-making.

4. **Controlling A Stage**

   Controlling a stage are activities done to control, react to events and report project proceedings.

5. **Managing Product Delivery**

   The team manager is responsible for this process and this is where work packages are executed, planned products are created and work gets done.

6. **Managing a Stage Boundary –** Reporting of the current stage is done in this process plus planning for the next stage.

7. **Closing a Project -** A number of activities are done here to prepare the project for closure.

Tailoring is how the project manager applies the best practices of PRINCE 2 to the environment.

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Differences between PMBOK and PRINCE 2

In their study (*Ghosh et al.* 2012) explained the high level differences between use of PRINCE2 and PMBOK. Firstly, they highlighted how PRINCE2 focuses on key risks while PMBOK was more comprehensive. After identifying risks, PRINCE 2 was used to reduce the failure by managing these risks. PMBOK focused on using processes, tools and techniques to increase the chances of success in a project. Project managers, as well as organisations, have different styles of managing projects. Some project managers prefer a management style which involves identifying and reducing risks while others believe in the use of processes tools and techniques to increase the chances of success. Both styles work depending on how the project management methodologies are implemented. Reducing or managing risks results in improved chances for the project to be a success. If all team members know what risks to look out for, they can raise alarm if something goes wrong and thereby increase the chances of success. On the other hand, good and intelligent use of the right processes, tools and techniques ensures gives the project team a greater chance of addressing the business requirements. For this to happen, training might be given on how to select and use the best tools and techniques in a given situation.

Even though the aim is to bring about project success by managing risks when using PMBOK or using the best processes, tools and techniques when using PRINCE 2, the results may be negative if the wrong risks are identified or if the wrong process, tools and techniques are used. If the incorrect risks are identified, the project team and other stakeholders end up focusing on managing the wrong risks while ignoring the actual project risks which might result in project failure. There are also a variety of processes, tools and techniques to be used with certain project management methodologies and if the wrong ones are selected, then there is also a high chance of project failure.

Secondly they saw PRINCE 2 as being product based, that is, mainly focusing on product planning to produce a quality product while PMBOK did not focus on the same. PRINCE 2 focuses on producing deliverables according to the given business requirements. This means the project team should know what product or deliverable should be produced after the project is complete. In practice this is an effective approach as the team applies different techniques to come up with the product by the end of the scheduled time. This might also have a negative effect as the project team might end up focusing on the final product while ignoring all the other factors.

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Thirdly, (*Ghosh et al.* 2012) highlighted how control is exercised by splitting the project into manageable stages and milestones while PMBOK did not include control. Splitting the project in PRINCE 2 allows the project manager as well as other stakeholders to assign milestones for each stage and to easily track what has been completed. It is also easier to divide and allocate tasks between team members. Even though (*Ghosh et al.* 2012) highlighted that control by splitting the project was not included in PMBOK, in practice it is applied. Tasks are divided between project team members even though it is in a different way and the project manager works on controlling how these are completed. Even though this is the aim it is not always easy to split some parts of the project and there it becomes somehow complicated to enforce control in such stages.

Fourthly, they looked at the management and technical stages in PRINCE2, while PMBOK does not highlight differences between management and technical aspects.

The fifth point they raised was how the business case drives a PRINCE2 project while the customer requirements drive projects in PMBOK. The business requirements which at times change are the main focus when using PRINCE 2. The aim is to come up with an end product that addresses business needs. When using this project management methodology the aim is for the project manager to motivate his/her team into addressing all the needs of the business. For PMBOK the requirements gathered also need to be addressed in the same way. Focusing on these two is an effective way of ensuring that the project is a success as the final product will be used by business. This is not always easy as the business case or customer requirements sometimes change during the project.

The sixth point was on how PMBOK defines a stakeholder as being someone or the business whose interests may be affected by execution or completion of the project in any way while PRINCE2 went on to categorize the stakeholder as being either the business sponsor, user or supplier.

Lastly, PRINCE2 is said to be prescriptive and yet adaptable where the process structure has to be followed and scaled according to the size of the project. PMBOK, on the other hand, is a performance based standard which suggests use of tools and techniques at a high level. Depending on the type of project it might be effective to be adaptable or to be performance based. If it is a project where the business case is always changing, the project team or

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stakeholders need to adapt and come up with the right solution. Some projects to not have major changes to customer requirements, therefore it is advisable to use the best tools and techniques to ensure that these requirements are met.

Similarities between PMBOK and PRINCE 2

(*Ghosh et al.* 2012) looked at six high level synergies between PRINCE2 and PMBOK. These are highlighted below:

Firstly they looked at how the project is defined by both PMBOK and PRINCE 2, where PRINCE2 viewed a project as being a temporary organisation aimed at producing one or more business products according to an agreed Business Case, while PMBOK also viewed the project as being a temporary setup undertaken to create a unique product, service or result. When undertaking a project or using a project management methodology regardless of which one it is, the aim is to produce a product or service at the end. If the project management methodology is effectively applied and all the stakeholders play their part, the right product or service will be produced.

Secondly they looked at the role of the project manager in both PRINCE 2 and PMBOK where both saw his/her role as achieving project objectives within the set targets. The role of the project manager is to achieve all project objectives by using the different kinds of project management methodologies to manage the team. If a project manager selects a project management methodology they should just ensure that other factors like communication, planning and execution are applied effectively to aid in project success.

Thirdly they looked at the six project variables/performance constraints where these are defined in PRINCE2 as time, costs, quality, scope, benefits, and risk, while the same are highlighted as project constraints in PMBOK. Project management methodologies have factors that they focus on to guide in successful projects. This guides the project manager and team in knowing what needs to be done. When using project management methodologies, these factors should be taken into consideration as they guide the team in coming up with the final product successfully.

Fourthly, *Ghosh et al.* (2012) looked at how the themes of PRINCE2 are very comparable to the knowledge areas of PMBOK and procurement being the only knowledge area not covered by the

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PRINCE 2. As the fifth point they looked at how the process groups of PMBOK and PRINCE2 are comparable, with 'starting up a project' not being included in PMBOK. Lastly they highlighted the similarities between the 40 activities that are demonstrated throughout the project in the different processes by PRINCE 2 and the 42 processes illustrated by PMBOK.

From the discussion of this section, we can see how two different project management methodologies are used. We also take note of the similarities and differences between the two project management methodology examples. The next section, 2.4, defines and explains what a virtual and distributed project is.

2.4 Explanation of Virtual and distributed projects

A virtual team is usually organized by a project manager and is a group of people who share common objectives and interact with each other to meet specific objectives mainly in an online environment (O'Keefe and Chen, 2011). Distributed projects are defined as the implementation of a related set of projects across two or more locations. The projects are related in that they share or pass data between them (Felix and Harrison, 1984). Virtual team members are selected for their expertise and fit. Part of being successful and increasing social capital is for members to network and ensure that there is effective communication throughout.

Some of the projects need several coordinated multidisciplinary teams that consist of highly skilled individuals working in different geographical locations (Guzman et al., 2010). The experience needed for some projects can not only be found in one location and therefore the aim is to get experienced people from different locations to form a project team. This does not only bring up the required skill but at times the skilled individuals offer their services at cheaper rates.

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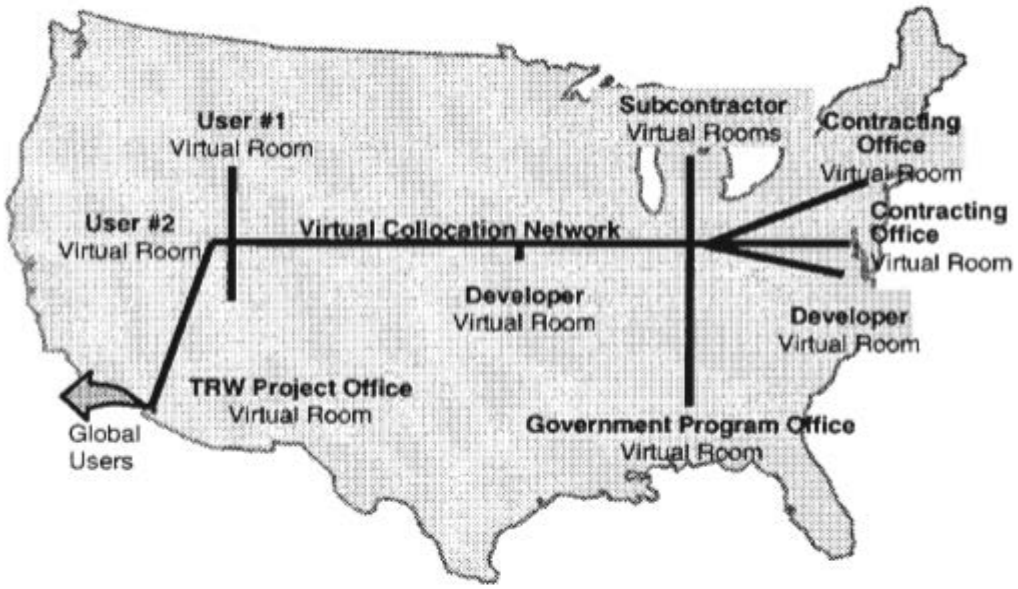

Fig 2.5: Distributed project using virtual rooms (Penedo, 2000)

In her research Penedo (2000) came up with an example of a distributed project using virtual rooms, shown in fig 2.5. Networking is an essential role in carrying out project tasks and achieving buy-in from stakeholders (O'Keefe and Chen, 2011). Various electronic communication tools are now being used to ensure that teams that are physically distributed across different geographical areas can use these tools to constantly communicate. Project teams make use of conference centers, virtual rooms, knowledge repositories and personal computers to communicate and ensure that all team members are working towards the same goals. This is illustrated in fig 2.6 by Penedo (2000).

Another reason for virtual and distributed projects is now because of outsourcing. For outsourcing to happen, people in different locations form one software development team and work together to address the project objectives or goals (Guzman et al., 2010). Companies have now resorted to outsourcing their projects to other external companies that are more experienced and that have the skilled individuals. This helps address all project needs effectively and efficiently. Other reasons are that most companies want to do away with the hustles that come when dealing with projects as well as project management.

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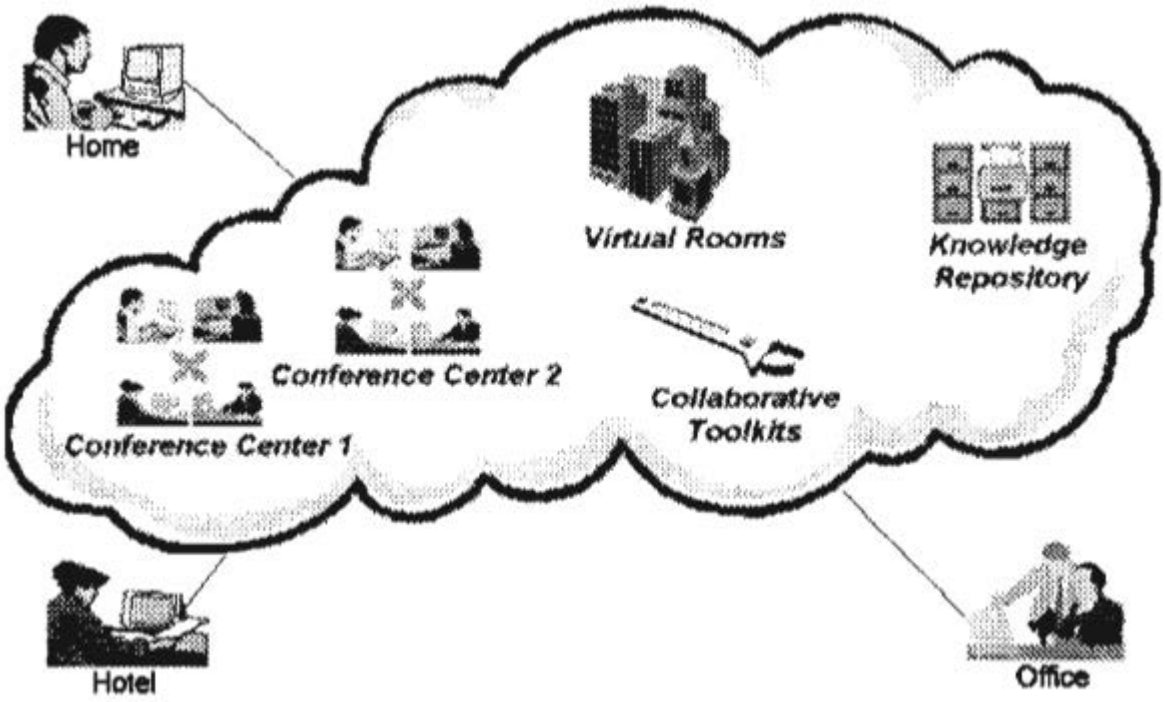

Fig 2.6: Virtual and distributed projects (Penedo, 2000)

Virtual and distributed projects where influenced by various factors. A large pool of qualified human resources led to companies wanting to fully utilize these. The centralized computing facility may not be able to provide the ever-increasing capacity necessary to adequately provide for the local organisation's data processing needs (Felix and Harrison, 1984) Instead of companies just focusing on the available skills that they had centrally, they saw the need to utilize the skills that were also in other different locations. Another factor was the significant cost advantages that the virtual and distributed projects bring. Another rational motivation is a function of the difference in the rate of change of computing and communications costs. Computing (mainly hardware) costs are declining at a much faster rate than communication costs. In many circumstances this means that data may be processed and stored locally in order to forego potentially excessive communication costs which might otherwise be incurred (Felix and Harrison, 1984) Technology is improving at alarming rates and as this happens firms enjoy the benefits of lower cost. Other factors included speeding up of work by working round the clock and enhanced “strategic flexibility”.

Just as with collocated project teams, virtual and distributed project teams are sometimes difficult to manage for project managers as they usually do it while using various information technologies

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such as Web 2.0 applications, cell phones, faxes, email, web pages, and intranets. The technology used by project managers usually helps to improve the efficiency and productivity of virtual teams by giving them a platform to contribute, collaborate and communicate (O'Keefe and Chen, 2011). This does not only give the virtual project team a platform to work on project but it also helps the project manager to track risk factors and create a knowledge management system.

Performance of virtual teams is also influenced by other factors such as an organisations culture, the development of trust and the lack of face-to-face communication (O'Keefe and Chen, 2011). Trust is usually easier to gain in collocated teams were there is face to face communication as compared to virtual teams were there is none. The culture and face-to-face communication form part of the questionnaire and the results from the survey highlighting their impact is covered in chapter 4 and chapter 5.

Other factors which influence virtual and distributed teams covered in chapter 4 and 5 include time or schedule constraints and communication costs (O'Keefe and Chen, 2011). Time or schedule constraints are usually caused by the virtual and distributed project teams being located in different time-zones resulting in others having to work flexible schedule just to accommodate and communicate with the other project team members. Costs associated with communication might also be a concern for the project manager.

After having looked at the project management methodologies and virtual and distributed projects as well as teams, focus is given to the use of project management methodologies in virtual and distributed projects in section 2.5

2.5 Use of Project Management Methodologies in Virtual and Distributed projects

Communication

Issues such as communication and coordination have led to the need for project management methodologies in virtual and distributed projects. Effective communication is a very important soft skill required by project managers. Appropriate ISD techniques decision and negotiation processes are needed to ensure that the proper channels are followed to encourage constant communication between distributed teams (*Sukhoo et al.* 2005).

It is generally agreed that effective communication is the key to the success of any endeavor in which people are involved (*Sukhoo et al.* 2005). During software development this is very important as progress and updates are needed to ensure everyone is working towards the same

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goals. Very often, aspects such as language, learning styles, communication networks, preferred learning mode, memory access and retrieval systems, attention and retention, and information processing and communication are simply disregarded (*Sukhoo et al.* 2005). Hence, team building and team development will be the manager's responsibility. The project manager will have to ensure and encourage individuals to join teams and create situations to promote effective teamwork (*Sukhoo et al.* 2005). This can be done through the use of a project management methodology. A specific structure has to be followed to ensure success.

Geographical, temporal and cultural differences

Other problems also challenge communication and are related to the fact that stakeholders can be distributed throughout different countries. The first of these problems is the time difference which signifies that timetables do not overlap or overlap for only a short period (*Aranda et al.* 2010*)*

Another factor is the geographical, temporal, and cultural distances. Cultural diversity is another problem when team members are distributed in different countries, since these countries tend to have diverse religions, languages, and customs (*Aranda et al.* 2010*).* A way of synchronizing or dealing with the cultural issues needs to be established. A project management methodology can help implement constant synchronization and learning between team members from different cultures.

Risk analysis

Risk analysis is important when selecting and planning the processes of a project's life cycle (O'Keefe and Chen, 2011). The project manager as well as other team members like senior management must consider the uncertainty of how a virtual team will be able to execute the project. While both collocated and virtual teams share the same risks, it is important for an additional level of managing risk in virtual and distributed projects which should be done throughout the projects life cycle.

From the literature reviewed it is evident that not much work has been covered on the use and effectiveness of project management methodologies in virtual and distributed projects. The different authors mainly highlight the challenges or issues faced when working on virtual and distributed projects which are, communication, geographical, temporal and cultural differences.

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Not much work has been covered on the types of project management methodologies used in virtual and distributed projects and whether these have been effective. It is, however, the aim of this study to analyse the project management methodologies used in virtual and distributed projects and how effective they have been while taking note of the opportunities offered as well as the challenges faced. This is covered in chapter 4 and chapter 5 of this study.

This chapter has looked at the different aspects of project management and virtual teams. Focus has also been given on the literature covered on the use and effectiveness of project management methodologies in virtual and distributed projects. The next chapter, chapter 3, looks at the research paradigm used for this study.

2.6 Conceptual Framework

After completing the literature review a framework was developed. The framework is shown in figure 2.6.1. The framework shows five main components which are: project management, project management methodologies, virtual and distributed projects, virtual and distributed teams and the team member. The components also highlight the main characteristics involved and how they are linked as explained in the different sections of chapter 2.

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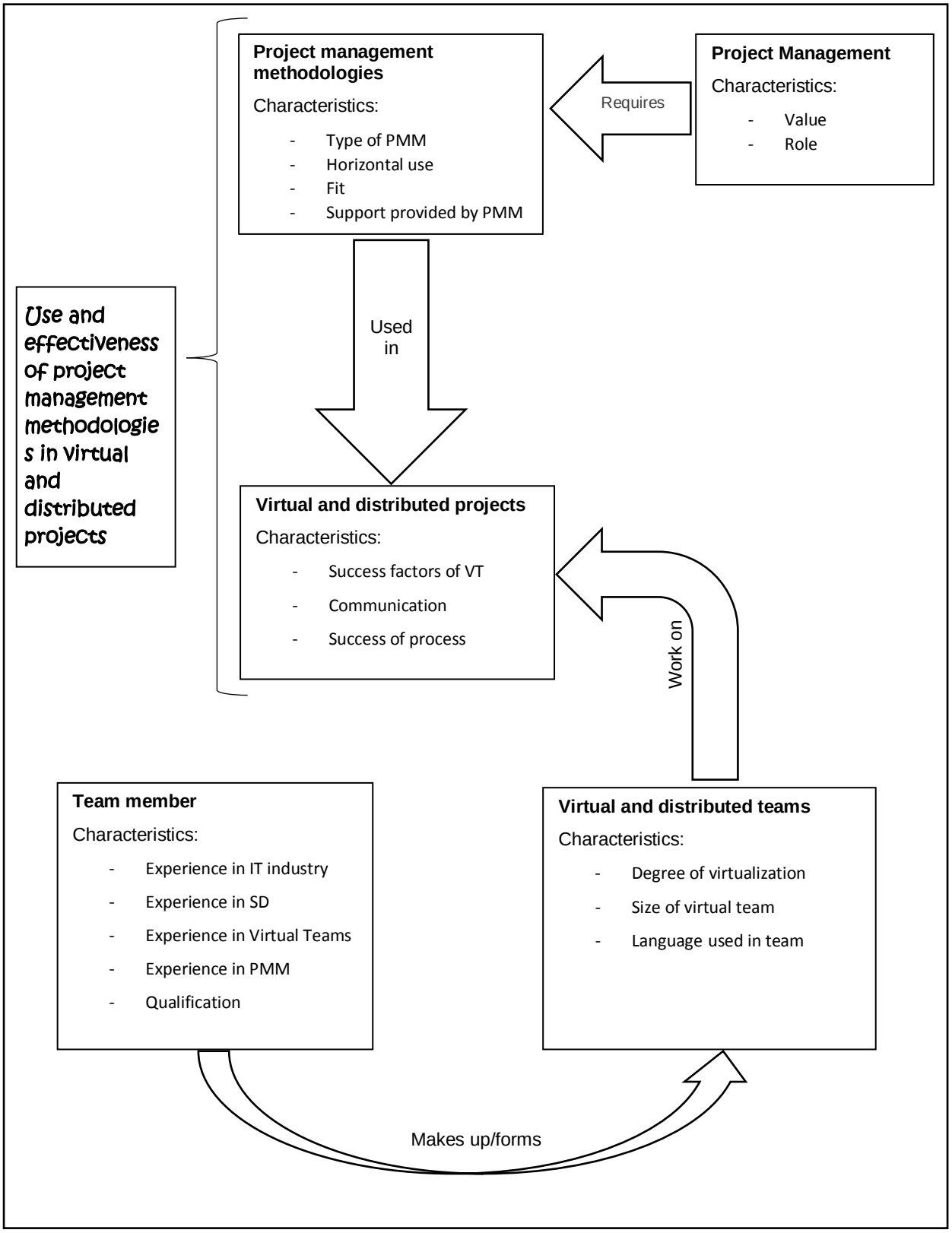
Fig 2.6.1 Overview of chapter 2 (Conceptual Framework)



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Chapter 3: Research Method

After looking at the literature covered by other authors in chapter 2, we move on to chapter 3 which covers the Research paradigm that will be used in this study. The following sections summarized in fig 3.1 will be looked at:

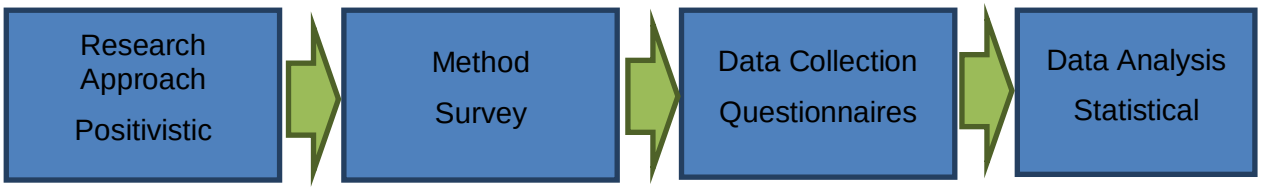
3.1 Research Approach – Positivistic (Scientific)

3.2 Method – Survey

3.3 Data Collection – Questionnaires

3.4 Data analysis: Statistical

Fig 3.1: Research Method



These sections are explained in detail below.

3.1 Research Approach: Positivistic

In this study the Positivistic approach will be followed. Research can be done using three approaches namely the positivistic, interpretive and critical social.

Positivistic research paradigm

The positivistic research paradigm is more of a hard paradigm. The positivistic paradigm is mainly associated with a positivist epistemology, deductive reasoning and quantitative or reductionist techniques, attributes which are often associated with rigor and objectivity (Pollack, 2006). Six characteristics of positivism: the world exists independent of humans, measurement and modelling, objectivity, hypothesis testing, quantitative data analysis and universal laws where highlighted by (Oates, 2006). These are explained below:

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- The world exists independent of humans:

  The positivistic paradigm sees the world as being operational without the human views. The observer is separate from the entities that are subject to observation (Johnson and Onwuegbuzie, 2004). In this study, the observer is not the one using project management methodologies in virtual and distributed projects and therefore is separated from the sample being observed. Since the observer is not part of the entities being observed his personal feelings do not play a part in the research as he was not part of the sample under study.

- Measurement and modelling

  According to the positivistic paradigm, for the separate world that was highlighted in the first point to be discovered they had to study it, deal with measurements and capture the results to produce models of how this separate world works. There is a wide range of statistical measures that have been developed as a means of measuring reliability and validity. These two criteria are taken as evidence of intellectual rigour in the positivistic paradigm (McGregor and Murnane, 2010). As a result one model would be produced for any part of the world. In this study, focus was given on how a sample of project managers and developers (programmers) and a few other Information Technology specialists were using project management methodologies in virtual and distributed projects and the effectiveness of these project management methodologies. Results of how the sample answered the questionnaire were captured and different methods of statistical data analysis were employed.

- Objectivity

  Researchers should do away with all bias, not become emotionally involved and not interfere with the objects of study, then test or empirically justify their stated hypotheses (Johnson and Onwuegbuzie, 2004). This was to say that the researcher was not supposed to be biased towards any specific outcome but had to be neutral and objective. Once the researcher considers his personal beliefs and opinions it would cease to be objective. In the research, study is based on the responses that were filled out on the questionnaires and

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the researchers' emotions or feelings were not part of this. If another researcher were to use the same responses on the questionnaires they would come up with the same results.

- Hypothesis testing

"The scientific approach to research, consists of the familiar process of proposing hypotheses as explanations of phenomena and then designing experiments to test the hypotheses" (McGregor and Murnane, 2010). This hypothesis is constantly tested to see if it's true. According to our knowledge not much is known about the research topic of this study. In order to state a hypothesis, one needs previous research to base the hypothesis upon. Since the formulation of hypotheses are problematic for this study, we attempt to answer research questions instead. Therefore, this work can be considered to be exploratory in nature,

- Quantitative data analysis

Positivism focuses on the scientific approach, which mainly deals with proving mathematical equations and models. Researchers work with different quantities as a way of analysing results. Quantitative purists believe that social observations should be treated as entities in much the same way that physical scientists treat physical phenomena (Johnson and Onwuegbuzie, 2004). Descriptive statistics, t-tests, factor analysis, KMO and Bartlett's test, Cronbach's alpha test, spearman's rho, Levene's test for equality of variance and non-parametric correlations were done in this research as part of the quantitative data analysis and these are further explained in section 3.4.

- Universal laws

Positivistic paradigms generalise research findings when the data is based on random samples of sufficient size. Laws that are universal are used no matter who uses them and no matter where they are done. In this study the aim is to apply the findings to the general Information Technology on the use and effectiveness of project management methodologies on virtual and distributed projects. When the positivism approach was

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chosen, the researcher took note of some of the criticisms identified by (Oates, 2006) below and also used different ways to counter act them:

- Reductionism

The paradigm assumes that it is always easy to break a complex situation into smaller parts, then study the smaller components until you work your way up. This might work for small non-complex problems or simple scientific problems but there are cases in which the problem cannot be broken down into its component parts. The situation would have to be studied as a whole.

In this study, the researcher found the approach most suitable to use as the research was easily broken down into various smaller tasks and tackled individually. From identifying the topic to identifying the sample to be studied, developing the questionnaires, capturing the results and doing the data analysis.

- Repetition

Chen and Hirschheim (2004) stated that with laboratory experiments, special treatments are used to study two or more controlled groups and are conducted in a real-world setting. McGregor and Murnane (2010) also highlighted the same point by saying that science is isolated from human beings, who are seen as objects to be studied and controlled where most of this research is contrived and happens in a laboratory or controlled setting, which does not resemble the real world of lived experiences.

When dealing with laboratory experiments or solving mathematical equations it is possible to repeat the process. It might, however, not be applicable when in the real world setting. Most of the variables change and to get the same setting it might be impossible. If you miss one chance, trying the process again might be a difficult challenge.

In this research it is not important to carry out the tests over and over again with the same sample as with laboratory experiments but to understand the use and effectiveness of project management methodologies in virtual and distributed projects for a specific sample. A sample of 700 IT specialists was selected and 162 responded. This was sufficient to carry out this research and do my analysis in chapter 4 and 5.

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- Generalising

Validity which looked at the strength of the conclusions and inferences, also referred to whether it is appropriate to generalize the findings of the research done to larger populations or settings other than those examined in the study (McGregor and Murnane, 2010). In as much as generalising makes it easier to do your research, be objective and come up with results, at times, unique and special patterns or features which are very important might be ignored. This will result in wrong conclusions being arrived at.

The researcher took note of this but used generalising as it gave a picture of what was actually happening rather than not having a clue. It is impossible to get views from everyone in the IT industry on the use and effectiveness of project management in virtual and distributed projects, hence it is important to study a certain sample and take note of all limitations. This way, we understand what goes on in the industry. From the sample done of the 162 IT specialists, analysis and conclusions were made in chapter 5, which were then applied to the general IT industry.

- Not everyone sees the world in the same way

The positivistic paradigm assumes that the world exists independently of humans. The weaknesses with this approach led to the ideas behind introducing the post-positivistic paradigm. According to McGregor and Murnane (2010), the post-positivistic paradigm assumes that research should not be value-free and unbiased but be value-laden, subjective and inter-subjective, even value-driven within the critical paradigm. The researcher and participants in the study should also have a say and should be seen as central to the research process, rather than isolated from it. In as much as we would want to eliminate the human factor, the humans play an important part in the world and their contributions are important.

The aim of this research was to describe the use and effectiveness of project management methodologies in virtual and distributed projects. Since we consider the nature of this research to be exploratory, our aim is to describe the current situation in South Africa, and not to understand the various opinions of individual IT professionals.

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Allthough the interpretive and critical social paradigm will not be used in this study, a short discussion of each is provided for the sake of completeness.

Interpretive paradigm

The interpretive paradigm focuses on the following characteristics identified by Oates (2006): multiple subjective realities, dynamic and socially constructed meaning, researcher reflexivity, study of people in their natural social setting, qualitative data analysis and multiple interpretations

- Multiple subjective realities

Interpretive research looks for various interpretations and aims to understand the often conflicting reality of the people involved in IS innovation (McGrath, 2005).

In the interpretive approach the researchers have different views of the same thing, be it the world, a project or any other aspects that can be researched. Unlike the positivistic approach, which is objective, the interpretative approach is subjective. The researchers' beliefs, actions and views shape the results of the research process.

The interpretive approach works with the soft paradigm in which humans and how they interact in their natural systems is studied. The soft paradigm is commonly associated with an interpretive epistemology, inductive reasoning, and exploratory, qualitative techniques, which emphasize contextual relevance rather than objectivity Pollack (2007) Different people can come up with different conclusions and both conclusions can be regarded as being correct.

- Dynamic, socially constructed meaning

The society, which is the individual or groups' shared meaning, shape up the reality. It is based within the interpretivist/contructivist paradigm that acknowledges the importance of context and the co-construction of knowledge between researcher and 'researched' (Mulhall, 2003)

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- Researcher reflexivity

  Qualitative research is generally explicitly reflexive; that is, researchers are often transparent about any biases they bring to the data, so that others reading their analysis can take that into consideration (Crabb and Chur-Hansen, 2009) when doing their research, researchers are usually biased and bring about their own assumptions to the field of study. This usually shapes the results of this study. In the interpretive approach researchers should, however acknowledge and highlight how they influenced the research process.

- Study of people in their natural social setting

  The interpretive approach aims to study people in their natural social setting. This way the best results should be generated. MULHALL (2003) highlighted the following from using unstructured observation when people are studied in their natural setting:

  • provides insight into interactions between dyads and groups;
  • illustrates the whole picture;
  • captures context/process;
  • informs about the influence of the physical environment.

  When the researcher is studying people in their natural setting they get to view the whole picture, all kinds of interactions and can also check how the physical environment influences the whole process. This is difficult to do when using experiments in which the study is done in a controlled environment. Using a lab setup can result in the researcher getting inaccurate results. The researcher aims to get input from the participants without influencing the environment or giving their own contributions to the situation.

  Qualitative research can also examine the language and literature of the field exposing various meta-communications and presuppositions (Hanna and Shank, 1995)

- Qualitative data analysis

  Unlike the positivistic approach which focuses on quantitative data analysis, the interpretive approach focuses on the words people use and the images they create (qualitative analysis). Researchers do not focus on the quantities but the meaning behind the results. Qualitative research is often defined by contrasting it to quantitative research in that its findings are not arrived at by statistical or other quantification procedures.

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Statistical or quantified procedures do not get into the detailed explanations that are needed in the interpretive approach (Hanna and Shank, 1995). With quantitative analysis, a lot of figures and quantities might be given but these do not explain things like the interactions and languages used in the field of study.

- Multiple interpretations

The interpretive approach does not have one interpretation which is viewed as correct but researchers expect many different interpretations from the same research. All these interpretations can be viewed as correct depending on the amount of supporting evidence given.

Critical social paradigm

The critical social paradigm, on the other hand, is associated with identifying power relations, conflicts and contradictions, and empowering people to eliminate them as sources of alienation and domination (Oates, 2006). The following characteristics have been identified for the critical social research paradigm:

- Emancipation

Criticalists advocate a reality that is constructed within a social– historical context. They derive concepts from the reality and events within power relations, and they use their research inquiry to help empower oppressed groups (Ponterotto, 2005). The critical researchers focus on liberating people from power relations that form our organisations and society as a whole. They study these power relations and find ways of freeing people from these (McGrath, 2005) Their aim is to understand the power relations that shape up organizations and the society, explain these to the oppressed and make a difference by empowering people. Scholars who embrace this particular paradigm argue that to truly understand society, we need to appreciate the complexities and contradictions of modern life. The researchers are more of activists, who want to make a difference and not be mere researchers (Kane and Maxwell, 2011).

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- Critique of tradition

  The critical researchers do not accept status quo but highlight and confront existing patterns of power and assumptions that are taken for granted by the society. In their research in sports.

- Non-performative intent

  The critical research paradigm believes in consensus decision making as compared to improving or increasing managerial efficiency and control. There are cases were organisations are now focusing on reducing the number of employees, overworking the employees that remain and getting maximised profits. Critical researchers are against such theories and try to make a difference or change to avoid such things from happening.

- Critique of technological determinism

  Critical researchers also argue that people and society can shape the technology that we develop as compared to the idea that technology development follows its own rules and the society is supposed to adjust to this (McGrath, 2005). In their research, McGrath (2005) aimed to empower people so that they would have a say and play a huge role in the changes in technology.

- Reflexivity

  With respect to sport media coverage, a critical theorist would ask whose voices, perspectives, and experiences are seen as valid and dominant? Or who are considered the "real," meaning the most important athletes by analyzing whom the media gives attention and credibility to. Critical researchers question the possibility of objective and value-free knowledge (Kane and Maxwell, 2011). They claim that knowledge is often shaped by those with power and vested interests. Criticalists take values a step further than constructivists in that they admittedly hope and expect their value biases to influence the research process and outcome (Ponterott, 2005) They also go a step further and highlight how they have also influenced the research process.

After looking at the different research paradigms, the Positivistic approach proved to be the best suited for this research, as the aim is to show the effectiveness of using a project management methodology in a virtual and distributed project. In the next section we will look at the research method used for the positivistic research approach.

3.2 Research method: Survey

In the positivistic research paradigm, various research methods like experiments, surveys, design and creations, can be used. The key is to select the most suitable for the research being done as well as the research paradigm chosen. In this study a survey was used. In their research Chen and Hirschheim (2004) found that, US journals, as opposed to European journals, are more positivistic, quantitative, cross-sectional and survey oriented. Positivistic paradigms tend to be quantitative and surveys can be used to gather the quantitative information (facts). According to their research they found that this is the most common way used by the positivists. Surveys gather data by means of questionnaires (Chen and Hirschheim, 2004). Surveys are done to systematically collect the same data from a large group of people. Standard questionnaires can be given to a large group of people, then they can give feedback. The researcher then tries to find a pattern on the given feedback. After identifying the patterns on the sample, the researcher then applies it to a larger population.

The survey was conducted from May 2013 to September 2013. A purposive selected sample of project managers, developers and other information technology specialists of about 700 people from mainly IT companies was chosen. Mainly IT development companies were targeted as they work on various types of projects ranging from small systems (for example library systems) to complex systems like banking applications. These companies also had experience in virtual and distributed projects which would make it easier to get the most relevant information for this research. The internet targeted software development companies plus word of mouth from colleagues and friends helped to create the IT sample. Questionnaires were sent to this group of people and 162 managed to give feedback on how they applied project management methodologies in

virtual and distributed projects they had last worked on. To track the responses an excel work book shown in fig 3.2.1 was used.

Fig 3.2.1: Monitoring feedback from questionnaires

	A	B	C	D	E	F	G
	Date	**Activity Description**	**Contact person**	**Feedback**	**Status**	**Comments**	
	27/05/2013	Questionnaire sent for pilot testing	name withheld	29/05/2013	complete		
		Questionnaire sent for pilot testing	name withheld	30/05/2013	complete	2 corrections made	
		Questionnaire sent for pilot testing	name withheld	30/05/2013	complete		
		Questionnaire sent for pilot testing	name withheld	01/06/2013	complete		
	03/06/2013	Questionnaire sent to Dimension Data - 5 IT Specialists	name withheld	03/06/2013	pending	3 received	
	03/06/2013	Questionnaire sent to I-Net Bridge - 1 IT Specialist	name withheld	03/06/2013	pending	none received	
	03/06/2013	Questionnaire sent to Maxxor -Project Manager	name withheld	14/08/2013	complete	1 received	

This made is easier to check the status and to send reminders (in the form of emails). Only two reminders were sent after every four days. If the individuals did not respond the status was captured as incomplete as some of them were too busy chasing after project deadlines. The responses received came from different companies and since this information was confidential it is difficult to give specific numbers of were the responses came from. Each response was captured on a separate excel work book for different quantitative analysis tests highlighted in section 3.1 (Quantitative data analysis) and explained in chapter 4. The results were then analysed in chapter 5 to establish a pattern between them.

Reasons for using a survey

Surveys are efficient when collecting information from a large number of respondents. After selecting the target group it was easier to send questionnaires via emails as well as visit different companies to gather all the necessary information. Many questions about the research topic where asked giving considerable flexibility to the data analysis.

Since the survey was standardized, All respondents in the target group got the same set of questions and for multiple choice questions, the same set of answers. This reduced errors like misinterpretation of questions and answering questions in an irrelevant way.

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Standardisation also helps when applying different statistical techniques to the survey data. This helps determine the validity, reliability, and statistical significance even when analyzing multiple variables.

While conducting the survey there are a few challenges that the researcher was aware of like the reliability of survey data which depended on the respondents' motivation, honesty, memory, and ability to respond. Some respondents are not motivated to participate in the surveys and therefore a strategy was applied to get the best responses from the target group. The respondents gave the different times where there would be free and relaxed to answer questions. All respondents were given enough time to complete the questionnaire even though some questionnaires were received way after the expected time.

The survey was mainly done in two ways which were drop-off questionnaires and distribution of questionnaires via electronic mails.

Drop-off questionnaires

This is an easier method of distributing the questionnaire for companies that are within reach. This method was used for companies that were close to the researchers' work place. This allowed the researcher to be selective about who to give the questionnaire to and an opportunity to explain what was needed from the different individuals and why the research was being done. As this was a purposive survey, a selection of knowledgeable respondents was made as there were people who did not know anything about the research topic and did not want to take part.

This was not always easy as it was time consuming and some people were reluctant to give up their time as they were working on other projects.

Electronic Mail

This was a better and easier way of carrying out this survey on part of the target group. It was cheaper as one email with the questionnaire was sent to various people without incurring any additional costs. It was also fast regardless of the persons' location as the emails were received a few seconds after being sent. This also made it easier to store the

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people's responses and to keep backup copies as it was already stored on the machines. Some people forwarded the questionnaire to their colleagues and friends and thereby getting responses from other people who had not been initially included in the target group, but who were knowledgeable about the research topic.

One challenge encountered by the researcher was that, it was difficult to tell the number of responses that would be received until a lengthy period had elapsed. To solve this problem the researcher had to constantly remind people in the target group to respond at their earliest convenience.

After looking at the research method, the focus was turned to the data collection method used in section 3.

3.3 Data collection method - Questionnaire

There are many ways of collecting data namely structured interviews, questionnaires, existing documents, observation, archival records and physical artifacts. In this study, questionnaires were used for the data collection as they were the most suited for the survey (Addendum C).

The questionnaire used consisted of questions that were developed by the researcher as well as questions adopted and adapted from other sources. After the first draft of the questionnaire it was sent to four people for pilot testing to ensure that the questions were valid and reliable. From the responses received, corrections were made and the questionnaire was resent for further testing before being finalized and sent to the individuals in the target group. A cover note explaining the purpose of the research was sent along with the questionnaire introducing the researcher and who to contact if the subject had any queries. The researcher provided a pre-defined set of questions with the questionnaire, which required the respondent to give one word answers or in most cases, selection of the most appropriate answer from a given list. These questions were based on the objectives mentioned in the research proposal and are summarized in table 3.3.1:

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Table 3.3.1 Question and research objectives mapping

Research Objectives	**Variable being tested**	**Question Number in Questionnaire**
- Review background of individual respondent	Age Qualifications Role Experience in IT industry Experience in SD Experience in Virtual Teams Experience in PMM Source of PMM training	Question 1 Question 2 Question 4 Question 5 Question 6 Question 7 Question 11 Question 3
- Describe characteristics of virtual and distributed **teams**	Degree of virtualization Size of virtual team Language used in team	Question 8 Question 9 Question 15
- Describe the characteristics of virtual and distributed **projects**	Success factors of VT Communication Success of process	Questions 14 Question 16 Question 22
- Identify the challenges faced by project managers who have worked in virtual teams.	challenges	Question 21
- Identify the opportunities experienced by project managers who have worked in virtual teams.	opportunities	Question 20
- Determine the use of PMM in virtual and distributed teams	Types of PMM Horizontal use Fit	Questions 10 Question 12 and 13 Question 19
- Determine the	Support provided by PMM	Question 17

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effectiveness of PMM in virtual and distributed teams	Impact	Question 18
- Determine the relationship between project management methodologies and the success of virtual and distributed projects	Support provided by PMM Impact Fit	Question 17 Question 18 Question 19

Each of the research objectives were listed in table 3.3.1. The variables to be tested for each objective were then listed and the questionnaire was developed to cover all these variables. From each questionnaire sent it was now easier for the researcher to collect all relevant information to address the objectives of this research. The Questions were created to get as much important feedback as possible to better understand the area of study.

In as much as this was a good way of getting quantitative information in the positivistic paradigm it had its own weaknesses. The questionnaire did not give an option for thorough explanations, plus the researcher could not ask further questions. This would have made the questionnaire longer and much more difficult to analyse.

After looking at the data collection method in this section, focus was now on the data analysis methods covered in section 3.4

3.4 Data analysis method(s) - Quantitative Analysis (Statistical)

The data analysis method that is mainly used within the positivistic paradigm is quantitative analysis. The difference between the quantitative and the qualitative analysis is that while quantitative analysis uses numerical analysis to show the relationship among factors in the phenomenon studied, qualitative describes and brings out an understanding of the situation behind the factors (Chen and Hirschheim,2004). The positivistic paradigm mainly deals with the numerical analysis and hence we can say it mainly uses quantitative analysis.

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Quantitative analysis involves things like regression analysis, likert scaling and structural equation modelling. The positivistic paradigm deals with things like statistics and hence statistical formulae for calculating regression can be used. As part of the quantitative data analysis, the following tests were used in this research: Descriptive statistics, t-tests, factor analysis, KMO and Bartlett's test, Cronbach's alpha test, spearman's rho, Levene's test for equality of variance and non-parametric correlations. A brief description of the tests done follows this paragraph:

Descriptive statistics

Descriptive statistics help the researcher and those using the research reports to better understand the research data by showing how the data is distributed among the possible range of values (McHugh, 2003). Descriptive statistics show different patterns and help those using the reports to understand whether data is grouped together at one variable or scattered throughout the possible range of values, also referred to this as measures of central tendency like the mean, median and mode (McHugh, 2003; Etchegaray, 2009).

To show the right picture of the data McHugh (2003) suggests using two selection criteria which are:

- Firstly, the level of measurement must match the measurement criteria specified by the particular statistic the researcher wants to use; and
- secondly the statistics should provide the information being sought by the researcher.

T-Tests

T-Tests allow for comparison of differences between two groups and is significant if the score is less than 0.05 (Etchegaray, 2012). The level of significance also known as the p value is used to quantify the probability that the null hypothesis is true with values ranging from 0.00 (0% chance that the null hypothesis is true) to 1.00 (100% chance that the null hypothesis is true) (Mowery, 2011). They use normal distributions to explain data in each of the two groups (Etchegaray, 2012; Kruschke, 2013).

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Factor Analysis

Factor analysis is used to bring out any latent variables that cause the manifest variables to co-vary (Costello and Osborne, 2005). Data reduction is used with the aim of removing redundant variables from the data while at times using a smaller number of uncorrelated variables. This is done to identify relationships between variables. KMO and Bartlett's test, which shows the proportion of variance in the variables caused by underlying factors, was used as part of the factor analysis.

Reliability tests

Reliability tests using Cronbach's Alpha test were also done to measure reliability of a scale (Field, 2005)

Non-parametric correlations

Spearman's rho was used as part of the non-parametric correlations. The spearman's correlation is a standardized measure of the strength of relationship between two variables that do not depend on assumptions of a parametric test (Field, 2005).

After doing the quantitative analysis the results will be analysed in chapter 5. This will help show the use and effectiveness of project management methodologies in virtual and distributed projects. Weaknesses and challenges of the method used will also be highlighted as part of the results.

A description of the research paradigm used, the method, data collection and data analysis used, were explained in this chapter based on the available literature. The next chapter (Chapter 4) looks at the different tests being applied and the results obtained.

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Chapter 4: Results

Questionnaires were sent to around seven hundred IT people and one hundred and sixty two responded. The same copy of questionnaire was sent to all and it covered the individual's educational background, experience in the IT industry, experience with virtual teams, project management methodologies used in the last virtual and distributed project, project characteristics, cultural differences, communication, project management methodologies and the project outcomes. Chapter 4 is based on the results of the analysis done on the survey while covering each of the sections covered by the questionnaire. The following tests were performed on the questionnaires filled out by the different respondents and will be covered in this chapter:

4.1 Descriptive Statistics

4.2 Factor Analysis

4.3 Reliability Analysis

4.4 Non-parametric correlations

4.5 T-tests

4.6 Regression Analysis

Please note that a discussion of the results will follow in the next chapter.

4.1 Descriptive Statistics

A survey of 162 Information Technology (IT) specialists, mainly consisting of programmers and project managers was done to assess the use and effectiveness of project management methodologies in virtual and distributed teams. The results of the descriptive statistics from the survey are summarized and explained in the tables below:

4.1.1 Individual and Educational background

The questionnaire was sent to individuals in different age groups. Their age groups were captured and summarised in Table 4.1 below:

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4.1.1.1 Age

Table 4.1: Age range

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20 - 25	39	24,1	24,1	24,1
	26 - 30	54	33,3	33,3	57,4
	31 - 35	37	22,8	22,8	80,2
	36 - 40	18	11,1	11,1	91,4
	41 - 50	10	6,2	6,2	97,5
	51 - 60	4	2,5	2,5	100,0
	Total	**162**	**100,0**	**100,0**	

From the survey done the majority (33.3%) was in the 26 – 30 years age group, followed by 20 – 25 years (24.1%) and 31 – 35 years (22.8%) respectively. From table 4.1 it can be seen that most respondents, (80%) were younger than 36 years of age. The remaining 20% were in the 36 – 60 age group.

4.1.1.2 Highest Qualification

The highest qualifications, for each of the respondents, was also captured to assess their levels of education and the results were summarized in table 4.2.

The results show that at least 74.1% of the respondents had at least a university/ technicon degree, Honors/Masters degree or a PhD showing that the majority of the respondents were highly educated.

Table 4.2: Highest Qualification

	Frequency	Percent	Valid Percent	Cumulative Percent
Senior certificate (High School)	2	1,2	1,2	1,2
Certificate/Diploma	38	23,5	23,5	24,7
University/ Technicon Degree	51	31,5	31,5	56,2
No answer	1	,6	,6	56,8
Honors/ Masters degree	64	39,5	39,5	96,3
PhD degree	5	3,1	3,1	99,4
Other	1	,6	,6	100,0
Total	**162**	**100,0**	**100,0**	

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4.1.1.3 Source of project management training

After assessing the highest qualification the respondents had to highlight where they learnt about project management methodologies. They could select either one or more of the following different options:

- 1. University
- 2. Technicon or Technical college
- 3. Training provided at work
- 4. Taught by other colleagues at work
- 5. Self-study

Table 4.3: Source of PMM training

	Frequency	Percent	Valid Percent	Cumulative Percent
University	103	37,6	37,6	37,6
Technicon or Technical college	42	15,3	15,3	52,9
Training provided at work	53	19,3	19,3	72,2
Taught by colleagues at work	37	13,5	13,5	85,8
Self-study	39	14,2	14,2	100
Total	**274**	**100**	**100**	

Most of the respondents, 52.9% highlighted having learnt about project management methodologies while at a university, technicon or technical college, while the rest learnt from either self-study or on the job.

4.1.1.4 Job Title/Role

To get a clearer picture on the work experience of the respondents, they were asked to give their job titles. These were captured and summarized in table 4.4 as follows:

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Table 4.4: Job Title/Role

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Project Manager	30	18,5	18,5	18,5
	Programmer	70	43,2	43,2	61,7
	Software Tester	**11**	6,8	6,8	68,5
	Head of IT	7	4,3	4,3	72,8
	Systems Analyst	14	8,7	8,7	81,5
	IT Support	20	12,3	12,3	93,8
	Networks	4	2,5	2,5	96,3
	Applications Development	6	3,7	3,7	100,0
	Total	**162**	**100,0**	**100,0**	

43.2% of the respondents were programmers ranging from junior to senior programmers. They also had experiences in different development languages like C# and Java. Project managers were 18.5% of the respondents which was the second largest group. The network administrators were the least with 2.5%.

4.1.1.5 Experience working in the IT environment

Table 4.5 was also used to check how much experience the respondents had in the IT industry, where most had 3 – 5 years. This was 26.5% of the respondents, closely followed by 5 – 10 years which was 25.9%. The group, however, had a few people with more than 10 years' experience and this was just 10.5% of the respondents. We can attribute this to the fact that the respondents were relatively young.

Table 4.5: Experience in IT industry

	Frequency	Percent	Valid Percent	Cumulative Percent
Less than a year	35	21,6	21,6	21,6
1 – 2 years	25	15,4	15,4	37,0
3 – 5 years	43	26,5	26,5	63,6
5 – 10 years	42	25,9	25,9	89,5
More than 10years	17	10,5	10,5	100,0
Total	**162**	**100,0**	**100,0**	

4.1.1.6 Experience in Systems Development

From experience in the IT industry an analysis was also performed to check how much of this had been spent developing systems and the results were captured in table 4.6 below:

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Table 4.6: Experience in systems development

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	6	3,7	3,7	3,7
	Less than 1 year	40	24,7	24,7	28,4
	1 – 2 years	31	19,1	19,1	47,5
	3 – 5 years	46	28,4	28,4	75,9
	5 – 10 years	33	20,4	20,4	96,3
	More than 10 years	6	3,7	3,7	100,0
	Total	**162**	**100,0**	**100,0**	

Most of the respondents had 3 – 5 years' experience while 3.7% had more than ten years' experience. Another significant group was the one with less than a years' experience in systems development with 24.7% of the survey group.

4.1.1.7 Experience working in virtual teams

From this group 28.4% had less than a year working in virtual and distributed projects closely followed by 27.8% of the respondents which had 3 – 5 years' experience. The least had more than 10 years' experience (2.5%) followed by 5.6% which had no experience working in virtual and distributed projects, summarized in the table below:

Table 4.7: Experience working in virtual and distributed teams

	Frequency	Percent	Valid Percent	Cumulative Percent
None	9	5,6	5,6	5,6
Less than 1 year	46	28,4	28,4	34,0
1 – 2 years	37	22,8	22,8	56,8
3 – 5 years	45	27,8	27,8	84,6
5 – 10 years	21	13,0	13,0	97,5
More than 10 years	4	2,5	2,5	100,0
Total	**162**	**100,0**	**100,0**	

4.1.1.8 Degree of virtualisation

From experience in virtual and distributed projects, the degree of virtualisation and distribution was analysed. The respondents were asked to highlight the degree of virtualisation of the last project they had worked on and the results were summarised in table 4.8 below:

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Table 4.8: Degree of virtualisation and distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Within the same city	37	22,8	22,8	22,8
	Within the same country	54	33,3	33,3	57,3
	Different countries	26	16,0	16,0	73,3
	All environments	37	22,8	22,8	94,9
	No answer	8	5,1	5,1	100
	Total	**162**	**100,0**	**100,0**	

The most respondents (33.3%) stated that the last project they had worked on had the project being distributed within the same country, followed by within the same city and all environments with both having 22.8%.

4.1.1.9 Virtual and distributed team size

The size of the virtual and distributed teams where each IT respondent had worked was also analyzed in table 4.9 below to understand the most frequent team sizes used.

Table 4.9: Size of virtual and distributed team

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2 – 5 people	42	25,9	25,9	25,9
	6 – 10 people	51	31,5	31,5	57,4
	11 – 20 people	37	22,8	22,8	80,2
	21 – 50 people	20	12,3	12,3	92,6
	51 – 100 people	2	1,2	1,2	93,8
	more than 100 people	1	,6	,6	94,4
	No answer	9	5,5	5,6	100,0
	Total	**162**	**100,0**	**100,0**	

The majority, 31.5%, mentioned having worked in project teams of 6 – 10 people in their last virtual and distributed projects. Only 0.6% worked in a virtual and distributed project of more than a hundred team members. 5.5% did not give an answer to the question.

4.1.1.10 Project management methodologies used

One of the objectives of this research was to identify the project management methodologies that are used in virtual and distributed projects. Of the 162 IT specialists, 18 (9.2%) did not specify the project

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management methodology they had used, 128 used only one project management methodology, 11 (5.6%) used a combination of two project management methodologies and 5 (2.5%) used a combination of three project management methodologies in the last virtual and distributed project they had worked on. The summaries are highlighted in the table below:

Table 4.10: Types of project management methodologies used

Methodology	Frequency	Percentage	Cumulative Percentage
PRINCE 2 (Projects IN Controlled Environments)	42	21,3	21,3
PMBOK	51	25,9	47,2
Agile Project Management Methodology	20	10,2	57,4
Scrum	14	7,2	64,6
DSDM (Dynamic Systems Development Methodology)	5	2,5	67,1
SDLC (Systems Development Life Cycle)	13	6,6	73,7
UPMM (Unified Project Management Methodology)	5	2,5	76,2
MTP (Managing Information Technology Projects)	4	2,0	78,2
MBP (Managing By Project)	2	1,0	79,2
AdPM (Achievement-driven Project Management Methodology)	3	1,5	80,7
ITIL (Information Technology Infrastructure Library)	1	0,5	81,2
PMMM (Project Management Methodology Manager)	3	1,5	82,7
No Project Management Methodology specified	18	9,2	91,9
Used two project management methodologies	11	5,6	97,5
Used three project management methodologies	5	2,5	100
Total	**197**	**100**	**100**

The mostly used project management methodologies were PMBOK (25.9%) followed by PRINCE 2 (21.3%), which is adaptable and flexible. This might be as a result of people still sticking to the tried and tested project management methodologies. Less people in the survey made use of uncommon project management methodologies as well as in-house methodologies.

Some people highlighted system development methodologies instead of project management methodologies due to different reasons. This is further discussed in chapter five under the

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objective, “Identify the project management methodologies that are used in virtual and distributed projects.”

4.1.1.11 Experience using project management methodologies

After having come up with the project management methodologies used the experience in using these project management methodologies was assessed and captured in table 4.11 below:

Table 4.11: Experience using Project Management Methodologies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	9	5,6	5,6	5,6
	Less than 1 year	42	25,9	25,9	31,5
	1 – 2 years	49	30,2	30,2	61,7
	3 – 5 years	42	25,9	25,9	87,7
	5 – 10 years	15	9,3	9,3	96,9
	More than 10 years	4	2,5	2,5	99,4
	no answer	1	,6	,6	100,0
	Total	162	100,0	100,0	

Most respondents, 30.2%, had one to two years’ experience in using project management methodologies. Those who had less than one years’ experience and between three and five years had the same number of respondents which was 25.9%. Only 2.5% of the respondents had more than ten years’ experience. The survey group mainly consisted of a younger group, discussed earlier under section 4.1.1.1, which might be the cause for having the majority of people with less than 2 years’ experience in using project management methodologies.

4.1.1.12 Frequency of PMM application (horizontal use)

After highlighting their experienced in using project management methodologies the respondents had to highlight how frequently they had applied it in the last virtual and distributed project. This was captured in table 4.12.

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Table 4.12: Frequency of applying PMM in last virtual and distributed project					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	8	4,9	4,9	4,9
	Once a month or less	14	8,6	8,6	13,6
	A few times in a month	34	21,0	21,0	34,6
	A few times in a week	35	21,6	21,6	56,2
	Several times in a week	39	24,1	24,1	80,2
	Every working day	28	17,3	17,3	97,5
	No answer	4	2,5	2,5	100,0
	Total	**162**	**100,0**	**100,0**	

Most respondents, 24.1% highlighted that they applied project management methodologies several times in a week followed by those who applied it a few times in a week at 21.6%. Only 4.9% of the respondents did not apply project management methodologies in their virtual and distributed projects. 92.6% of the IT people indicated that they somehow made use of project management methodologies, be it once a month or every working day.

4.1.1.13 Duration of PMM application (horizontal use)

The respondents were also asked how long they had applied the project management methodologies in the last virtual and distributed projects. The most people, 25.9%, had applied project management methodologies for one to two hours. The least, 4.9%, had never applied the methodologies. All the information was summarized in table 4.13.

Table 4.13: Duration of applying PMM in a day

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	8	4,9	4,9	4,9
	Less than 30min	16	9,9	9,9	14,8
	Between 30min and 1 hr	27	16,7	16,7	31,5
	1 – 2 hours	42	25,9	25,9	57,4
	2 – 4 hours	33	20,4	20,4	77,8
	4 – 6 hours	13	8,0	8,0	85,8
	More than 6 hours	19	11,7	11,7	97,5
	No answer	4	2,5	2,5	100,0
	Total	**162**	**100,0**	**100,0**	

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Only 4.9% had highlighted never using project management methodologies. The results of table 4.13 are closely linked to the results in table 4.12, which shows that most of the respondents use the methodologies extensively.

SUCCESS FACTORS FOR Virtual and Distributed Teams

The next section will describe the descriptive statistics of the success factors for virtual and distributed teams.

4.1.1.14 Face-to-face interaction

Different factors also contribute to how project management methodologies are applied to virtual and distributed projects and in this study the researcher looked at, face to face interactions, time separation, language and customs and the amount of information coming from multiple sources. As part of the questionnaire, a Likert scale (1 being no effect to 5 being a huge effect) was used and the IT specialists were asked to highlight if these factors had no effect, some effect or huge effect on virtual and distributed projects. Their responses were captured in the tables 4.14, 4.15, 4.16, 4.17 and 4.18 below:

Table 4.14: Lack of face to face communication in the virtual and distributed project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No effect	14	8,6	8,6	8,6
	2	33	20,4	20,4	29,0
	3	54	33,3	33,3	62,3
	4	42	25,9	25,9	88,3
	Huge effect	11	6,8	6,8	95,1
	No answer	3	4,9	4,9	100,0
	Total	**162**	**100,0**	**100,0**	

33.3% of the respondents didn't feel strongly about it and were undecided as to whether lack of face to face communication had an effect or no effect. This was followed by 25.9% who saw lack of face to face communication as having some effect. The lowest percentage was 6.8 who saw it as having a huge effect while 8.6% saw it as having no effect.

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4.1.1.15 Time separation between sites

Table 4.15: Effect of time separation between virtual and distributed sites

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No effect	36	22,2	22,2	22,2
	2	26	16,0	16,0	38,3
	3	52	32,1	32,1	70,4
	4	29	17,9	17,9	88,3
	Huge effect	10	6,2	6,2	94,4
	No answer	9	5,6	5,6	100,0
	Total	**162**	**100,0**	**100,0**	

Table 4.15 covered the effect of time separation between the virtual and distributed sites. Most respondents, 32.1% were undecided followed by 22.2% who saw this as having no effect. Only 6.2% saw this factor as having a huge effect on the virtual and distributed project.

4.1.1.16 Religion effect

Since the virtual and distributed teams consisted of different individuals with different backgrounds, the effect of different religions was looked at in table 4.16 below:

Table 4.16: Effect of different religions in the virtual and distributed project team

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No effect	62	38,3	38,3	38,3
	2	29	17,9	17,9	56,2
	3	38	23,5	23,5	79,6
	4	20	12,3	12,3	92,0
	Huge effect	4	2,5	2,5	94,4
	No answer	9	5,6	5,6	100,0
	Total	**162**	**100,0**	**100,0**	

The most respondents (38.3%) saw this as having no effect on the success of the virtual and distributed project with 2.5% saying it had an effect.

4.1.1.17 Language and customs

Apart from the above factors, the researcher also asked about the effect of language and customs in the success of the virtual and distributed project and the results are summarized as follows in table 4.17:

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Table 4.17: Effect of language and customs in the virtual and distributed project team

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No effect	49	30,2	30,2	30,2
	2	37	22,8	22,8	53,1
	3	39	24,1	24,1	77,2
	4	21	13,0	13,0	90,1
	Huge effect	8	4,9	4,9	95,1
	No answer	8	4,9	4,9	100,0
	Total	**162**	**100,0**	**100,0**	

30.2% saw language and customs as having no effect while only 4.9% saw it as having a huge effect.

4.1.1.18 Information from multiple sources

The greatest issues were caused by gathering information from multiple sources. 51.9% saw this factor as having an effect on the virtual and distributed projects while only 3.7% saw it as having no effect. More results on this factor are summarized in table 4.18.

Table 4.18: Effect of huge amount of information coming from multiple sources

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No effect	6	3,7	3,7	3,7
	2	23	14,2	14,2	17,9
	3	41	25,3	25,3	43,2
	4	68	42,0	42,0	85,2
	Huge effect	16	9,9	9,9	95,1
	No answer	8	4,9	4,9	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.19 Language

How language used by team members was also assessed in table 4.19. Most team members selected one language which everyone was familiar with. 40.7% understood this language at a high level. The least was 1.2% with the team members selecting a common language and understanding it at a low level.

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Table 4.19: Effect of language used by virtual and distributed project team members

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	All members from the same country and used mother tongue	8	4,9	4,9	4,9
	Common language selected and team members understood at a high level	58	35,8	35,8	40,7
	Common language selected, team members understood at medium to high level	55	34,0	34,0	74,7
	Common language selected, team members understood at an intermediate level	26	16,0	16,0	90,7
	Common language selected, team members understood at a low to intermediate level	4	2,5	2,5	93,2
	Common language selected, team members understood it at a low level	2	1,2	1,2	94,4
	No answer	9	4,6	4,6	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.20 Communication

The researcher went on to ask the respondents to highlight the stages in the virtual and distributed projects where they had encountered problems caused by lack of face to face interaction. The respondents were allowed to select multiple answers from the ones highlighted below:

- 1. No problems were encountered because of this factor
- 2. Requirements elicitation
- 3. Allocation of duties
- 4. Feedback on the allocated tasks
- 5. Gathering information from multiple sources
- 6. Throughout the whole project

Their responses are tabulated in table 4.20 below:

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Table 4.20: Stages were most problems were encountered

	Frequency	Percent	Valid Percent	Cumulative Percent
No Problems encountered	9	3,8	3,8	3,8
Requirements elicitation	20	8,4	8,4	12,2
Allocation of duties	26	10,9	10,9	23,1
Feedback on allocated tasks	83	34,9	34,9	58
Gathering information	54	22,7	22,7	80,7
Throughout the whole project	36	15,1	15,1	95,8
No answer	10	4,2	4,2	100
Total	**238**	**100**	**100**	

Most of the IT specialists, that is 57.6%, highlighted that they had issues with feedback on allocated tasks as well as getting information from multiple sources, followed by 15.1% who had issues throughout the whole project.

Support Provided by Project management methodologies in virtual and distributed projects

From 4.1.1.21 to 4.1.1.34 focus is on support provided by project management methodologies in virtual and distributed projects. The different aspects are explained below:

4.1.1.21 Align project to the business

The IT specialists were then asked to if the project management methodology they had used aligned the virtual and distributed project to the business requirements and the results were captured in table 4.21 shown below.

Table 4.21: PMM helped align virtual and distributed project to the business

	Frequency	Percent	Valid Percent	Cumulative Percent
Totally disagree	0	0	0	0
2	12	7,4	7,4	7,4
3	36	22,2	22,2	29,6
4	74	*45,7	45,7	75,3
Totally Agree	31	*19,1	19,1	94,4
No answer	9	5,6	5,6	100,0
Total	**162**	**100,0**	**100,0**	

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Most of the IT specialists, *64.8%, agreed or totally agreed that the project management methodology had helped to align the project to the business, while a few (*7.4%) disagreed.

* Note - 64.8% is calculated by adding 4 (partly agree) and 5 (totally agree)

* Note – 7.4% is calculated as 1 (Totally disagree) plus 2 (partly disagreed)

4.1.1.22 Involvement of end-user in virtual and distributed projects

Table 4.22 below was also used to capture the results of how the different IT specialists viewed project management methodologies when it came to user involvement in virtual and distributed projects.

Table 4.22: PMM helped to involve end-user in virtual and distributed projects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	2	1,2	1,2	1,2
	2	18	11,1	11,1	12,3
	3	49	30,2	30,2	42,6
	4	57	35,2	35,2	77,8
	Totally agree	27	16,7	16,7	94,5
	No answer	9	5,5	5,5	95,1
	Total	**162**	**100,0**	**100,0**	

Most of the IT specialists, 51.9%, agreed that the project management methodology had helped to involve end-users in their latest virtual and distributed project. 12.3% disagreed or totally disagreed.

4.1.1.23 Decompose virtual project into workable parts

The researcher went on to ask if project management methodologies had helped decompose the last virtual and distributed project into workable parts and the results were captured in the following table: (table 4.23)

Table 4.23: PMM helped decompose the virtual and distributed project into workable parts

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	1	,6	,6	,6
	2	15	9,3	9,3	9,9
	3	31	19,1	19,1	29,0
	4	70	43,2	43,2	72,2
	Totally agree	36	22,2	22,2	94,5
	No answer	9	5,5	5,5	100,0
	Total	**162**	**100,0**	**100,0**	

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65.4% of the IT specialists' agreed that the project management methodology had helped decompose the virtual and distributed project into workable parts. 9.9% of them disagreed that project management methodologies had helped decompose the virtual and distributed project.

4.1.1.24 Estimate time and effort to complete virtual and distributed project

The majority, 67.3%, of the same survey population highlighted in table 4.24 that project management methodologies had helped estimate the time and effort required to complete the virtual and distributed project as compared to 0.6%, who totally disagreed with this point.

Table 4.24: PMM helped estimate time and effort required to complete the virtual and distributed project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	1	,6	,6	,6
	2	14	8,6	8,6	9,3
	3	29	17,9	17,9	27,2
	4	69	42,6	42,6	69,8
	Totally agree	40	24,7	24,7	94,4
	No answer	9	5,5	5,5	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.25 Definition of useful milestones in virtual and distributed projects

Another factor considered was if the use of project management methodologies helped to define useful milestones in the last virtual and distributed project. In table 4.25 most of the IT specialists, 54.3% agreed that the project management methodology had been useful in defining the milestones in the last virtual and distributed project they had worked on. Only 6.1% disagreed while 33.3% neither agreed nor disagreed.

Table 4.25: PMM helped define useful milestones in the last virtual and distributed project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	2	1,2	1,2	1,2
	2	8	4,9	4,9	6,2
	3	54	33,3	33,3	39,5
	4	74	45,7	45,7	85,2
	Totally agree	14	8,6	8,6	93,8
	No answer	10	6,2	6,2	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.26 Control of virtual and distributed project

Control is another important factor that was being looked at. Table 4.26 was used to summarize the responses on whether the project management methodology used had

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helped keep the last virtual and distributed project under control. The majority at 54.9% agreed that use of the project management methodology had helped keep the virtual and distributed project under control. Only 11.8% disagreed.

Table 4.26: PMM helped keep the last virtual and distributed project under control

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	3	1,9	1,9	1,9
	2	16	9,9	9,9	11,7
	3	44	27,2	27,2	38,9
	4	64	39,5	39,5	78,4
	Totally agree	25	15,4	15,4	93,8
	No answer	10	6,2	6,2	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.27 Develop a more functional project

Assessment was also performed to check if the project management methodology had helped develop a more functional project. None of the respondents totally disagreed whereas 48.1% partly agreed as shown in table 4.27.

Table 4.27: PMM helped develop a more functional project in the last virtual and distributed project

		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally disagree	0	0	0	0
Valid	2	21	13,0	13,0	13,0
	3	38	23,5	23,5	36,4
	4	78	48,1	48,1	84,6
	Totally agree	16	9,9	9,9	94,4
	No answer	9	5,6	5,6	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.28 Develop a more reliable system

When asked if the project management methodology had helped develop a more reliable system (table 4.28) in their last virtual and distributed project, none of the IT specialists totally disagreed, and 10.5% partly disagreed. 13.6% totally agreed that the project management methodology had helped develop a more reliable system.

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Table 4.28: PMM helped develop a more reliable system in the last virtual and distributed project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	17	10,5	10,5	10,5
	3	49	30,2	30,2	40,7
	4	65	40,1	40,1	80,9
	Totally agree	22	13,6	13,6	94,4
	No answer	9	5,6	5,6	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.29 Develop a maintainable system

Apart from building a reliable system the IT specialists were also asked if the project management methodology had helped develop a more maintainable system (table 4.29) in the last virtual and distributed project, where 64.2% had agreed that it had. Only 9.2% disagreed.

Table 4.29: PMM helped develop a more maintainable system in last virtual and distributed project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	1	,6	,6	,6
	2	14	8,6	8,6	9,3
	3	32	19,8	19,8	29,0
	4	92	56,8	56,8	85,8
	Totally agree	12	7,4	7,4	93,2
	No answer	11	6,8	6,8	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.30 Provide Guidelines of working on a virtual and distributed project

As part of the topic it was part of the objectives to understand if the project management methodology used in the last virtual and distributed project had provided useful guidelines of working on the project. The question was asked to all respondents and the results were summarized in table 4.30.

Table 4.30: PMM provided useful guidelines of working on a virtual and distributed project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	12	7,4	7,4	7,4
	3	45	27,8	27,8	35,2
	4	84	51,9	51,9	87,0
	Totally agree	12	7,4	7,4	94,4
	No answer	9	5,6	5,6	100,0
	Total	**162**	**100,0**	**100,0**	

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58.3% of the survey population agreed that useful guidelines had been provided by the project management methodology while working on the virtual and distributed project.

4.1.1.31 Ideal process of working on a virtual and distributed project

After checking if useful guidelines had been provided it was important to check if the project management methodology had defined an ideal process of working in virtual and distributed projects. A summary of the results is shown in table 4.31 where 51.9% (majority) agreed that it had defined an ideal process.

Table 4.31: PMM defined an ideal process of working in virtual and distributed projects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	3	1,9	1,9	1,9
	2	17	10,5	10,5	12,3
	3	49	30,2	30,2	42,6
	4	67	41,4	41,4	84,0
	Totally agree	17	10,5	10,5	94,4
	No answer	9	5,6	5,6	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.32 PMM helped stakeholders learn from virtual and distributed projects

The survey was also done to check if the use of project management methodologies had helped stakeholders learn from working on a virtual and distributed project and 52.5% agreed that it had.

Table 4.32: PMM helped stakeholders learn from working on a virtual and distributed project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	1	,6	,6	,6
	2	15	9,3	9,3	9,9
	3	52	32,1	32,1	42,0
	4	53	32,7	32,7	74,7
	Totally agree	32	19,8	19,8	94,4
	No answer	9	5,6	5,6	100,0
	Total	**162**	**100,0**	**100,0**	

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4.1.1.33 Achieve objectives of virtual and distributed project

The results of table 4.32 were also related to checking if the project management methodology used in the last virtual and distributed project had helped achieve the objectives of the virtual and distributed project in table 4.33, where 35.2% partly agreed that it had. Only 2.5% felt that the use of project management methodologies had not helped achieve the objectives.

Table 4.33: PMM helped achieve objectives of the virtual and distributed project

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	4	2,5	2,5	2,5
	2	16	9,9	9,9	12,3
	3	53	32,7	32,7	45,1
	4	57	35,2	35,2	80,2
	Totally agree	22	13,6	13,6	93,8
	No answer	10	6,2	6,2	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.34 Increase of project teams morale

In table 4.34 39.5% of the IT specialists were undecided whether the project management methodology had increased the morale of the project team. Only 2.5% totally disagreed that the morale of the project team had been increased.

Table 4.34: PMMs helped increase the morale of the virtual and distributed project team

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	4	2,5	2,5	2,5
	2	26	16,0	16,0	18,5
	3	64	39,5	39,5	58,0
	4	51	31,5	31,5	89,5
	Totally agree	6	3,7	3,7	93,2
	No answer	11	6,8	6,8	100,0
	Total	**162**	**100,0**	**100,0**	

When asked about the support provided by the project management methodology from 4.1.1.21 to 4.1.1.34 the responses were mainly positive, that is, on average more respondents had either agreed or totally agreed as compared to disagreeing or disagreeing to the support provided.

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Experience with project management methodologies in virtual teams

The following section looks at how different factors affect virtual and distributed projects and teams.

4.1.1.35 Solve cultural differences between project team members

In table 4.35 a greater percentage of 42.6% neither agreed no disagreed that the project management methodology used in the last virtual and distributed project had solved cultural differences between team members. Only 2.5% had totally agreed that the project management methodology had in fact helped in solving cultural differences.

Table 4.35: PMM helped solve cultural differences between virtual and distributed project team members

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally Disagree	20	12,3	12,3	12,3
	2	26	16,0	16,0	28,4
	3	69	42,6	42,6	71,0
	4	33	20,4	20,4	91,4
	Totally agree	4	2,5	2,5	93,8
	No answer	10	6,2	6,2	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.36 Issues caused by working from different locations

There are issues which are normally caused by working from different locations that vary from lack of face to face communication or working in different time zones that were considered and captured in table 4.36. 58.7% of the IT specialists agreed or totally agreed that the project management methodology used in the last virtual and distributed project had assisted in solving issues caused by being at different locations.

Table 4.36: PMM helped deal with issues caused by working from different locations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	4	2,5	2,5	2,5
	2	12	7,4	7,4	9,9
	3	40	24,7	24,7	34,6
	4	73	45,1	45,1	79,6
	Totally agree	22	13,6	13,6	93,2
	No answer	11	6,8	6,8	100,0
	Total	**162**	**100,0**	**100,0**	

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4.1.1.37 PMM allowed contribution and discussions from different team members

This was related to checking if the project management methodology used in the last virtual and distributed project had allowed contributions and discussions from different team members covered by the results in table 4.37. The greatest percentage of 44.4% agreed or totally agreed that this had allowed contribution and discussions.

Table 4.37: PMM allowed contribution and discussions from different team members

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	3	1,9	1,9	1,9
	2	17	10,5	10,5	12,3
	3	58	35,8	35,8	48,1
	4	53	32,7	32,7	80,9
	Totally agree	19	11,7	11,7	92,6
	No answer	12	7,4	7,4	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.38 Challenges worsened by using PMM in virtual and distributed projects

In contrast to the results covered in table 4.37, the IT specialists were also asked if the project management methodology used in the last virtual and distributed project had worsened the challenges faced in the last virtual and distributed project where the greater part, 57.4%, of the respondents disagreed or totally disagreed that the challenges had been exacerbated as shown in table 4.38 and only 6.2% agreed to this.

Table 4.38: PMM worsened challenges faced in the virtual and distributed projects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	58	35,8	35,8	35,8
	2	35	21,6	21,6	57,4
	3	49	30,2	30,2	87,7
	4	10	6,2	6,2	93,8
	Totally agree	0	0	0	93,8
	No answer	10	6,2	6,2	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.39 Size of virtual and distributed project team

Another factor considered by the researcher was whether the size of the teams also had an effect on how project management methodologies had been effectively implemented. Table 4.39 captured results on whether the project management methodology had worked better on smaller

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teams as compared to larger teams. 45.7% neither agreed nor disagreed that the project management methodology had worked better on smaller teams than on larger teams. 22.2% confirmed that the project management methodology had in fact worked better on smaller teams as compared to larger teams while 25.9% thought otherwise.

Table 4.39: PMM worked better on smaller teams (<50) than on larger teams (>50)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	17	10,5	10,5	10,5
	2	25	15,4	15,4	25,9
	3	74	45,7	45,7	71,6
	4	25	15,4	15,4	87,0
	Totally agree	11	6,8	6,8	93,8
	No answer	10	6,2	6,2	100,0
	Total	**162**	**100,0**	**100,0**	

From the results, when asked if project management methodologies had helped increase the morale of the virtual and distributed project team, helped solve cultural differences between virtual and distributed project team members, had allowed contribution and discussions from different team members, had worked better on smaller teams (<50) than on larger teams (>50) most respondents were undecided (4.1.1.35 to 4.1.1.39), most respondents were undecided. More than 50% agreed that the project management methodology helped deal with issues caused by working from different locations. More than 50% disagreed, indicating that the project management methodology used had challenges faced in the virtual and distributed projects. The next section describes the **fit** between the project management methodologies and the virtual and distributed project.

Fit between PMM and virtual and distributed project

Project managers had an additional question to answer on whether project management methodologies were suitable, helped them manage the project team well and whether they worked better in collocated teams as compared to virtual and distributed teams. This question was broken and tabulated as table 4.40, 4.41 and 4.42.

4.1.1.40 PMM suited the way the project manager wanted to manage the team

Table 4.40 summarizes the responses on whether the project management methodology used had suited the way in which the project manager wanted to manage the team.

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Table 4.40: PMM suited the way I wanted to manage the team

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	3	1,9	1,9	1,9
	2	8	4,9	4,9	6,8
	3	28	17,3	17,3	24,1
	4	11	6,8	6,8	30,9
	Totally agree	19	11,7	11,7	42,6
	No answer	93	57,4	57,4	100,0
	Total	**162**	**100,0**	**100,0**	

57.4% of the respondents did not answer the question as it was meant for project managers. The most respondents, 17.3%, were undecided. 6.8%, which was the least, disagreed that the project management methodology suited the way they wanted to manage the project team. 18.5%, however, agreed that the project management methodology suited the way they wanted to manage the project.

4.1.1.41 PMM suitability in virtual and distributed teams

From there the project managers were asked if the project management methodology used was suitable for virtual and distributed projects. The results are captured in table 4.41 below.

Table 4.41: PMM used was suitable for virtual and distributed teams

		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally disagree	0	0	0	0
Valid	2	8	4,9	4,9	4,9
	3	27	16,7	16,7	21,6
	4	16	9,9	9,9	31,5
	Totally agree	15	9,3	9,3	40,7
	No answer	96	59,3	59,3	100,0
	Total	**162**	**100,0**	**100,0**	

From the results, none of the project managers totally disagreed with the fact that the project management methodology used had been suitable for the virtual and distributed project they were working on. 16.7% were undecided while the least, 4.9% disagreed.

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4.1.1.42 Collocated team versus virtual and distributed team

The project managers were then given a chance to highlight their opinion on whether the project management methodology used worked better in collocated teams as compared to virtual and distributed teams. The results were captured in table 4.42 below:

Table 4.42: PMM works better in collocated teams as compared to virtual and distributed teams

		Frequency	Percent	Valid Percent	Cumulative Percent
	Totally disagree	5	3,1	3,1	3,1
	2	16	9,9	9,9	13,0
	3	28	17,3	17,3	30,3
	4	17	10,5	10,5	40,8
	Totally agree	3	1,9	1,9	42,6
	No answer	93	57,4	57,4	100,0
	Total	**162**	**100,0**	**100,0**	

12.4% agreed that the project management methodology used had been better in collocated teams, closely followed by 13% who disagreed that it was better in these teams.

In all three questions asked about the fit, most respondents from those who answered were partly agreed. The next section focuses on the project outcomes.

Project Outcomes

This section describes the success of the development process of the VD project.

4.1.1.43 Project was completed on time

Analysis was also done on whether the project had been completed within the budgeted time and results were captured in table 4.43 where 33.3% partly agreed as compared to the 4.9% who totally disagreed.

Table 4.43: Project was completed on schedule

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	8	4,9	4,9	4,9
	2	19	11,7	11,7	16,7
	3	35	21,6	21,6	38,3
	4	54	33,3	33,3	71,6
	Totally agree	31	19,1	19,1	90,7
	No answer	15	9,3	9,3	100,0
	Total	**162**	**100,0**	**100,0**	

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4.1.1.44 Virtual and distributed project completed within budget

After analyzing the budgeted time, focus was on the budget or cost. The responses were captured in table 4.44 where 51.2% agreed or totally agreed that the virtual and distributed project had been completed within budget. 17.9% disagreed or totally disagreed that the virtual and distributed project had been completed within budget.

Table 4.44: Project was completed within budget

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	8	4,9	4,9	4,9
	2	21	13,0	13,0	17,9
	3	34	21,0	21,0	38,9
	4	72	44,4	44,4	83,3
	Totally agree	11	6,8	6,8	90,1
	No answer	16	9,9	9,9	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.45 System Requirements

Focus was also put on the system to check if the developed system had satisfied all stated requirements from using the project management methodology in the virtual and distributed project. The results are in table 4.45 where 53.7% agreed or totally agreed that all the stated requirements had been met. 8.6% disagreed.

Table 4.45: Developed system satisfied all stated requirements

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	1	,6	,6	,6
	2	13	8,0	8,0	8,6
	3	44	27,2	27,2	35,8
	4	71	43,8	43,8	79,6
	Totally agree	16	9,9	9,9	89,5
	No answer	17	10,5	10,5	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.46 Development speed

In table 4.46, 39.5% were undecided that the speed of development had been high. 41.3% agreed and totally agreed that the speed had been high while 9.9%disagreed and totally disagreed.

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Table 4.46: Speed of development was high

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	4	2,5	2,5	2,5
	2	12	7,4	7,4	9,9
	3	64	39,5	39,5	49,4
	4	60	37,0	37,0	86,4
	Totally agree	7	4,3	4,3	90,7
	No answer	15	9,3	9,3	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.47 Productivity of project team members

The respondents were also asked if the productivity of the project team members had been high where the greater part of the IT specialists (47.6%) agreed or totally agreed that it had while 5.5% disagreed or totally disagreed.

Table 4.47: Productivity of virtual and distributed project team members was high

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	2	1,2	1,2	1,2
	2	7	4,3	4,3	5,6
	3	61	37,7	37,7	43,2
	4	68	42,0	42,0	85,2
	Totally agree	9	5,6	5,6	90,7
	No answer	15	9,3	9,3	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.48 Cost versus size and complexity of system developed

The cost of the virtual and distributed project versus the size and complexity was also compared in table 4.48 where the majority, 51.8%, agreed or totally agreed that the cost had been low versus the 13% who totally disagreed or disagreed.

Table 4.48: Cost of virtual and distributed project was low compared to the size and complexity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	5	3,1	3,1	3,1
	2	16	9,9	9,9	13,0
	3	42	25,9	25,9	38,9
	4	47	29,0	29,0	67,9
	Totally agree	37	22,8	22,8	90,7
	No answer	15	9,3	9,3	100,0
	Total	**162**	**100,0**	**100,0**	

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4.1.1.49 Virtual and distributed project goals

After most analysis was done, 63.5% in table 4.49 agreed or totally agreed that the virtual and distributed project had achieved its goals as compared to only 3.1% who totally disagreed or disagreed that the goals had been achieved.

Table 4.49: Virtual and distributed project achieved its goals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	1	,6	,6	,6
	2	4	2,5	2,5	3,1
	3	39	24,1	24,1	27,2
	4	72	44,4	44,4	71,6
	Totally agree	31	19,1	19,1	90,7
	No answer	15	9,3	9,3	100,0
	Total	**162**	**100,0**	**100,0**	

4.1.1.50 Project team work

The respondents were then asked to indicate if the virtual and distributed project had represented excellent work and this was summarized in table 4.50. 56.1% agreed or totally agreed that the virtual and distributed project had represented excellent work by the team members. Only 1.8% disagreed or totally disagreed. This is closely related to the results from all the other tables where either the project management methodology had been successfully implemented or the virtual and distributed project team had worked hard to achieve the stated project goals.

Table 4.50: Virtual and distributed project represents excellent work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	2	1,2	1,2	1,2
	2	1	,6	,6	1,9
	3	53	32,7	32,7	34,6
	4	66	40,7	40,7	75,3
	Totally agree	25	15,4	15,4	90,7
	No answer	15	9,3	9,3	100,0
	Total	**162**	**100,0**	**100,0**	

4.11.51 Overall project success

After all work had been done, the respondents had to indicate if the overall project had been a success where most respondents agreed or totally agreed at 63%. With the majority of the respondents highlighting some positive aspects about the methodology and project team effort, the percentage of respondents who agreed meet the expectations.

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Table 4.51: Overall the virtual and distributed project was a success

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Totally disagree	2	1,2	1,2	1,2
	2	4	2,5	2,5	3,7
	3	39	24,1	24,1	27,8
	4	57	35,2	35,2	63,0
	Totally agree	45	27,8	27,8	90,7
	No answer	15	9,3	9,3	100,0
	Total	**162**	**100,0**	**100,0**	

In general the project outcomes showed that most projects had been developed fast and completed within the stipulated times. The project requirements had also been met, with most respondents highlighting that overall the project had been a success. The next section looks at the opportunities offered by the project management methodology in the latest virtual and distributed project.

4.1.1.52 Opportunities offered by the project management methodology used

Identify the opportunities experienced by using project management methodologies in virtual and distributed projects

The other objective was to identify the opportunities experienced by project managers and project team members who had worked with project management methodologies in virtual and distributed projects. From the questionnaires the IT specialists where asked to highlight the opportunities offered by using project management methodologies in virtual and distributed projects and these are listed in appendix A. The results were then categorized into the sections covered in table 4.52.

Table 4.52: Opportunities

Opportunities		Frequency	Percent	Valid Percent	Cumulative Percent
	Time	10	7,2	7,2	7,2
	Communication	8	5,8	5,8	13
	Professional use	21	15,2	15,2	28,2
	Reviewing progress	17	12,3	12,3	40,5
	Planning and guidelines	45	32,6	32,6	73,1
	Individual growth and team development	30	21,8	21,8	94,9
	Task allocation	7	5,1	5,1	100
	Total	**138**	**100**	**100**	

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The opportunities were grouped into different sections in table 4.52 and are explained below.

- Time – This covers all opportunities highlighted by the respondents that are associated with the time taken to complete the given tasks or project.

- Communication – Communication covers all opportunities offered by the project management methodology which are associated with the virtual and distributed teams' ability to communicate with one another effectively.

- Professional use – The respondents gave answers related to how the project management methodology had assisted in professionalizing the work done on the virtual and distributed project.

- Reviewing progress - In the opportunities listed by the respondents, there were opportunities associated with the project management methodologies allowing the virtual and distributed team to track progress, or review the work performed.

- Planning and guidelines – This group was used for opportunities listed that had anything to do with the project management methodology guiding or helping in the planning of the virtual and distributed project activities.

- Individual growth and team development – This opportunity was linked to all opportunities that were identified by the respondents as improving on their individual skills and knowledge as well as the team as a whole, including training opportunities and mentoring offered by other team members.

- Task allocation – Task allocation grouped all opportunities highlighted which assisted the project manager as well as project team in allocating tasks to the team members.

From the results the majority of the respondents (32.6%) highlighted opportunities that fell under the planning and guidelines. The least (5.1%) highlighted opportunities within the task allocation section.

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4.1.1.53 Challenges experienced when using project management methodology

Identify the challenges faced by using project management methodologies in virtual and distributed projects

The other objective was to identify the challenges faced by project managers and the project team after having used project management methodologies in virtual and distributed projects. These are highlighted in appendix B and were also categorized and captured in table 4.53. These were also analysed and discussed in chapter 5 under the challenges faced objective.

Table 4.53: Challenges

Challenges	Frequency	Percent	Valid Percent	Cumulative Percent
Lack of PMM knowledge and need for training	21	20,6	20,6	20,6
Guideline not always provided or inappropriate for given situation	24	23,5	23,5	44,1
Insufficient time to learn or follow PMM	23	22,6	22,6	66,7
Different ways of understanding and applying PMMs	26	25,5	25,5	92,2
Higher cost as compared to budget	3	2,9	2,9	95,1
Not suitable where project requirements are constantly changing	5	4,9	4,9	100
Total	**102**	**100**	**100**	

The challenges were also grouped into categories and these are explained below:

- Lack of PMM knowledge and need for training – This category was for all challenges mentioned by the respondents that were related to the project team not knowing about the project management methodology and the team's need for training on the tools and techniques to use with the project management methodology.

- Guideline not always provided or inappropriate for given situation – This category was for all challenges that included the respondents stating that the project management methodology was not suitable for the given project or not having manuals for using the project management methodology in different projects.

- Insufficient time to learn or follow PMM – Some respondents highlighted challenges faced because of insufficient time to know more about the project management methodology as well as the techniques and tools used while others highlighted that they did not always use project management methodologies as they did not have enough time to use them

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- Different ways of understanding and applying PMMs – This category was used to capture all challenges faced by the respondents that were associated with different project team members applying the project management methodology in different ways because some understood it differently while others had developed their own unique style of applying it.

- Higher cost as compared to budget – This category was for all challenges with the project not meeting its' budgeted cost.

- Not suitable where project requirements are constantly changing – This category was used for all challenges that were related to the wrong project management methodology being used and in cases where respondents highlighted challenges with changing requirements that were not properly dealt with

Even though most respondents (25.5%) highlighted challenges within the different ways of understanding and applying project management methodologies section, a huge number, 23.5% and 22.6%, highlighted challenges within the guidelines not always provided and Insufficient time sections.

After looking at the descriptive statistics, the next section, 4.2 focuses on factor analysis done and the research variables used.

4.2 Factor Analysis

The factor analysis was used to identify if correlations between observed variables stemming from their relationship to latent variables in the data. As discussed in chapter 3, Data reduction is used for factor analysis with the aim of removing redundant variables from the data while at times using a smaller number of uncorrelated variables. This test was performed on the following research variables:

- success factors for Virtual and Distributed teams (Success of process),
- Support provided by the project management methodology
- Impact of PMM on the system and the development process

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- Virtual and distributed project success
- Fit

These research variables are covered by questions 14, 17, 18, 19, and 22 in the questionnaire.

The KMO and Bartletts' test was used. The KMO indicates the proportion of variance in the variables caused by underlying factors while Bartletts' test is used to measure the null hypothesis to ensure the original matrix is an identity matrix. For an identity matrix all correlation coefficients are 0 and p should be less than 0.001 for it to be significant. The value of KMO should be greater than 0.5 if the sample is adequate (Field, 2005). Higher values which are close to 1 indicate the factor analysis might be useful with the available data and the opposite is true if they are below 0.50. The values of the KMO as highlighted by Field (2005) are further shown as follows:

- Values between 0.5 and 0.7 are average
- Values between 0.7 and 0.8 are good
- Values between 0.8 and 0.9 are very good
- Values above 0.9 are extremely good

4.2.1 Success Factors for virtual and distributed teams

The KMO and Bartlett's Test for the success factors of virtual teams had a KMO of 0.609, which is average and a significant result for the Bartlett's test of .000 (p value) as shown in table 4.2.52 below:

Table 4.2.52: KMO and Bartlett's Test for success factors

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,609
Bartlett's Test of Sphericity	Approx. Chi-Square	162,665
	df	10
	Sig.	,000

Table 4.2.53: Component Matrix for the success factors

	Component
	1
Religions (Question 14.3.1)	,861
Language and customs (Question 14.3.2)	,853
Lack of face to face interaction (Question 14.1)	,545
Time separation between sites (Question 14.2)	,442
Huge amount of information coming from multiple sources (Question 14.4)	,424

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As illustrated in table 4.2.53 all the items loaded on only one factor (success factor of virtual and distributed projects). Table 4.2.53 shows that the success factor of virtual and distributed projects is highly correlated to Religions and Language and customs.

4.2.2 Support provided by project management methodology

KMO and Bartletts' test was also used on the support provided by the project management methodology and it resulted in two factors.

The KMO and Bartlett's Test for the support provided by the project management methodology gave a KMO of 0.853, which is very good and a significant p value of .000 for the Bartlett's test.as shown in table 4.2.52 below:

4.2.54: KMO and Bartlett's Test for support provided by project management methodology

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.853
Bartlett's Test of Sphericity	Approx. Chi-Square	669.938
	df	36
	Sig.	.000

Two components were extracted for the support provided by project management methodologies where component 1 was named " Support provided "and component 2 was named "Quality of system". The results of the test are shown in table 4.54 below:

Table 4.54: Pattern Matrix for the support provided by project management methodology

	Component	
	1	2
PMM helped define useful milestones for VD project (Question 17.5)	,841	-,228
PMM helped align project to the business (Question 17.1)	,792	
PMM helped estimate time and effort required for project tasks to be complete (Question 17.4)	,775	
PMM helped decompose project into workable parts (Question 17.3)	,771	
PMM helped to involve the end users in VD projects (Question 17.2)	,643	,288
PMM helped keep VD project under control (Question 17.6)	,555	,425
PMM helped define an ideal process of working on VD project even though it was not followed in practice (Question 17.11)		,872
PMM provided useful guidelines of working on VD projects (Question 17.10)		,739
PMM helped the stakeholders learn from VD projects (17.12)	,428	,570

The results in table 4.54 show that the support provided by project management methodologies is highly correlated to:

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- PMM helped define useful milestones for VD project (Question 17.5)
- PMM helped align project to the business (Question 17.1)
- PMM helped estimate time and effort required for project tasks to be complete (Question 17.4)
- PMM helped decompose project into workable parts (Question 17.3).

For the quality of system component the results in table 4.54 show that quality of system is highly correlated to:

- PMM helped define an ideal process of working on VD project even though it was not followed in practice (Question 17.11)
- PMM provided useful guidelines of working on VD projects (Question 17.10)

4.2.3 Impact of project management methodology on the system and development process

When one component was loaded for the Impact of project management methodology on the system and development process, the KMO was 0.819 showing a very good value while the p value showed a significant value of .000 for the Bartlett's test as shown in table 4.55.

Table 4.55: KMO and Bartlett's Test for the impact of project management methodology on the system and development process

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,819
Bartlett's Test of Sphericity	Approx. Chi-Square	322,269
	df	10
	Sig.	,000

The results in table 4.56 show that the impact of project management methodology on the system and development process is highly correlated to:

- PMM helped develop a more functional system (Question 17.7)
- PMM helped develop a more maintainable system (Question 17.9)
- PMM helped develop a more reliable system (Question 17.8)

Table 4.56: Component Matrix for the impact of project management methodology on the system and development process

	Component
	1
PMM helped develop a more functional system (Question 17.7)	,878
PMM helped develop a more maintainable system (Question 17.9)	,871
PMM helped develop a more reliable system (Question 17.8)	,861
PMM helped achieve the objectives of the virtual and distributed project (Question 17.13)	,646
Morale of project team was high due to use of PMM (Question 17.14)	,573

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4.2.4 Virtual and distributed Project success

KMO and Bartletts' test was also used on the virtual and distributed project success and it resulted in two factors.

The KMO and Bartlett's Test for the virtual and distributed project success gave a KMO of 0.864, which is very good and a significant p value of .000 for the Bartlett's test as shown in table 4.57 below:

Table 4.57: KMO and Bartlett's Test for success of process - two components loaded

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,864
Bartlett's Test of Sphericity	Approx. Chi-Square	759,426
	df	36
	Sig.	,000

The items measuring the success of the virtual and distributed project loaded on 2 factors. The first component was the success of the process and the other one was the cost. Table 4.58 shows the results obtained.

Table 4.58: Pattern Matrix for success of process - two components loaded

	Component	
	1	2
The productivity of team members involved with the project was high (Question 22.5)	,893	-,304
Overall, the project represents excellent work (Question 22.8)	,782	
The speed of developing the project was high (Question 22.4)	,744	
Overall, the project was a success (Question 22.9)	,744	,282
The developed system satisfied all the stated requirements (Question 22.3)	,593	,408
The project achieved its goals (Question 22.7)	,576	,374
cost of the project is low when compared to the size and complexity of the system developed (Question 22.6)		,817
The project was completed on schedule (Question 22.1)	,324	,699
The productivity of team members involved with the project was high (Question 22.5)	,336	,658

In order to explore the factor structure further, the item regarding the cost of the virtual and distributed project were deleted and the factor analysis was repeated. The results are presented in table 4.60. This resulted in one factor which will be called "Success of virtual and distributed

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project". The item measuring the cost of the virtual and distributed project will be treated separately.

When one component was loaded (success of process) the KMO became 0.866 with a significant p value of .000 as shown in table 4.59

Table 4.59: KMO and Bartlett's Test for success of process - one component loaded

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,866
Bartlett's Test of Sphericity	Approx. Chi-Square	721,131
	df	28
	Sig.	,000

The results in table 4.60 show that the success of the process is highly correlated to:

- Overall, the project was a success (Question 22.9)
- The developed system satisfied all the stated requirements (Question 22.3).
- Overall, the project represents excellent work (Question 22.8)
- The project achieved its goals (Question 22.7)
- The project was completed on schedule (Question 22.1)
- The project was completed within the budget (Question 22.2)

Table 4.60: Component Matrix - one component loaded

	Component
	1
Overall, the project was a success (Question 22.9)	,884
The developed system satisfied all the stated requirements (Question 22.3).	,835
Overall, the project represents excellent work (Question 22.8)	,818
The project achieved its goals (Question 22.7)	,787
The project was completed on schedule (Question 22.1)	,787
The project was completed within the budget (Question 22.2)	,776
The speed of developing the project was high (Question 22.4)	,674
The productivity of team members involved with the project was high (Question 22.5)	,607

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4.24 Fit between the project management methodology and the virtual and distributed team

The KMO and Bartlett's test was also used to measure the fit between the project management methodology and the virtual and distributed team. The KMO was average with a value of 0.644 while the p value for the Bartlett's test was significant with a value of .000 as shown in table 4.61

Table 4.61: KMO and Bartlett's Test for the fit

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,644
Bartlett's Test of Sphericity	Approx. Chi-Square	104,231
	df	3
	Sig.	,000

All the items loaded on one factor and the results are shown in table 4.62 shown below: This factor will be called "the fit." The results in table 4.62 show that the fit was highly correlated to:

- Using a Project Management Methodology suited the way the project manager wanted to manage the team (Question 19.1) and
- The Project Management Methodology used was suitable for managing virtual and distributed teams (Question 19.2).

Table 4.62: Component Matrix for the fit

	Component
	1
Using a Project Management Methodology suited the way the project manager wanted to manage the team (Question 19.1)	,935
The Project Management Methodology used was suitable for managing virtual and distributed teams (Question 19.2).	,910
The Project Management Methodology used works better in collocated teams as compared to virtual and distributed teams (Question 19.3)	-,770

In the next section the reliability of the above factors will be determined.

4.3 Reliability Analysis

Cronbach's alpha test was used to measure the reliability of the different factors identified above. A value closer to 1 for the Cronbach's alpha test shows high reliability and a Cronbach's alpha of 0.8, or higher, is considered very reliable (Field, 2005). Cronbach's alpha test for each factor in section 4.2 is shown in the sub sections that follow.

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4.3.1 Reliability of success factors for virtual and distributed teams

The factor analysis on the items measuring the success factors of virtual and distributed projects indicate that all the items loaded on one factor. he Cronbach's alpha should be above 0.7% but can be realistically lower where a Cronbach alpha of 0.642 is acceptable as shown in table 4.63 below.

Table 4.63: Reliability Statistics of success factors for virtual and distributed teams

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,642	,635	5

Reliability was also checked to see how each of the five items had an effect on the Cronbach alpha if they were deleted and the results are shown below:

Table 4.64: Item-Total Statistics of success factors for virtual and distributed teams

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Lack of face-to-face interaction (Question 14.1)	10,651	9,964	,327	,109	,620
Time separation between sites (e.g. different working hours, weekends, lunch breaks) (Question 14.2)	10,987	9,907	,254	,079	,660
Religions (Question 14.3.1)	11,493	8,066	,576	,587	,493
Languages and customs (Question 14.3.2)	11,316	7,767	,602	,594	,475
Huge amount of information coming from multiple sources (Question 14.4)	10,237	10,738	,245	,063	,652

It indicated that if Question 14.2 (Time separation between sites (e.g. different working hours, weekends, lunch breaks) was removed the Cronbach alpha will increase to 0.660. Furthermore,

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when Question 14.4 (Huge amount of information coming from multiple sources) was deleted the Cronbach's alpha will increase to 0.652 Both these increased values don't differ much from the original Cronbach Alpha, and it was decided to keep the factor structure as it was.

4.3.2 Support provided by project management methodology

Factor analysis performed on the items measuring support provided by PMM, resulted in 2 factors, called Support provided and Quality of system. Factor analysis was also performed to present the results if only one factor, support provided, was selected. Reliability tests were performed on all the items measuring the support provided, and this is depicted in table 4.66. Cronbach's alpha test was also used to test question 17:

The Cronbach's alpha of the support provided by project management methodologies showed a higher reliability of 0.879 shown in table 4.65.

Table 4.65: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,879	,877	9

Nine items were tested and the test reported a Cronbach's alpha of 0.879. The test results are summarized in table 4.66

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Table 4.66: Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
The Project Management Methodology helped to align the project to the business (Question 17.1)	29,219	26,225	,668	,618	,862
The Project Management Methodology helped to involve end-users in the virtual and distributed projects (Question 17.2)	29,457	25,063	,713	,671	,858
The Project Management Methodology helped decompose the project into workable parts (Question 17.3).	29,212	26,341	,583	,552	,870
The Project Management Methodology helped estimate the time and effort required for the project tasks to be completed (Question 17.4).	29,159	24,975	,750	,673	,854
The Project Management Methodology helped define the useful milestones for the virtual and distributed project (Question 17.5).	29,437	27,928	,512	,363	,875
The Project Management Methodology helped keep the virtual and distributed project under control (Question 17.6).	29,424	24,846	,742	,575	,855
The Project Management Methodology provided useful guidelines for working on a virtual and distributed project (Question 17.10).	29,397	28,454	,477	,332	,877
The Project Management Methodology defined an ideal process of working on the virtual and distributed project even though it was not followed in practice (Question 17.11).	29,523	27,824	,433	,317	,882
The Project Management Methodology helped the stakeholders learn from working on the virtual and distributed project (Question 17.12).	29,384	25,105	,723	,610	,857

On further inspection, it becomes clear that by removing item 17.11 the Cronbach Alpha will increase to 0.882. This is such a small difference, that we decided to keep it in the structure.

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Since the Cronbach Alpha is so high when we combine the 9 items, we decided to use only one factor instead of two. This factor will be called “Support provided by PM in virtual and distributed projects”

4.3.3 Impact of PMM on system and development process

In section 4.2 a factor analysis was performed for the impact of project management methodologies on the system and development process. Reliability tests were also performed on the five items and a Cronbach’s alpha of 0.825 showed a higher reliability as shown in table 4.67.

4.67: Reliability Statistics for the impact of project management methodologies on the system and development process

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.825	.830	5

4.68: Summary Item Statistics for the impact of project management methodologies on the system and development process

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Inter-Item Correlations	.494	.331	.763	.432	2.304	.029	5

4.69: Item-Total Statistics for the impact of project management methodologies on the system and development process

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
The Project Management Methodology helped develop a more functional system (Question 17.7)	13.980	6.796	.762	.670	.748
The Project Management Methodology helped develop a more reliable system (Question 17.8)	13.946	6.963	.710	.614	.764
The Project Management Methodology helped develop a more maintainable system (Question 17.9)	13.878	7.278	.730	.644	.762
The Project Management Methodology helped achieve the objectives of the virtual and distributed team(Question 17.13)	14.034	7.434	.496	.256	.831
The morale of the project team I work in, was high due to the use of Project Management Methodologies (Question 17.14)	14.351	8.080	.446	.212	.838

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Since the Cronbach Alpha is so high when we combine the 5 items, removing item 17.14 will increase the Cronbach Alpha to 0.838. This is such a small difference, that we decided to keep it in the structure.

4.3.4: Fit

Following the factor analysis done for the fit in section 4.2 reliability tests were also performed on the three items and a Cronbach's alpha of 0.849 showed a high reliability as shown in table 4.70.

4.70: Reliability Statistics for the Fit

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.849	.850	3

4.71: Item-Total Statistics for the Fit

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Using a Project Management Methodology suited the way I want to manage the team (Question 19.1)	6.6667	2.995	.782	.717	.730
The Project Management Methodology used was suitable for managing virtual and distributed teams (Question 19.2).	6.5758	3.540	.821	.732	.697
The Project Management Methodology used works better in collocated teams as compared to virtual and distributed teams (Question 19.3)	7.0606	4.242	.581	.343	.908

Allthough removing Question 19.3 (The Project Management Methodology used works better in collocated teams as compared to virtual and distributed teams) will increase Cronbach Alpha to 0.908, we decided to keep it in structure, because reliability is already very high.

4.3.5: Virtual and distributed Project success

The reliability for virtual and distributed project success was also tested and produced the results in table 4.69 below of 0.901:

Table 4.69: Reliability Statistics for virtual and distributed project success

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,901	,903	8

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Since the Cronbach's alpha of 0.901 already shows high reliability we decided not to remove any of the factors in table 4.70. Removing question 22.5 only increases the Cronbach's alpha to 0.904 which is not much different to 0.901.

Table 4.70: Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
The project was completed on schedule (Question 22.1)	25,389	20,743	,726	,681	,888
The project was completed within the budget (Question 22.2)	25,556	21,941	,702	,682	,888
The developed system satisfied all the stated requirements Question 22.3)	25,313	22,692	,771	,641	,882
The speed of developing the project was high (Question 22.4)	25,556	24,011	,598	,430	,896
The productivity of team members involved with the project was high (Question 22.5)	25,417	25,168	,499	,433	,904
The project achieved its goals (Question 22.7)	25,069	23,450	,702	,539	,888
Overall, the project represents excellent work (Question 22.8)	25,174	23,249	,736	,681	,885
Overall, the project was a success (22.9)	24,993	21,797	,819	,754	,876

This section helped carry out reliability tests on the success factors for virtual and distributed teams, support provided by project management methodologies, impact of project management methodologies on the system and development process, virtual and distributed project success and the fit. The next section focuses on the results of the nonparametric correlations.

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4.4 Nonparametric Correlations

Spearmans' rho was used to test the nonparametric correlations between the different variables (sig 2 tailed). To highlight the strength of the correlation, the following categories will be used:

- Values between 0.0 and 0.2 indicate a weak relationship
- Values between 0.2 and 0.4 indicate a moderate relationship
- Values between 0.4 and 0.6 indicate a strong relationship
- Values between 0.6 and 1 indicate a very strong relationship

In his study, Field (2005) highlighted that the closer the value of the spearman's rank correlation coefficient is to 1, the stronger the correlation.

Table 4.71 below shows all the variables, that is, those that were correlated (where ** show that correlation is significant at the 0.01 level (2-tailed) and *. Correlation is significant at the 0.05 level (2-tailed) and those that were not:

Table 4.71: Nonparametric Correlations

			Success_Q22	Fit_Q19	Support	Impact of PMM on system and development process	Success_VT_Q14
Spearman's rho	Success_Q22	Correlation Coefficient	1,000	.396**	.406**	.516**	-,087
		Sig. (2-tailed)		,001	,000	,000	,295
		N	147	64	147	147	147
	Fit_Q19	Correlation Coefficient	.396**	1,000	.585**	.626**	-,055
		Sig. (2-tailed)	,001		,000	,000	,655
		N	64	69	69	69	69
	Support	Correlation Coefficient	.406**	.585**	1,000	.676**	,139
		Sig. (2-tailed)	,000	,000		,000	,086
		N	147	69	153	153	153
	Impact of PMM on system and development process	Correlation Coefficient	.516**	.626**	.676**	1,000	,046
		Sig. (2-tailed)	,000	,000	,000		,576
		N	147	69	153	153	153
	Success_VT_Q14	Correlation Coefficient	-,087	-,055	,139	,046	1,000
		Sig. (2-tailed)	,295	,655	,086	,576	
		N	147	69	153	153	154

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	Age (Question 1)	Correlation Coefficient	-.164*	-.274*	-.295**	-.252**	.261**
		Sig. (2-tailed)	,047	,023	,000	,002	,001
		N	147	69	153	153	154
	Qualification (Question 2)	Correlation Coefficient	-,006	,024	-.174*	-.188*	.196*
		Sig. (2-tailed)	,944	,846	,032	,020	,015
		N	146	68	152	152	153
	Experience in IT (Question 5)	Correlation Coefficient	-,143	-.282*	-.323**	-.235**	.234**
		Sig. (2-tailed)	,083	,019	,000	,003	,004
		N	147	69	153	153	154
	Experience in Systems Development (Question 6)	Correlation Coefficient	-,107	-,196	-.160*	-,084	.266**
		Sig. (2-tailed)	,195	,106	,048	,304	,001
		N	147	69	153	153	154
	Experience in virtual and distributed teams (Question 7)	Correlation Coefficient	-,147	-,188	-.173*	-,114	.371**
		Sig. (2-tailed)	,075	,122	,032	,159	,000
		N	147	69	153	153	154
	Size of virtual and distributed team (Question 9)	Correlation Coefficient	-.242**	-.262*	-,125	-,146	.424**
		Sig. (2-tailed)	,003	,030	,123	,072	,000
		N	147	69	153	153	153
	Experience using project management methodologies (Question 11)	Correlation Coefficient	-.220**	-,187	-.183*	-,156	.421**
		Sig. (2-tailed)	,007	,125	,023	,055	,000
		N	147	69	153	153	154
	Horizontal use (Question 12)	Correlation Coefficient	-,023	.484**	.306**	.182*	.222**
		Sig. (2-tailed)	,781	,000	,000	,024	,006
		N	147	69	153	153	154
	Horizontal use (Question 13)	Correlation Coefficient	.164*	.516**	.447**	.380**	.218**
		Sig. (2-tailed)	,047	,000	,000	,000	,006
		N	147	69	153	153	154
	Language (Question 15)	Correlation Coefficient	-.194*	-,033	-,089	-,115	.200*
		Sig. (2-tailed)	,018	,787	,274	,158	,013
		N	147	69	153	153	153

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	Cost of project development (Question 22.6)	Correlation Coefficient	.397**	.679**	.479**	.402**	-.256**
		Sig. (2-tailed)	,000	,000	,000	,000	,002
		N	147	64	147	147	147

Table 4.71.2 goes on to show only the variables that were correlated.

Table 4.71.2: Summary of Non-parametric Correlations

	Success	Fit_Q19	Support	Quality
Success		0.396**	0.406**	0.516**
Fit	0.396**		0.585**	0.626**
Support	0.406**	0.585**		0.676**
Impact on the Quality of the system	0.516**	0.626**	0.676**	
Success factors				
Age (Question 1)	-0.164*	-0.274*	-0.295**	-0.252**
Qualification (Question 2)			-0.174*	-0.188*
Experience in IT (Question 5)		-0.282*	-0.323**	-0.235**
Experience in Systems Development (Question 6)			- 0.160*	
Experience in virtual and distributed teams (Question 7)			- 0.173*	
Size of virtual and distributed team (Question 9)	- 0.242**	- 0.262*		
Experience using project management methodologies (Question 11)	- 0.220**		- 0.183*	
Horizontal use (Question 12)		- 0.484**	- 0.306**	0.182*
Horizontal use (Question 13)	0.164*	0.516**	0.447**	0.380**
Language (Question 15)	- 0.194*			
@Q226 Cost of development	0.397**	0.679**	0.479**	0.402**

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4.4.1: Success of process

After having done the factor analysis and reliability tests in section 4.2 and section 4.3, focus is now on the nonparametric correlations based on the success of the process. Table 4.4.1 shows that there were strong correlations between the success of the process and the support provided (0.406**) as well as with the impact on the quality (0.516**).

Table 4.4.1: Nonparametric Correlations – Success factors for virtual and distributed teams

Variable	correlation coefficient	Strength of correlation coefficient
Fit	0.396**	Moderate
Support	0.406**	Strong
Impact on the Quality…	0.516**	Strong
Age (Question 1)	-0.164*	Weak
Size of virtual and distributed team (Question 9)	- 0.242**	Moderate
Experience using project management methodologies (Question 11)	- 0.220**	Moderate
Horizontal use (Question 13)	0.164*	Weak
Language (Question 15)	- 0.194*	Weak
@Q226 Cost of development	0.397**	Moderate

4.4.2: Fit

Non-parametric correlations were also performed for the fit (question 19) were there was a very strong correlation of 0.626** between the fit and impact on quality of the system. There was also a strong correlation of 0.585** between support provided and the fit as shown in table 4.4.2

Table 4.4.2: Non-parametric Correlations for the Fit (Question 19)

Variable	correlation coefficient	Strength of correlation coefficient
Success	0.396**	Moderate
Support	0.585**	Strong
Impact on the Quality of the system	0.626**	Very strong
Age (Question 1)	-0.274*	Moderate
Experience in IT (Question 5)	-0.282*	Moderate

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Size of virtual and distributed team (Question 9)	- 0.262*	Moderate
Horizontal use (Question 12)	- 0.484**	Strong
Horizontal use (Question 13)	0.516**	Strong
@Q226 Cost of development	0.679**	Very strong

4.4.3 Support Provided

The impact on quality and support showed a very strong correlation of 0.676**. The success and fit also showed strong correlations to the support provided as shown in table 4.4.3

Table 4.4.3: Non-parametric Correlations – Support provided

Variable	**Support**	**Strength of correlation coefficient**
Success	0.406**	Strong
Fit	0.585**	Strong
Impact of PMM on system and development process	0.676**	Very strong
Age (Question 1)	-0.295**	Moderate
Qualification (Question 2)	-0.174*	Weak
Experience in IT (Question 5)	-0.323**	Moderate
Experience in Systems Development (Question 6)	- 0.160*	Weak
Experience in virtual and distributed teams (Question 7)	- 0.173*	Weak
Experience using project management methodologies (Question 11)	- 0.183*	Weak
Horizontal use (Question 12)	- 0.306**	Moderate
Horizontal use (Question 13)	0.447**	Strong
@Q226 Cost of development	0.479**	Strong

4.4.4 Quality of system

Very strong correlations were shown between the quality of the system and the fit (0.626**) and also the quality of the system and the support (0.676**) shown in table 4.4.4

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Table 4.4.4: Non-parametric Correlations – quality of system

Variable	Quality of the system	Strength of correlation coefficient
Success	0.516**	Strong
Fit	0.626**	Very strong
Support	0.676**	Very strong
Age (Question 1)	-0.252**	Moderate
Qualification (Question 2)	-0.188*	Weak
Experience in IT (Question 5)	-0.235**	Moderate
Horizontal use (Question 12)	0.182*	Weak
Horizontal use (Question 13)	0.380**	Moderate
@Q226 Cost of development	0.402**	Strong

4.5 T-tests

- After looking at the non-parametric correlations the t-test were performed to test the significance of the difference between two groups. The effect size was used to show practical significance by using the difference between two means and dividing by an estimated value of the standard deviation. The following values will be used to measure the effect size:

- Between 0.0 and 0.15 – small effect

- Between 0.15 and 0.35 – medium effect

- Larger than 0.35 – larger effect

4.5.1 PRINCE 2

We tested whether there was a difference between the perceptions of respondents using Prince 2 and those who don't use it. Research variables tested were

- Success of the virtual and distributed project
- Project management methodology fit
- Support provided by project management methodology

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- Impact of project management methodology on the system and the development process
- Success factors for virtual and distributed project.

No significant differences were identified between the responses.

4.5.2 PMBOK

The same test as above was performed for PMBOK. Just as PRINCE 2, PMBOK also had no significant differences.

4.5.3 Agile

In order to explore further, we also tested whether there was a difference between the perceptions of respondents using Agile PMM and those who don't use it. The results are presented in the tables below.

4.5.1: Group Statistics – Agile project management methodology

Agile		N	Mean	Std. Deviation	Std. Error Mean	Effect size	Interpretation
Success_Q22	1.0	20	3,9188	,47647	,10654	0,49	Large effect
	.0	118	3,5890	,66629	,06134		
Fit_Q19	1.0	7	3,8571	,81325	,30738	0,59	Large effect
	.0	56	3,3095	,92082	,12305		
Support	1.0	20	3,8667	,77953	,17431	0,26	Medium effect
	.0	124	3,6641	,57440	,05158		
Impact of PMM on system and development process	1.0	20	3,7200	,60663	,13565	0,34	Medium effect
	.0	124	3,4956	,65661	,05897		
Success_VT_Q14	1.0	20	2,4000	,62576	,13992	0,59	Large effect
	.0	124	2,8246	,72307	,06493		

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4.5.2: Independent Samples Test – Agile project management methodology

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Success_Q22	Equal variances assumed	2,079	,152	2,120	136	,036	,32977	,15552	,02221	,63732
	Equal variances not assumed			2,682	33,091	,011	,32977	,12294	,07968	,57986
Fit_Q19	Equal variances assumed	,005	,946	1,500	61	,139	,54762	,36513	-,18251	1,27775
	Equal variances not assumed			1,654	8,055	,136	,54762	,33109	-,21499	1,31022
Support	Equal variances assumed	2,943	,088	1,388	142	,167	,20258	,14600	-,08603	,49119
	Equal variances not assumed			1,114	22,447	,277	,20258	,18178	-,17398	,57913
Impact of PMM on system and development process	Equal variances assumed	2,516	,115	1,433	142	,154	,22444	,15666	-,08526	,53413
	Equal variances not assumed			1,517	26,712	,141	,22444	,14791	-,07920	,52807
Success_VT_Q14	Equal variances assumed	1,737	,190	-2,479	142	,014	-,42460	,17128	-,76319	-,08600
	Equal variances not assumed			-2,753	27,865	,010	-,42460	,15426	-,74065	-,10855

From the above it is clear that there is significant difference in the perceptions regarding the success of the virtual and distributed project and the Success factors for virtual and distributed projects.

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Success of virtual and distributed project

The significance of the differences for the Success of the virtual and distributed project is a (2 tailed) 0.036 on the equal variances assumed and 0.011 on the equal variances not assumed. Respondents using agile PMM reported a mean value of 3.92 while those not using agile PMM reported a mean value of 3.59. The effect size (practical significance) of this is 0.49 and is large.

Success of virtual and distributed teams

The significance of the differences for the success of virtual teams was 0.014 (2 tailed) for the equal variances assumed and 0.010 for the equal variances not assumed. Based on table 4.5.1 the respondents using agile project management methodology reported a mean of 2.40 while those not using the agile project management methodology reported a mean of 2.82. This gave a large effect of 0.59.

T-tests were also performed for Scrum, MPMM, UPMM, MBP, SDLC and DSDM where no variables showed any significance.

The next section will explain the regression analysis that was performed.

4.6: Regression Analysis

Section 4.6 covers the regression analysis that was performed. The best subset regression was performed by using the stepwise method which searches fewer combinations of sub-models and selects the best (Field, 2005). For this research the maximum adjusted R2 was used to summarize the proportion of variance in the dependent variable associated with the independent variables, A large value closer to 1 (which is the maximum) indicates that more of the variation is explained by the model. The following variables were used for the analysis:

4.6.1 Support provided by project management methodology (dependent variable)

Independent variables

- 18.3 - (The project management methodology allowed team members at different locations to contribute and discuss to the satisfaction of most team members)
- 13 – (For how long, during the last virtual and distributed project, did you apply project management methodology knowledge per day?)

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- 18.4 – (The project management methodology did not help much but it actually worsened the problems that were caused by the distributed teams)

4.6.2 Impact of project management methodology on the system and development process (dependent variable)

Independent variables

- 18.4 – (The project management methodology did not help much but it actually worsened the problems that were caused by the distributed teams)
- 13 – (For how long, during the last virtual and distributed project, did you apply project management methodology knowledge per day?)
- 12 – (How frequently did you need and apply project management methodology knowledge in the last virtual and distributed project you worked on?)
- 18.5 – (The project management methodology worked better on smaller virtual teams of less than 50 as compared to larger teams of more than 50)

The results of each are explained in the sections that follow

4.6.1 Results of best subset regression for Support provided by PMM.

The results of best subset regression for support provided by project management methodologies is shown in table 4.6.1 and 4.6.2.

4.6.1: Model Summary for results of best subset regression for support provided by PMM

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.766[a]	.586	.579	.33972	.586	83.563	1	59	.000
2	.836[b]	.699	.689	.29207	.113	21.820	1	58	.000
3	.866[c]	.750	.736	.26888	.050	11.435	1	57	.001

a. Predictors: (Constant), 18.3 (The project management methodology allowed team members at different locations to contribute and discuss to the satisfaction of most team members)

b. Predictors: (Constant), 18.3, 13 (For how long, during the last virtual and distributed project, did you apply project management methodology knowledge per day?)

c. Predictors: (Constant), @183, @13, 18.4 (The project management methodology did not help much but it actually worsened the problems that were caused by the distributed teams)

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Based on the results in table 4.6.1 for the support provided by project management methodologies, there is an adjusted R square value of 57.9% for model 1, After adding predictors Question 18.3 (The project management methodology allowed team members at different locations to contribute and discuss to the satisfaction of most team members) and question 13 (For how long, during the last virtual and distributed project, did you apply project management methodology knowledge per day?) the adjusted R square value increases to 69.9% for model 2. After an additional predictor was added on to b, that is question 18.4 (The project management methodology did not help much but it actually worsened the problems that were caused by the distributed teams) the adjusted R square value increased to 73.6% for model 3.

4.6.2 Coefficientsa for results of best subset regression for support provided by PMM

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.411	.176		13.727	.000
	@183	.420	.046	.766	9.141	.000
2	(Constant)	2.172	.159		13.622	.000
	@183	.305	.047	.556	6.551	.000
	@13	.132	.028	.396	4.671	.000
3	(Constant)	2.730	.221		12.364	.000
	@183	.234	.048	.426	4.890	.000
	@13	.127	.026	.380	4.850	.000
	@184	-.142	.042	-.264	-3.382	.001

a. Dependent Variable: Support

The results in table 4.6.1 and 4.6.2 indicated that Support provided by PMM can be predicted by team members at different locations who can contribute and discuss to the satisfaction of most team members, the horizontal use of project management methodologies, and PMM helped to solve problems that were caused by virtual and distributed projects.

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4.6.2 Results of best subset regression for Impact on the quality of the system and development process by PMM.

The results of best subset regression were also done for the impact on the quality of the system and development process by the project management methodology.

4.6.3 Model Summary for the Impact on the quality of the system and development process by the PMM

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.664[a]	.442	.431	.46697	.442	41.906	1	53	.000
2	.747[b]	.558	.541	.41930	.117	13.737	1	52	.001
3	.816[c]	.666	.646	.36812	.108	16.462	1	51	.000
4	.837[d]	.701	.677	.35195	.035	5.795	1	50	.020

a. Predictors: (Constant), @184

b. Predictors: (Constant), @184, @13

c. Predictors: (Constant), @184, @13, @12

d. Predictors: (Constant), @184, @13, @12, @185

4.6.4 Coefficientsa for the Impact on the quality of the system and development process by the PMM

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.552	.138		32.969	.000
	@184	-.442	.068	-.664	-6.474	.000
2	(Constant)	3.701	.261		14.185	.000
	@184	-.393	.063	-.591	-6.269	.000
	@13	.150	.041	.349	3.706	.001
3	(Constant)	4.060	.246		16.533	.000
	@184	-.407	.055	-.612	-7.380	.000
	@13	.279	.048	.647	5.850	.000
	@12	-.210	.052	-.447	-4.057	.000
4	(Constant)	4.538	.307		14.761	.000
	@184	-.371	.055	-.557	-6.758	.000
	@13	.244	.048	.566	5.099	.000
	@12	-.217	.050	-.462	-4.382	.000
	@185	-.121	.050	-.220	-2.407	.020

a. Dependent Variable: Quality

Based on table 4.6.3, the adjusted R square for the impact on the quality of the system and development process by the project management methodology was 43.1% for model 1 when one

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predictor was used (question 18.4 - The project management methodology did not help much but it actually worsened the problems that were caused by the distributed teams). When another predictor, question 13 (For how long, during the last virtual and distributed project, did you apply project management methodology knowledge per day?) was added to question 18.4 for model 2 the adjusted R square increased to 54.1%. An additional predictor, question 12 (How frequently did you need and apply project management methodology knowledge in the last virtual and distributed project you worked on?), was additionally put for model 3 and the adjusted R square increased to 64.4%. The last model, model 4 had an increased adjusted R square value of 67.7% after question 18.5 (The project management methodology worked better on smaller virtual teams of less than 50 as compared to larger teams of more than 50) had been added to the other predictors.

These results show that, question 18.4 (The project management methodology did not help much but it actually worsened the problems that were caused by the distributed teams), question 13 (For how long, during the last virtual and distributed project, did you apply project management methodology knowledge per day?), question 12 (How frequently did you need and apply project management methodology knowledge in the last virtual and distributed project you worked on?) and question 18.5(The project management methodology worked better on smaller virtual teams of less than 50 as compared to larger teams of more than 50) all have an impact on the quality of the system and development process by the project management methodology

This chapter looked at the different quantitative data analysis tests that were carried out as part of this study. The next chapter, chapter 5, focuses on the conclusion which includes interpretation of the results, limitations encountered, explanation of the results, recommendations and conclusion of the research.

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Chapter 5: Conclusion

The aim of this research was to study the use and effectiveness of project management methodologies in virtual and distributed projects. The available literature mainly focuses on either virtual and distributed projects or project management methodologies and the strengths and weaknesses of these, but not on the use and effectiveness of the project management methodologies in virtual and distributed projects. This study sought to find out patterns and regularities between the following two aspects highlighted in chapter 1:

- The use of project management methodologies in virtual and distributed projects
- The effectiveness of project management methodologies in virtual and distributed projects

This would be done by focusing on the objectives that were highlighted in chapter 1 which are as follows:

- Review background of individual respondent
- Describe characteristics of virtual and distributed teams
- Describe the characteristics of virtual and distributed projects
- Identify the challenges faced by project managers who have worked in virtual teams.
- Identify the opportunities experienced by project managers who have worked in virtual teams.
- Determine the use of project management methodologies in virtual and distributed projects.
- Determine the effectiveness of PMM in virtual and distributed teams
- Determine the relationship between PMM and the success of virtual and distributed projects

This chapter covers the discussion of results, limitations and the conclusion. The following sections are included; discussion of results, additional results, lessons learnt, recommendation and limitations. Each of the sections is explained in the following paragraphs.

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5.1 Discussion of results

Each of the objectives listed in chapter 1 and in the introduction of this chapter is explained below based on the results found in chapter 4. In order to address our research objectives a survey was performed from May 2013 to September 2013. Responses were received from 162 respondents and 45 organisations in South Africa. The explanations of the objectives are as follows:

Research objective 1: Review background of individual respondent

For reviewing the background of individual respondents the following variables, highlighted in Chapter 3 table 3.3.1, will be addressed: Age, Qualification, Role, Experience in IT industry, Experience in SD, Experience in Virtual Teams, Experience in PMM, Source of PMM training. These variables are now reviewed in this section.

The respondents who took part in this study were mainly IT professionals in the age range of 26 – 50. An important fact noted was the fact that most respondents, (80%) were younger than 36 years of age and very few, (2.5%) were older than 50. This showed that the respondents were mainly young professionals.

Of these professionals, 74.1% had at least a university/ technicon degree, Honors/Masters degree or a PhD showing that the majority of the respondents were highly educated.

The sample was mainly made up of programmers who were at 43.2% and project managers who were 18.5%. This was ideal for the study as initially the goal was to get as much input as possible from mainly project managers and system developers (programmers).

63.6% of the sample had 5 years or less experience in the IT environment with the most, 26.5%, having between 3 – 5 years. This showed that most of the respondents were in their early to mid-careers. 36.4% had more than 5 years experience. This was a significant number of IT professionals who now had vast experience in the IT industry.

From the sample 75.9% had either 5 years or less experience in systems development. This also shows that the majority of the sample were between the entry level and mid-level in developing systems. 24.1% had more than five years experience which showed that a significant number of respondents were professionals in the development of systems.

87.7% of the respondents had 5 years or less experience in using project management methodologies while 11.8% had more than 5 years experience. The number of respondents who

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had more than 5 years experience was far less than those who had 5 years or less maybe due to the fact that most respondents also had less than 6 years experience in the IT industry.

84.6% of the IT professionals had 5 years or less experience of working on virtual and distributed projects while 15.5% had more than 5 years experience.

This sample was mainly made up of young IT professionals who were in their early to mid-careers. The majority of the respondents also had less than five years experience of working with project management methodologies as well as virtual and distributed projects. The experience that the majority of the respondents had, was interesting in that, it is the stage when individuals are excited in learning more about their jobs which included the use of project management methodologies in virtual and distributed teams. This excitement helps them learn more about the strengths and challenges of project management methodologies and how virtual and distributed projects, as well as teams, operate. These lessons are important as they contribute so much to analysing the use and effectiveness of project management methodologies in virtual and distributed projects.

From the survey all respondents had reported learning about project management methodologies with the greater number, 37.6%, having learnt while at university. An interesting percentage of 19.3 had received training while at work which means they had learnt about the specific project management methodologies they were using in the industry they were working. This would provide more accurate results as they had both theoretical and practical knowledge. 13.5% were trained by colleagues at work. Another interesting fact is that just above half of the respondents (52.9%) received training on PMM from academic institutions, while the nearly half, (47%) received in-house training.

The most popular project management methodology used by the respondents was PMBOK (25.9%) followed by PRINCE 2 (21.3%) and Agile project management methodology (10.2%). The project management methodologies are further explained under research objective 6.

The respondents were mainly young professionals who are still eager to learn more about the IT industry, project management methodologies and virtual and distributed teams. There were a significant number of professionals and experts in the field who had vast experience in the IT industry, project management methodologies and virtual and distributed teams. The respondents from this sample were highly educated with almost half learning about project management

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methodologies at college or university while the other half had in-house training. This was good for the study as the sample accommodated a variety of professionals who gave input to the study.

Research objective 2: Describe success factors of virtual and distributed projects

In order to address this research objective, we will discuss the following:

- Success factors for virtual and distributed projects
- Success of the development process followed in the virtual and distributed project
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Success factors of virtual and distributed projects

In Table 5.1.1 below the 5 success factors for virtual and distributed projects that were investigated are depicted in the first column. The rest of the columns represent the percentage of respondents that felt it had a small effect, neutral, and large effect on the project. It was calculated as follows: The response frequencies were based on a scale 1 to 5, with 1 being small effect and 5 being huge effect. The small effect was a combination of no effect and small effect while the large effect was a combination of medium to huge effect and neutral was for those in between.

Table 5.1.1: Success factors of virtual and distributed projects

Success factor	Small effect(%)	Neutral (%)	Large effect(%)
Lack of face to face interaction	29	33.3	32.7
Time separation between sites	38.3	32.1	24.1
Religions	56.2	23.5	14.8
Language and customs	53.1	24.1	17.9
Huge amount of information coming from multiple sources	17.9	25.3	51.9

Lack of face to face interaction

32.7% of the IT respondents highlighted how lack of face to face interaction had an effect on the virtual and distributed project with those seeing a small effect at 29%. Face to face interaction is necessary as it is easier to iron out all issues and get clarification on the spot. In the case of virtual and distributed projects it is not always easy to have face to face interactions. If the technology available does not accommodate a close substitution of face to face interaction in the form of video conferencing, video chats (for example Skype), emails and telephones it becomes difficult

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for project team members to communicate. Even though virtual and distributed project team members are geographically separated there should be some communication medium that connects them to one location through virtualisation. Most respondents highlighted issues caused by lack of face to face communication maybe because the available technology did not allow for a close substitute.

Time separation between sites

From the sample, 38.3% mentioned they had no issues with time separation between sites. This factor usually affects virtual and distributed projects that span over more than one country or continent. In table 4.8 (chapter 4) 56.1% of the respondents highlighted working on virtual and distributed projects that either spanned one city or one country (South Africa). In this case there will be no time differences and hence no effect caused by time separation on the virtual and distributed project. 16% highlighted working on virtual and distributed projects that spanned more than one country and therefore it is possible to get different time zones between these countries. 24.1% of the respondents mentioned that time separation between the sites had a large effect on the virtual and distributed project. When this happens some of the project team members have to work overtime or at odd hours to make sure they manage to communicate with the other sites especially when meetings are scheduled after work hours. Failure to do this will worsen the problems caused by face to face interactions.

Effect of culture, religion and customs in virtual and distributed teams

Virtual and distributed teams are characterised by culture, religion, language and customs and communication. Three factors were used to review the effects of culture in companies were virtual software development took place. These were the effect of different religions, the effect of language and customs, and the effect of huge amounts of information coming from multiple sources. These were recorded in tables 4.16, 4.17, 4.18 and 4.19 in chapter 4 and summarised in table 5.1.1 in this chapter.

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Effect of religion

When looking at the effect of the different religions in the virtual and distributed project, 56.2% (highest) highlighted that this factor had a small effect on the last virtual and distributed project they had worked on in table 5.1.1. This might have been affected by the degree of virtualization and distribution of the project. The greater part of the survey population had mostly worked within one city or country were they are used to most of the different religions used there.

14.8% more also highlighted that there was little effect. For the 16% who had worked on a virtual and distributed project spanning over more than one country the view might have been different.

Since most of the virtual and distributed projects were within South Africa, the effects caused by different religions were minimal. This might be because the respondents are quite familiar with the religions in South Africa. This factor might also not have much of an effect if the project team members strictly focus on business and not the social aspects.

Language used in the virtual and distributed

The next factor that was looked at in table 5.1.1 was the effect of language and customs in the success of the virtual and distributed teams. Just like with the previous factor most of the respondents, 53.1%, highlighted that this had a small effect on the success of the virtual and distributed project.

The effect of the language used by team members was also assessed in table 4.19 (Chapter 4) were most team members selected one language which everyone was familiar with. The majority, 35.8%, understood this language at a high level. The least was 1.2% with the team members selecting a common language and understanding it at a low level. This might have been directly linked to the fact that since most of them had been working on virtual and distributed projects within the same country or city they had selected one common language that most people understood at a high level (35.8% shown in table 4.19 of chapter 4). This was closely followed by those who understood the chosen language at a medium level.

If all or most of the project team members understand the language being used they are most likely going to understand the requirements as well as give feedback on the allocated tasks in a way that is understood by all the other team members. 1.2% understood the language at a low level and this might be I the cases were the degree of virtualization and distribution spans in more than one country.

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Effect of huge amounts of information coming from multiple sources

The last factor that was looked at for this objective was the effect of huge amounts of information coming from multiple sources (table 5.1.1). Unlike with the other two factors this factor had a huge effect (51.9%) on the virtual and distributed project. 17.9% mentioned having a small effect on the virtual and distributed project.

This might have been caused by failing to keep track and capture feedback from the different project team members. Problems like project team members failing to track the progress of their colleagues and not knowing the information or resource needs of the other team members might be faced if information is not captured well. If the communication channels are improved and storage facilities made available at a central location it becomes easier to update and notify all the other team members of the changes. The main thing is to manage the information coming in from the different sites and to also broadcast these to all the other team members effectively.

Research objective 3: Describe the degree of virtualisation and size of virtual and distributed teams

In order to address this research objective, we will discuss the following:

- Degree of virtualization
- Size of virtual and distributed team

Degree of virtualisation

Table 4.8 in chapter 4, which is replicated below to increase readability, showed that the majority of the respondents, 33.3%, had worked on virtual and distributed projects within the same country, which is South Africa. This was followed by those who had worked on virtual and distributed projects within the same city at 22.8% and those who had worked on projects within the same city, country and different countries also at 22.8%. The least number of respondents, 16%, highlighted that they had worked on virtual and distributed projects spanning from South Africa into other countries.

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Table 4.8: Degree of virtualisation and distribution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid					
	Within the same city	37	22,8	22,8	22,8
	Within the same country	54	33,3	33,3	56,1
	Different countries	26	16,0	16,0	72,1
	All environments	37	22,8	22,8	94,9
	No answer	8	5,1	5,1	100
	Total	**162**	**100,0**	**100,0**	

The higher percentage was for those working within the same country, the reason being that most of the respondents had been from countries which had branches in South Africa only. Their main focus was on working on virtual and distributed projects in South Africa. The smaller project teams had people situated at different locations but within the same country. This was followed by those who had worked on virtual and distributed projects within the same city. Since most of the respondents were within the 26 – 30 years age group (33%) and also had less than a year experience working on virtual and distributed projects (28.4%), they were most likely assigned to virtual and distributed projects within the same city or country to gain experience.

Table 4.8 in chapter 4 also shows that 16.0% IT specialists had worked on virtual and distributed projects spanning different countries. This may be companies that have different branches worldwide, or companies that offer extended services to other countries apart from South Africa. This might also be due to the factor that the local companies are also seeking IT expertise from other countries and adding onto the available resources they have.

As technology improves and competition increases, companies are moving away from collocated projects to the virtual and distributed projects so as to enjoy the benefits of getting better services, better man power and technology at a cheaper cost.

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Size of virtual and distributed teams

Another factor considered in this study was whether the size of the teams also had an effect on how project management methodologies had been effectively implemented. For better clarification, reference is given to table 4.9 from chapter 4 shown below:

Table 4.9: Size of virtual and distributed team (Chapter 4)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2 – 5 people	42	25,9	25,9	25,9
	6 – 10 people	51	31,5	31,5	57,4
	11 – 20 people	37	22,8	22,8	80,2
	21 – 50 people	20	12,3	12,3	92,6
	51 – 100 people	2	1,2	1,2	93,8
	more than 100 people	1	,6	,6	94,4
	No answer	9	5,5	5,6	100,0
	Total	**162**	**100,0**	**100,0**	

Most respondents, 92.6%, reported working on a virtual and distributed project of 50 people or less with 1.8% having worked in larger teams of more than 50 people. This might have been because the majority were in their early to mid-level careers and were mainly working on small virtual and distributed projects to gain as much experience as possible before moving onto larger projects. This might also have been because of the advantages of working in smaller teams (less than fifty people) compared to the disadvantages of working in larger teams (more than fifty people). This is further explained below.

From the sample, 22.2% confirmed that the project management methodology had in fact worked better on smaller teams as compared to larger teams while 25.9% disagreed. Most respondents might have enjoyed a lot of benefits from working in larger teams of more than fifty virtual and distributed team members. A larger virtual and distributed project team brings about more structure, that is, clearly defined roles for the team members. This also allows for better skilled team members, a variety of problem solving strategies and expertise that is diverse (Bradner *et al.* 2005).

In as much as working in larger virtual and distributed project teams of more than fifty has its benefits, it also has its weaknesses. 22.2% of the respondents preferred working in smaller teams of less than fifty virtual and distributed project team members. This might be because larger team are harder to coordinate than smaller groups. 42% of the respondents highlighted issues with

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receiving information from multiple sources (**Effect of huge amounts of information coming from multiple sources)** and this had an effect on the virtual and distributed projects. Other factors also include lack of participation from other team members if the group is large, low motivation to perform and as a result less satisfaction (Bradner *et al.* 2005).

Research objective 4: The use of project management methodologies in virtual and distributed projects.

In order to address this research objective, we will discuss the following:

- Type of PMM used
- Frequency of PMM use
- Duration of use

Type of project management methodology used

In table 4.10 in chapter 4, the responses from the different IT specialists were captured on the project management methodologies they had used in the last virtual and distributed project they had worked on. Most of them, 25.9%, used PMBOK followed by 21.3% who used PRINCE 2. The third highest was the use of Agile project management methodologies at 10.2%. Other in-house methodologies had very low usage levels at 1%. An interesting factor was people who used two or three project management methodologies at 5.6% and 2.5% respectively. 9.2% highlighted that they had not used any project management methodologies.

From the survey, most IT professionals who took part in the survey preferred to stick to the tried and tested method which has been in the industry for a while. This might be due to knowledge of the different processes that are used with this project management methodology. Since the project management methodology has been around for a while, and has been used within these organisations it is easier for companies to stick to the methods they know best.

There are also a great number of individuals (21.3%) who highlighted using PRINCE 2 followed by agile project management methodologies (10.2%). This might be because they once used PMBOK and identified some weaknesses which they tried to cover for by using an alternative competitive project management methodology. PRINCE 2 also comes with different tools and techniques that can be used by the project team members to aid in the successful implementation of a virtual and distributed project. The introduction of more flexible project management methodologies which

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empower the project team have been introduced as agile project management methodologies. Most companies are still buying into the idea of moving away from what they are used to in search of better ways of dealing with virtual and distributed projects.

There is an interesting percentage using a combination of either two or three project management methodologies in their virtual and distributed projects. This might be because they are actually using only the processes, tools and techniques they see most suitable to their situation. They combine these and customise it into their own project management methodology. Alternatively, some use one project management methodology to market their company and services while they actually use a different one for the actual virtual and distributed project.

9.2% highlighted that they did not use any project management methodology which might be because they do not have a clearly defined way of carrying out their virtual and distributed projects. On paper they might mention using a certain project management methodology while in practice they do not use one. The same sample highlighted not applying the project management methodology not even once in the last virtual and distributed project they worked on. Some use it to flourish their CVs and market themselves and yet do not apply anything.

Another portion of the respondents seemed to confuse the project management methodologies with the systems development methodologies and mentioned the use of the SDLC and DSDM. This was, however, lower than 10% of the population.

Frequency of project management methodology use

From the statistics captured in table 4.12 (chapter 4) 24.1% of the respondents highlighted they had applied project management methodologies several times in a week. 21.6% mentioned they had used project management methodologies a few times in a week while 21.0% highlighted using project management methodologies a few times in a month. 17.3% mentioned using project management methodologies every working day. 4.9% highlighted they had never applied any project management methodology in their last virtual and distributed project.

The results show that the greater part of the sample had applied project management methodologies in the last virtual and distributed project. This might have been because of the opportunities offered by project management methodologies like sticking to the budget and within specified timelines and also explained under the objective: "**Identify the opportunities experienced by project team members who have worked in virtual and distributed teams".** The frequency of applying project management methodologies depends on the virtual and distributed

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projects being carried out. If it is a long term project the frequency of applying the project management methodology might be lower than that of short-term virtual and distributed projects.

Some respondents, 4.9% did not apply project management methodologies in their last virtual and distributed project. This might have been because of the challenges highlighted under the objective: "**Identify the challenges faced by project team members who have worked in virtual and distributed teams".** Some respondents mentioned how project management methodologies had failed to give them the right guidelines in other projects. Others explained they had no knowledge of applying them while others just mentioned they followed a specific project management methodology for professional reasons like obtaining more customers or marketing themselves.

Duration of applying project management methodologies in a day

Based on table 4.13 in chapter 4, 4.9% of the respondents also highlighted never applying project management methodologies in a day which is consistent with the number who had mentioned they had never used project management methodologies in their last virtual and distributed project. The most respondents, 25.9% highlighted applying project management methodologies for 1 to 2 hours. The IT specialists might have referred to the processes and applied them step by step to ensure they were following the stipulated guidelines or process.

An interesting fact was the 11.7% who mentioned using the project management methodology for more than six hours. Since most of the respondents were young professionals it seems they were spending more hours learning about the project management methodology and how to apply it or customise it.

9.9% of the sample stated that they had applied the project management methodology for less than 30 min. This might have been the people who were already familiar with the project management methodology, its strengths and weaknesses from past experiences and were just refreshing the knowledge they had.

The duration of application also depends on the skills and expertise of the team, whether they partially or fully apply the project management methodology and the nature of the project itself. This is why they were variances in the duration of application.

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Research objective 5: Identify the opportunities experienced by project team members who have worked in virtual and distributed teams.

Seven opportunities were highlighted by the different IT specialists in their responses and captured in addendum A. These include time, communication, professional use, planning and guidelines, individual growth and team development, task allocation and progress review. The top 4 most mentioned ones are highlighted and explained below:

- Time

  The use of project management methodologies in virtual and distributed projects aids in rapid production of the project deliverables. When the project team knows what is expected and when it is expected, it becomes easier to work towards the given business objectives.

- Communication

  Project management methodologies assist and encourage communication within the team members in a virtual and distributed project. This is done by updating everyone on the feedback given by other team members as well as when allocating tasks to the team members.

- Professional Use

  Using a project management methodology helped the project team members gain more knowledge and experience on virtual and distributed teams as well as the project management methodology that was being used. This goes on to encourage team work where everyone becomes involved in the virtual and distributed project.

  Using a project management methodology gives all the stakeholders confidence in the virtual and distributed project, therefore giving the organisation a competitive advantage over its rivals.

  In the case of PRINCE 2 the virtual and distributed project team members are empowered to make their own decisions and to grow.

- Reviewing progress

  When using a project management methodology in virtual and distributed projects it is easier to track what the team members are doing, the phase at which the project is and make adjustments were necessary.

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The project management methodology is used as a guideline to track the progress being made and also know the expected deliverables of each phase. It enables the project manager and team members to plan first.

Research objective 6: Identify the challenges faced by project team members who have worked in virtual and distributed teams.

Six challenges were also highlighted by the project team members and captured in addendum B. These include lack of PMM knowledge and need for training, guideline not always provided or inappropriate for given situation, insufficient time to learn or follow PMM, different ways of understanding and applying PMMs, higher cost as compared to budget, not suitable where project requirements are constantly changing. The top 3 most mentioned ones are highlighted and explained below:

- Guideline does not always provide for or is inappropriate for given situation.

  Project management methodologies provide a general guideline which is not always applicable to different virtual and distributed projects. The project management methodology does not provide a detailed step by step guideline for a specific scenario. This results in some people trying to customize the project management methodology to suit the virtual and distributed project they will be working on. Even though it is difficult to come up with a project management methodology for every virtual and distributed project, not having the correct guideline for that specific project increases the chances of each project team member doing what they see suitable especially when they are not managed well.
- Lack of PMM knowledge and need for training

  Most respondents highlighted the lack of training, the lack of assistance from senior project team members as another weakness of using the project management methodologies in virtual and distributed teams. If the project team members do not know how to apply and use the project management methodology it results in demotivation or people using their own ways of working on these projects. Some of the project management methodologies used do not have sufficient documentation for the team members to read and learn.

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- Different ways of understanding and applying PMMs

  Nowadays people tend to use the best of different project management methodologies to suit the given virtual and distributed project. This might give positive results, but if it does not, it compromises the success of the virtual and distributed project.

Many strengths and weaknesses of using project management methodologies were highlighted but they vary according to the virtual and distributed project being worked on. For example, as a benefit, project management methodologies provide a guideline on how virtual and distributed projects should be conducted, but on the negative side, it does not give specific guidelines and might end up being the wrong project management methodology for that specific virtual and distributed project.

Research objective 7: Effectiveness of Project Management Methodologies

In order to address this research objective, we will discuss the following:

- Support provided by PMM (production technology, control technology, the impact on the quality of the system and the development process, cognitive cooperation technology, quality of process)
- The fit between the PMM and the V&D team
- Experiences of respondents regarding PMM use

To assess the effectiveness of the project management methodologies that were being used in the virtual and distributed projects, respondents were asked to answer the following:

Support provided by project management methodologies (PMM)

Regarding the support provided by PMM, we focused on support as production technology, support as control technology, and support as cognitive and cooperation technology (Huisman and Livari, 2006) These will be discussed next.

Production Technology

Question 1: PMM helped align virtual and distributed project to the business

64.8% agreed or totally agreed that the project management methodology had helped to align the project to the business while 7.4% disagreed or totally disagreed. For most of the respondents

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project management methodologies helped align the virtual and distributed project to the business. This might have been because the project management methodologies had phases for aligning the project objectives to the business needs.

Question 2: PMM helped to involve end-user in virtual and distributed projects

When asked about end-user involvement, the majority, 51.9%, agreed that users had been involved in the virtual and distributed project due to use of a project management methodology. The project management methodology used might have had phases were it was encouraged for users to be included frequently. Some end- users might not have been included if project management methodologies were not applied or partially applied.

Control technology

Question 3: PMM helped decompose the virtual and distributed project into workable parts

65.4% of the respondents highlighted that project management methodologies had helped them decompose the virtual and distributed project into workable parts. The different phases allow for the project to be divided into smaller parts which can then be allocated to the specific resource.

Question 4: PMM helped estimate time and effort required to complete the virtual and distributed project

The majority, 67.3%, also highlighted how they had been able to estimate time and effort required due to project management methodologies. This might have been closely related to being able to decompose the virtual and distributed project into workable parts. Once the project has been divided it becomes easier to estimate the time and effort.

Question 5: PMM helped define useful milestones in the last virtual and distributed project

This is also related to question 4 and 5. A high margin of 54.3% highlighted how useful milestones had been defined due to the use of project management methodologies. Milestones help the project team know what to focus on at any given time during the course of the project.

Question 6: PMM helped keep the latest virtual and distributed project under control

Once the virtual and distributed project has been decomposed into workable parts and milestones defined, control of the project becomes easier. 54.9% agreed that the project management methodology had helped control the virtual and distributed project. This percentage was lower than the expected 64% who had highlighted that the project management methodology had helped decompose the project and estimate time and effort needed. This might have been

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because other factors like communication and information coming from multiple sources had made it much more difficult to control the project.

Support as cognitive cooperation technology

Questions 10, 11 and 12 are analysed in the results of table 5.1.2 shown below.

Table 5.1.2: Support as cognitive cooperation technology

	Disagree	Neutral	Agree
PMM provided useful guidelines of working on a virtual and distributed project	7.4	27.8	59.3
PMM defined an ideal process of working in virtual and distributed projects	12.4	30.2	51.9
PMM helped stakeholders learn from working on a virtual and distributed project	9.9	32.1	52.9

Question 10: PMM provided useful guidelines of working on a virtual and distributed project

59.3% found project management methodologies useful in providing guidelines. Without project management methodologies the project team might not have an idea were to start and what needs to be done at different levels of the project. 7.4% disagreed, possibly because wrong project management methodologies had been used for the virtual and distributed project, or the IT specialists had no training or no knowledge in the use of that project management methodology.

Question 11: PMM defined an ideal process of working in virtual and distributed projects

This question is closely related to question 10 were guidelines define an ideal process of working in virtual and distributed projects. 51.9% agreed as compared to the 12.4% who disagreed that the ideal process had been defined.

Question 12: PMM helped stakeholders learn from working on a virtual and distributed project

52.5% of the IT specialists highlighted that the project management methodology had helped them learn from working on a virtual and distributed project. This might be because most experience is gained from working on a number of projects at a time. You identify the challenges and work on solving them for the next project. 9.9% disagreed, possibly because they were working on the same type of projects over and over and not learning anything new.

From the summarised table, table 5.1.2, more than half of the respondents had found project management methodologies helpful in terms of defining an ideal process, giving guidelines and

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helping stakeholders learn from the virtual and distributed project. In this case it was easier to work on projects due to clearly defined guidelines that had been provided by project management methodologies. This in turn helped the young professionals, who were the majority in this sample, to learn more about the particular project management methodology and how it is applied in different virtual and distributed projects.

The impact on the quality of the system and the development process

The impact on the quality of the system was captured in chapter 4 and is now summarised in table 5.1.2. Questions 7, 8 and 9 are based on this table and the explanation is given after the table.

Table 5.1.2: Impact on the quality of the system and the development process

	Disagree	Neutral	Agree
PMM helped develop a more functional project in the last virtual and distributed project	13	23.5	58
PMM helped develop a more reliable system in the last virtual and distributed project	10.5	30.2	53.7
PMM helped develop a more maintainable system in last virtual and distributed project	9.2	19.8	64.2

Question 7: PMM helped develop a more functional project in the last virtual and distributed project. 58% agreed that project management methodologies had help develop a more functional project compared to the 13% who disagreed. Some project management methodologies encourage different functions of the project to be created incrementally and hence the high percentage in those who agreed. With the rate of respondents who got guidelines and an ideal process to follow, the percentage which found project management methodologies as having helped in developing a functional project was also expected to be high.

Question 8: PMM helped develop a more reliable system in the last virtual and distributed project53.7% agreed the project management methodology had helped develop a more reliable system in the last virtual and distributed project they had worked on. When projects are developed function by function more emphasis is put on that level and hence reliable systems might be developed because of that. Sufficient resources are allocated to ensure each phase is completed well and this helps in developing reliable systems.

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Question 9: PMM helped develop a more maintainable system in last virtual and distributed project64.2% of the respondents mentioned that project management methodologies had helped them develop a more maintainable system. This may be due to the fact that with some project management methodologies, monitoring of the last phase is done to check if errors crop up. With some project management methodologies like PMBOK (as discussed in chapter two) while working on a different phase of the project, monitoring can be done on a completed phase. This allows for systems to be easily maintained.

Quality of process

The quality of the process was also analysed and the results were captured and summarised in table 5.1.3. These are further explained in question 13 and question 14.

Table 5.1.3: Quality of process

	Disagree	Neutral	Agree
PMM helped achieve objectives of the virtual and distributed project	12.4	32.7	48.8
PMMs helped increase the morale of the virtual and distributed project team	18.5	39.5	35.2

Question 13: PMM helped achieve objectives of the virtual and distributed project: Based on table 5.1.3, 48.8% highlighted how project management methodologies had helped achieve objectives of the virtual and distributed project. When all the above questions have been addressed it is most likely that the objectives will be achieved. 12.4% disagreed that project management methodologies had helped achieve the objectives due to reasons like the wrong project management methodology being used or lack of training highlighted in the challenges faced.

Question 14: PMMs helped increase the morale of the virtual and distributed project team:From the sample, 35.2% (table 5.1.3) agreed that the project management methodology used had increased the morale of the virtual and distributed project team. By providing guidelines and helping monitor progress, the project team is motivated into meeting the project specification. Once this is done, the morale of the project team increases, as they will be working like a well-oiled machine were they understand each other and how to address the issues at hand. 18.5%, however, highlighted the project management methodology had not help increase the morale of the virtual and distributed project team. If the project management methodology is not properly

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followed it increases problems and meeting the specified requirements becomes an even challenging issue. This in-turn has a negative impact on the project team and project success.

From the questions asked on the use of project management methodologies in virtual and distributed projects it can be concluded that these were effective as most respondents found them useful. In cases where they were not effective, it was mainly because project management methodologies had partially been applied while other team members did not have an idea of how to use them.

Fit between the project management methodology and the virtual and distributed team

To assess the fit between the project management methodology and the virtual and distributed team project managers (18.5% of the respondents) were asked to answer three questions specific to them. Their responses are summarised in table 5.1.4.

Table 5.1.4: Fit between PMM and virtual and distributed team

Question	Disagree	Neutral	Agree	No answer
Using a PMM suited the way I wanted to manage the team.	6.8%	17.3%	18.5%	57.4%
The PMM used was suitable for managing virtual and distributed teams	4.9%	16.7%	19.2%	59.3%
The PMM used works better in collocated teams as compared to virtual and distributed teams	13%	17.3%	12.4%	57.4%

The most project managers, 18.5%, highlighted that the project management methodology used had helped manage the team. Project managers have tools and techniques at their disposal to manage the team. This may involve allocating tasks, monitoring progress and receiving feedback from project team members. 17.3% were neutral. This may be because the project management methodology used had helped managed the team at some stages, but not all phases of the project. 6.8% highlighted they had not been able to manage the team well as a result of using project management methodologies. As highlighted by some respondents in the weaknesses of using project management methodologies, this might be due to the fact that project management methodologies were not fully applied, the wrong project management methodology was being used or there was lack of training on how the project management methodology is used.

This was closely related to the other question were project managers were asked if the project management methodology used was suitable for managing virtual and distributed teams. 19.2%

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agreed that it had helped in managing virtual and distributed project teams. 16.7% were neutral and the percentage of project managers who disagreed dropped to 4.9%. Virtual and distributed teams are difficult to manage without a project management methodology as there are more factors to deal with as compared to working in collocated teams. From the responses, most project managers had found them useful. The factor analysis done on question 19.2 (The PMM used was suitable for managing virtual and distributed teams) also showed a very good fit of 0.910.

Factor analysis was also done for question 19.3 (The PMM used works better in collocated teams as compared to virtual and distributed teams) showed a negative good fit of -0.770. This was because the question had been asked in a negative way. The final question made a comparison on whether the project management methodology had been suitable for collocated teams versus virtual and distributed teams. The majority, 17.3% were neutral, 13% disagreed and 12.4% agreed. There are certain aspects of a project and its team that are similar, be it collocated or virtual and distributed, like allocating tasks, monitoring progress and getting feedback. This therefore makes it difficult to compare if the project management methodology is suitable for either project team. For those project managers who had experience working in both collocated and virtual and distributed teams it would have been easier if the same project management methodology had been used.

Experiences of respondents regarding PMM use in virtual and distributed projects

In the literature review done in chapter two, virtual and distributed teams were said to be influenced by culture, distribution, communication and size of team. A Likert scale, with a scale of 1(Totally disagree) to 5(Totally agree), was used to analyse if the project management methodology had helped with the factors highlighted in table 5.1.5. The results were captured and summarised as shown in table 5.1.5

Table 5.1.5: Experiences of respondents regarding PMM use

	Disagree	Neutral	Agree
PMM helped solve cultural differences between virtual and distributed project team members	28.3%	42.6%	22.9%
PMM helped deal with issues caused by working from different locations	9.9%	24.7%	58.7%
PMM allowed contribution and discussions from different team members	12.4%	35.8%	44.4%
PMM worsened challenges faced in the virtual and distributed projects	57.4%	30.2%	6.2%
PMM worked better on smaller teams (<50) than on larger teams (>50)	25.9%	45.7%	22.2%

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The results are explained as follows:

PMM helped solve cultural differences between virtual and distributed project team members

From the results, the majority 42.6% were not committed either way, while 28.3% disagreed. The project management methodologies used do not focus on how to deal with different cultures. The main aim for the project team is to work on addressing the project objectives or specified requirements. No time is spent on learning other cultures and at times the project team does not have sufficient time to try and learn about other cultures due to tight deadlines. It is, however, necessary to understand the basics of the culture of other project team members in order to understand how they carry out their business. 22.9% highlighted that issues with cultural differences had been solved by using the project management methodology. This might have been because, if all project team members understood the project specification and cooperated in meeting the project objectives, culture would have not played a major role in affecting the virtual and distributed projects' success.

PMM helped deal with issues caused by working from different locations

When asked if project management methodologies had helped to deal with issues caused by working from different locations 58.7% agreed. The project management methodology used might have assisted in keeping monitoring and reviewing progress of all tasks allocated to the project team members situated at different locations. This way the project management methodology would have assisted to keep all team members on the same level of what was happening in the virtual and distributed project. The tools and techniques plus good communication channels might have also helped the project team members stay connected even though they were geographically separated. 9.9% disagreed. This might be influenced by project teams who had used a project management methodology that was not suitable for the given virtual and distributed project or the teams that had partially applied the project management methodology.

PMM allowed contribution and discussions from different team members

The respondents were also asked if the project management methodology they had used allowed contribution and discussions from different team members. 44.4% agreed. Due to monitoring, constant communication and the ability to review progress and notify other project team members, project management methodologies allow for different project team members to contribute and discuss or review the progress of virtual and distributed projects. 12.4% of the respondents disagreed. As mentioned in the previous paragraph, partial application of the project

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management methodology or applied a project management methodology that does not suit the situation will not encourage the project team but will demotivate the team members instead.

PMM worsened challenges faced in the virtual and distributed projects

Respondents were asked if the project management methodology they had used had worsened the challenges that had been face in the virtual and distributed projects. The most respondents, 57.4% disagreed. Since this was related to the three questions asked earlier, most respondents would have disagreed as expected from their responses to the three questions. Most specialists had highlighted that the project management methodology had helped solve issues in virtual and distributed teams while also allowing for contribution and discussions. This would in-turn reduce the challenges faced. 6.2% agreed to this as maybe they had partially used an incorrect project management methodology, which complicated the process, resulting in more work trying to figure out how to cater for the wrong choice made.

PMM worked better on smaller teams (<50) than on larger teams (>50)

Just as discussed under Research objective 3: **(Describe the degree of virtualisation and size of virtual and distributed teams)** 22.2% confirmed that the project management methodology had in fact worked better on smaller teams as compared to larger teams while 25.9% disagreed. Most respondents might have enjoyed a lot of benefits from working in larger teams of more than fifty virtual and distributed team members. A larger virtual and distributed project team brings about more structure, that is, clearly defined roles for the team members. This also allows for better skilled team members, a variety of problem solving strategies and expertise that is diverse (Bradner *et al.* 2005).

In as much as working in larger virtual and distributed project teams of more than fifty has its benefits, it also has its weaknesses. 22.2% of the respondents preferred working in smaller teams of less than fifty virtual and distributed project team members. This might be because larger team are harder to coordinate than smaller groups. 42% of the respondents highlighted issues with receiving information from multiple sources (**Effect of huge amounts of information coming from multiple sources)** and this had an effect on the virtual and distributed projects. Other factors also include lack of participation from other team members if the group is large, low motivation to perform and as a result less satisfaction (Bradner *et al.* 2005).

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Research objective 8: Determine the relationship between project management methodologies and the success of virtual and distributed projects

In this study we focused on the type of PMM used, the duration of PMM use (horizontal use), the support provided by PMM, the impact of PMM on the system and the development process, and the fit between the PMM and the V&D project. In order to address the above research objective we will report the correlations that exist between the success of the virtual and distributed project and the above items based on table 5.1.6 (taken from chapter 4 for easier referencing).

Table 5.1.6: Success of virtual and distributed projects and the non-parametric Correlations

Variable	correlation coefficient	Strength of correlation coefficient
Fit between project management methodology and the virtual and distributed project	0.396**	Moderate
Support provided by PMM	0.406**	Strong
Impact on the quality of the system and development process.	0.516**	Strong
Horizontal use (Question 13)	0.164*	Weak

** show that Correlation is significant at the 0.01 level (2-tailed)

* shows that correlation is significant at the 0.05 level (2-tailed))

Table 5.1.3 above shows the correlations between the project management methodologies used and the factors that ensure the success of virtual and distributed projects. The correlations are further explained below:

Fit between project management methodology and the virtual and distributed project

This had a moderate correlation of 0.396. The project management methodology used had a reasonable fit to the success of the virtual and distributed project used. The choice of a project management methodology that suits virtual and distributed projects is important as it also increases the chance of virtual and distributed project success.

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Support provided by the project management methodology

The support provided by project management methodologies had a strong correlation of 0.406 with the success of the virtual and distributed project. When support provided by project management methodologies, for example in the form of effective and full use of the project management methodology and guidelines, increases then the chances of virtual and distributed projects being successful also increases.

Impact on the quality of the system and development process.

The impact on the quality of the system and development process also had a strong correlation of 0.516 with the success of the virtual and distributed project. As the impact on the quality of the system and development process increase so does the success of the virtual and distributed project.

Horizontal use (Question 13)

The horizontal use was the duration project management methodologies had been applied in a day in the virtual and distributed project. This had a weak correlation (0.164) to the virtual and distributed projects success. The longer the project management methodology was applied the more the virtual and distributed project was likely to succeed but at a lower rate.

5.2 Additional results

Apart from the above, some additional results were obtained. In order to investigate further, we tried to answer the following questions:

- What factors influence the support provided by project management methodologies in virtual and distributed teams?
- What factors influence the impact of PMM on the quality of the system and the development process?
- Are there any differences between the perceptions of respondents for different types of PMM?

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- Are there any other relationships between project management methodologies and the success of virtual and distributed projects?

What factors influence the support provided by project management methodologies in virtual and distributed teams?

The factors influencing support provided by project management methodologies in virtual and distributed teams are shown in table 5.1.7 and explained afterwards.

5.1.7 : Model Summary for results of best subset regression for support provided by PMM

Model	R	R Square	Adjusted R Square
1	.766[a]	.586	.579
2	.836[b]	.699	.689
3	.866[c]	.750	.736

a. Predictors: (Constant), 18.3 (The project management methodology allowed team members at different locations to contribute and discuss to the satisfaction of most team members)

b. Predictors: (Constant), 18.3, 13 (For how long, during the last virtual and distributed project, did you apply project management methodology knowledge per day?)

c. Predictors: (Constant), @183, @13, 18.4 (The project management methodology did not help much but it actually worsened the problems that were caused by the distributed teams)

These factors helped to resolve issues that had been caused by virtual and distributed projects. After adding all this factors in section the adjusted R square had increased from 53.9% to 73.4%. From the value of adjusted R square there is evidence that these factors influenced the support that was provided by project management methodologies to virtual and distributed projects.

After carrying out the regression analysis in chapter 4 of this study there were a few factors discovered that influence the support provided by project management methodologies in virtual and distributed teams. These additional factors were contributions and discussions done by project team members at different locations and the horizontal use (length/duration of applying project management methodologies). The more the virtual and distributed project team members were able to discuss and contribute to the project, the more positive they were about the support that was provided by the project management methodology. The more they

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used the project management methodology, the more the support provided experienced, because they became familiar with it.

What factors influence the impact of PMM on the quality of the system and the development process?

Regression analysis was also done on the impact of project management methodologies on the quality of the system and the development process. The value of the adjusted R square was 67.7% after a few factors had been combined.

5.1.8 Model Summary for the Impact on the quality of the system and development process by the PMM

Model	R	R Square	Adjusted R Square
1	.664[a]	.442	.431
2	.747[b]	.558	.541
3	.816[c]	.666	.646
4	.837[d]	.701	.677

a. Predictors: (Constant), @184

b. Predictors: (Constant), @184, @13

c. Predictors: (Constant), @184, @13, @12

d. Predictors: (Constant), @184, @13, @12, @185

The results obtained in table 5.1.8 showed that, question 18.4 (The project management methodology did not help much but it actually worsened the problems that were caused by the distributed teams), question 13 (For how long, during the latest virtual and distributed project, did you apply project management methodology knowledge per day?), question 12 (How frequently did you need and apply project management methodology knowledge in the last virtual and distributed project you worked on?) and question 18.5(The project management methodology worked better on smaller virtual teams of less than 50 as compared to larger teams of more than 50) all have an impact on the quality of the system and development process by the project management methodology. Using a project management methodology plus applying it frequently for longer periods of time while using smaller project teams increased the quality of the system as well as that of the development process. This may be as a result of the ability to control smaller teams while using project management

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methodologies. Frequent application for longer times also assisted in making everyone follow the guidelines provided by the project management methodology.

Are there any differences between the perceptions of respondents for different types of PMM?

In section 4.5.1 we tested five variables, success of the virtual and distributed project, project management methodology fit, support provided by project management methodology, impact of project management methodology on the system and the development process and success factors for virtual and distributed project to see whether there was a difference between the perceptions of respondents using Prince 2 and those who don't use it. No differences were identified between the two groups. This was also done for PMBOK were no significant differences were found.

Table 5.1.9: Agile project management methodology – Differences in perceptions

Agile		Mean	Std. Error Mean	Effect size	Interpretation
Success of virtual and distributed project	1.0	3,9188	,10654	0,49	Large effect
	.0	3,5890	,06134		
Fit	1.0	3,8571	,30738	0,59	Large effect
	.0	3,3095	,12305		
Support provided by PMM	1.0	3,8667	,17431	0,26	Medium effect
	.0	3,6641	,05158		
Impact of PMM on system and development process	1.0	3,7200	,13565	0,34	Medium effect
	.0	3,4956	,05897		
Success of virtual teams	1.0	2,4000	,13992	0,59	Large effect
	.0	2,8246	,06493		

In table 5.1.9, in the use of the agile project management methodology under success of the process, there was a large effect (0.49) on those who used agile project management methodologies versus the ones that did not.

This was the same in the case of the fit (0.59) and success of virtual and distributed teams (0.59). There was a large effect on the success of virtual and distributed teams caused by either using project management methodologies or not. Use of project management methodologies increase the chances of success for the project.

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There was a medium effect on the support (0.26) and the impact on system and development process (0.34). Project management methodologies provided support for working on virtual and distributed projects. Not using them had a medium effect on the result of the project.

Are there any other relationships between project management methodologies and the success of virtual and distributed projects?

Table 5.1.10: Additional success of virtual and distributed projects and the non-parametric Correlations

Variable	correlation coefficient	Strength of correlation coefficient
Age (Question 1)	-0.164*	Weak
Size of virtual and distributed team (Question 9)	- 0.242**	Moderate
@Q226 Cost of development	0.397**	Moderate

** show that Correlation is significant at the 0.01 level (2-tailed)

* shows that correlation is significant at the 0.05 level (2-tailed))

Table 5.1.10 above shows the correlations between the project management methodologies used and the additional factors that ensure the success of virtual and distributed projects. The correlations are further explained below:

Age (Question 1)

The age had a weak negative correlation of -0.164 to the success of the virtual and distributed project success. Even though at a lower rate, it showed that as the age of the IT professional increased the chances of success for the virtual and distributed projects.This may be explained by the fact that as IT specialists grow older and gain more experience they tend to start using their own methods and partially apply the project management methodologies. The younger professionals rely heavily on the methodology in use.

Size of virtual and distributed team (Question 9)

The size of the virtual and distributed team had a moderate negative correlation of -0.242 to the success of the virtual and distributed project. As the team size increases the chances of success for the virtual and distributed project decrease at a moderate rate. This might be caused by the factors discussed earlier under the size of virtual and distributed project team (Research objective

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3). This includes low motivation among team members and failure to track team member progress. The chances of success increase at a moderate rate, as the size reduces.

Cost of development (Question 22.6)

The cost of development had a strong correlation of 0.397 with the success of the virtual and distributed project. As the amount spent on the project increased the size and complexity of the system developed successfully, increased as well. This might be because more funds will be used to acquire the best skills available as well as getting diverse expertise.

5.3 Lessons learnt

From the study the researcher learnt the following:

While doing the literature review above a few lessons where leant about the use and effectiveness of project management methodologies in virtual and distributed projects.

Team Rotation

For these to be successful there is need for rotation of team members across locations and units. This allows each team member to at least work with every other team member who is working on the project. In a team of for example ten people, five at location A and the other five at location B. One member from team A can go and work with the other team for a week while one from team B does the same with the other team. This will give the team a chance to work together and learn the traits of the other team members. This eliminates the problem of not knowing who you are dealing with.

Periodic Meetings

Another lesson to consider is arranging periodic meetings between the team members. Scheduling frequent (if possible, short) meetings is important. Meetings in the form of video conferences, audio conferences, Skype meetings and so on can help eliminate the problems associated with the distance factor. The more meetings team member have, even if they are daily fifteen minute meetings helps to ensure that everyone knows what is going on and if there are any issues these can be resolved quickly. Technology is now advanced and even though people are physically apart logically they will be working like a collocated team.

Standardised Technology platform

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Maintaining a standardized technology platform enabling uniform information access at all locations is also important. If one location has much more advanced technology this might cause problems in failure to connect. This will therefore not help as the aim is to have constant and continuous communication between the distributed techniques. This might however be difficult to achieve if the distributed teams are working in different countries or continents.

Technology in the first world countries is usually much more advanced as compared to that in third world countries. There should be a standardised technology platform, that is, facilities for video conferencing, audio conferencing and Skype should be made available at all facilities. Assistants should also be available to make the bookings and IT support to make sure connections are available whenever they are needed. Effective communication must be enhanced, where there is constant feedback and clarification to keep projects moving in the right direction. In this way, the software project manager may also encourage the project team to be open and honest.

Choice of project management methodology

The question is also not about using a combination of traditional or agile project management methodologies, but is about which project management methodology best suits the current situation. Some projects are very complex and need careful planning and step by step processing, that which is usually addressed by traditional project management methodologies. Some projects might need fast results and can be developed in iterations, functionality by functionality which requires the use of agile project management methodologies. In some instances a mixture of both is recommended as long as a viable solution is agreed upon.

Historical information on past projects

It is also important to keep historical performance data for teams that used project management methodologies in virtual and distributed projects in a specific place. Details on the type of project, duration, team size and project management methodology used can be stored to assist when projects of a similar nature are undertaken. This helps get to the desired outcome quicker and it helps avoid repeating mistakes that were done by other teams.

Involvement of stakeholders

The other important lesson learnt is the building and maintaining of close relationships with all project stakeholders. Everyone who is taking part in the project is important and should always be involved. When team members have a sense of belonging they tend to work hard and produce favourable results. An effort will be made to involve even other team members located elsewhere.

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Central management of virtual and distributed project

Even though they are referred to as virtual and distributed projects or teams, central management is required for the user organization. There should be a main branch or main site from where the main control is. Issues, like problems with differing procedures at the various project team sites, selecting the right people experienced in the procedures, shifting the powerbase regardless of how much power needs to be shifted, and managing the overall training and installation require a strong central control. Without central project management, it is difficult to coordinate the project and the team members. This central management also assists those taking part in the project to know where to report and where to get the main instructions.

Virtual and distributed project team

In as much as distributed projects aim to minimize costs through diversification, they still need experts in using the project management methodology at different locations. Experts who know how to use technology, and experts who understand how to link the projects that are being done virtually. A lot of technology is involved in making people who are physically distributed act as if they were working in one location.

For virtual and distributed projects to be successful there is need for team work. There is a need to carry out activities like team building which involves the setting up of a team with an appropriate mix of skills to ensure the successful completion of a project. Project managers should identify conflicts between team members as early as possible and deal with these accordingly. Even though physically distributed teams are working on a project, project management is typically a team activity which should guarantee the achievement of defined objectives related to software project management. Team work involves senior management level down to and including lower levels. Different types of teams are necessary: inter-disciplinary teams, informal teams, autonomous teams, and others, during the various phases of a project.

Project management methodology choice

From the journal papers studied it is evident that most projects still suffer from not meeting the deadlines and going over budget. Newer project management methodologies have been introduced to try and fix these issues but with the introduction of distributed projects newer problems have been identified.

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It was also noted in the research that emphasis is on which project management methodology is used and whether it is a traditional or agile one. There are important elements that can be used from both types of project management methodologies and in some case a combination of both might be advisable. Most project management methodologies were originally developed for projects developed by collocated teams and adjusted to suit distributed projects.

5.4 Limitations

The study offered insight and knowledge in the use and effectiveness of project management methodologies in virtual and distributed projects. This, however, came with a number of limitations which need to be taken into consideration. Some of the limitations encountered were that: Some IT specialists were working on other projects and had deadlines to meet and therefore did not have sufficient time to answer the questionnaire and hence some blank answers. Some did not return the questionnaires.

Another limitation was time. If the survey had been done over more time, more respondents would have been found thereby increasing the accuracy of the results found.

The last limitation was the funding. Some respondents needed incentives to answer the questionnaire and this was not available hence only 162 IT specialists responded. Funding was also a limitation in that it was difficult to travel and research on other development companies who would have taken part in the study.

5.5 Recommendation on how best project management methodologies can be applied in virtual and distributed projects

While most research has been done on either project management methodologies or virtual and distributed projects or teams, the right project management methodologies need to be created for virtual and distributed projects or a framework on using the existing project management methodologies should be created to assist project managers as well as project team members in undertaking this type of project. Technology should be made available in the form of conference rooms (both video and audio), video chats (Skype, Google talk), group chats (Lync), and telephones, to help maintain constant communication at any given time or part of the project. This addresses the problems with face to face interactions. Flexi hours should also be applied to cater for differences in time zones. Project team members know when they need to communicate

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with other team members in advance through appointments and can therefore come to the office at specific given times. This helps make sure the team is fresh and energetic at all times and reducing overtime. For problems with customs, religion and languages site rotations can be done were most team members get to work with all other team members face to face by rotating locations. This enables team members to better understand how other team members operate and interpret information at different sites. Training should also be scheduled for those who are not familiar with the project management methodologies in use. This may be in-house, just to ensure that the whole team sticks to the objectives of the business and well as understand how the project management methodology should be applied in different situations.

5.6 Conclusion

From the survey most IT professionals showed that project management methodologies had an effect on how virtual and distributed projects were conducted. From the outcomes, it showed that most virtual and distributed projects had most of their requirements met by using project management methodologies. Most project managers also found project management methodologies helpful in managing teams even though they felt the methodologies had been originally meant for collocated teams.

The survey showed that application of a project management methodology brought about positive results as it assisted project managers as well as the project team with guidelines on how to tackle the huge task at hand. The main problem was that most people found the project management methodologies most useful in collocated teams as compared to virtual and distributed projects.

With the degree of virtualization and distribution being mainly in South Africa, Religion did not have a major influence on how project management methodologies. Most people used a common language which they found easier to do as they were mainly from the same country or same city. As the degree of virtualization increased from South Africa only to South Africa and other countries, factors like time differences, religion, customs and language started to have an effect. People in the same country are bound to understand the customs, religions and languages in that country. Even though there are more than five languages and religions in South Africa, most people understood at least two and therefore used a common language to communicate.

Even though project management methodologies were effective in virtual and distributed projects certain factors caused them not to be fully effective. Lack of face to face interaction, time

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separation, languages and customs and huge amount of information coming from multiple sources also played a huge role. In some projects not enough technology exists to assist project team members in communicating and providing feedback on allocated tasks. Most respondents highlighted how difficult it was to know what was being done at another site. Time separation is also a factor that caused problems as the degree of virtualization increased. The differences in time zones meant that some people had to work extra hours just to make sure they manage to communicate with other team members at different locations.

Most people highlighted lack of training as a challenge as they did not know how to apply the different tools and techniques for a particular project management methodology. This has a huge impact on how project management methodologies are applied to virtual and distributed projects. Even those who knew about the project management methodologies were reported as not having sufficient time to educate the other team members.

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Addendum A: Opportunities

The methodology gave the team greater standing and competitive edge, It also enhanced effectiveness in delivering services	A good project plan can come up, Assist people working on the project, Good opportunity for growth	Able to identify flows that you make in projects, Set of good practice they need to follow	Allocation of tasks is made easier, You know the time to expect completion and starting on project tasks
Allows you to guide the team into following specified procedure, Team tried to deliver deliverables where specified, Planning is made easier, Easier to guide the junior programmers and graduate trainees	Apart from the above the methodology also Improved growth and development within the team, The methodology used helped team members to focus on the right things in the right way	At least as the project team we have an idea of what is expected	At least we have some form of structure
Can be customised to suit the project we are working on, Helps deliver services in a transparent and effective manner, Team members learn a lot from it	Clarify what you are doing and why you are doing it	Commuication is good if you also include video conferencing and use chat applications like Microsoft lync. You set appointments knowing what function of the system will be developed	Communication barriers were reduced and communication was improved. A standardized measure was accessible to everyone through the use of Prince 2.
Communication was easy for us as we knew the phases we had to follow, We knew the deliverables of each stage an the team tried by all means to produce even though we didn't meet the stipulated times always, Faster development as compared to when we did anything we wanted, We were able to also look at quality of the product	Each one is allocated an appropriate task	Easier to identify the mistakes you make in projects, Opportunities to expand	Easier to meet targets when you know what you want to do, You learn a methodology and it improves your chances of getting a better job
Easier to work with	Easy to control projects.	Easy to follow at times	Easy to follow set standards, Helps improve team performance, Most set targets are met excluding the ones that are forever changing
Easy to track and monitor what is going on, Helps standardize the process	educative, efficient, effective	Empowers project team to make decisions, Easier to control what happens as compare to when no methodology is used	Encourages team work if some people are behind other team members easily discover this and assist
Everyone is involved in the project	Faster	From planning everyone is involved and knows what is expected from them, Educative and more rewarding	From the experience I have had methodologies are very helpful.
Getting to learn to work with different software products, Gaining more people skills and working with a group of different	Good guideline to use when working on projects	Good marketing tool and guideline to use in projects	Good news – project management methodologies exist and sometimes can be helpful in putting all

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people			parties involved on the same page
Good time management tool	Having a standard structure to follow and also using a methodology as a point of reference	Helped us with a guideline, Managed to track progress	Helps allocate responsibilities and development of certain functions to different team members
Helps develop systems rapidly, Different skills can be applied in a uniform way, Good platform to learn and teach new junior team members	Helps everyone working on the project to communicate.	Helps formalize the process and involve business	Helps us get projects
Helps us when we work as a team	I am not so involved everytime. I also do not have extensive knowledge with regards to the methodologies, The methodology does not help me make some minor decisions as I have to consult with the project manager every time	I am still learning but so far I hear it is faster to do projects	Important guideline, Easy to monitor different people on the team
Improved Communication between project team members	Improved communication, Improved understanding of what needs to be done on the project, Caters for everyone working on the project	Improved growth and development within your team, Increase in quality	In my view the methodology somehow motivates the team members to work hard as it is easy to track what they have done, They are good especially when you get certification as they help you qualify for a better job
In the planning stage you focus on the risk factors, You also analyse the available resources against what needs to be done, Help with getting a framework that needs to be followed	Interesting to use, You learn new methods of applying the methodology with every project	It gave the team a guideline to follow even though some people never really followed it	It helped us to focus on the appropriate stage and deliverables
It helps us with planning when we expect the next deliverable, The structure allows for regular meetings, in our case its weekly, There is some form of structure in what needs to be followed and therefore makes it easier for me to manage the team.	It is a good learning experience, we got trained and improved on some skills	It is an interesting learning curve for me	It is easier to show the team what needs to be done, Reviewing project progress is easier even though it does not mean problems can be easily fixed, Interesting to use as it gives confidence to the clients we develop systems for
It is easier to understand what needs to be done as in objectives, They also help the project team know what will be expected from each team member	It is good to follow certain standards to be on the same page with everyone	It offered a means of control and also a barometer of the project meting or missing its delivery.	Know who will do what, what they need to know, More flexibility and agility in addressing resourcing issues from an organisational view, Enhanced effectiveness in delivering services
Learn more on the IT environment and how to apply what I leant	Lots of staff to learn	Mainly affects the development team	Makes developing systems for companies professional, - Interesting

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			to know what needs to be done
Methodologies help clarify what needs to be done to the team, I personally find the planning stage important as you get to look at the most important aspects of the project. Whether we should carry it out or find alternatives. We have the cost benefit analysis were you look at the costs vs the benefits.	methodology involved the business, methodology improved growth and development within my team	More deliverables are produced, We get to meet and discuss every week	Most team members had training provided at work and we enjoy using PRINCE2 even though we didn't use all the phases in the current project, We work as a team and get to review progress almost every day before we start work
Not so useful. Only to a certain extent.	People try to follow the same process, Improves developer skills	Planning is done well and everyone has a rough idea of what needs to be done	PMBOK helps very much when leading a project as you know who is accountable for what, It also helps when there is need to track progress against the dates set on the gantt chart
PMMs help align the project to the business objectives	rapid delivery, improved communication	Standardizes the development process	Structural, controlled approach to developing systems
Team bonding, Team responsibility	Team members know what to do at different stages	The cost of the project was reduced massively thus allowing the project to continue and provide value to the business, the time/duration of the project was reduced	The methodology allowed us to be efficient through knowing what tasks where to be done and by which project team member.
The methodology helped in delivering services efficiently	The methodology helped team members to get focused on the right things in the right way, The methodology improved growth and development within my team	The methodology helped the team follow the stages at almost the same time, we also knew what was expected from us by our boss	The Methodology helped to break down the project into smaller tasks.
The methodology helped us to focus on the right things in the right way	The methodology helps check what is involved before hand	The methodology managed to standardize work practices and improved communication between team members	The methodology provided a platform to take action with known deliverables and objectives to be met
The methodology used increased opportunities to expand our services, The methodology used enable us to identify flows that were made in projects	The methodology was more efficienct in delivering services, The methodology created great opportunities to expand your services	The tea improves on their skills with each project. Personally I have grown into a better skilled person, It is good to follow certain procedures when working on projects unlike doing whatever anyone wants at any given time	There was control, Interesting to use since I had studied it at a detailed level
We get tasks from the project manager and he can easily track	We have regular reviews (almost on a daily basis), Aims to accommodate everyone in the project	We managed to do some tasks at the stipulated times, The methodology acts as a good framework for the projects we work on	We were able to involve our clients from the word go, Team members know what is expected at each stage, Allocation of duties is easier as we have developers testers

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			and all
With diligent SWOT analysis and brain storming sessions, were able to account for and provide a platform that was easily integrated into other business areas, A design that could adapt to a changing environment, governed by external factors	You choose what you want to follow, You get new opportunities from using a methodology		

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Addendum B: Weaknesses

Miscommunication and misunderstanding with regards to verbal communication, Getting to do things according to other people's views	At times no one has time to follow it especially when under pressure	At times not applicable and team was using a free style approach	Bad news – sometimes people understand project management methodologies differently and have got different experience in using them.
Certifying is expensive.	Dates on the gantt chart are not always applicable as requirements change every now and again, At times experience from other projects helps you solve problems in the current project and using methodologies is not so useful	Different team members have different ways of applying the methodology which does not always work in favour of the project and team	Difficult to learn from other people as they are always busy
Cost and time targets are not always met but it can be because of the inflation that is there from when you start to when you finish	Difficult to understand the explanations from different developers showing me how to use a methodology	End user and stake holders changing outcome and end product criteria, External vendors shifting development teams on the project	Hard to follow at times
Having to align objectives to a methodology. Time taken in training other individuals on how to implement the methodology	I am not so involved everytime. I also do not have extensive knowledge with regards to the methodologies	It has to be changed to suit the project and at times it is difficult	Hard to use in some cases
It is mostly never used	If the other team members do not perform or delay then everyone is affected	It is difficult to give all the credit to the methodology as we do not fully use it, We adjust to a given project and some team members especially the developers, have their own unique styles that help.	Not everyone knew how to use it and it is hectic to educate lots of people
It seems most people do not exactly know how the methodology works leading to the assumption that we just use our own methods to come up with the overall product.	managing the business as usual and change aspect required a lot of compromises from business, defining the roles and responsibilities within a big organisation was a big issue but it was ultimately resolved	It is difficult to use in an environment where requirements are forever changing, You still need to customize the methodology so that it suits the environment	Not always fun to follow
It takes time to learn and understand them.	Methodologies waste time and are not always interesting to use		Not always sufficient time to monitor and follow
It wastes time in most cases as people disagree at times, - Some times it is useful especially during the planning stage but from my experience with projects, things tend to change and you now have to correct what was	methodology was restrictive as programmers did not use methodologies in their entirety, Knowledge sharing was limited due to different working sites and working hours	No time to learn when you are working on a project, Assisting others and delivering on time can be straneous	Not always used

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initially planned			
Its not always the best approach when time is not available	Most of the times people are too busy to teach you about the methodology and how to apply	No training was provided, Not everyone I the team managed to successfully follow the methodology	Not applicable
Knowledge sharing was limited, Not everyone managed to follow the methodology successfully due to lack of training	Most projects are either over budget or not delivered on time due to various factors related to the methodology being used	Not all project team members are keen on using the methodology and I believe that is the main factor determining the success of carrying out a project using the specified methodology	Not appropriate for some projects
Language barrier, Communication issues	No detailed step by step guideline for any specific environment	Sharing ideas is limited.	Not every team member understands the methodology being used.
Not everyone was following the methodology	Only some parts can be used	Some may hide behind the use methodologies as a way to cover their personal shortcomings, Knowledge sharing is limited	Some parts of the methodology are not applicable so we customise and ignore the others. The hard part is we do not have a clear set of instructions on which stage of the methodology is important or which one needs to be customised.
Not good to be tied to one methodology when you have different parts that are good from other methodologies, You don't choose the methodology you want to use you are just told what to use	Only works well to a certain level but you still have to use experience gained while working on other projects, Some staff is good on paper bt hard to apply	Some of the staff learnt seems to be applicable on paper and not practically	Some people do not usually follow the stipulated processes.
Not sure if the problems were caused by the team or methodology	PMMs are not fully applied if applied at all but are mainly used to formalize everything, As an organization we have a way or culture of working on our projects	Some of the team members were hiding behind the use methodologies as a way to cover their personal shortcomings	Some phases of the methodology are hard to apply
Only needs a good project manager for it to work well and to motivate the team to use it well	Resources allocated to the project are not enough, we are forever working overtime., Most people apply their own skills	Some things are confusing	Some team members were not exposed to Prince 2 and needed training which took some time off the project scheduled time. This then translated into crashing for some team members in order to meet deliverable set deadlines.
Some things I learnt at the college can not be applied	Team does not know all the tools to be used, Some people prefer using their own style since it has no restrictions, Soe people are demotivated as they like using Prince methodology	The challenges were not caused by the project management methodology, by other external factors	The methodology used was restrictive as programmers did not use methodologies in their entirety, Knowledge sharing was limited

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Sometimes not interesting as the meetings and feedback process become too much.	Team members are not always willing to help and make you understand, they just get requirements and do what they have to.	The methodology does not always suit the environment	The methodology was a bit restrictive in the sense that there was no room for team members to be creative and express themselves
Still getting used to the methodologies but having trouble adjusting	Team members not sure of what to do at the different levels	The methodology is not usually followed. If you complete your task early you end up doing some of the other peoples work. Every one drags on to avoid this.,- I do not think our project manager knows how to allocate task as some people get much more difficult tasks as compared to the others every time	The methodology was restrictive and team members with more experience in handling projects felt limited in carrying out their day to day activities.
Takes unnecessary time trying to follow procedure, Most methodologies do not go hand in hand with the application (easier said than done)	Team members who are not familiar with the methodology are not helpful, they lack motivation, Maybe if we introduce more training we will get better performance	The methodology is only remembered in some cases as it is not always fully applicable always.	The methodology was sometimes forgotten when things were hectic
The methodology was used for compliance purposes only and not beneficial to the clients or organization, Knowledge sharing was limited	The problem with the projects that we work on nowadays is that people always change requirements and hence it becomes difficult to use methodologies. Theoratically we should be flexible but practically it is difficult.	There is no specific methodology for a certain project, Not enough documentation to understand how to apply, Training is needed and we were not trained.	Things we set do not always go according to plan, Customers change their requirements every time, I prefer writing programs in my own way
The methodology was used for compliance purposes only and not beneficial to the clients or organization, Not everyone managed to follow the methodology successfully	There are lots of tools and skills that I need to master	They are rigid and are usually hard to customise	Time and Scheduling
Time wasting needs patience	Training was not provided, since it takes up project time and money. As a result some team members did not totally understand	Wastes time	We are not always able to apply the defined methodology to the full and hence we structure it to suit the project we are working on
Time, Scheduling	Was restrictive as we didnt use the agile methodology fully	We are forever changing methodologies and we have to understand it everytime, Not everyone likes using it.	We do not always understand how to apply the methodology in some projects.

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We have a lot of juniors who do not even know what a methodology is so it is difficult to standardize things at times	We only use parts of the methodology when it suits the project, Some concepts are not easy to use and would rather use our own judgement	We skipped some phases as they were not useful	When requirements change it is difficult to follow the methodology as people will be worried about fixing those changes, At times you start to follow the methodology from the initial stage if the customers want something different.

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Addendum C: Questionnaire

Section A: Individual and Educational background

Mark relevant answer with an X.

1. Please indicate your age range.	
1.1) 20 - 25	1
1.2) 26 – 30	2
1.3) 31 – 35	3
1.4)36 – 40	4
1.5)41 – 50	5
1.6) 51 - 60	6
1.7)Other, please specify …… ……	7

2. Please indicate the highest qualification that you have obtained.	
2.1)Senior certificate (High school)	1
2.2)Certificate or diploma	2
2.3)University or Technicon degree	3
2.4) Honors or Masters degree	4
2.5) PhD degree	5
2.6)Other, please specify …… ……	6

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3. Where did you learn about the Project Management Methodologies? (e.g. PMBOK, PRINCE 2) . You may select more than one option.	
3.1)University	1
3.2)Technicon or Technical college	2
3.3)Training provided at work	3
3.4)Taught by other colleagues at work	4
3.5)Self study	5
3.6)Other, please specify …… ……	6

Section B: Experience in the IT industry

4. What is your job title?	
4.1)Project Manager	1
4.2)Programmer	2
4.3)Software Tester	3
4.4)Head of IT	4
4.5)Systems Analyst	5
4.6)Other. Please specify ……	6

5. What is your experience working in an IT environment?	
5.1)None	1
5.2)Less than 1 year	2
5.3)1 - 2 years	3
5.4)3 - 5 years	4
5.5)5 - 10 years	5
5.6)More than 10 years	6

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6. What is your experience in systems development?	
6.1)None	1
6.2)Less than 1 year	2
6.3)1 - 2 years	3
6.4)3 - 5 years	4
6.5)5 - 10 years	5
6.6)More than 10 years	6

Section C: Experience with virtual teams

For the purpose of this research: Virtual and Distributed Software Development projects take place in an environment in which stakeholders or members of the virtual team are dispersed throughout many distanced sites across the limits of a country/countries.

7. What is your experience working in virtual and distributed teams?	
7.1)None	1
7.2)Less than 1 year	2
7.3)1 - 2 years	3
7.4)3 - 5 years	4
7.5)5 - 10 years	5
7.6)More than 10 years	6

8. Which option best describes the virtual and distributed team you last worked in.	
8.1)Within the same city	1
8.2)Within the same country	2
8.3)Different countries	3
8.4)All of the above given environments	4

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9. What was the size of the last virtual and distributed project team you worked in?	
9.1)2 – 5 people	1
9.2)6 – 10 people	2
9.3)11 - 20 people	3
9.4)21 - 50 people	4
9.5)51 - 100 people	5
9.6) Other. Please specify **…….**	6

Section D: Project Management Methodologies used in the last virtual and distributed project

10. For the purpose of this research a **Project Management Methodology** is a body of logically related practices, methods and procedures that determine how best to plan, develop, control and deliver a project throughout the continuous implementation process until successful completion and termination**In the space provided below, please specify the Project Management Methodology/Methodologies you used in the last virtual and distributed project you worked on. (for example PMBOK, PRINCE 2)**

11. What is your experience in using project management methodologies? (for example PMBOK, PRINCE2)	
11.1)None	1
11.2)Less than 1 year	2
11.3)1 - 2 years	3
11.4)3 - 5 years	4
11.5)5 - 10 years	5
11.6)More than 10 years	6

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12. How frequently did you need and apply project management methodology knowledge in the last virtual and distributed project you worked on?	
12.1)Never	1
12.2)Once a month or less	2
12.3)A few times in a month	3
12.4)A few times in a week	4
12.5)Several times in a week	5
12.6)Every working day	6

13. For how long, during the last virtual and distributed project, did you apply project management methodology knowledge per day?	
13.1)Never	1
13.2)Less than 30 minutes	2
13.3)Between 30 minutes and 1 hour	3
13.4)1 – 2 hours	4
13.5)2 – 4 hours	5
13.6)4 – 6 hours	6
13.7)More than 6 hours	7

Section E: Project Characteristics

14. On a scale of 1 to 5 rate the effects of the factors highlighted below on the last virtual and distributed project you worked on. 1 being no effect and 5 being a huge effect on the success of the project.

	No effect				Huge effect
14.1) Lack of face-to-face interaction	1	2	3	4	5
14.2) Time separation between sites (e.g. different working hours, weekends, lunch breaks)	1	2	3	4	5
14.3) Cultural diversity:					
14.3.1) Religions	1	2	3	4	5
14.3.2) Languages and customs	1	2	3	4	5
14.4) Huge amount of information coming from multiple sources	1	2	3	4	5

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Section F: Cultural differences

15. With regards to the language used by team members in the last virtual and distributed team you worked in, select the most appropriate choice.	
15.1)All team members were from the same country and used their mother language	1
15.2)Team members used a selected common language and understood it at a high level	2
15.3)Team members used a selected common language and understood it at a high to intermediate level	3
15.4)Team members used a selected common language and understood it at an intermediate level	4
15.5)Team members used a selected common language and understood it at a low intermediate level	5
15.6)Team members used a selected common language and understood it at a low level	6

Section G: Communication

16. Which part of the last virtual and distributed project did you have challenges caused by lack of face to face interactions between team members. You may select more than one.	
16.1) No problems were encountered because of this factor	1
16.2) Requirements Elicitation	2
16.3) Allocation of duties	3
16.4) Feedback on the allocated tasks	4
16.5) Gathering information from multiple sources	5
16.6) Throughout the whole project	6

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Section H: Project Management Methodologies

17. In the last virtual and distributed project you worked on, to what extent do you agree with the following statements when using project management methodologies?

	Totally disagree				Totally agree
17.1) The Project Management Methodology helped to align the project to the business	1	2	3	4	5
17.2) The Project Management Methodology helped to involve end-users in the virtual and distributed projects.	1	2	3	4	5
17.3) The Project Management Methodology helped decompose the project into workable parts.	1	2	3	4	5
17.4) The Project Management Methodology helped estimate the time and effort required for the project tasks to be completed.	1	2	3	4	5
17.5) The Project Management Methodology helped define the useful milestones for the virtual and distributed project.	1	2	3	4	5
17.6) The Project Management Methodology helped keep the virtual and distributed project under control.	1	2	3	4	5
17.7) The Project Management Methodology helped develop a more functional system.	1	2	3	4	5
17.8) The Project Management Methodology helped develop a more reliable system.	1	2	3	4	5
17.9) The Project Management Methodology helped develop a more maintainable system.	1	2	3	4	5
17.10) The Project Management Methodology provided useful guidelines of working on a virtual and distributed project.	1	2	3	4	5
17.11) The Project Management Methodology defined an ideal process of working on the virtual and distributed project even though it was not followed in practice.	1	2	3	4	5
17.12) The Project Management Methodology helped the stakeholders learn from working on the virtual and distributed project.	1	2	3	4	5
17.13) The Project Management Methodology helped achive the objectives of the virtual and distributed team.	1	2	3	4	5
17.14) The morale of the project team I work in, was high due to the use of Project Management Methodologies	1	2	3	4	5

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18. To what extent do you agree with the following statements as valid descriptions of the Project management methodology you applied in the last virtual and distributed project you worked on?

	Totally disagree				Totally agree
18.1) The project management methodology used helped to solve cultural differences between team members (e.g. language, religion and customs)	1	2	3	4	5
18.2) The project management methodology used helped to deal with the issues caused by working on one project while deployed at different locations.	1	2	3	4	5
18.3) The project management methodology allowed team members at different locations to contribute and discuss to the satisfaction of most team members.	1	2	3	4	5
18.4) The project management methodology did not help much but it actually worsened the problems that were caused by the distributed teams.	1	2	3	4	5
18.5) The project management methodology worked better on smaller virtual teams of less than 50 as compared to larger teams of more than 50.	1	2	3	4	5

Please answer question 19 if you are a project manager or if you were a project manager in the last distributed and virtual project you worked on.

19. To what extent do you agree with the following statements about the last project you Worked on?

	Totally disagree				Totally agree
19.1) Using a Project Management Methodology suited the way I want to manage the team.	1	2	3	4	5
19.2) The Project Management Methodology used was suitable for managing virtual and distributed teams.	1	2	3	4	5
19.3) The Project Management Methodology used works better in collocated teams as compared to virtual and distributed teams.	1	2	3	4	5

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20. Highlight two or more opportunities that were offered by the project management methodology you used in the last distributed and virtual project you worked on.

21. Highlight two or more challenges you faced while using a project management methodology in the last distributed and virtual project you worked on.

Section I: Project Outcomes

22. To what extent do you agree with the following statements about the last virtual and distributed project you were involved in?

	Totally disagree				Totally agree
22.1) The project was completed on schedule.	1	2	3	4	5
22.2) The project was completed within the budget.	1	2	3	4	5
22.3) The developed system satisfied all the stated requirements.	1	2	3	4	5
22.4) The speed of developing the project was high.	1	2	3	4	5
22.5) The productivity of team members involved with the project was high.	1	2	3	4	5
22.6) The cost of the project is low when compared to the size and complexity of the system developed.	1	2	3	4	5
22.7) The project achieved its goals.	1	2	3	4	5
22.8) Overall, the project represents excellent work.	1	2	3	4	5
22.9) Overall, the project was a success.	1	2	3	4	5

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You do not have to include your details, if you however decide to provide your details space is available at the bottom for follow-up interviews.

Name: ……..

Company: ……

Email Address: ……

Contact Number: …….

Thank you for your cooperation!