ENHANCING INFORMATION SYSTEMS PROJECT TEAM PERFORMANCE: TEAM MEMBER SELECTION STRATEGIES

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Preface

This research is not confidential.

I would like to thank my research supervisor, Professor Derek Smith of the Department of Information Systems at the University of Cape Town, for his contributions, suggestions and constructive criticisms throughout this research. I would also like to thank Albert Brink from the National Productivity Institute for providing access to the software that was used to analyse certain aspects of the data. Appreciation is conveyed to Professor Mike Hart of the Department of Information Systems at the University of Cape Town for the statistical advice that he provided.

Gratitude is also conveyed to those teams who responded to the questionnaire, and to the organisations for which those teams worked. Without their valuable contributions this research would not have been possible.

Finally, tribute must be paid to those academics at the University of Cape Town who gave valuable opinions regarding the composition of the questionnaire, the analysis of the data, and the revision of this document.

I certify, except as noted above, that this research is my own work and all references are fully acknowledged.

Lionel Waker
May 2001

Synopsis

It is widely acknowledged that the Information Systems (IS) industry suffers from a high failure rate with regards to IS development projects. Much of the effort to improve IS project performance has been focussed on technological issues. However, there is an increasing body of evidence that suggests that the nature of the problems facing the teams that are assigned to these projects is more sociological than technological.

As the adoption and utilisation of teams becomes more prolific in the IS industry, it is becoming increasingly important to develop team composition methods that take the compatibility of team members into consideration. Many IS team member selection strategies are based primarily on the traditionally measurable skills of individuals. Yet, selecting a team in which the members have the appropriate skills does not guarantee that the individuals in the team will combine to form an effective and cohesive unit.

Several team effectiveness models relating to sociological constructs have been developed in past research. These identify variables that have been predicted to influence the effectiveness of various types of teams. This research proposes a model that demonstrates the extent to which certain variables that have been identified in the literature influence the effectiveness of IS project teams. Through this assessment, it is possible to isolate the variables that have a significant impact on IS team effectiveness, thereby highlighting some of the sociological issues that should be considered when selecting team members.

The relationships in the model were tested through a questionnaire that was distributed amongst 33 Information Systems project teams. Individuals in 4 of the teams submitted incomplete responses, thereby yielding a final sample of 29 teams comprising 163 individuals. Where possible, all questions were based on previously validated instruments. Initial construct validity was improved by removing 2 items from the questionnaire. Certain constructs were broken into 2 dimensions, yielding a set of constructs with reasonably high validity. All construct measures in the instrument were shown to be statistically reliable.

It was found that certain variables did have a significant impact on the effectiveness of IS project teams. The predicted relationships that were supported were those between skill heterogeneity and IS team effectiveness, and between team role balance and IS team effectiveness. It was shown that individuals are more likely to combine to form an effective

team if they are diverse in terms of their skills and abilities. The members should also fulfil team roles that combine to provide the team with a team role profile that is balanced. The levels of cohesion within the teams mediated the relationship between skill heterogeneity and IS team effectiveness. A strong correlation between cohesion and IS team effectiveness was demonstrated.

One of the relationships in the research model that was not supported was that between background heterogeneity and IS team effectiveness. It was initially predicted that teams in which members displayed a diverse set of backgrounds, expertise, and experience would be more effective than those that did not. The diversity levels of these characteristics within IS project teams were shown to have no influence on the effectiveness of the teams. Past research in which the impact of background heterogeneity on team effectiveness has been examined has also yielded mixed results. It is recommended that future research examine this relationship more closely as an increasingly migrant global work force will ensure that this issue will be one of the key issues facing IS management in the future. It is also suggested that research into the area of IS team composition variables be specific to both the type of IS project being undertaken, and the lifecycle stage in which the project is operating.

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1. INTRODUCTION

"The major problems of our work are not so much technological as sociological in nature."

[DeMarco & Lister, 1999, pg. 3]

The term 'Information Systems' (IS) is used frequently in this research. For purposes of clarity, the term is assumed to be synonymous with the term 'Information Technology' (IT). Information Systems can be defined as '*the preparation, collection, transport, retrieval, storage, access, presentation, and transformation of information in all its forms*' [Boar, 1994, pg. 30]. The non-capitalised form of the term (*information systems*) is used to refer to a physical system that resulted from the actions described in the above-mentioned definition.

1.1 THE IMPORTANCE OF TEAM WORK

The use of teams has been evident throughout mankind's history. From events as diverse as the construction of the pyramids of Giza, the landing on the moon, and the design and development of the Internet, it is clear that the results of any team effort are potentially far greater than the results that could be achieved by the individuals that make up those teams [Katzenbach & Smith, 1993].

The nature of teams is also changing. Where teamwork was previously dominated by teams of individuals with similar skills, performing similar tasks, and with distinct leadership (e.g. the building of the pyramids), it is now characterised by a multitude of skills and shared status in decision making and other responsibilities [Belbin, 1996]. According to Verma [1997], this is attributable to the dramatic increase in complexity of projects in recent times.

Knowledge work has historically been the domain of individuals. However, as technology has progressed, it has become increasingly difficult for an individual to have expert knowledge in many specific areas [Leonard & Swap, 1999]. Yet, the endeavours of today's society dictate that many tasks and projects do require a broad range of specialised expertise. This has lead to the prolific utilisation of teams in a variety of work settings [Mohrman, Cohen & Mohrman Jr, 1995; Janz, Colquitt & Noe, 1997]. Klenke [1997] identifies the increased interdependencies between organisational units as another reason behind the surge in team usage.

The increased desire for tasks to be performed by groups instead of individuals has been recognised by many authors [e.g. Mohrman et al, 1995; Campion, Papper & Medsker, 1996].

It has been enhanced by a move towards flatter organisational structures [Klenke, 1997]. Organisations around the world are replacing management layers with self-managing teams [Jones & Harrison, 1996; Wheatly in Fisher, Macrosson & Sharp, 1996; Belbin, 1997] in an effort to create an organisational environment that can adapt and respond to rapid changes. These changes include technological and social transformations, a demand for responsiveness and innovation, and an increase in global competition [Klenke, 1997]. Klenke [1997] attributes part of the rise in team usage to the increased commitment, improved decision making and greater innovative potential that result from teamwork.

1.2 TEAMS IN THE INFORMATION SYSTEMS INDUSTRY

Teamwork is not a new phenomenon, yet many of the tasks that must be performed by teams are unique. This is especially true in the field of Information Systems (IS), where development projects often have unique requirements, and teams possess a unique set of knowledge and skills [Klenke, 1997].

This uniqueness is problematic in terms of team selection criteria, as an individual's productivity is difficult, if not impossible, to assess in a knowledge work environment [Campion et al, 1996]. This has implications of particular concern in the IS industry. The extremely competitive nature of the industry [Boar, 1994] requires that teams work effectively and produce a high quality product. The complexity of IS development tasks ensures that the skills of individuals need to be combined effectively in order to ensure success [Leonard & Swap 1999].

The IS industry is heavily reliant on teamwork to improve the quality of information systems, and the role that teams play in the industry appears to be becoming increasingly important [Jones & Harrison, 1996]. However, the effectiveness of past and current IS teams comes into question when one considers that very few IS projects meet all their objectives [McLeod & Smith, 1996]. De Marco & Lister [1999] estimate that 15% of IS projects are aborted before they deliver useable products. Klenke [1997] provides a possible reason for this 'failure' by noting that the performance of IS team members is highly dependent on other members of the team.

Given the high percentage of project failures in the industry, finding ways of designing effective IS project development teams would be of great value to IS management and other stakeholders. Improvements in team effectiveness could lead to the generation of more

effective products, greater numbers of customers, higher levels of user satisfaction, and ultimately, greater profits.

A number of authors [Campion et al, 1996; Guzzo & Dickson, 1996; Leonard & Swap, 1999] note that the creation of diverse or heterogeneous teams may be a way of improving teamwork, resulting in higher performance and greater effectiveness. More effective teamwork would be of particular importance to the IS industry considering its above-mentioned problems. Guzzo & Dickson [1996] argue that the value of team diversity is highest in domains of creative and intellectual tasks, such as those performed by IS teams.

One of the problems with today's team building exercises is that they are reactive - they try to improve the team's performance once the team has already been formed [Mankin, Cohen & Bikson, 1996]. Mohrman et al [1995] argue that many of the issues that these exercises try to address could be avoided through careful team design, which, if applied correctly, could enhance the team's performance.

1.3 THE AREA OF RESEARCH

This research examines certain team composition variables and intra-team process variables that have been identified in the literature. Team composition variables are factors that can be considered when selecting members to be part of a team, while process variables refer to the interactions among team members. The impact that these variables have on IS project team effectiveness will be explored.

Cohen & Bailey [1997] have stressed the need for additional research to clarify the impact of functional diversity on team performance. This research will focus on the influence that functional and role diversity have on team effectiveness.

1.4 NECESSITY FOR RESEARCH INTO IS TEAM EFFECTIVENESS

The field of Information Systems has many examples of high profile software development failures, and the importance of effectively managing these projects is becoming increasingly obvious [Guinan, Cooprider & Faraj, 1998]. According to Mohrman et al [1995] these failures are indicative of a broader, industry-wide problem: teams of knowledge workers are being assembled using methods that were developed in production settings and are not necessarily applicable to teams of knowledge workers. The difference between success and

failure often lies in the team leader's or manager's ability to capitalise on crucial criteria relating to team members' roles, backgrounds, experience, and culture [Verma, 1997].

Cohen & Bailey [1997] argue that there is a scarcity of research examining the impact of group composition variables on effectiveness in project teams. Janz et al [1997] agree, noting that despite the fact that knowledge workers represent one of the fastest growing segments of the workforce, there are very few studies examining the effectiveness of teams composed of these knowledge workers. Jones & Harrison [1996] relate this need to the IS industry by stating that continued research is needed to gain an insight into the factors influencing successful IS team performance.

Identifying and isolating the key determinants of team effectiveness will supply organisations with criteria on which to base team member selections. This should result in increased levels of effectiveness, and greater levels of Information Systems project success.

1.5 VALUE OF IS TEAM EFFECTIVENESS RESEARCH

"*As projects become increasingly the building blocks of organisational strategy, multi-disciplinary teams are replacing individuals as the basic building blocks of organisations. Project success depends upon how well participants can work together to accomplish objectives within scope, time, cost and quality constraints.*"

[Verma, 1997, pg. 113]

The fact that technical skills are the primary basis on which individuals are chosen for IS team membership could be attributed to the fact that these skills are easy to measure, and the skills required by the projects are usually well defined. De Marco & Lister [1999, pg. 10] refer to these skills as '*steady-state characteristics*', and argue that a person's value to a project team is often based on these characteristics, rather than on how they fit into the project team.

This research aims to provide an alternative to basing IS project team member selection on an individual's technical skills. By finding the team member characteristics that are likely to combine to form effective teams, IS management should be able to base team member selection criteria on both technical skills and characteristics that have been identified in this research.

1.6 OBJECTIVES OF THE RESEARCH

The objectives of this research are to:

IDENTIFY KEY INPUTS

The initial objective of this research is to identify key team composition variables or team inputs that, according to the literature, may have an impact on the effectiveness of Information Systems project teams. Very little of the research relating to team effectiveness is specific to IS teams. It is therefore necessary to test whether variables that have been identified as being significant to the effectiveness of other types of teams are applicable to IS teams.

DEVELOP AN IS TEAM EFFECTIVENESS MODEL

The variables that are identified will be placed in a model depicting the hypothesised relationships between the independent variables and IS project team effectiveness. The hypothesised relationships and model structure will be based on the findings of past research.

EXAMINE THE INFLUENCE OF THE VARIABLES

The research will test the impact that the identified variables have on IS project team effectiveness. This will provide IS practitioners with an insight into which variables should be taken into consideration when team members are selected for IS project teams. The relationships between the variables and IS project team effectiveness will also be tested to determine if the variables influence team effectiveness directly, or if intra-team processes mediate the relationship.

TEST THE PROPOSED IS TEAM EFFECTIVENESS MODEL

The team effectiveness model makes predictions about the relationships between various constructs. Once these relationships have been tested, the validity of the model can be determined. The proposed model can then be adapted if the relationships are not accurately depicted.

COMPARE THE FINDINGS

Comparing the findings of this research to those in other research of a similar nature will help determine the consistency of the findings across various studies. Areas for future research can be identified by isolating the findings that are inconsistent with other research.

MAKE RECOMMENDATIONS

The ultimate objective of this research is provide IS management with more information regarding composition variables that can be considered when selecting members for IS project teams. By examining the implications of the research findings, this research will make recommendations on strategies that can be used to combine the correct human resources to form effective IS project teams.

1.7 OVERVIEW OF PAPER

Chapter 2 of this paper will provide an overview of the pertinent literature relating to this research. Various team effectiveness frameworks will be discussed and contrasted. The uniqueness of Information Systems projects and teams (and the resultant need to examine them in isolation) will also be discussed.

This is followed by Chapter 3, which develops an IS team effectiveness model derived from the research literature, and states the research hypotheses.

Chapter 4 will outline the methods used to gather, record and interpret the data needed for this research. The design of the research instrument will be explained, and issues relating to the sampling, data collection, and data integrity will be discussed.

Chapter 5 outlines the results of the research. Comments are made regarding all of the findings, and the findings are compared with those obtained from other relevant research. The theoretical and practical implications of the findings are also discussed.

Chapter 6 concludes this research paper. It provides a summary of the research and its findings, and also discusses the limitations of the study. This is followed by a recommendation for areas of future research. References and appendices appear at the end of the paper.

2. LITERATURE REVIEW

2.1 BACKGROUND

The requirements of today's society dictate that many tasks and projects require a broad range of specialised expertise. This has lead to an increase in the usage of teams in situations pertaining to knowledge work [Mohrman et al, 1995, Lipman-Blumen & Leavitt, 1999]. At the same time, routine work is becoming increasingly automated, which implies that knowledge work (e.g. Systems Development) is becoming more prevalent [Mohrman, Cohen & Mohrman, 1995]. This trend will help support Katzenbach & Smith's [1993] prediction that teams will become the primary unit of performance in high-performance organisations.

As the field of Information Systems (IS) has progressed and diversified, it has become increasingly difficult for individuals to have an expert knowledge in the field's many specialised areas. The time constraints and technological complexities associated with IS projects often necessitate the use of teams. The trend towards a greater degree of teamwork within Information Systems shows little sign of abating [Mohrman et al, 1995].

The literature review will focus initially on: definitions of teams; team structures; and the phases through which teams pass. The relevance of examining teams within the context of the IS industry will be made apparent through a discussion of the uniqueness of Information Systems teams. This is followed by a commentary on team effectiveness frameworks. The identification and comparison of team effectiveness frameworks forms a useful introduction to the variables (and the interactions between these variables) that potentially influence the effectiveness of a team. Team diversity and heterogeneity, and their impact on team effectiveness, will be discussed. Literature pertaining to team roles will then be reviewed, after which the cohesion between team members is examined.

2.2 THE NATURE OF TEAMS

Much of the literature that examines aspects of teamwork is preceded by a definition of the term '*team*', and places great emphasis on the difference between groups (or work groups) and teams [e.g. Katzenbach & Smith, 1993; Klenke, 1997; Sears, 1998]. Others however, use the terms interchangeably [e.g. Hackman, 1990; Guzzo & Dickson, 1996; Cohen & Bailey, 1997; Leonard & Swap, 1999]. Those authors that do differentiate between groups and teams tend to use the latter term to denote a phenomenon more specific than a group [Guzzo &

Dickson, 1996; Jones & Harrison, 1996; Verma, 1997], or in the words of Guzzo & Dickson [1996], "*'team' connotes more than 'group'*".

Cohen & Bailey [1997] are of the opinion that the term '*team*' is generally used in the popular management literature to represent what are termed '*groups*' by the academic literature. Their opinion appears to be somewhat isolated in the team-related literature. Cleland [1996] highlights the difference between a team and a group by stating that:

- Groups emphasise individual efforts within a loosely co-ordinated substructure of the organisation.
- Teams rely on integrated efforts aimed at achieving the goals of the team.

Katzenbach & Smith [1993] emphasise the need for organisations to realise the unique characteristics of groups and teams: " *the choice between a working group and team is neither recognised nor consciously made...*". Hayes [1997] concurs by noting that what is often referred to as a team is actually no more than a work group which lacks the co-ordination, common objectives and sense of teamwork that make a team.

2.2.1 Work Groups

A work group can be described as a group "*of individuals who see themselves and who are seen by others as a social entity, who are interdependent because of the tasks they perform as members of a group, who are embedded in one or more larger social systems ... and who perform tasks that affect others*" [Guzzo & Dickson, 1996, pg. 308].

Work groups are characterised by a number of workers acting under the instructions of a single leader [Walter & Walter, 1998]. The groups have minimal input regarding their goals and the plans to achieve these goals, and group members share information, yet work independently on related tasks [Sears, 1998]. Walter and Walter [1998] note that work groups are commonly found in production operations, where the potential for performance increases through collective working is very low.

Sears [1998] notes that work groups are structured according to traditional organisational roles, and the primary reason for interaction is to share information and perspectives. Individuals also interact to ensure that each member performs effectively within their own discrete task.

2.2.2 Teams

Katzenbach & Smith [1993] stress the need to completely comprehend the accepted standard definition of a team in order to fully understand and quantify the impact that teams may have on an organisation. They define a team as "*... a small group of people with complementary skills committed to a common purpose and set of performance goals.*" According to the authors the following elements are necessary for a group of individuals to be termed a team:

- Small enough number of members
- Adequate levels of complementary skills
- A truly meaningful team purpose
- Specific goal or goals
- A clear working approach
- A sense of mutual accountability

One of the benefits of teamwork is that it minimises resistance to change by encouraging participation and co-operative interactions between members [Verma, 1997]. This co-operation and participation spans across hierarchies and positional status, as members all share common team objectives.

According to Katzenbach and Smith [1993], teamwork encourages listening, constructive responses to ideas generated by others, the provision of support, and recognition of the achievements of other team members. However, Klenke [1997] notes that the use of teams is often controversial because they can force managers to relinquish control of key functions. This raises questions about team leadership responsibilities and team functions. Hackman [1990] adds his opinion regarding the advantages of teams by stating that members can stimulate each other, cover for each other, and test ideas on other members.

2.2.3 Teams vs. Work Groups

Klenke [1997] argues that it is necessary to distinguish between teams and other forms of work groups in order to understand how teams perform effectively. Her guidelines for differentiating teams from work groups are included in Table 2.1, which contrasts characteristics of teams and work groups.

Cleland [1996] agrees that teams are distinctly different from groups. The author argues that groups emphasise individual efforts within a loosely co-ordinated substructure of the organisation, while teams rely on integrated efforts aimed at achieving the goals of the team.

ELEMENTS OF DISTINCTION	TEAMS	WORK GROUPS
Performance	A function of • member interactivity • collaboration • behavioural integration	• A function of what its members accomplish individually
Performance Focus	• Team goals • Individual goals	• Individual goals
Trust and Communication	• Work in climate of trust and communication • Accept that different roles enable different perspectives	• Distrust each other's motives • Roles are not clarified • Disagreements can be taken personally
Accountability	• Mutual and individual, as team members work on inter-dependent tasks	• Individual, as group members work parallel to each other on discrete tasks
Management	• Share in management functions such as planning, team organisation, setting performance goals, change management, securing resources	• Managed in a traditional style. • Management functions are often performed from outside the group
Leadership	• Shared leadership • Dependence on team as a unit rather than on individual	• Well-defined • Strong leader • Group can become dependent on leader
Skills	• Complementary • Sometimes under development	• Functional • Established • May be complementary
Effectiveness Measure	• Direct evaluation of collective work product	• Indirect influence (e.g. impact on business financial performance) • Sum of individual efforts
Source of Motivation	• Commitment to a performance goal • Commitment to other team members	• Group leader • Own initiative

TABLE 2.1: CHARACTERISTICS OF TEAMS AND WORK GROUPS
ADAPTED FROM KLENKE [1997], KINSLAW [1991], WALTER & WALTER [1998], VERMA [1997]

2.2.4 What Lies Between a Team and a Work Group?

Logic would suggest that if work groups and teams are separate entities, and if there are various categories of distinction that exist between the two, then there should be instances of groups of people who fall somewhere between the two definitions. Katzenbach & Smith [1993] agree, and have depicted their hypothesised categories on their team performance curve (see Figure 2.1).

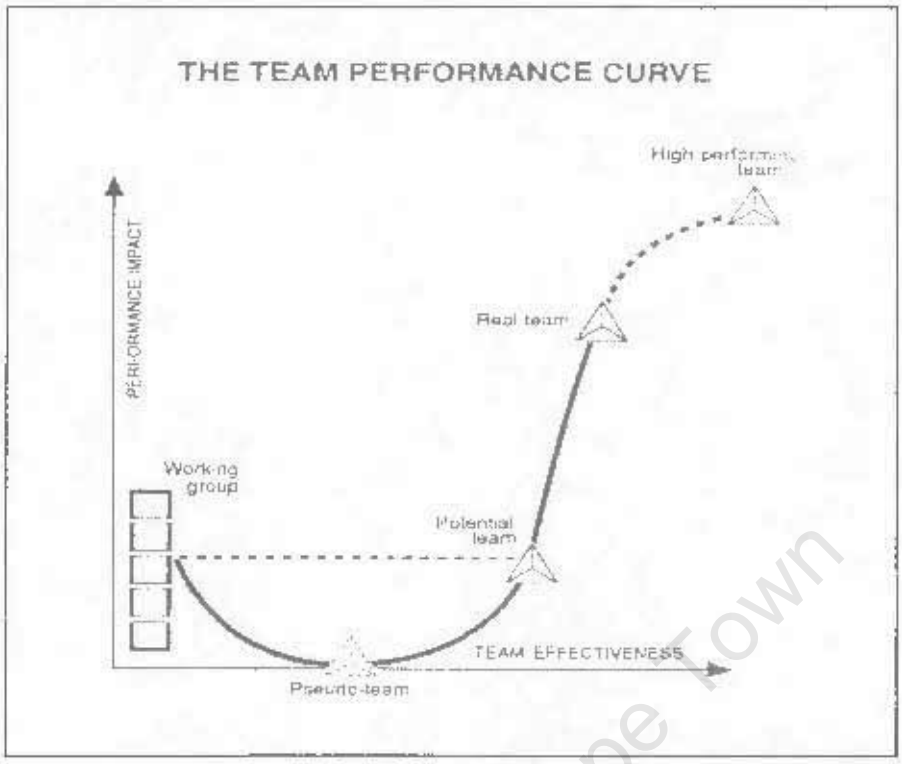

FIGURE 2.1: THE TEAM PERFORMANCE CURVE
KATZENBACH & SMITH [1993]

They cite three categories of teams that lie between work groups and high performance teams:

- **Pseudo-teams**: the interactions between team members detract from individual performances. The team does not focus on collective performance.
- **Potential teams**: the team is united in trying to improve its performance impact. Collective accountability is not present, and purposes, goals, and a working approach need to be clarified.
- **Real teams**: members have complementary skills and are committed to goals and a common working approach. They hold themselves mutually accountable.

Katzenbach & Smith [1993] note that a team's deep commitment to other members' personal growth and success is what distinguishes a high performance team from a real team. The authors believe that the closer one moves towards a high performance team, the more effective the team is likely to be.

Klenke [1997, pg. 155] provides a specific definition of high performance IS teams. She notes that they have the same attributes as high performance teams (as defined by Katzenbach & Smith [1993]), and "*are composed of a small number of IS professionals with the requisite skills who share a common purpose and accountability for performance beyond expectations*".

2.2.5 Team Types

Several authors [Koze & Masciafe, 1993; Cohen & Bailey, 1997; Devine & Clayton, 1999] distinguish between various types of teams, yet despite a number of proposed classification systems [Stewart & Barrick, 2000], Devine & Clayton [1999] claim that a widely accepted typology or framework to categorise teams does not yet exist.

Devine & Clayton [1999] assert that during the last 30 years it has been realised that work groups and teams cannot be understood independently of their context. According to the authors, knowledge or research that pertains to teams in one setting cannot necessarily be generalised to apply to teams in another setting. They note two distinct lines of team categorisation or classifications that have emerged:

- **Those based on key dimensions inherent in the task:** These categories are initialised with the prioritisation of contextual factors that are presumed to vary across work groups. All possible combinations of these dimensions are identified, with each combination being labelled a '*type of team*'. For example, Devine & Clayton [1999] identify *product type* and *temporal duration* as two contextual factors. Thus a combination of three product types with two temporal durations would yield 6 different team categories.
- **Those based on the identification of clusters of related teams found in actual organisations:** These categories of team types are based on empirical observations of real-world teams. Perceived similarities are identified, and the teams are grouped accordingly. This method of classification has the advantage of being simple and intuitive, and also tends to yield fewer team types than the dimensional method.

Stewart and Barrick [2000] note that many of these categorisations are based on the type of task that the team performs, yet in actual work situations, teams rarely perform only one type of task. They hypothesise that a more appropriate alternative could be to arrange the amount of time that each team spends on pre-identified tasks along a continuum, thus avoiding the use of mutually exclusive categories.

Devine & Clayton [1999] suggest that the lack of a recognised typology has limited the generalisability of past team research, with researchers often having assumed that one model applies to all team types. They add that identifying multiple models relating to teams may be difficult, but is important for conducting and interpreting empirical research.

Table 2.2 provides a categorisation of team types according to various authors. Categories into which IS project teams fit are displayed in bold font.

Author(s)	Types of Teams Defined
Mohrman et al [1995]	**Work teams**, Integrating Teams, Management Teams, Improvements Teams
Hackman [1990]	Top Management Groups, **Task Forces**, Professional Support Groups, Performing Groups, Human Service Teams, Customer Service Teams, Production Teams
Devine & Clayton [1999]	**Ad Hoc Project Teams**, **Ongoing Project Teams**, Ad Hoc Production Teams, Ongoing Production Teams
Cohen & Bailey [1997]	Work Teams, Parallel Teams, **Project Teams**, Management Teams
Koze & Masciale [1993]	Functional Teams, Continuous Improvement Teams, **Product Teams**, **Project Teams**, Management Teams, Problem-Solving Teams
Verma [1997]	Problem Solving Teams, **Special Purpose Teams**, **Self-Managed Teams**

TABLE 2.2: THE VARIOUS TYPES OF TEAMS DEFINED IN THE LITERATURE

2.2.6 Stages of Team Development

Teams are often assembled to meet the specific requirements of a single project. This is almost always the case in the Information Systems industry, making the rapid formation and development of the team vital. The four stage model of group development [Tuckman, 1965] has been accepted as, and remains, the standard model of small group development in the social sciences [McGrew, Bilotta & Deeney, 1999]. An adaptation of the four stages through which teams develop follows:

- **Forming (Orientation)** – The boundaries of interpersonal and task behaviours are tested by members, and dependency relationships are established.
- **Storming (Dissatisfaction)** – Boundaries are more clearly defined. Resistance and conflict relating to group influence, task requirements, and interpersonal issues grow.
- **Norming (Resolution)** – Interpersonal and task related issues are resolved. Team roles are accepted, accompanied by the evolution of standards of behaviour. Group members freely express opinions and ideas.
- **Performing (Production)** – The team structure now supports the task at hand. Tasks are accomplished through the team's interpersonal structure. Roles become functional and flexible (members covering for each other) and the team is totally task focussed.

[Verma, 1997; McGrew et al, 1999]

Thus, it could be expected that IS teams (or any type of team) would be less effective in their formative stages than later in their lives.

In their review of team performance and effectiveness literature, Guzzo & Dickson [1996] found evidence to suggest that the length of time that a group has been functioning together can have a notable impact on the team's performance and effectiveness. Their research also cites literature suggesting that group decision-making effectiveness rises as the team spends more time together. This is partly attributed to the increased familiarity amongst team members.

2.3 IS TEAMS – DEFINITIONS AND UNIQUE CHARACTERISTICS

IS development projects usually take place over a long time period, and are characterised by the high number of person-hours that are often required. This necessitates the use of teams throughout the course of the projects. The broad nature of the skills generally needed for these projects also requires that people with varying talents work together in teams to create a unit that can provide the wide range of skills and experience that are needed.

There is a large body of research literature that is specific to Information Systems teams. Thus, the assumption is made that IS project teams are in some way different from other types of teams. Before the distinctiveness of IS project teams is discussed, it is appropriate to define an Information Systems project. ISSIG [1999] defines an IS project to be a project falling into one or more of the following categories:

- Software development projects including new development and the enhancement of existing software
- The selection, acquisition and implementation of software packages, including customisation where applicable
- The selection, acquisition and implementation of computer hardware equipment
- The selection, acquisition and implementation of telecommunication and network products and services
- Systems integration

Klenke [1997] notes that IS teams differ from both traditional work groups and other organisational teams because of the nature of their work. The performance of IS team members is highly interdependent, making the concept of a "*collective work product*" particularly relevant for IS teams. Verma [1997] agrees, remarking that teams are especially effective for interdependent tasks. Katzenbach & Smith [1993] define a collective work product as the work that two or more team members must accomplish together, reflecting the

joint and real contributions of these members. They add that teams outperform individuals especially when performance requires multiple skills, judgements and experiences. This would make them particularly suited to Information Systems projects.

Klenke's [1997] assertion that IS teams are unique is based on three criteria:

- They possess a unique set of knowledge, skills, and abilities: these include both technical competence and interpersonal skills.
- They are engaged in continuous learning: their high dependency on information ensures that the individual and the organisation expect the IS team to be committed to and engage in continuous learning. This often attracts professionals in the industry to companies that place emphasis on education and training.
- They are composed of knowledge workers: the work of the IS team is complex collaborative work requiring intensive and interactive communication. Four important knowledge domains in the field of Information Systems are:
  1. Technical knowledge
  2. Domain knowledge regarding the system's area of application
  3. Design knowledge
  4. Organisational knowledge

McGrew et al [1999] add their voice to the opinion that IS teams are different by stating that they differ from other teams studied in the literature because their task (developing, maintaining, and enhancing a software product) requires them to remain together for a long period. The relevance of this point to the current research can be questioned because of the high staff turnover rate in the industry [Igbaria, Meredith & Smith, 1994], and the fact that many of the IS projects examined focus only on one of the three tasks mentioned.

Lipman-Blumen & Leavitt [1999, pg. 216] provide a suitable explanation as to why teams are suited to IS projects: "For the individual, the new tasks are too big and too connected with other people's tasks. For the organisation, the new tasks are too fast changing". They add that teams provide an intermediate answer, as they can take on large, multiple tasks, and they are flexible enough to respond to a changing environment.

2.4 TEAM EFFECTIVENESS

Although many authors appear to show reluctance towards committing themselves to a specific definition of team effectiveness, there seems to be consensus regarding the opinion that in an effective team the potential output of the team is greater than the potential output of

the individuals in that team [e.g. Hackman, 1990; McLeod & Smith, 1996; Belbin, 1997; Humphrey, 1997; Verma, 1997].

Hackman [1990] defines effectiveness in terms of three dimensions:

1. The degree to which the group's output meets the standard of quantity, quality and timeliness of the people who receive or use that output.
2. The degree to which the process of carrying out the work enhances the capability of members to work together interdependently in the future.
3. The degree to which the group experience contributes to the growth and personal well-being of team members.

According to Hackman [1990] the weighting assigned to each of the three criteria should vary according to the particular circumstances faced by the team. An effective team can thus be defined as a team that satisfies each of the above three dimensions at a level that is applicable to the type of team. Hackman's three dimensions of effectiveness are widely used in the team literature [e.g. Guzzo & Dickson, 1996; Barrick, Stewart, Neubert & Mount, 1998].

Cohen & Bailey [1997] make the important distinction between team performance and team effectiveness. They define effectiveness as a construct broader in scope than performance, with performance being only one of three major dimensions of effectiveness. According to the authors, the three major dimensions of team effectiveness are:

1. Performance Effectiveness – including efficiency, productivity, response times, and the quantity and quality of outputs
2. Member Attitudes – including employee satisfaction and commitment
3. Behavioural Outcomes – including absenteeism and turnover

Cohen and Bailey [1997] note that *'behavioural outcomes'* is a dimension that is not included in the effectiveness dimensions cited by other authors [e.g. Hackman, 1987; Guzzo & Dickson, 1996]. The view that team performance is an element of effectiveness is shared by Vinokur-Kaplan [1995] and Gladstein [1984], as they argue that team effectiveness is enabled by the actual performance of team members.

Mohrman et al [1995] highlight the importance of designing teams correctly by noting that effectiveness is a function of team design. The authors do however add that the benefits of focusing on the design of the team are limited and that the organisational structure, and the way in which the team relates to and manages its context, also have roles to play.

Campion, Medsker & Catherine Higgs [1993] note that the composition (or design) of the team is a theme in all the models of team and group effectiveness, yet the evidence linking the two has been mixed.

According to Hackman [in Gladstein, 1984], group effectiveness can be represented by performance, satisfaction, and the ability of the group to exist over a period of time. The last of these criteria may not be applicable to IS project development teams as these teams are often assembled on a per-project basis.

The need for a recognised team classification model is again emphasised in the literature on team effectiveness, as Devine & Clayton [1999, pg. 683] accentuate: "*The message here is clear: Factors impacting team effectiveness are contingent on the team's context.*"

2.4.1 Theories on Determinants of Effectiveness

There has been a substantial amount of literature and research covering the area of team and group effectiveness [e.g. Gladstein, 1984; Hackman, 1990; Campion et al, 1993; Campion et al, 1996; Neuman, Wagner & Christiansen, 1999]. One of the common purposes of this literature has been to discover which variables are most predictive of team effectiveness.

Some authors [e.g. Gladstein, 1984; Campion et al, 1993; Campion et al, 1996] have looked at a broad range of variables in an attempt to include any predictors that might exist. Variables that have been examined include group composition, group structure, available resources, organisational structure [Gladstein, 1984], job design, interdependence, and context [Campion et al, 1993]. Others [e.g. Neuman et al, 1999; Adwani, Rai & Ramaprasad, 2001] have focused on specific variables (e.g. personality composition and team based rewards) that were believed to be likely determinants of team effectiveness.

There is some debate as to whether or not it is possible to successfully isolate the determinants of team effectiveness. Hackman [1990] is of the opinion that no single factor has a significant effect, while each possible predictor of effectiveness loses its potency when examined in isolation from other conditions. He postulates that even in the case of groups with identical tasks, there is no single performance strategy that will provide consistent results. Hackman's stance suggests that it will be difficult (if not impossible) to establish positive links between individual factors and team effectiveness.

Hackman's claims have been indirectly disputed through the results of research efforts that have in fact examined the influence that isolated variables have on team effectiveness. These include Neuman et al [1999] who found a positive link between personality composition and team performance, and Adwani et al [2001] who found a direct link between group based rewards and group performance.

2.4.2 Team Effectiveness Models

Vinokur-Kaplan [1995] suggests that models of team effectiveness are moving beyond their focus on internal dynamics and team development, and are focusing more on the organisational environment in which the teams must perform. These models place more emphasis on the role of the organisation in supporting or undermining the effectiveness of a team.

Many models of team effectiveness have been developed, proposed and explored [Janz et al, 1997]. According to Cohen & Bailey [1997] the frameworks for analysing team effectiveness fall into 2 broad categories:

- The "Input-Process-Output" approach in which team design factors (e.g. size and team member diversity) have an indirect impact on team effectiveness (output) via group process (e.g. communication and conflict) [Gladstein, 1984; Barrick et al, 1998; Stewart & Barrick, 2000].
- Frameworks in which design factors have both a direct and indirect (via group process) influence on team effectiveness [Cohen & Bailey, 1997].

A simplistic overview of the differences between the two approaches is graphically depicted in Figure 2.2.

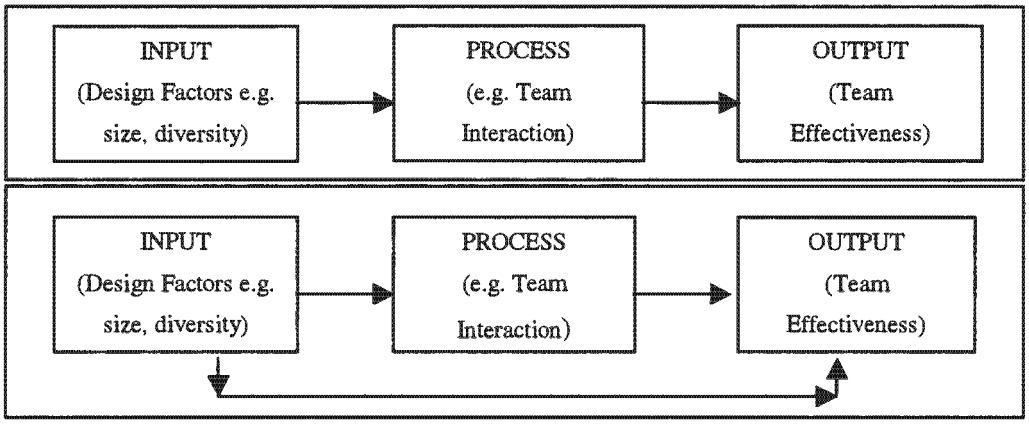

FIGURE 2.2: THE TWO VERSIONS OF THE INPUT-PROCESS-OUTPUT MODEL ADAPTED FROM COHEN & BAILEY [1997] AND BARRICK ET AL [1998]

Campion et al [1996, pg. 432] define processes as those events that take place within the team that influence effectiveness.

Bowers [2000], in his meta-analysis of 13 team performance studies, maintains that the above-mentioned models are widely supported in the literature. He reports that it is '*abundantly clear*' that the link between input variables and performance output is mediated by process variables.

Rao & An [1995] assert that the link between inputs and processes also exists within the context of an information processing perspective. They report that information input (including knowledge, ideas, opinions and preferences) is dependent on team composition variables (input). The influence that team composition variables have on team processes is increased for tasks in which the utilisation of member knowledge strongly determines team performance [Rao & An, 1995]. The process effectiveness of teams involved in IS development projects should therefore be heavily influenced by the composition of the team.

In reviewing the research into groups and teams over a period of 6 years, Cohen & Bailey [1997] propose a model that "*moves away from the input process output approach*". They cite the main reason as design factors (task, group and organisation), which have an indirect impact on outcomes (via group processes) and group psychosocial traits, as well as having a direct impact on outcomes (or effectiveness). This direct relationship between inputs (design factors) and outputs (effectiveness/outcomes) is what differentiates the Cohen & Bailey [1997] model from previous models (e.g. Barrick et al [1998]). An adaptation of the model appears in figure 2.3, followed by an explanation of its contents. The arrows in figure 2.3 depict relationships between variables, with the direction of the arrow depicting which variable has the influence over the other.

According to the Cohen & Bailey [1997] model of team effectiveness:

- Environmental factors are elements of the organisation's external environment such as industry characteristics and turbulence. These factors influence:
- Design factors, which are defined as those features of the task, team, or organisation that can be directly manipulated by managers in order to improve team performance. Examples of design factors include autonomy and interdependence (task related), size and diversity (group related), and rewards and training (organisation related). Design factors impact team effectiveness directly, and in turn are influenced by the team's effectiveness. The factors also influence the team process, and the team's:

- Psychosocial Traits, which are shared understandings or beliefs, including group norms and cohesiveness. Psychosocial traits have a direct impact on effectiveness, and an indirect impact through:
- Group Process, which refers to the processes and interactions that occur amongst team members and those external to the team. Examples include communication and conflict.

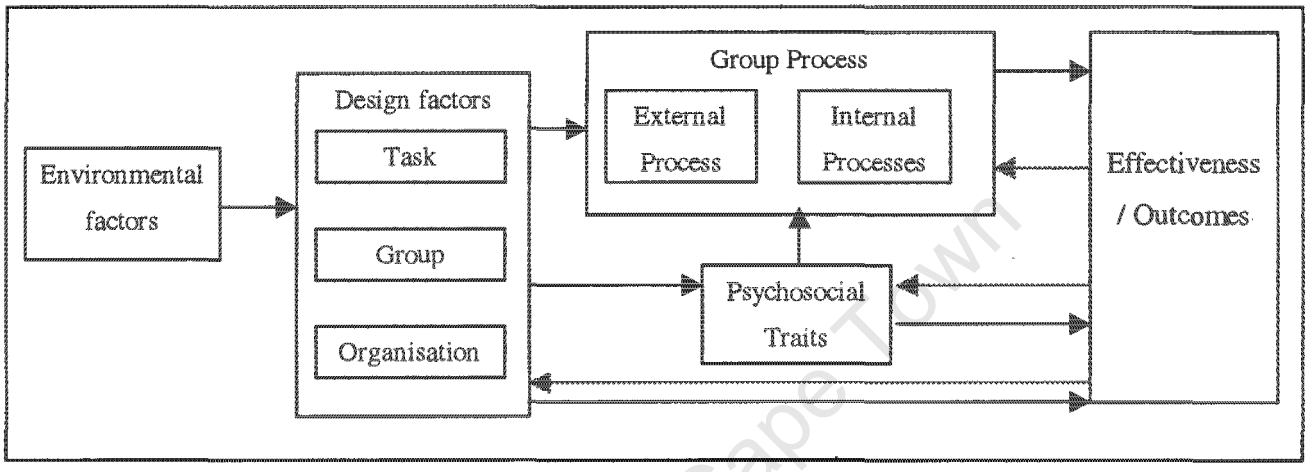

FIGURE 2.3: A MODEL OF TEAM EFFECTIVENESS ADAPTED FROM COHEN & BAILEY [1997]

Thus, according to the Cohen & Bailey [1997] model, team effectiveness can be increased through adjustments or improvements in the team's environmental factors, design factors, psychosocial traits (shared understandings and beliefs), as well as improvements in their group processes. Subsequent changes in team effectiveness will reciprocally influence group processes, psychosocial traits and design factors.

Table 2.3 depicts a summary and comparison of six of the prominent effectiveness frameworks that appear in the team literature. The inputs, processes and outputs that were used in each model are listed under the appropriate column. The 'Influences' column shows what influences the inputs, processes and outputs have over other variables. If an influence column is left blank, it implies that according to that particular model, the variables listed under that heading have no causal relationships with the other variables or constructs.

Reference	Input		Process		Output	
	Constructs	Influences	Constructs	Influences	Constructs	Influences
Gladstein [1984]	Group Structure, Group Composition (e.g. Heterogeneity), Available Resources (e.g. Training), Organisational Structure	Group Process & Group Effectiveness	Group Process (e.g. Communication, Supportiveness, Conflict)	Group Effectiveness	Group Effectiveness	
Barrick et al [1998]	Individual Level Factors, Group Level Factors, Environmental Level Factors	Intra Group Process	Intra Group Process (e.g. Communication and Conflict)	Team Outputs	Team Outputs (e.g. Productivity)	
Cohen & Bailey [1997]	Environmental Factors, Design Factors, Psychosocial Traits	Other Inputs, Group Process, Team Effectiveness	Group Process	Team Effectiveness	Team Effectiveness	Group Process, Inputs including Environmental Factors & Psychosocial Traits
Campion et al [1996]	Job Design (e.g. Task Variety), Interdependence, Composition (e.g. Heterogeneity), Context (e.g. Training & Support)	Effectiveness	Process (e.g. Potency, Workload Sharing)	Effectiveness	Effectiveness (e.g. Productivity)	
Jones & Harrison [1996]	Task Routineity, Cohesion, User Representativeness, Team Member Involvement, Task Priority	IS Project Team Performance			IS Project Team Performance	
Guinan et al [1998]	Behavioural Factors (e.g. Experience and Skill), Technical Factors (e.g. Methods and Technology)	Group Process, Team Performance	Group Process	Team Performance	Team Performance	

TABLE 2.3: A SUMMARY OF PROMINENT EFFECTIVENESS FRAMEWORKS

The major differences in the models are:

- Jones and Harrison [1996] fail to distinguish between inputs and processes in their model of Information Systems Project Performance.
- Cohen & Bailey [1997] propose a model that is more complex than the other models due to two factors. Firstly, some inputs are purported to have a direct impact on effectiveness (a view shared by Gladstein [1984] and Guinan et al [1998]), thereby bypassing '*group process*' as a mediator. Secondly, there is a cause and effect relationship between process and effectiveness, psychosocial traits and effectiveness, and design factors and effectiveness. This implies that these factors influence the team's effectiveness, which in turn has an impact on these factors. This reciprocal relationship can only be tested by examining teams over an extended period of time [Cohen & Bailey, 1997].
- Campion et al [1996] fail to define any relationships between inputs and processes. Their model depicts processes in the same way that the other inputs (e.g. job design

and interdependence) are portrayed, suggesting that processes influence effectiveness in a similar manner to inputs.

All models clearly show that outputs (effectiveness, performance and productivity) can be improved by adjusting input variables, although the particular variables examined vary between models. Table 2.3 also highlights the fact that there are differences in opinion regarding the mediating effects that processes have on the relationship between inputs and outputs.

2.5 TEAM CATEGORISATION THEORIES

While many authors have commented on the existence of various types or categories of teams [Hackman, 1990; Mohrman et al, 1995; Mankin et al, 1996], much of the research into project team effectiveness factors has failed to isolate the broader category or type of team to which the research applies [Cohen & Bailey, 1997]. It has been difficult to assess whether some of the research is applicable to only the exact types of teams that were tested, or if there is a broader category of teams for which the research is relevant. Cohen & Bailey [1997] note that, in order to clarify the factors that predict effectiveness for the different team types, it is important to categorise the teams.

Hackman [1990] emphasises the need for more detailed descriptions of the technology, task and product associated with a work group. Cohen & Bailey [1997] note that these descriptions are still missing from much of the team effectiveness research that has been conducted. They continue to suggest six features that should be present in team effectiveness studies to ensure that the results are fully understandable and are able to be interpreted in context. These include the type of organisation, the functions represented in the team, and the nature of the product to be designed or completed.

2.6 TEAM MEMBER DIVERSITY AND HETEROGENEITY

An increase in the migration of skilled knowledge workers has meant that teams are often comprised of highly diverse (in terms of demographics, backgrounds, experience, and expertise) individuals. Diversity, or heterogeneity, has been operationalised in two broad categories. Some researchers have examined diversity in terms of demographic differences such as gender, race, physical abilities, sexual orientation, and national origins [e.g., Knouse & Dansby, 1999; Pelled & Eisenhardt, 1999], while others have referred to the presence of members with different functional specialities or experience levels [e.g. Rao & An, 1995; Campion et al, 1996; Adwani et al, 2001]. Jackson, May & Whitney [1995] refer to the

elements within each of the two categories of diversity as "*detectable attributes*" and "*underlying attributes*" respectively.

Over the years, projects have dramatically increased in complexity, often requiring individuals with a diverse mix of backgrounds, skills, and expertise [Verma, 1997]. According to Kliem & Ludin [1994] the need for a diverse number of specialised skills is particularly prevalent in IS teams, and it is vital that these skills complement each other. The prevalence of this need is most likely attributable to the fact that the task of IS development is relatively complex [Bradley & Hebert, 1997].

Campion et al [1993] refer to the diversity of expertise, backgrounds, experiences, skills, and abilities as heterogeneity. Thus, a team in which the above characteristics of each member differed from those of the other members would be considered a heterogeneous team. Guinan et al [1998] and Verma [1997] agree that a diverse range of backgrounds, skills and expertise are needed for a team performing complex tasks to be effective.

Evidence obtained from empirical research leads to some debate as to whether or not this diversity (or heterogeneity) has a positive influence on the effectiveness of teams [Devine & Clayton, 1999; Bowers, 2000]. Mankin et al [1996] believe that an increase in the level of diversity (in terms of both backgrounds and functions of team members) can lead to increased conflict within the team, implying decreased effectiveness. Others, such as Adwani et al [2001], Bradley & Hebert [1997], and Campion et al [1996] contend that there may well be a positive link between heterogeneity and effectiveness/performance.

One of Katzenbach and Smith's [1993, pg. 21] definitions of a team signifies their belief that heterogeneity in terms of skills is vital: "*A team is a small group of people with complementary skills committed to a common purpose and set of performance goals*". Walter & Walter [1998] concur, noting that the team approach is more effective if there is a varied distribution of complementary skills within the team. Campion et al [1996] attribute the value of heterogeneity to the increase in the range of competencies that it brings to the team.

The link between demographic diversity and team effectiveness has been examined in numerous research papers [Leonard & Swap, 1999], with most evidence suggesting that demographic homogeneity is preferable for effective teamwork. This research will therefore move away from measuring the '*detectable attributes*' and will rather examine heterogeneity, adopting the Campion et al [1993] interpretation of the construct (diversity of expertise,

backgrounds, experiences, skills, and abilities). Numerous studies have found heterogeneity, defined in this way, to be linked to team effectiveness [Leonard & Swap, 1999].

Campion et al [1993] report that heterogeneous teams are more likely to be effective when the tasks assigned to the group are diverse, as these will require a large range of competencies. McLeod & Smith [1996] emphasise the diversity of the tasks constituting IS projects by noting that they contain a variety of technical, managerial and people orientated tasks. Janz et al [1997] agree, stating that knowledge work (e.g. the development of information systems) is characterised by unpredictable, multidisciplinary, and non-repetitive tasks. Hackman [1990] notes that a group's diversity may spark creative conflict that could contribute towards improved effectiveness. Guzzo & Dickson [1996] add to the body of literature that supports the use of heterogeneous teams for projects similar in nature to IS projects, arguing that the evidence supporting the value of member heterogeneity is clearest in the domains of creative and intellectual tasks.

According to Bradley & Hebert [1997], complex problem solving can be dealt with effectively by teams made up of different types of individuals with a variety of skills, knowledge, abilities and perspectives. They cite the development of an Information Systems project as an example of complex problem solving. Leonard and Swap [1999] agree, noting that teams working on complex, non-routine problems are more effective when composed of individuals with diverse types of skills, knowledge, abilities and perspectives.

There is evidence that points towards heterogeneity's impact on team effectiveness being a function of the period of time that the team has worked together [Guzzo & Dickson, 1996]. It is suggested that the positive impact of member homogeneity on team effectiveness increases with the amount of time that the team stays together.

Table 2.4 demonstrates how heterogeneity and diversity have been operationalised in the literature. The first column depicts the authors of the various research articles, while the second column lists the various constructs across which diversity was measured. The third column describes the research that was conducted, as well as mentioning results that were obtained.

Guzzo & Dickson [1996, pg. 331] highlight the need for research in the area of team member homogeneity: *"There is a real need to develop theory and data on the ways in which dissimilarity among members contributes to task performance"*.

Author(s)	Diversity Measured In Terms Of:	Nature of Research / Results
Bowers [2000]	Gender, Abilities, Personality	A meta-analytic study of past research found that tasks with low stimulus uncertainty, processing demands and response complexity are better suited to homogeneous groups. Heterogeneous teams performed better than homogeneous teams on high difficulty and performance tasks.
Jackson, May, Whitney [1995]	Personality, Gender, Attitudes, Background, Experiences	A review of evidence from related disciplines that attempted to find a link between diversity and team effectiveness. It was found that heterogeneity is positively related to the creativity and decision-making effectiveness of teams.
Watson, Kumar, Michaelsen [1993]	Culture	In examining culturally diverse teams it was found that culturally heterogeneous groups initially performed less effectively than their homogeneous counterparts. Over a 15-week period, this trend was reversed for selected aspects of task performance.
Campion, Papper, Medsker [1996]	Expertise, Skills, Abilities, Experiences, Background	Empirical research examining the relations between team characteristics and effectiveness found little evidence supporting either a negative or a positive relationship between heterogeneity and team effectiveness.
Neuman, Wagner, Christiansen [1999]	Personality Type	In a study of teams of retail assistants it was found that Team Personality Diversity (TPD) is positively related to team performance.
Bradley, Hebert [1997]	Personality	A case study of Information Systems teams and a literature review lead the authors to the conclusion that for complex tasks such as IS development, a balanced team of diverse personality types is needed.
Adwani et al [2001]	Background, Abilities, Experiences	In a study of 103 IS development projects it was found that heterogeneity positively impacts on performance through increased levels of participation

TABLE 2.4: A SUMMARY OF PAST HETEROGENEITY AND DIVERSITY RESEARCH

2.7 TEAM ROLES

Much of the team literature places emphasis on team design [e.g. Mohrman et al, 1995; Belbin, 1996; Mankin et al, 1996] as opposed to assembling teams on an ad-hoc basis, or merely basing selections on technical skills. Team design implies the utilisation of set criteria and/or methods for creating teams. Mohrman et al [1995] note that team design and organisational context play a direct role in determining the effectiveness of a team.

One of the problems with currently applied design criteria is that they are often developed in production settings and are not always applicable to knowledge work teams [Mohrman et al, 1995]. Creating design criteria in knowledge work settings is a far more challenging prospect,

as knowledge-based skills and abilities are difficult to measure. Testing the design criteria is also problematic, as the performance of a knowledge-work team is not easily measurable.

Numerous theories for assisting in the process of team design in knowledge work settings have been developed in recent years. These include the Sixteen Personality Factor (16PF) Questionnaire [Cattel, Eber, & Tatsuoka, 1992], the Myers-Briggs Type Indicator (MBTI) and the Belbin Team Role Self-perception Inventory (BTRSPI) [Belbin, 1996]. DeMarco & Lister [1999] observe that the IS industry has had a long irregular flirtation with the idea of aptitude and psychometric testing, sometimes using instruments such as those mentioned above.

Smith [1989] used the MBTI to assess the personality profiles of systems analysts, and in doing so, found that the vast majority of them were technically orientated and preferred working with facts and data rather than with people. Kaiser & Bostrom [1982] found a similar trend, and voiced their opinion that systems were being created without the necessary people oriented dimension. Although somewhat old, this research clearly shows that the IS industry has its roots deeply entrenched in a task oriented environment, as opposed to a people orientated one.

In more recent research, Bishop-Clark & Wheeler [1994] found that personality type (measured using MBTI) influenced individual achievement in programming exercises. This research has the shortcoming of ignoring the fact that real world programming performance usually relies heavily on team work and team interactions.

One research area that has taken cognisance of the importance of teams and interactions within teams, is that of team roles. Team roles have been explored by a number of authors [Margerison & McCann, 1992; Davis, Millburn & Murphy, 1992; Woodstock, 1992; Spencer & Pruss, 1992; Belbin, 1996]. Francis & Young [1992] define roles as the explicit definition of the contribution that a person makes to his or her team. Senior [1997] notes that team role theories have been applied extensively, with Belbin's framework being one of the most commonly applied. Belbin's [1996] work identifies nine distinct team roles that indicate different types of behaviour and natural abilities, but that are not necessarily linked to specific skills and knowledge (see Table 2.5). According to the theory, each member of a team will naturally adopt some of these roles.

	Team Role	Strengths	Allowable Weaknesses
	Plant	Creative, imaginative, unorthodox. Solves difficult problems.	Ignores details. Too pre-occupied to communicate effectively.
	Resource Investigator	Extrovert, enthusiastic, communicative. Explores opportunities. Develops contacts.	Overoptimistic. Loses interest once initial enthusiasm has passed.
	Co-ordinator	Mature, confident, a good chairperson. Clarifies goals, promotes decision-making, delegates well.	Can often be seen as manipulative. Delegates personal work.
	Shaper	Challenging, dynamic, thrives on pressure. The drive and courage to overcome obstacles.	Can provoke others. Offends people's feelings.
	Monitor Evaluator	Sober, strategic and discerning. Sees all options. Judges accurately.	Lacks drive and ability to inspire others. Overly critical.
	Teamworker	Co-operative, mild, perceptive and diplomatic. Listens, builds, averts friction, calms the waters.	Indecisive in crunch situations. Can be easily influenced.
	Implementer	Disciplined, reliable, conservative and efficient. Turns ideas into practical actions.	Somewhat inflexible. Slow to respond to new possibilities.
	Completer	Painstaking, conscientious, anxious. Searches out errors and omissions. Delivers on time.	Inclined to worry unduly. Reluctant to delegate.
	Specialist	Single-minded, self-starting, dedicated. Provides knowledge and skills that are rare in supply.	Contributes only on a narrow front. Dwells on technicalities. Overlooks the 'big picture'.

TABLE 2.5: BELBIN'S NINE TEAM ROLES

What sets Belbin's work apart from the other research in the area of team roles is that Belbin specifically set out to create an instrument that would be able to make predictions about team performance [Belbin, 1996, pg. 20]. His method ignores the required technical skills and work-attitudes (these are assumed to be present) and focuses rather on the interactive relationships within the team. The team role concept moves away from the hierarchical concept of functional roles that has previously dominated team structures.

Belbin [1996] emphasises the need to appoint people based on their natural behaviour (i.e. natural roles) rather than on their specific skills alone. He suggests that for a team to be effective, all nine team roles should be adequately represented in the team. Belbin [1996] refers to teams in which all 9 team roles are adequately represented as '*balanced*' teams. He

hypothesises that in "*a perfectly balanced team there is always someone who can deal naturally with any set of responsibilities*"[Belbin, 1996, pg. 83].

Some authors [Furnham, Steel & Pendleton, 1993; Fisher et al, 1996] have criticised the psychometric properties of Belbin's team roles and questioned the value of the Belbin Team Role Self-perception Inventory (BTRSPI) in establishing team role preferences. The BTRSPI is the instrument developed by Belbin that aims to establish the team role preferences of individuals by asking how they relate to certain predefined situations. Belbin [1993] has defended his work by stating that his critics did not always follow the recommended method of scoring the BTRSPI, and the BTRSPI was not intended to be a formal psychometric test. Belbin has also created a role-determining assessment sheet to be completed by close work colleagues (observers) of the subject in question. This can be used in conjunction with the self-perception inventory to determine an individual's team roles. The observer component of Belbin's work was not utilised by Belbin's critics in the above-mentioned research [Belbin, 1993].

In a survey of 11 teams, Senior [1997] tested Belbin's theory by examining whether teams that were balanced (in terms of team roles present in the team) were high performing teams. The results of the investigation provided support to the proposed link between team role balance and team performance.

Katzenbach & Smith [1993] make mention of roles when they state that effective teams have each member assuming different social roles, thereby creating trust and encouraging creativity. Lipman-Blumen & Leavitt [1999] have adapted the concept of team roles to form what they refer to as '*achieving styles*'. They cite nine different achieving styles that, like Belbin's team roles, should be diversely represented to ensure effectiveness. The authors contend that empirical evidence suggests that having access to a full range of these achieving styles will allow the team to contend with a wide variety of problems. Having a team in which all roles are not fulfilled can be one the main causes of ineffective teams [Mohrman et al, 1995]. Verma [1997] confirms the need for teams to be composed of members with a variety of roles.

Lipman-Blumen & Leavitt [1999] also touch on an extremely relevant point when they note that a difference in achieving styles amongst members may result in a certain amount of conflict. According to Mankin et al [1996] conflict within a team is inevitable. Belbin [1996] stresses the need for such conflict to be resolved at a conscious level. Katzenbach & Smith

[1993] argue that although conflict is threatening to teams, it is necessary for the generation of creative ideas and solutions. Bradley & Hebert [1997, pg. 343] concur: "*it is in conflict that ideas are evaluated for their true contribution*".

Senior [1997], while noting the extensive application of team role theories, argues that more empirical evidence is needed to establish a link between the application of these theories and team performance and effectiveness.

2.8 TEAM COHESION

Carron, Brawley & Windmeyer [in Carron & Brawley, 2000] define cohesion as "*a dynamic process that is reflected in the tendency for a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of affective needs*". Research has found "*substantial positive association between cohesion and performance (although) the topic is still very much an unsettled concern*" [Guzzo & Dickson, 1996, pg. 310]. Vinokur-Kaplan [1995] established that the cohesion of a team predicts overall team effectiveness, while Bowers [2000] cites research that revealed evidence of a relationship between team cohesiveness and performance.

Team literature identifies several constructs that could be considered to act as mediators on the effects that basic team composition characteristics (inputs) have on team effectiveness (outputs). These process constructs include participation [Campion et al, 1996; Cohen & Bailey, 1997], conflict [Cohen & Bailey, 1997; Devine & Clayton, 1999], co-operation [Campion et al, 1996; Cohen & Bailey, 1997], workload sharing [Janz et al, 1997], communication [Campion et al, 1996; Bradley & Hebert, 1997; Cohen & Bailey, 1997], supportiveness [Gladstein, 1984], and motivation [Janz et al, 1997].

Of these process measures, all except conflict have been linked to cohesion by Carless & de Paola [2000] in their paper on the measurement of cohesion in work teams. A link between cohesion and conflict is noted by Verma [1997] who argues that cohesion leads to lower conflict and effective conflict management. Thus, assessing cohesion's mediating role between heterogeneity and effectiveness, and between role diversity and effectiveness, should give an indication of whether or not some of the above-mentioned constructs also play a mediating role. Most effectiveness frameworks have viewed cohesion as a group process [Guzzo & Dickson, 1996; Cohen & Bailey, 1997]. This, combined with the fact that cohesion can be seen as a combination of the majority of other group processes, has lead to the adoption of cohesion as a measure of group process for the purposes of this research.

Leonard & Swap [1999] believe that mutual liking and cohesiveness within a team increase as a team spends more time together. They argue that high levels of cohesion can also have a negative impact in the form of 'Groupthink': "*a mode of thinking that people engage in when they are deeply involved in a cohesive in-group, when the members' strivings for unanimity override their motivation to realistically appraise alternative courses of action*" [pg. 59]. They continue by stating that a group of similar people is likely to develop the interpersonal bonds that promote cohesion, while dissimilar people are not. This line of thinking is supported by Cohen & Bailey [1997], who note that diversity adversely affects the formation of social integration and cohesion. What is not clear in the literature is whether heterogeneity (as defined is section 2.6) has any impact on the levels of cohesion in the team.

Bradley & Hebert [1997] emphasise that cohesion does not imply the absence of conflict. Rather, it demonstrates the potential for a team to resolve conflicts in a manner that does not result in long-term divisions, but rather in the synergism that makes team work valuable.

Verma [1997] contends that teams faced with complex tasks are likely to be cohesive, especially if the tasks involve creativity and innovation.

2.9 THE RELEVANCE OF STUDYING IS TEAMS

DeMarco & Lister [1999] report that, from a total of more than 500 IS projects that they have observed, 15 % were cancelled, aborted, postponed, or they delivered products that were never used. They observed that more than 25% of large projects (those lasting 25 work years or more) were never completed. They note that in most cases, there was not a single technological issue to explain the failure.

Stokes and Stewart [1990] report that one of the major reasons for systems professionals having negative experiences with project team building is the lack of information about how to build collaborative project teams.

According to a study on key issues in IS management [Brancheau, Janz & Wetherbe, 1996], improving the effectiveness of software development was the 6th most important issue in the IS industry. The authors note that this issue is closely linked to the 8th ranked issue – recruiting and developing IS human resources. The human resources issue also ranked 8th in 1983, while the effectiveness of software development was ranked 10th in the same year [Watson, Kelly, Galliers & Brancheau, 1997]. This implies that the need to improve

development effectiveness through the recruitment of individuals and the development of teams has been a long-term problem that is consistently highly rated by IS managers.

The importance of studying the Belbin team role theory in the context of Information Systems teams is emphasised by Dawson, Lord & Pheiffer [2001] as they contend that the nature of the task at hand (IS development) might be a significant moderating variable in Belbin's Work.

DeMarco & Lister [1999] believe that the high performance of some companies in the IS arena can be entirely attributed to their effective methods of selecting and handling people. They maintain that a company's skill in selecting new team members will determine their eventual success. This research aims to add to the body of knowledge from which those skills are derived, thereby affording companies a greater opportunity for success through effective team member selection.

The issues facing the IS industry are succinctly summarised by DeMarco & Lister [1999, pg. 3 & pg. 96]: *"The major problems of our work are not so much technological as sociological in nature... your skill at selecting new team members will determine to a large extent your eventual success"*.

2.10 SUMMARY

Teams are vital components of modern organisations and the way in which they operate. The team-based approach is particularly suited to Information Systems projects, where the work is complex and requires knowledge in the technical domain, the area of application, systems design, and organisational operations [Klenke, 1997].

There appears to be consensus regarding the fact that team effectiveness is a function of both the inputs of the team (e.g. group composition, environment factors) and group processes (e.g. communication, conflict, and cohesion). However, the way in which inputs and processes impact on effectiveness is unclear, with two basic schools of thought emerging: those that believe that inputs can only influence effectiveness through group processes, and those that believe that inputs impact on effectiveness both directly and through group processes. Cohen & Bailey [1997] argue the latter approach, also suggesting that the influence runs in both directions, with effectiveness influencing group processes and certain inputs.
This research will test the two approaches by examining the direct impact that inputs (team heterogeneity and team role diversity) have on effectiveness, as well as testing the possible

mediating role that group processes (team cohesion) play. This should shed light on which type of effectiveness framework is more suited to IS teams. Group process will be measured through the determination of the levels of cohesion in participating teams. Cohesion has been positively linked to numerous measures of group process, including participation, co-operation and communication.

Two broad categories of diversity have been identified: demographic diversity; and diversity of skills, backgrounds, experiences, expertise, abilities and personalities. Diversity as defined in terms of demographics has generally been shown to have a negative impact on team effectiveness and performance. Past research has found mixed relationships between heterogeneity (the term applied to the latter category of diversity) and effectiveness, with most studies indicating a positive link (i.e. greater heterogeneity leads to more effective teamwork). The literature suggests that heterogeneity is important for IS teams to function effectively. This research will test that assertion.

A team role has been defined in terms of the type of contribution that a member makes to his or her team. The assertion that a balanced set of well represented team roles is necessary for teams to perform effectively will be tested. The relevance of testing this in the context of IS teams lies in the nature of IS project work: it is complex, collaborative work that requires intensive and interactive communication [Klenke, 1997]. This is emphasised by Leonard & Swap [1999] who note that the complexity of systems development tasks requires that the skills of individuals need to be combined effectively in order to ensure success.

The relevance of examining the particular issues discussed in this research are made apparent by Verma [1997, pg. 75]: "*The effectiveness of a project team depends on its size, diversity, and composition in terms of similarities and differences amongst team members and the roles they prefer to assume in a team*".

3. AN IS TEAM EFFECTIVENESS MODEL

The variables discussed in the literature review will be placed in a model that aims to show their impact on the dependent variable: IS project team effectiveness. The importance of developing models based on recognised literature becomes apparent when one considers a statement by Everitt & Dunn [1991, pg. 272]: *"Correlation does not imply causation"*. Examining the statistical relationships between variables does not give one the authority to suggest that the one variable may be a significant cause of another. However, by developing a model based on recognised literature and past research, one can use the model and combine it with an analysis of relevant data to demonstrate how, and to what extent, variables impact on each other.

3.1 THE EFFECTIVENESS MODEL

The structure of the model is based on the theory and model developed by Cohen & Bailey [1997] as it predicts that inputs or team composition variables will have both a direct and indirect effect on outputs (IS team effectiveness). The model developed by Cohen & Bailey [1997] was derived from their meta-analysis of 54 research articles relating to team effectiveness, which were published over a 6-year period. The structure of their model can therefore be assumed to be an accurate reflection of the current state of thinking in the area of team effectiveness.

The independent variables used in the model (Figure 3.1) have been derived from the literature presented in the literature review (Chapter 2). All have been associated with IS team effectiveness in the literature.

IS team role balance is predicted to have both a mediated and a direct positive relationship with IS team effectiveness. IS team member heterogeneity is assumed to have a similar relationship with IS team effectiveness. In both cases, the mediation is expected to take place through IS team cohesion.

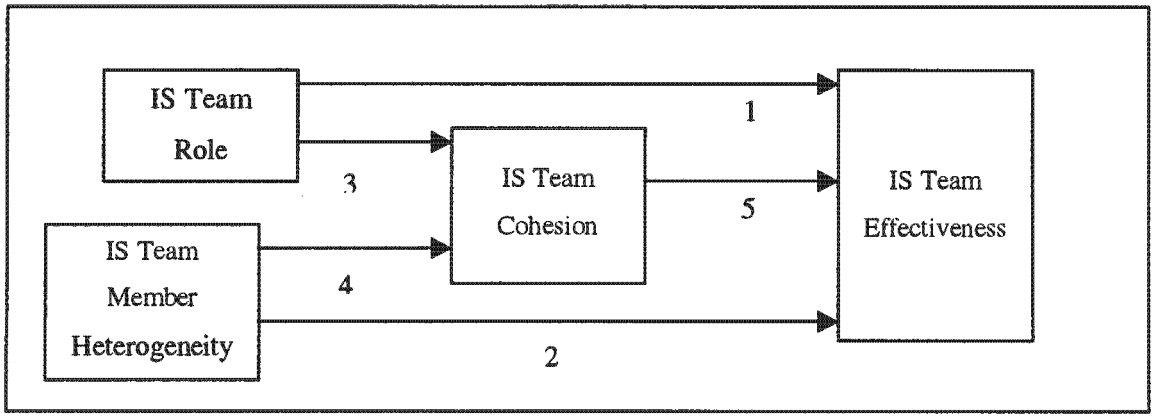

FIGURE 3.1: A PROPOSED MODEL OF IS TEAM EFFECTIVENESS

3.2 THE RESEARCH HYPOTHESES

Several hypotheses, which are based on the research model, were tested. Each hypothesis was based on one or more of the relationships represented in Figure 3.1. The declaration of each hypothesis is followed by a description of its association with one or more of the labelled relationships in Figure 3.1.

H_1) *Information Systems project teams with high levels of team member heterogeneity display higher levels of effectiveness than teams consisting of homogeneous members.*

This hypothesis is represented by relationship #2 in Figure 3.1.

H_2) *Information Systems project teams that exhibit a balanced set of team roles display higher levels of effectiveness than teams with an unbalanced set of roles.*

This hypothesis is represented by relationship #1 in Figure 3.1.

H_3) *Information Systems project teams with high levels of team cohesion display higher levels of effectiveness than teams that demonstrate low levels of team cohesion.*

This hypothesis is represented by relationship #5 in Figure 3.1.

H_4) *Team processes mediate the relationships between team inputs and team outputs.*

This hypothesis is represented by relationships #1 to #5 in Figure 3.1

Developing and testing these hypotheses in the context of the effectiveness model was necessary to clarify the relationships between the independent variables and the dependent variable: IS project team effectiveness. It also allowed for an evaluation of the nature and magnitude of these relationships.

In order to test the hypotheses, data relating to each of the stated variables had to be collected. Numerous methodological issues had to be considered, and various data collection techniques were evaluated.

4. RESEARCH METHODOLOGY

This chapter details the sample used to collect the data required for this research, and the issues affecting the choice of sample. Problems with the sampling technique and choice of sample are discussed. The procedures used in deriving the research instrument are explained, and the reliability and validity of the instrument are examined. The data collection techniques are also described.

4.1 METHODOLOGICAL ISSUES

4.1.1 The State of Team Theory and Generalisability of Research Results

The importance of identifying the context in which the team works and categorising the type of team(s) being studied is well recognised in the team effectiveness literature. As Devine & Clayton [1999] have suggested, the lack of a recognised typology has limited the generalisability of past team research, with researchers often having assumed that one model applies to all team types. Identifying multiple models of effectiveness according to team types is vital for conducting and interpreting empirical research, as there may be great variations in results from different categories of teams.

Cohen & Bailey [1997] suggest that the following features should be present and described in team effectiveness studies. These will ensure that the context of the team can be fully understood for the application of the results and for the purposes of future research:

1) Type of organisation
2) The organisational structure in which the team is embedded
3) The functions represented in the team
4) The percentage of time that members dedicate to the team
5) The leadership structure
6) The nature of the product to be designed/completed

Section 4.3.3 will detail how the sample used in this research can be categorised according to the above criteria.

Cohen and Bailey [1997], in their meta-analysis of team effectiveness research, note the importance of studying effectiveness outcomes of real teams in real organisations. They argue that sampling students (as many researchers have done) leads to results that are not applicable

to practising professionals, while laboratory experiments ignore organisational features external to the team. Gladstein [1984] agrees, noting that while many team performance theories are adequate for laboratory tasks, they are not adequate for the more complex interdependent tasks in real organisational environments.

4.1.2 Role of Data

Two major philosophical perspectives of research are apparent in the social sciences [Licker, 1999]:

1) Positivism (scientific) – Empirical, or real world situations can be reduced into properties that are independent of the research instrument. This approach is objective, mechanical, and not open to interpretation. It seeks to make predictions about the real world and ways in which real world phenomena can be controlled.
2) Non-Positivist Approaches (experimental) – An experimental approach that is holistic and can include any externalities. The research is subjective, open to interpretation, and is an expression of the researcher's views. It seeks to promote understanding and debate regarding the research subject.

This research aims to make predictions about team effectiveness based on team member heterogeneity and team role balance. In doing so, it aims to provide methods that can be used to control team effectiveness. This, combined with the large amounts of prior research in the general area of this research, promotes the adoption of the positivistic approach. Data is a vital component of this approach.

The adoption of the positivistic, quantitative research methodology will allow the author to demonstrate the relationships between various items of data that have been collected. This is based on the '*correlational*' research design [Bryman, 1990] in which data is collected from a cross-section of people at a single point in time in order to discover how variables relate to each other. This data will represent instances of the variables that are to be measured: team effectiveness, team cohesion, team member heterogeneity, and team role balance. The literature review and the research hypotheses suggest that certain relationships exist between these variables. The data will demonstrate if the theoretical relationships between the variables do in fact exist.

Once the data has been analysed, the complete set of relationships will become apparent and it will be possible to predict whether IS teams could be made more effective by adjusting the independent variables under scrutiny.

4.1.3 Data Collection Techniques

As with most empirical research in the field of Information Systems, several data collection techniques were available. Team effectiveness research is very well established, particularly in the academic sphere of the social sciences and, as has been illustrated in Chapter 2 of this research, several team effectiveness frameworks have been developed. Despite team effectiveness frameworks not having been widely applied in the field of Information Systems, the vast amounts of research and literature on the topic lend themselves towards quantitative research methodologies.

Interviews were ruled out as a possible data collection technique for a number of reasons. Firstly, the sheer volume of interviews that would have to have taken place would have been logistically prohibitive. The relationships between certain variables are measured in terms of teams, yet to gather the team data, it would have been necessary to interview each team member. Secondly, the required data was quantitative in nature: a characteristic that is not suited to interviews. All required responses, except those to 2 background questions, were suited to a closed set of answers.

Conducting group interviews (all team members at once) would have alleviated the volume issue, but it would have been virtually impossible to get each participating team to assemble as a single group for the length of time that would have been required. Interviews of this nature also tend to marginalise the opinions of quieter members of the team.

Questionnaires were deemed the most appropriate data collection technique. The vast majority of team effectiveness empirical research in recent years has adopted the questionnaire-based survey approach.

Questionnaires provide a highly structured method of gathering data from a large sample. The high degree of structure allows for easy comparison of the resulting data. The questionnaire approach does not necessitate the congregation of the team at a particular place and time, as individuals can respond at any time and location during the given period. This is especially beneficial for IS teams, as heavy workloads and potentially distributed working venues enhance the difficulties of setting up a meeting for the entire team.

Questionnaires are also suited to a large sample size, as they are relatively easy to distribute and do not need the attention of anyone but the participant (it must be remembered that the unit of analysis for certain variables is the team, yet responses had to be obtained from each team member). They offer perfect anonymity and confidentiality, which is imperative in a questionnaire of this nature. Without these properties, respondents would be likely to inflate their opinions regarding their team's effectiveness and the levels of cohesion in the team. This would be to avoid any negative sentiments or detrimental reactions from management or other team members, should these people gain access to the completed questionnaire.

Bryman [1990] criticises the survey method, saying that groups of questions have to be developed in order to represent each of the delineated dimensions being assessed. Even if these questions are based on past 'validated' research, there is still no guarantee that the questions are assessing the dimensions they are purported to be representing. Bryman [1990] adds that questionnaires are primarily geared towards the establishment of simple associations and correlations amongst variables.

Another data collection technique that had to be considered was that of observation. However, observations are inappropriate for research that requires quantitative data, and are usually only applicable if there are a small number of cases. Much of the required data related to team members' perceptions of their team's effectiveness, while some data related to their personal opinions regarding the interactions within their team. Team roles would be extremely difficult to assess through observations, unless the observer was able to observe each team for a number of days or weeks.

Observations would also require that the IS team be working together in the same physical venue for the duration of the observation. This would have created serious logistical problems.

As Cohen & Bailey [1997] have noted, performing team effectiveness research using a '*controlled experiment*' methodology ignores organisational features external to the team. Because this research aims to provide information regarding IS project team effectiveness, it is necessary to have all the relevant external organisational features in place. Without them, as would be the case in a controlled experiment, the results would not necessarily be applicable to real IS teams working in real organisations.

Although team effectiveness could be measured through the results of some form of team exercise in a controlled experiment, other variables such as team member heterogeneity, team cohesion, and team role balance only become apparent once the team has worked together for a substantial period.

A case study is a form of observation, and hence suffers under the same set of inadequacies as the observation technique. Case studies offer a general understanding of a phenomenon, and an understanding of the context within which the phenomenon lies. They are appropriate for generating theories, but cannot be used to determine 'cause and effect' relationships, nor to prove theories.

4.2 QUESTIONNAIRE DESIGN & MOTIVATION FOR QUESTIONS

Zmud & Boynton [1991] have criticised IS researchers for developing their own instruments rather than using existing, validated instruments from other disciplines. The current instrument was developed taking cognisance of this fact. All questions in section 1 of the questionnaire were based on questions used in previous peer-reviewed research relating to teams, Information Systems, organisational behaviour, psychology, or a combination of these fields. Section 2 comprised the Belbin Team Role Self Perception Inventory.

The questionnaire was accompanied by a 1-page covering letter explaining the nature of the research, the criteria that teams and individuals had to meet to participate in the research, and contact details for both the author and the research supervisor. A 1-page set of instructions, which included a required return date and a promise of confidentiality, was also included.

This was followed by section 1, which consisted of 2 open-ended questions, and 23 questions answerable by means of a 7-point Likert scale (ranging from 1=*strongly disagree* to 7=*strongly agree*). The remaining 4 pages of the questionnaire comprised section 2: the Belbin Team Role Self Perception Inventory.

The 7-point scale was selected as it provided a relatively wide range of responses to statements that were open to subjective interpretation. Although the 5-point scale has also been widely used in the team effectiveness literature, the 7-point scale allowed for a greater level of accuracy when applying parametric and non-parametric statistical techniques to the

resultant data. The application of parametric techniques to ordinal data is discussed in Section 5.5.

The instrument was pretested on 5 fellow Masters students and staff from the Department of Information Systems at the University of Cape Town. Minor structural changes (e.g. layout) were made on their recommendations.

The following section details how each of the four variables in the research model (Figure 3.1) was assessed in the questionnaire.

4.2.1 Team Member Heterogeneity

The three questions measuring team member heterogeneity were taken directly from the work of Campion et al [1993 & 1996]. The authors used the three questions in two studies that examined the relations between work group characteristics and team effectiveness. They permitted responses in the form of a five-point response format (Likert scale).

The initial research [Campion et al, 1993] was conducted on teams of clerical staff, suggesting that the three questions measuring heterogeneity may not be applicable to teams of knowledge workers such as IS project teams. However, Campion et al [1996] repeated the study using teams of professional knowledge workers as their sample. Their questions were not altered, and the scale was adjusted to include 7 possible answers, ranging from 1=*strongly disagree* to 7=*strongly agree.*

Questions 1, 4 & 7 (see Appendix A) of section 1 of the questionnaire were used to measure member heterogeneity within the team.

Diversity in terms of '*areas of expertise*' (Question 1) may at first appear synonymous with diversity in terms of '*skills and abilities*' (Question 7). However, the former measure refers to disciplines in which members possess a high level of knowledge, while the latter refers to the members' skills and abilities within those disciplines.

4.2.2 Team Cohesion

Team cohesion was measured in order to assess the potential mediating role that group processes play in the relationships between the inputs (team member heterogeneity and team role balance) and outputs (team effectiveness). Participation, co-operation, communication, supportiveness, workload sharing, and motivation have all been recognised as group processes (see section 2.8), and have all been positively linked to team cohesion [Carless &

de Paola 2000]. Team cohesion itself has been categorised as a group process in various studies [Cohen & Bailey, 1997]. Measuring each of the above constructs and other process measures would have made the questionnaire prohibitively long. Thus, team cohesion has been used as a summary measure of group processes in order to assess the role that processes play in the relationship between team inputs and outputs. Barrick et al [1998] adopted a similar approach when they used social cohesion as a measure of team process in their research, which related member ability and personality to work-team process and team effectiveness.

Team cohesion was measured using 6 questions, each of them answerable by means of the 7-point scale. Four of these questions were borrowed from an instrument adapted by Carless & de Paola [2000]. Only questions that the authors had associated with task cohesion (the degree of commitment to the task) were used. They noted that their questions measuring social cohesion and individual attraction to the team were not significantly related to performance. It must also be noted that the effectiveness measures used in this research relate to the team's task, thereby further enhancing the relevance of measuring task cohesion. Questions 2,3,8 & 9 (see Appendix A) of section 1 of the questionnaire were based on the work of Carless & de Paola [2000] and were used to measure task cohesion within the team.

The remaining two team cohesion questions measured social cohesion, and were based on the work of Bollen and Hoyle [1990]. Jones & Harrison [1996] used Bollen & Hoyle's questions to measure team cohesion in their empirical assessment of IS project team performance. Carron & Brawley [2000] note that task factors are the major contributors to cohesion in work teams, but they also make mention of the small role that social cohesion plays. Barrick et al [1998] add that social cohesion can represent many team processes. Questions 12 & 13 (see Appendix A) of section 1 of the questionnaire were used to measure an individual's perceived social cohesion.

4.2.3 Team Effectiveness

In recent research into team effectiveness, the work of Hackman [1990] has been widely recognised as one of the key pieces of effectiveness literature [Vinokur-Kaplan, 1995]. The questionnaire sought to assess team effectiveness under all three dimensions identified by Hackman [1990, pg. 6 & 7]: The degree to which the group's output meets the standards of quantity, quality and timeliness of the people who receive or use that output; the degree to which the process of carrying out the work enhances the capability of members to work

together interdependently in the future; and the degree to which the group experience contributes to the growth and personal well-being of team members.

Team effectiveness was measured by assessing the perceptions of team members. Measuring perceived team effectiveness is consistent with the literature pertaining to project team effectiveness, as Cohen & Bailey [1997] report that none of the project team research they reviewed used objective measures of effectiveness.

Some of the questions were adapted directly from Hackman's [1990] work, while others were taken from the instrument used by Campion et al [1993 & 1996] in their study of the relationships between work team characteristics and effectiveness. Some of the assessment methods used by Campion et al [1993 & 1996] could not be utilised, both due to logistical problems (e.g. assessing a manager's judgements of team effectiveness at two separate points in time) and a lack of access to certain information (e.g. performance appraisals for each member). Campion et al [1996] note that measures of team characteristics provided by employees were more predictive of team effectiveness than those provided by managers. The questions used were however still able to comprehensively cover all three of the effectiveness criteria suggested by Hackman [1990].

Questions 5, 6, 10, 11, 14, 15, 16,17, 18, 19, 20, 21, 22 & 23 (see Appendix A) of section 1 of the questionnaire measured the perceived effectiveness of the team. Of these, questions 5, 6, 10, 11, 14, 15, 18, 19, 22 & 23 measured team effectiveness through employee judgements of effectiveness (including outputs). Questions 20 and 21 measured the degree to which the group experience contributed to the growth and well being of team members. The degree to which the capability of team members to work interdependently in the future was enhanced, was measured through questions 16 & 17. The ratio of questions [5:1:1] assigned to each of Hackman's three dimensions (or the weighting of each dimension) was determined in accordance with the guidelines provided by Hackman [1990, pg. 7].

Jones & Harrison [1996] note that self-evaluation of performance has been widely adopted in team related research. They argue that this method is useful in measuring IS project team success, as the examination of the psychometric properties of performance self-appraisals has indicated that self-ratings reduce perceptual errors made by other appraisal sources.

4.2.4 Team Roles

Team roles were assessed using an updated version of the Belbin Team Role Self Perception Inventory (BTRSPI) [Belbin, 1997]. The instrument identifies the team roles fulfilled by each of the respondents within the team. These can then be combined to assess the presence, strengths and balance of the various roles that are present in a particular team.

The methodology used by Belbin to measure team roles through the BTRSPI has been questioned and criticised by numerous authors [e.g. Furnham et al, 1993; Broucek & Randell, 1996]. Much of the criticism is based upon the ipsative nature of the questionnaire. It is considered to be ipsative as Belbin forces respondents to distribute a fixed number of points to sentences that best describe their behaviour. According to Johnson, Wood & Blinkhorn [1988] some of the recognised drawbacks of ipsative tests include:

1) They cannot be used for comparing individual results on a scale-by-scale basis.
2) The results of factor analysis on correlations derived from ipsative scales are questionable.
3) Means, standard deviations and correlations derived from ipsative tests are not independent and cannot be interpreted and treated in the usual way.

Belbin [1993] responds by arguing that the BTRSPI is not a forced choice questionnaire, but rather one based on a restricted choice. He asserts that this distinction allows his methodology to be distanced from the problems associated with ipsative tests. This research uses the BTRSPI in its original form, thus relying on the counter-argument that Belbin used to defend his methodology.

Furnham et al [1993] also question the validity of Belbin's methodology by highlighting problems associated with the psychometric properties of the BTRSPI. Senior [1997] acknowledges the value of examining the psychometric properties of the BTRSPI, but argues that since the instrument is already widely used, anecdotal research that examines the link between team role theory and performance could be more relevant. The extensive application of the BTRSPI in a variety of organisational contexts (including IS teams) also reduces the relevance of examining its derivation, intended applicability, and temporal validity before its link to team effectiveness has been established.

Belbin's team role theory was designed to be applied to management teams [Furnham et al, 1993; Belbin, 1997]. This research is therefore testing its generalisability through its application to IS project teams.

It was decided not to include the Observer's Assessment (OA) component of Belbin's team role theory. In a study of 330 BTRSPI results and over 2500 observer assessments for the same individuals, the results of the BTRSPI were found to have extremely high correlation to the results obtained from the Observer's Assessment component for that same individual [Brink, 2000]. Senior [1997] also noted a degree of agreement between self-perception and observed perception. Broucek & Randell [1996] found that the scales of the BTRSPI and OA displayed significant agreement, but nevertheless conclude that they are not parallel forms.

Had the observer component been included in the questionnaire, the extra workload for the respondents and co-ordinators of the questionnaire's distribution could have had extremely negative implications for the response rate. Had this approach been taken, each team member would have been required to complete at least 2 more sets of team role questionnaires.

Section 5.4.1 provides details of how team role balance, as depicted in the research model (see Figure 3.1) is derived from the team role scores obtained from the BTRSPI.

Section 2 of the survey instrument (Appendix A) comprised the Belbin Team Role Self Perception Inventory.

4.2.5 General Questionnaire Design

Some authors [e.g. Guzzo & Dickson, 1996] have suggested that heterogeneous teams may only become effective once they have worked together over a certain period, while Jones & Harrison [1996] maintain that the priority of the project is linked to the team's performance. Hence, respondents were asked to state the number of months they had been working on the project in which the team was involved, and the number of other projects they had been involved in during that period. These queries allowed for open responses, and were placed at the beginning of section 1 of the questionnaire (Appendix A).

The order of the questions in section 1 was altered from its original sequence to counter possible order effects in the responses.

In section 1, some of the questions were phrased in a negative manner (e.g. Question 3: *I'm unhappy with my team's level of commitment to the task*). This was done to ensure that respondents had to think about their response for each question, and to discourage them from circling the same response for every question. This was aided by adding a description/definition for each of the seven points on the scale of all questions in section 1.

4.3 SAMPLING

4.3.1 The Sample

Seven organisations in the greater Cape Town area were approached to participate in the research. The head of the Department of Information Systems at the University of Cape Town and research supervisor for this research, Professor Derek Smith, suggested the choice of companies. The choice was based on several factors. All companies had large in-house IS departments that were involved in multiple team-based IS development projects, and all were situated in the greater Cape Town area of South Africa.

Three of the larger companies were in the insurance industry, while two were in the retail sector. The two smallest companies in the sample specialised in the development of information systems.

One of the companies in the retail sector declined to accept the invitation to participate in the research, citing staff time constraints as the primary reason. This brought the total number of companies in the sample down to 6. Each of the 6 expressed an interest in the results of research relating to the effectiveness of IS project teams.

The companies' proximity to Cape Town was believed to be crucial as it was felt that, due to the extreme pressure under which many of the IS departments operate, personal meetings would have to be set up to encourage and promote participation. The service provided by the national post office was considered too unreliable to ensure the safe distribution and return of the necessary documents from the researcher to the respondents.

The names of contact people at each company were obtained, and they were contacted via e-mail. This e-mail (see Appendix B) explained the nature of the research, and what was required of the company if they chose to assist. The e-mail was followed up with a phone call to each contact, enquiring whether they were willing to allow IS teams within their company to participate. If the contact agreed, a meeting was set up so that the researcher could explain the final details of the data collection process, and deliver enough copies of the questionnaire to provide for the expected response. It was left to the discretion of the contact person as to how many teams within their company would complete the questionnaire. The importance of receiving responses from all members of participating teams was emphasised both verbally and via e-mail.

It was decided to distribute the questionnaire by hand instead of by mail. The unreliable service offered by the local postal service was the primary reason behind this decision. Web based distribution was ruled out as the response rate was predicted to be low due to lack of personal accountability from team members. If Web based distribution was used, grouping the responses according to teams, without compromising on anonymity, would also have been difficult.

4.3.2 The Sampling Frames

There were two sampling frames from which teams were selected. The outer frame consisted of companies in which IS project teams were operating. The seven companies that were initially selected from this frame were selected for a number of reasons:

- They had large contingents of IS development staff which meant that each could provide data from a significant number of teams. This also meant that the results of the research would be most applicable to companies such as themselves. The research aims to make predictions about team effectiveness based on team member heterogeneity and team role balance. This information would be most meaningful to companies with large pools of IS human resources from which to choose project team members. Companies with fewer IS staff would face greater restrictions when selecting personnel for teams, and would therefore not be able to design teams effectively (presuming some of the hypotheses are proven correct).
- They were all in the greater Cape Town area of South Africa, which meant that the questionnaires could be delivered to the companies by the researcher. This allowed the researcher to personally explain the concepts behind the research, and encourage active participation. It also avoided reliance on the national postal service.
- They all had multiple IS teams working on multiple projects.
- All the IS projects being undertaken by these companies were of a similar nature. They were all software development or maintenance projects aiming to provide software that could support or add business functions within the company, or for an external organisation.
- The companies could provide teams that ranged from highly developed and cohesive units to units similar in nature to traditional work groups. This mix is important when examining the correlates of team effectiveness [Campion et al, 1996].

The sampling frame has the advantage that it provides respondents that are fairly homogeneous with respect to possible intervening variables such as corporate culture, management style, and economic sector [Jones & Harrison, 1996].

The inner sampling frame consisted of IS projects teams within the selected organisations. The sample from this frame was left up to the discretion of the contact person at each organisation, although the instructions attached to the questionnaire (Appendix A) did place some restrictions on the teams that could be selected: '*The team should be working towards the common goal of analysing, planning, developing, maintaining, or adapting an Information System or software product. In order to derive useful information from the data, the team must have been in existence for a period of at least three weeks*'. Samples from this frame were also limited to teams consisting of at least three members. Based on meetings that were held with each contact person, it was ascertained that teams were usually selected due to their hierarchical proximity to the contact and/or because they had no urgent deadlines in close proximity to the period in which the questionnaire was distributed.

Groups within this frame met the criteria stipulated in Guzzo & Dickson's [1996] conceptualisation of teams in that they were: seen by themselves and others as a social entity; they were interdependent because of the tasks they performed as a group; and they were embedded in a larger social system (the company in which they operated). Each team in each organisation could be considered as being significantly different from other teams in the same organisation, as they consisted of different members and were working on unique projects. Thus, in the context of the variables under scrutiny, the correlation between teams within a particular organisation should be no higher than the correlation between teams working in different organisations.

Another sampling frame can also be considered, namely the complete set of personnel who had worked on the project. The sample chosen from this frame was also left to the discretion of the contact person, team leader, or project manager. The team leader (or project manager) had to decide who were core members of the team, as people who had only performed a few minor tasks would not provide valuable data regarding team roles, team cohesion, and team member heterogeneity. Guidelines were provided in the instructions attached to the questionnaire (Appendix A): staff were considered part of the project team if they had devoted '*at least one third of their working time to the project for the duration of the project*'.

4.3.3 Sample Requirements

As mentioned in section 4.1.1, Cohen & Bailey [1997] suggest several characteristics that should be identified in teams when conducting team effectiveness studies. The presence of these ensures that the implications of the results can be fully understood, and that the results

of future research can be compared to the results from the current research. The following characteristics of the sample met these requirements:

- All teams were embedded within organisations that placed a large emphasis on the development of information systems. The organisations were either solely dedicated to this task or had large departments dedicated to it.
- All members of participating teams performed functions purely related to the field of Information Systems. The individual functions of respondents included analysis, programming/developing, testing, code maintenance, architecture, etc.
- All members dedicated at least one third of their working time to the team.
- All teams had some form of leader or project manager who was responsible for the team's task(s). In all cases, this person had to report to somebody further up the IS leadership structure.
- All teams were involved in software development or maintenance projects aiming to provide software that could support or add business functions within the company, or for an external organisation.

4.3.4 Problems with Representativeness

One of the problems with the sample could be potential bias stemming from the contact person in each company. The contact was made aware of the nature of the research, and was thus conscious of the fact that each teams' perceived effectiveness was being measured. This could have lead to the selection of teams that were perceived to be effective in the eyes of the contact person. In the same way, there could also have been bias towards or against teams that were perceived to be heterogeneous and/or balanced in terms of team roles. Thus, the selected teams may not be representative of the teams in that particular organisation.

Some of the organisations have employee equity programs, and some subject their potential IS employees to aptitude and personality tests before they are hired. These practices may imply that the diversity and heterogeneity of responding teams from a particular company may not be representative of IS teams in general.

It is possible that levels of the measured variables are in some way dependent on the stage of the project [Guinan et al, 1998]. Hence, it is reasonable to assume that the results derived from this research may not be applicable to all the phases of the project life cycle.

4.3.5 Ethical Problems

The covering letter attached to each copy of the questionnaire (see Appendix A) made the respondent fully aware of the nature of the research. It guaranteed anonymity and confidentiality, and explained that it was impossible to trace a questionnaire back to an individual respondent. Thus, there was informed consent from each research subject.

This promise did however raise an ethical issue. The researcher only collected the questionnaires once all teams had completed them, and they had been gathered together by the contact person. Project managers, team leaders, or other designated questionnaire distributors had the task of collecting the completed questionnaires from each team member from a particular team. They therefore had the opportunity to open envelopes and examine given answers, with the added possibility that they could have been aware of which team member was responsible for that particular set of answers.

It may be felt that the consent from respondents was in some way enforced, as the request for team members to respond to the questionnaire came either from the project manager, or a more senior member of staff. This raises the issue of whether or not there was in fact self-derived consent from all respondents.

Certain of the contact people at the organisations were acquainted with Professor Derek Smith, the research supervisor. These individuals may have felt obliged to ask teams to respond to the questionnaire due to this acquaintance. This potential problem was taken into consideration, and it was emphasised in all telephone conversations and email correspondence that participation was purely voluntary and organisations were very welcome to decline involvement. The effective communication of this message was borne out by the fact that one of the large organisations that was approached eventually declined the offer to participate.

4.4 METHOD

Questionnaires were sent to 33 teams within 6 organisations. All questionnaires were inserted into sealable envelopes, and delivered to a contact person at each company. It was left to the discretion of the contact person to decide which of the company's IS teams would participate in the research. The envelopes were then passed on to the team leader or project manager of each participating team. They were responsible for deciding who were core members of the team (according to guidelines provided in the covering letter), and for distributing and collecting the answered questionnaires to and from the team members. The team's set of completed questionnaires was then returned to the contact person, from whom they were

collected. The contact person was responsible for ensuring that each team's set of questionnaires was grouped together so that analysis could be done at both the individual and team level.

All responses from four of the teams had to be discarded due to incomplete questionnaire(s) or spoiled answers from one or more of the team's members. It was assumed that incomplete questionnaires could be attributed to work related pressure. Thus, 163 useable responses were obtained, representing 29 teams. This sample size compares favourably with much of the research conducted in the area of team effectiveness. Janz et al [1997] examined 231 members in 27 teams, while Senior [1997] had only 11 teams in her study examining the link between team roles and team performance. In their research into IS team effectiveness, Henderson & Lee obtained a sample of 41 teams [Cohen & Bailey, 1997]. Barrick et al [1998] attribute the lack of research into the link between individual characteristics and team performance to the difficulty of finding samples with an adequate number of teams.

It must be emphasised that the unit of analysis for certain variables is the team. Barrick et al [1998] note that this higher level of analysis is often problematic as there is not an established theoretical approach for proper aggregation of individual characteristics into team-level constructs. Some of the characteristics of the team must be understood in terms of the team as a whole, rather than in terms of individual team members.

A meaningful response rate cannot be derived when using a distribution technique of this nature, as all contact people had agreed to participate before questionnaires were delivered to them.

The average number of people in each team was determined as 5.62, with the largest team consisting of 20 members, and the smallest teams containing only 3 members each.

4.4.1 Role of Observers, Coders, Interpretation

Due to the nature of the research method, observers played no role. This negated potential observer errors that could have arisen (e.g. the consultant effect) when using other methodologies such as those based on interviews or observations. The author performed all coding tasks and the transcription of answers.

4.4.2 Handling Problems with the Method

All respondents were currently working on the project to which the questionnaire applied. Thus, all problems associated with retrospective information retrieval (e.g. recency effect) were not applicable.

One of the problems that could have arisen through the use of questionnaires is that of evaluation apprehension. Respondents could have been motivated to record false details regarding their project team (e.g. inflated team effectiveness responses) if they believed their performance, or that of their team would be evaluated in a business context. This problem was counteracted with a promise of total confidentiality and anonymity, which was conveyed in written form on the covering letter of each questionnaire.

One problem with perfect anonymity and confidentiality is that there is no possible recourse should an individual not complete the questionnaire in an appropriate or useable manner. Thus, if one respondent in a team returned an incomplete questionnaire, it was decided to regard all questionnaires from that team as unusable. As already mentioned, data from 4 teams had to be discarded due to problems of this nature.

A problem with the questionnaire distribution method that was used was that there was no guarantee that all members of participating teams would complete and/or return the questionnaire. The contact people and team leaders/project managers were relied upon to ensure that all team members partook in the research. The necessity for all members of participating teams to complete a questionnaire was emphasised to the contact people, and was also highlighted in the instructions attached to the questionnaire.

4.5 DATA INTEGRITY ISSUES

4.5.1 Recording of Data

All data was transposed from the questionnaires onto an Excel spreadsheet. The answers from section 1 were recorded directly as they were answered (ranging from 1=*strongly disagree* to 7=*strongly agree*), with those answers that were asked in a negative context (questions 3,8, & 9) being converted to the same scale as the other questions. The answers relating to the number of months the respondent had worked on the project and the number of other projects in which he/she was involved were recorded directly onto the spreadsheet. All answers were recorded at an individual level and were also grouped according to teams.

The answers from section 2 (the BTRSPI) were entered into the Interplace IV software package for Windows, which was developed by Belbin and Associates, a UK based company. The software converted the number of points assigned to each sentence of each sub-section of section 2 into team role scores. The software combined the data for each sub-section to produce a team role score in each of the nine possible team roles (see section 2.7) for each respondent. It is important to note that a manual method for converting the answers in the BTRSPI to team roles scores is also provided in the book *Management Teams - Why They Succeed or Fail* [Belbin, 1997].

The *Self Perception Inventory Raw Scores Report* (see Appendix C for an example) was then generated through the Interplace IV software. This report merely grouped the team role scores together according to team, producing both a total and an average for each of the nine team roles in the team. A raw score report for each team was printed, and the total and the average of the team's team role scores were recorded in the Excel spreadsheet mentioned above.

In order to perform statistical analysis on the data, all data was imported into Statistica for Windows [Statsoft, 2000].

4.5.2 Potential Problems with Recording

Most of the potential recording problems arose from the manual transposition of data from the questionnaires to both the Excel spreadsheet and Interplace IV. The potential problem re-occurred when transposing data from the *Self Perception Inventory Raw Scores Report* (produced by Interplace IV) to the spreadsheet.

To minimise the potential of errors occurring during this process, all figures were re-entered into a separate spreadsheet. This spreadsheet was compared to the original spreadsheet to ensure that the figures were consistent. Interplace IV performs automatic data verification to verify that all numbers allocated to items on an individual's completed BTRSPI add up to the original number of dispensable points.

The transfer of data from the spreadsheet to the Statistica package was performed using the import function in Statistica [Statsoft, 2000]. It was therefore assumed that there were no recording errors as far as the Statistica data was concerned.

4.5.3 Data Storage and Maintenance

The original copies of the completed questionnaires are stored in an access-controlled archive at the Department of Information Systems at the University of Cape Town (UCT). The data

files (both spreadsheet and Statistica) are kept on a PC, also in an access-controlled room within the department. Backups were made of the data files, and these were stored by the researcher in a secure external location. This counteracted potential data loss due to physical breaches (e.g. fire or theft). The electronic version of the data was archived on a Compact Disc to ensure that data is not lost due to age or magnetic interference.

Access to the data will only be authorised if permission is granted from both the author and the Department of Information Systems at UCT. Anonymity and confidentiality were guaranteed to all respondents. Data is therefore stored without any reference to its source.

4.6 INSTRUMENT VALIDITY AND RELIABILITY

Straub & Carlson [1989], in their paper on the validation of instruments in MIS research, recommend a three-stage validation process that should be applied to the research instrument before statistical conclusions are drawn:

1. Content Validity: have representative questions been drawn from a wide variety of sources?
2. Construct Validity: do measures show stability across methodologies?
3. Reliability: do measures show stability across the units of observation?

The authors note that increased validation will bring more rigour to IS research efforts, and will promote co-operative research efforts by allowing follow up research to utilise a tested instrument. It will also increase confidence in any findings concluded through the research.

4.6.1 Content Validity

Scott [1994] refers to content validity as a qualitative type of validity that indicates representativeness and sampling adequacy. She emphasises the need for relevant theories, research findings and literature to be examined in order to obtain clear construct definition.

The contents of the questionnaire were assumed to attain a fairly high level of validity as, following the recommendations of Straub & Carlson [1989], all questions were derived from recognised literature and previously validated instruments. Section 4.2 has detailed the sources of, and motivations behind, all questions.

The questions were selected after an extensive literature review, and preference was given to instruments that had been applied in multiple research efforts, and had previously been

validated. When available, preference was also given to literature pertaining specifically to IS team effectiveness. The instrument was also pre-tested, as outlined in section 4.2.

4.6.2 Construct Validity

Straub & Carlson [1989] state that construct validity assesses whether the data gathered through the questionnaire is a reflection of true scores, or if they are an artefact of the kind of instrument chosen. The authors recommend that confirmatory or principal components factor analysis be performed in order to validate the constructs under scrutiny.

Although most measures were adopted from pre-validated instruments, merging these scales may have changed their measurement properties and their validity [Jones & Harrison, 1996].

Hair, Anderson, Tatham & Grablowsky [1979] suggest that factor analysis should only be performed on large sample sizes ($n > 50$) in which the number of observations is four to five times the number of variables (or more). This research meets the first criterion ($n = 163$), and meets the second, with the sample size ($n = 163$) being over sixteen times larger than the final number of variables (10).

Construct validity of section 1 of the questionnaire was measured in two parts. Firstly, factor analysis was performed on each group of items that were purportedly measuring the same construct (team cohesiveness, team member heterogeneity, and team effectiveness). This was done to assess the convergent validity and to determine whether any sub-dimensions existed in each of the three constructs.

Secondly, all 23 ordinal items in section 1 of the instrument were analysed as a group using component factor analysis. This evaluated discriminant validity by ascertaining whether items loaded onto the correct construct, or factor.

Table 4.1 outlines the result of the factor analysis performed on each construct-specific group of questions.

A factor loading score can range between 0 and 1, with 1 representing a perfect loading. Bearing this is mind, most of the items display relatively high factor loadings. When analysing each construct separately, all items for each construct load onto 1 factor, except items 5 (team effectiveness), 3 (team cohesion) & 7 (team member heterogeneity). These factor loadings assume a cut-off level of 0.5 [Straub & Carlson, 1989].

Items 5 (*'I am satisfied with my job'*) and 3 (*'I'm unhappy with my team's level of commitment to the task'*) were dropped from subsequent statistical analysis due to the fact that they didn't load onto their respective factors: team effectiveness and team cohesion. It was apparent that respondents' job satisfaction was not dependent on the effectiveness of the project team in which they were working. Item 3's low factor score could be based on the wording of the item, with the possibility that respondents attempting to answer the questions quickly, mistook the word '*unhappy*' for '*happy*'.

Construct	Item	Loading	Action
Team Effectiveness	5	.489721	Remove
	6	.787581	
	14	.794405	
	15	.817680	
	10	.545537	
	11	.512388	
	18	.580244	
	19	.797989	
	22	.647700	
	23	.836224	
	16	.798037	
	17	.691342	
	20	.650083	
	21	.710091	
Team Cohesion	2	.755548	
	3	.392884	Remove
	8	.634044	
	9	.636200	
	12	.761928	
	13	.835296	
Team Heterogeneity	1	.784780	
	4	.840285	
	7	.399519	Separate

TABLE 4.1 FACTOR ANALYSIS PER CONSTRUCT

The fact that item 7 (*'The members of my team have skills and abilities that complement each other'*) did not load onto the team member heterogeneity construct with the other 2 items is consistent with the findings of Adwani et al [2001], who used the same three items to measure team member heterogeneity. The items were originally used in the instrument developed by Campion et al [1993]. For purposes of subsequent statistical analysis, team member heterogeneity was therefore split into two separate constructs. The first measured team member diversity in terms of areas of expertise, backgrounds, and experiences (items 1 & 4), while the other measured it in terms of skills and abilities (item 7). These constructs will be referred to as '*background heterogeneity*' and '*skill heterogeneity*' in the proceeding text. Due to the frequent referencing of constructs and dimensions of constructs in the subsequent text, all references to these items will appear in *italicised* font.

Table 4.2 portrays the results of the factor analysis of all section 1's constructs. This analysis was performed in order to determine the discriminant validity of the scales. The variable *skill heterogeneity* was not included as it was a single-item scale. Items relating to *team size*, *number of other projects worked on*, and *length of time in team* were also ignored as they were measured with single items [Campion et al, 1996, pg. 437].

Variable	Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Member Heterogeneity	1			.82		
	4			.82		
Team Cohesion	2				.67	
	8					.65
	9					.72
	12	.70				
	13	.73				
Team Effectiveness	6				.69	
	14				.76	
	15				.77	
	19				.77	
	23				.70	
	10		.80			
	11		.87			
	18	.49				
	22	.67				
	16	.68				
	17	.73				
	20	.65				
	21	.71				

TABLE 4.2 FACTOR ANALYSIS OF ALL ITEMS IN SECTION 1

The three constructs loaded onto five factors. The highest loading for each item is shown in the relevant factor column of table 4.2.

Factor 3 clearly represents *background heterogeneity.*

Factor 5 represents *task cohesion* (the extent of motivation towards achieving the team's goals and objectives [Carless & de Paola, 2000]), while *social cohesion* (the motivation to develop and maintain social relationships within the team [Carless & de Paola. 2000]) was represented by Factor 1. Gully, Devine & Whitney [1995] confirm the presence of these two dimensions, and recommend that any examination of the *team cohesion* construct should take both dimensions into consideration.

Factor 4, although loading onto a different factor to the 2 items representing *task cohesion,* was included as a measure of that dimension. This was done as the item was clearly related to the team's tasks (*'Our team is united in trying to reach its performance goals'*), and it demonstrated a high convergent validity when examined in isolation with the other *team cohesion* items. (see Table 4.1)

Factor 1 also appeared to represent *team effectiveness*. This result is not unexpected as the reviewed literature predicted a strong relationship between *team cohesion* and *team effectiveness*.

Factor 2 represents the team's effectiveness through adherence to budgetary and schedule constraints. Because of their low loadings (0.54 & 0.51) onto the team effectiveness construct (see Table 4.1), it was decided to partition the team effectiveness construct into 2 sub-dimensions, *constraints effectiveness* and *general effectiveness*. Although *general effectiveness* loaded onto 2 distinct factors (factors 1 & 4 in Table 4.2), the high convergent validity displayed by the individual items (see Table 4.1) allowed them to be treated as a single construct. Further references to *team effectiveness* will imply a reference to both *constraints effectiveness* and *general effectiveness*.

Section 2 of the questionnaire consisted of the Belbin Team Role Self Perception Inventory (BTRSPI) [Belbin, 1997]. Examining the construct validity of the BTRSPI was considered unnecessary due to two factors. Firstly, the statistical properties of the inventory have already been examined by several authors [e.g. Furnham et al, 1993; Broucek & Randell, 1996; Fisher et al, 1996]. Secondly, it is not the intention of this research to test the properties of the BTRSPI itself. The intention of part of this research is to determine what influence team roles (as measured through the BTRSPI) have on *team effectiveness*. Belbin's theory is one of the most widely applied team role theories in organisations, yet very little anecdotal evidence regarding its influence on team effectiveness exists [Senior, 1997]. The examination of the construct validity and possible subsequent altering of the structure and properties of the BTRSPI would undermine this research's relevance and applicability to the IS industry.

4.6.3 Revision of Hypotheses

The separation of certain of the constructs into sub-dimensions forced a revision of the original hypotheses that were presented in section 3.2. The original constructs that were split into separate dimensions were:

- *Team member heterogeneity* into *background heterogeneity* and *skill heterogeneity*
- *Team effectiveness* into *constraints effectiveness* and *general effectiveness*
- *Team cohesion* into *social cohesion* and *task cohesion*

Figure 3.1, which depicted the original IS team effectiveness model, was revised to reflect the changes in the constructs. Each arrow in Figure 4.1 represents a proposed relationship between constructs, with arrows sourced from, or leading to, constructs with 2 dimensions indicating relationships between each of those dimensions.

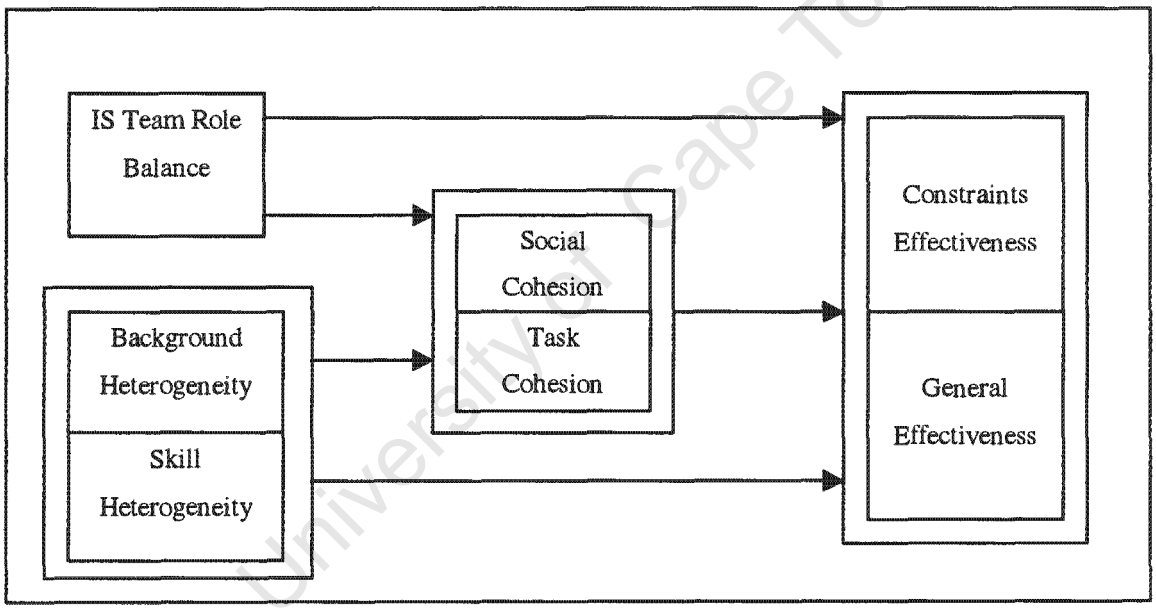

FIGURE 4.1: THE REVISED MODEL OF IS TEAM EFFECTIVENESS

The original hypotheses made predictions about the relationships between these constructs. Subsequently, dividing the constructs into sub-dimensions necessitated the decomposition of certain of the hypotheses. Hypotheses H_1 to H_3 were therefore revised as follows, while Hypothesis H_4 remained unchanged:

> **H_{1a})** *Information Systems project teams with high levels of skill heterogeneity display higher levels of constraints effectiveness than teams consisting of homogeneous members.*

$H_{1\,b}$) *Information Systems project teams with high levels of skill heterogeneity display higher levels of general effectiveness than teams consisting of homogeneous members.*

$H_{1\,c}$) *Information Systems project teams with high levels of background heterogeneity display higher levels of constraints effectiveness than teams consisting of homogeneous members.*

$H_{1\,d}$) *Information Systems project teams with high levels of background heterogeneity display higher levels of general effectiveness than teams consisting of homogeneous members.*

$H_{2\,a}$) *Information Systems project teams that exhibit a balanced set of team roles display higher levels of constraints effectiveness than teams with an unbalanced set of roles.*

$H_{2\,b}$) *Information Systems project teams that exhibit a balanced set of team roles display higher levels of general effectiveness than teams with an unbalanced set of roles.*

$H_{3\,a}$) *Information Systems project teams with high levels of task cohesion display higher levels of constraints effectiveness than teams that demonstrate low levels of task cohesion.*

$H_{3\,b}$) *Information Systems project teams with high levels of task cohesion display higher levels of general effectiveness than teams that demonstrate low levels of task cohesion.*

$H_{3\,c}$) *Information Systems project teams with high levels of social cohesion display higher levels of constraints effectiveness than teams that demonstrate low levels of social cohesion.*

$H_{3\,d}$) *Information Systems project teams with high levels of social cohesion display higher levels of general effectiveness than teams that demonstrate low levels of social cohesion.*

4.6.4 Reliability

Reliability is essentially an evaluation of the extent to which the respondent can answer the same (or approximately the same) questions the same way each time [Straub & Carlson, 1989]. The value obtained from measuring Cronbach's Alpha among each construct is a sign of the reliability of the measures [Scott, 1994]. High Alpha values (close to 1) are a sign of a reliable measure [Straub & Carlson, 1989].

An Alpha value of 0.7 will allow the researcher to assume instrument reliability if the research is testing theory, while a value of over 0.5 is adequate if the research is basic or exploratory [Moore & Benbasat, 1991].

Table 4.3 displays Cronbach's Alpha values for each construct. The values obtained for *background heterogeneity* and *task cohesion* fall below the target reliability of 0.7, although all values are above the 0.5 value and will therefore be regarded as reliable. This meets the specification laid out by Scott [1994] who notes that an Alpha value of 0.5 can be used as a minimum level for acceptable reliability. An Alpha value for *skill heterogeneity* could not be obtained as this dimension was assessed using only one item from the instrument.

Construct	Dimension	Cronbach's Alpha
Team Heterogeneity	Background Heterogeneity	0.59
	Skill Heterogeneity	Single Item
Team Cohesion	Task Cohesion	0.64
	Social Cohesion	0.86
Team Effectiveness	General Effectiveness	0.92
	Constraints Effectiveness	0.83

TABLE 4.3 RELIABILITY MEASURES USING CRONBACH'S ALPHA

4.7 SUMMARY OF METHODOLOGY

A positivistic, quantitative methodology was adopted for this research, while a questionnaire-based data collection technique was found to be most appropriate for research of this nature. A questionnaire, which was based on literature relevant to each of the constructs, was developed and tested. Thirty-three teams within 6 organisations were sampled.

The constructs measured by the questionnaire were proven to be statistically valid once 2 items were removed. Certain constructs were sub-divided as they were shown to represent 2

separate factors. A revision of the original hypotheses was necessary to reflect this sub-division.

Once the questionnaire validity had been determined and the final hypotheses had been formulated, it became necessary to test the revised hypotheses. This required both statistical analysis of the data, and an examination of the resultant statistically motivated relationships that were shown to exist between the constructs under scrutiny. Chapter 5 details this analysis.

5. DATA ANALYSIS AND FINDINGS

This chapter provides details on the various analyses conducted on the data, some of which were performed to test the stated hypotheses. Each analysis is explained, and the results are examined and discussed.

The chapter starts with a description of the data types of the variables under scrutiny. This is followed by a brief description of the methods of statistical analysis that were used. The results obtained from analysing each of the variables are presented. These include an examination of means, distributions, and an analysis of the variances. The implications of these initial results are briefly discussed.

Once the individual variables have been analysed, it becomes possible to examine the relationships that exist between them. This is initially achieved by scrutinising the correlation coefficients that exist between the various variables. The chapter is concluded with a discussion on the implications of the findings for theory, practice, and for the research hypotheses.

5.1 DATA TYPES OF THE VARIABLES

Both dimensions of the dependent variable, namely *team effectiveness*, are ordinal, as are the independent variables of *team cohesion* (task and social) and *team heterogeneity* (background and skill). All the above-mentioned scales were seven-point Likert scales ranging from '1=*strongly disagree*' to '7=*strongly agree*'.

Team size was assessed through the number of questionnaires that were returned from each team. This was assumed to be accurate as the contact person at each company in the sample had agreed to obtain responses from all members of participating teams. The variables measuring the length of time an individual had been in a team and the number of other projects worked on during that period were measured using open-ended single items. The data associated with these variables is of an interval nature.

Table 5.1 displays all the variables under scrutiny, their data types, and the number of items.

Variable		Data Type	Number of Items
Dependent	Team Effectiveness -general	Ordinal	11
	-constraints	Ordinal	2
Independent	Team Cohesion -task	Ordinal	2
	-social	Ordinal	3
	Team Heterogeneity -background	Ordinal	2
	-skill	Ordinal	1
	Team Size	Interval	-
	Length of Time in Team	Interval	1
	Other Projects worked on in period	Interval	1
	Team Role Balance	Ordinal	7*
* Measured using Belbin Team Role Self Perception Inventory (7 Sections, consisting of 70 items)			

TABLE 5.1: DATA TYPES AND FREQUENCY OF ITEMS

5.2 STATISTICAL ANALYSIS METHODS

Statistica, Kernel Release 5.5 [Statsoft, 2000], a statistical analysis package for Windows, was used for the purposes of data analysis.

Descriptive analysis techniques were initially performed in order to obtain a better idea of the nature of the teams and the respondents within the teams. The techniques used included calculating the means, medians and standard deviations of the various variables. Frequency tables were generated to provide an easily comprehensible overview of the data.

A correlation analysis of all the variables was then performed, using the team as the unit of analysis. This allowed for an assessment of the direct relationships between the variables, and gave an indication of which variables needed to be included in further statistical analysis.

Multiple regression techniques were used to assess the proportion of the dependent variables that were explained by the independent variables. The proceeding section, which discusses the theoretical implications of the data, includes a path analysis on the relevant data.

Path analysis is used to assess the direct and indirect effects that certain variables have on each other. It has been widely used in assessing the relationships between variables in research of this nature [e.g. Igbaria et al, 1994; Barrick et al, 1998; Adwani et al, 2001]. Path analysis is a form of regression analysis that is used to decompose total effects on dependent variables into direct and indirect components.

5.3 DESCRIPTIVE DATA ANALYSIS RESULTS

In performing basic analysis techniques on the data, it was necessary to examine the data at both the individual level of analysis (i.e. treat each response independently) and the team level of analysis (i.e. group all responses according to teams). There has been much debate surrounding the statistically appropriate method for performing this task [George & James, 1993].

Rousseau [1985] emphasises the importance of aggregating data to the team level of analysis, labelling team-based conclusions that are derived from individual level data as "*fallacies of the wrong level*". Valuable insights can still however be obtained from performing individual level analysis [Rao & An, 1995].

One of the most widely used methods of grouping the individual data according to teams is to take the mean of each team member's responses for each construct [e.g. Vinokur-Kaplan, 1995; Janz et al, 1997; Guinan et al, 1998]. Guinan et al [1998] argue that this process is justified if responses were obtained from all the team members of participating teams. They do note that the variances of the individual data and team data should be analysed to ensure there is significantly less variation in the intra-team responses. This is consistent with the approach adopted by Janz et al [1997].

Barrick et al [1998] mention 2 additional methods that can be used to aggregate individual characteristics to team level constructs: examining the variation in the members' responses, and identifying the highest or lowest individual trait score for that team. These two methods have not been widely adopted in the team effectiveness literature.

Vinokur-Kaplan [1995] does however warn that the aggregation of individual responses to team responses does reduce the statistical power of analysis due to the decrease in sample size (from 163 to 29 in this case).

The following analysis examines the data at both team and individual levels. Aggregation has taken place by taking the mean values of the individual responses, while the 2 additional methods proposed by Barrick et al [1998] have also been taken into consideration where appropriate.

5.3.1 Team Size

The average team size was 5.62, or 5 to 6 members. The smallest team size was 3, while the largest team consisted of 20 members. A minimum team size of 3 was stipulated in the instructions attached to each copy of the questionnaire. The median team size was 4, signifying the large number of teams consisting of 3 or 4 members. Figure 5.1 denotes the frequency distribution of the team sizes.

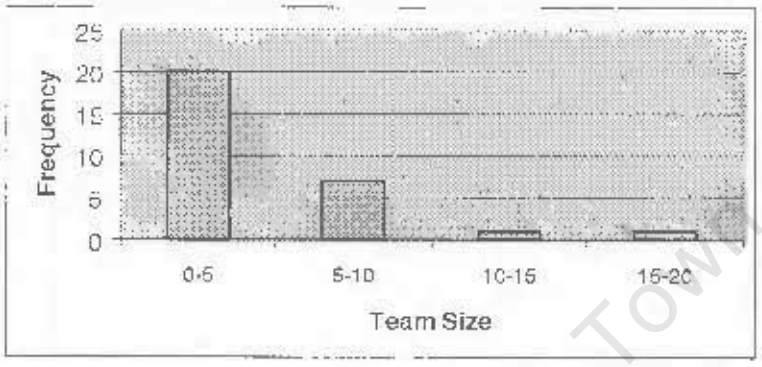

FIGURE 5.1: FREQUENCY OF TEAM SIZES

Figure 5.2 provides a more detailed breakdown of the frequency distribution amongst teams. A clear majority of the teams within the sample consisted of 4 members.

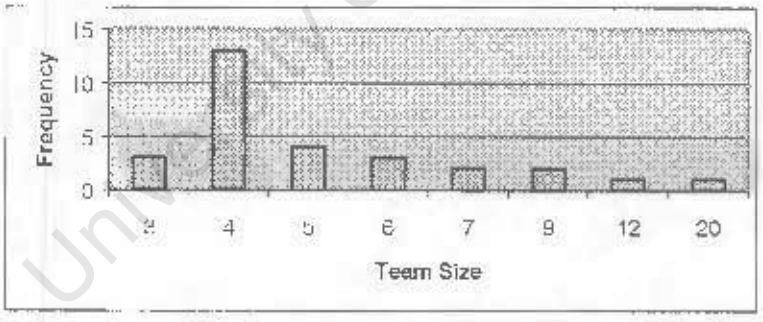

FIGURE 5.2: FREQUENCY OF TEAM SIZES

Cohen & Bailey [1997] suggest that size has a curvilinear relationship to work team effectiveness. Belbin [in Dulewicz, 1995] believes that the optimal team size on this curve is five or six members. This relationship is analysed in sections 5.4.1 & 5.8 of this chapter.

5.3.2 Team Member Roles

Every valid questionnaire that was returned featured a completed BTRSPI, which identified the team role scores (across 9 possible team roles) for each individual. Table 2.5 in Chapter 2

lists the 9 team roles and describes their attributes. Table 5.2 displays the average score recorded for each of the team roles.

Belbin [1997] has created what he terms *'a table of norms'* in which he categorises scores for each of the team roles as low, average, high, or very high. The scores that need to be achieved to be placed into these various categories vary between roles. Belbin [1997, pg. 152] states that these norms were derived from a sample of 78 completed BTRSPI forms from *"a cross-section of managers from various functions and industries"*. It must be noted that these norms were derived from managers and not IS staff, and are designed to be applicable to individual scores, and not necessarily the aggregated scores of a large group. Their relevance to the data in table 5.2 is thus uncertain.

Team Role	Average Score	Category from Table of Norms
Plant	4.44	Average
Resource Investigator	4.99	Low
Co-ordinator	5.18	Low
Shaper	5.99	Low
Monitor Evaluator	6.40	Average
Team Worker	7.47	Low
Completer	8.64	High
Specialist	9.40	N/A
Implementer	10.34	Average

TABLE 5.2: AVERAGE INDIVIDUAL TEAM ROLE SCORES

The highest scoring role in the sample is that of *implementer* (10.34). Belbin [1996] notes that individuals scoring highly in this role are *"disciplined, reliable, conservative and efficient. They are the sort of people that turn ideas into practical actions yet are somewhat inflexible and slow to respond to new possibilities"*.

The sample also produced a high score for the *completer* role, which was the only role that had an average score indicating a *'high'* ranking on the table of norms. The *specialist* role was also well represented. The table of norms does not categorise scores for the *specialist* role as Belbin only added this role to the BTRSPI after the compilation of this table.

The sample suggests that IS project team members fulfil roles that relate to the completion of pre-defined tasks (e.g. *Implementer, Completer, Specialist*) while the creative roles (e.g. *Plant, Resource Investigator, Shaper*) are not as well represented. This finding is consistent with earlier work by Smith [1989] who found that the majority of systems analysts in the IS industry fitted personality profiles that were indicative of a lack of creativity.

Belbin's [1997] theory predicts that a team in which all team roles are strongly represented (i.e. a balanced team) will be high performing. If this theory is shown to be correct, then these statistics suggest the need for an increased representation of the individuals fulfilling these creative roles (e.g. *Plant, Resource Investigator, Shaper*) in the IS industry.

5.3.3 Length of Time in Team

The average period that each respondent had spent in the responding team was 10.5 months, with a minimum value of 1 month, and a maximum value of 48 months. The median value was 6.0 months, indicating that the majority of the individuals had been in their teams for a shorter period than the mean value suggests.

Figure 5.3 displays a frequency distribution for the length of time that individuals had been members of their teams. Over two thirds of IS project team members had only been involved in their project for less than 10 months.

When analysing the standard deviations of this item within teams (see Appendix D), it becomes clear that there is a high within team variance in the length of time that members have been involved in their projects. The average within team standard deviation across all 29 teams is 5.71 months, which indicates that each team member has generally been involved in their project for a significantly different time period to their fellow team members.

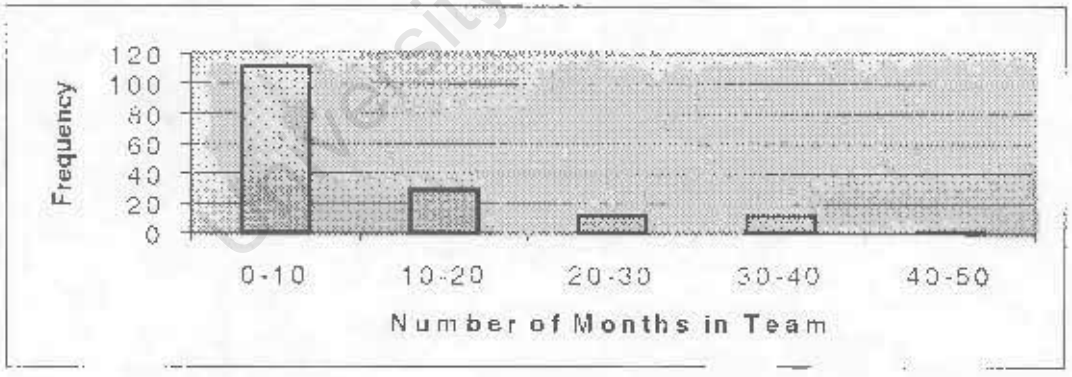

FIGURE 5.3: FREQUENCY DISTRIBUTION OF INVOLVEMENT PERIOD

This could be attributed to the fact that certain team members' membership might be specific to certain project lifecycle stages, implying that the team's profile changes according to project phase. It could also be indicative of the high staff turnover rate in South Africa's IS industry [Igbaria et al, 1994].

5.3.4 Number of Other Projects Worked on During Period

Each respondent worked on an average of 1.77 other IS projects during his/her time as a member of the team under consideration. The values ranged from 0 (i.e. no other projects) to 34 other projects, with a mean of 1.77 and a median of 1. Figure 5.4 displays the frequency distribution of the responses.

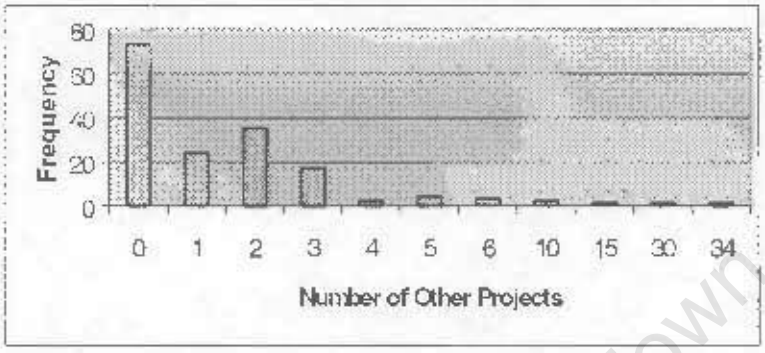

FIGURE 5.4: FREQUENCY DISTRIBUTION OF TASK PRIORITY

The two responses in the last 2 frequency categories (values of 30 & 34) are clearly outliers, although no explanation for these 2 responses could be obtained. Both the individuals responsible for these outliers had been involved with their respective projects for relatively long periods: 12 months and 30 months.

Figure 5.4 demonstrates that IS project team members are generally involved in very few projects simultaneously. Close to half of the sample were not involved in any other projects during the period under consideration. This implies that project managers and/or team leaders prefer team members to place a high priority on a few (or one) project(s), rather than dividing their attention and efforts across multiple projects. Jones & Harrison [1996] suggest that there may be a link between *task priority* and *team effectiveness*. This claim is examined in section 5.4.1.

5.3.5 Team Member Heterogeneity

BACKGROUND HETEROGENEITY

The data revealed that IS personnel come from a wide variety of backgrounds and have a diverse range of experience. At the individual level, the mean score achieved for this dimension of the heterogeneity construct was 5.55. Although the ordinal nature of the items does not allow for a high level of interpretation, it can be noted that this average falls midway between the '*agree to a certain extent*' and '*agree*' items on the Likert scale. The median value was 6.0, indicating that a large part of the sample felt quite strongly that their team

members had a diverse range of expertise, backgrounds, and experience. A standard deviation of 0.96 was recorded, indicating that, among team members at the individual level, there was a fair amount of consensus regarding the levels of *background heterogeneity*.

The distribution of the responses at the individual (n=163) and team (n=29) levels is indicated in Table 5.3. It is interesting to note that less than 3% of respondents felt that the members of their IS Project team were not heterogeneous in terms of this dimension of heterogeneity.

Background Heterogeneity	Frequency – Individual	Frequency – Team
1-2 (strongly disagree) to (disagree)	1 (0.61%)	
2-3 (disagree) to (disagree to certain extent)	3 (1.84%)	
3-4 (disagree to certain extent) to (possibly agree)	14 (8.59%)	
4-5 (possibly agree) to (agree to certain extent)	35 (21.47%)	7 (24.14%)
5-6 (agree to certain extent) to (agree)	78 (47.85%)	16 (55.17%)
6-7 (agree) to (strongly agree)	32 (19.63%)	6 (20.69%)

TABLE 5.3: FREQUENCY DISTRIBUTION OF BACKGROUND HETEROGENEITY RESPONSES

At the team level of analysis (n = 29), the median and mean were calculated as having values of 5.50. This shows that as a unit, all IS project teams in the sample felt that there was a fair degree of *background heterogeneity* amongst members. The standard deviation amongst team responses was 0.54. The third column of Table 5.3 shows the frequency distribution for this construct at the team level.

A one-way Analysis of Variance (ANOVA) of the results (see Appendix D) indicated that average within team standard deviation to the responses for *background heterogeneity* was 0.83. This value implies that there was slightly more agreement on the item within teams than within the sample as a whole. The standard deviation at the individual level was 0.96. The lower within team deviation is one of the prerequisites for aggregating individual responses to the team level [Guinan et al, 1998].

The teams with high *background heterogeneity* means tended to be more consistent in terms of their members' individual responses (i.e. low standard deviations, or more agreement within the team) than those with lower means.

SKILL HETEROGENEITY

The data suggested a high degree of heterogeneity in terms of team member skills and abilities within the IS industry. The mean score achieved for the skill dimension of the

heterogeneity construct was 5.67. Once again, the ordinal nature of the items restricted interpretation. The average falls between the *'agree to a certain extent'* and *'agree'* items on the scale. The median value of 6.0 indicated that the majority of responses were above the mean value. The standard deviation for *skill heterogeneity* at the individual level of analysis was 1.02.

Table 5.4 represents the distributions of the responses at the individual and team levels. The range of responses was greater than for that of *background heterogeneity*, an observation that is reinforced by the higher standard deviation value obtained for this dimension of the construct. It must be emphasised that this difference implies that there was less agreement regarding the levels of *skill heterogeneity*. It does not imply that individuals viewed fellow team members as more heterogeneous in terms of skills than in terms of backgrounds, although the higher mean for the skill dimension does imply this.

The third column of Table 5.4 represents the *skill heterogeneity* responses grouped according to team. No teams showed disagreement with the item, indicating that the 17 individual responses obtained in the scale range of 0-4 (column 2 of Table 5.4) were isolated individuals, whose teams did not agree with their opinions regarding *skill heterogeneity* within the team.

Skill Heterogeneity	Frequency – Individual	Frequency – Team
1 (strongly disagree)	1 (0.61%)	
1-2 (strongly disagree) to (disagree)	2 (1.23%)	
2-3 (disagree) to (disagree to certain extent)	4 (2.45%)	
3-4 (disagree to certain extent) to (possibly agree)	10 (6.13%)	
4-5 (possibly agree) to (agree to certain extent)	32 (19.63%)	5 (17.24%)
5-6 (agree to certain extent) to (agree)	91 (55.83%)	16 (55.17%)
6-7 (agree) to (strongly agree)	23 (14.11%)	8 (27.59%)

TABLE 5.4: FREQUENCY DISTRIBUTION OF SKILL HETEROGENEITY RESPONSES

A one-way ANOVA of the results at the team level (see Appendix D) indicated that the average within team standard deviation to the responses for *skill heterogeneity* was 0.80, once again demonstrating the degree of consensus within teams that is necessary to aggregate results at the team level.

Figure 5.5 shows a comparison of the profiles of the individual responses to the 2 different dimensions of the heterogeneity construct. The response distributions are quite similar, except

at the very top end of the scale where responses to the background dimension tended to be more frequent than those for the skill dimension.

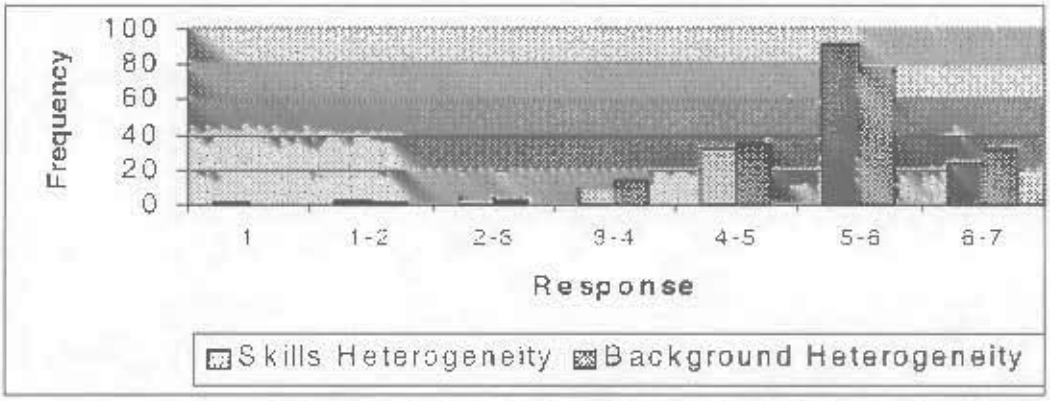

FIGURE 5.5: FREQUENCY DISTRIBUTION OF INDIVIDUAL HETEROGENEITY RESPONSES

If, as Campion et al [1996] have suggested, there is a link between *team member heterogeneity* and *team effectiveness*, then these relatively high heterogeneity results should have a positive impact on the effectiveness of the sampled teams.

5.3.6 Team Cohesion

TASK COHESION

The recorded levels of *task cohesion* were not as high as those of the 2 heterogeneity dimensions, although the ordinal measurement technique makes direct comparisons difficult. The mean value for *task cohesion* at the individual level was 5.2, with an observed median value of 5.33. The standard deviation amongst individual responses was 1.04.

Task Cohesion	Frequency – Individual	Frequency – Team
1-2 (strongly disagree) to (disagree)	3 (1.84%)	
2-3 (disagree) to (disagree to certain extent)	4 (2.45%)	
3-4 (disagree to certain extent) to (possibly agree)	21 (12.88%)	1 (3.44%)
4-5 (possibly agree) to (agree to certain extent)	42 (25.77%)	10 (34.48%)
5-6 (agree to certain extent) to (agree)	69 (42.33%)	14 (48.27%)
6-7 (agree) to (strongly agree)	24 (14.72%)	4 (13.79%)

TABLE 5.5: FREQUENCY DISTRIBUTION OF TASK COHESION RESPONSES

At the team level of analysis, the mean value obtained for cohesion derived from tasks was 5.31, while the median value was 5.42. Standard deviation was measured as 0.72. The large difference in the deviations at the team and individual levels indicates a large degree of agreement amongst team members regarding their task cohesiveness. The correlation between each team's mean response and the standard deviation amongst their members' responses was

significant, even at the 0.1% level (i.e. members whose teams demonstrated high levels of *task cohesion* showed a high degree of agreement in their responses). Similarly, significant correlation was also found between each team's mean response for this item and the standard deviation of the responses within each team for *skill heterogeneity* and *constraints effectiveness*. This demonstrates that teams showing high levels of task cohesion also show high levels of agreement amongst team members.

SOCIAL COHESION

High levels of *social cohesion* were apparent from the received responses. At the individual level the mean score for this dimension was 5.47, with a median value of 5.5 and a standard deviation of 0.94.

Once aggregated to the team level, the data revealed a mean of 5.53, and a standard deviation of 0.75. Once again the lower standard deviation at the team level (0.75 vs. 0.94) implies within team agreement and allows aggregation to the team level [Guinan et al, 1998]. The higher mean displayed at the team level of analysis suggests that smaller teams tend to be more socially cohesive than larger teams. This notion will be further investigated later in this chapter.

Social Cohesion	Frequency – Individual	Frequency – Team
2-3 (disagree) to (disagree to certain extent)	5 (3.07%)	
3-4 (disagree to certain extent) to (possibly agree)	14 (8.59%)	
4-5 (possibly agree) to (agree to certain extent)	38 (23.31%)	5 (17.24%)
5-6 (agree to certain extent) to (agree)	83 (50.92%)	19 (65.52%)
6-7 (agree) to (strongly agree)	23 (14.11%)	5 (17.24%)

TABLE 5.6: FREQUENCY DISTRIBUTION OF SOCIAL COHESION RESPONSES

As with *task cohesion*, the correlation between each team's mean response and the standard deviation amongst their members' responses to this construct and others was significant, this time at the 5% level. This suggests that socially cohesive teams demonstrate a slight tendency to show agreement among team members, although this pattern is not evident across as many constructs as it is for *task cohesion*.

Figure 5.6 shows a comparison of the profiles of the individual responses to the 2 different dimensions of the *team cohesion* construct. Respondents tended to show more disagreement to the notion that their teams were task cohesive than socially cohesive. This is confirmed by the higher individual mean achieved by *social cohesion*.

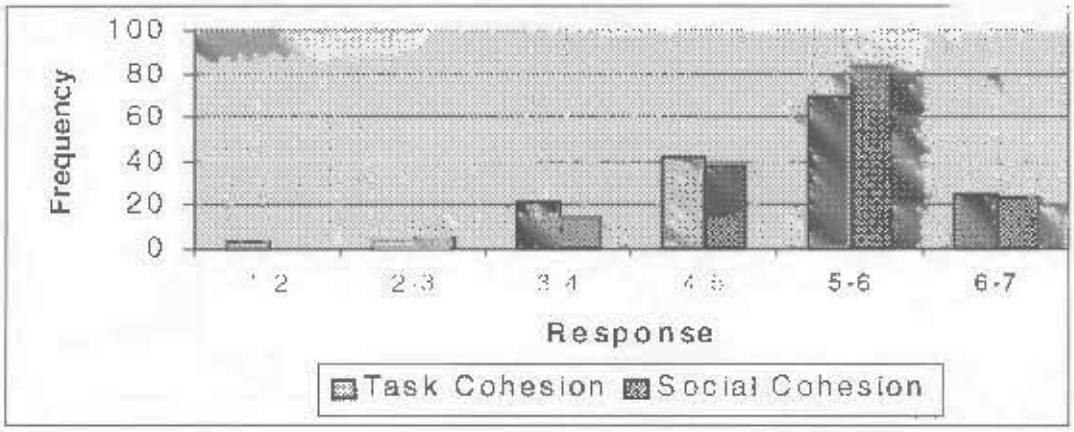

FIGURE 5.6: FREQUENCY DISTRIBUTION OF INDIVIDUAL COHESION RESPONSES

5.3.7 Team Effectiveness

GENERAL EFFECTIVENESS

The general perception amongst team members appeared to be that their project teams were fairly effective, with an individual mean score of 5.31 being obtained. The median value calculated from individual responses was 5.45, with a standard deviation of 0.88.

Table 5.7 displays the frequencies of the both the individual and team responses. Although over 30% of respondents provided a *general effectiveness* score of below 5, only 13% of the team responses fell into these categories. This indicates that members who gave extremely low scores on *general effectiveness* were often in disagreement with their fellow team members.

General Effectiveness	Frequency – Individual	Frequency – Team
1-2 (strongly disagree) to (disagree)	1 (0.61%)	
2-3 (disagree) to (disagree to certain extent)	1 (0.61%)	
3-4 (disagree to certain extent) to (possibly agree)	16 (9.82%)	2 (6.90%)
4-5 (possibly agree) to (agree to certain extent)	33 (20.25%)	2 (6.90%)
5-6 (agree to certain extent) to (agree)	83 (50.92%)	24 (82.75%)
6-7 (agree) to (strongly agree)	29 (17.79%)	1 (3.45%)

TABLE 5.7: FREQUENCY DISTRIBUTION OF GENERAL EFFECTIVENESS RESPONSES

At the team level of analysis, the mean score for *general effectiveness* was 5.34, with a standard deviation of 0.65. This standard deviation was the lowest amongst all the constructs measured at a team level, and, despite the findings in the previous paragraph, indicates a high degree of agreement within teams regarding their team's effectiveness. It also suggests that the *general effectiveness* measure is extremely reliable.

CONSTRAINTS EFFECTIVENESS

It would appear that IS project *team effectiveness* is relatively poor in terms of adhering to budgets and time constraints. Of all the constructs measured on the Likert Scale, *constraints effectiveness* achieved the lowest mean: 5.02. This confirms the findings of Guinan et al [1998] who state that many IS projects run over the schedule and budgetary constraints.

The large difference between the mean and median values (5.02 vs. 5.5) indicates that half the respondents did provide a constraints score of 5.5 or higher, but those that provided lower scores generally provided significantly lower scores. The standard deviation amongst individual level responses was 1.44, which was the highest deviation recorded for the constructs measured on the Likert Scale. This shows that the projects included in the sample varied greatly in terms of their adherence to their budgets and schedules.

At the team level, the mean *constraints effectiveness* score was 4.96 – again the lowest of the constructs measured on the same scale. The standard deviation was 0.87, indicating a fairly high degree of agreement within teams.

The difference between the team and individual level standard deviations was the highest amongst the constructs, implying that the effectiveness of IS project teams (in terms of adherence to budget and schedule) varied greatly between the teams.

Constraints Effectiveness	Frequency – Individual	Frequency – Team
1-2 (strongly disagree) to (disagree)	10 (6.13%)	
2-3 (disagree) to (disagree to certain extent)	13 (7.98%)	2 (6.90%)
3-4 (disagree to certain extent) to (possibly agree)	17 (10.43%)	4 (13.80%)
4-5 (possibly agree) to (agree to certain extent)	40 (24.54%)	10 (34.50%)
5-6 (agree to certain extent) to (agree)	62 (38.04%)	7 (24.14%)
6-7 (agree) to (strongly agree)	21 (12.88%)	6 (20.69%)

TABLE 5.8: FREQUENCY DISTRIBUTION OF CONSTRAINTS EFFECTIVENESS RESPONSES

Figure 5.7 shows a comparison of the profiles of the individual responses to the 2 different dimensions of the *effectiveness* construct. The lower scores given to the constraints dimension can clearly be seen, with very few individuals stating that their teams were ineffective in terms of *general effectiveness*.

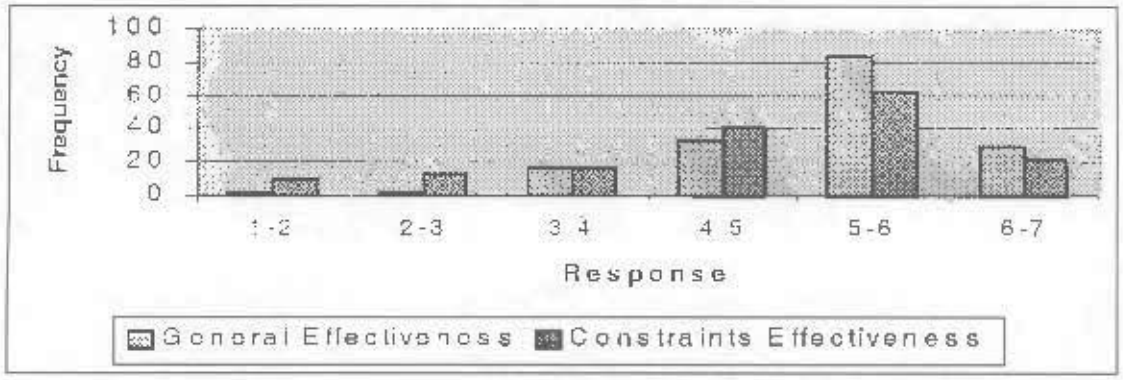

FIGURE 5.7: FREQUENCY DISTRIBUTION OF INDIVIDUAL EFFECTIVENESS RESPONSES

5.4 ANALYSIS OF RELATIONSHIPS BETWEEN VARIABLES

The standard Pearson correlation co-efficient is used to measure the relationship between two variables. It is only appropriate if both variables are at least of the interval scale: i.e. they are either of the interval or ratio scales [van den Honert, 1997]. Non-parametric methods are required to scrutinise relationships between variables of the ordinal scale. The Pearson correlation coefficient also assumes that the populations from which both variables are drawn are normally distributed.

Since the majority of variables were of the ordinal scale and the population distributions were uncertain, it was decided to use non-parametric techniques to examine the relationships between the variables. Van den Honert [1997] does warn that, given similar sample sizes and significance levels, non-parametric techniques may yield lower correlation coefficients than their equivalent parametric counterparts.

Van den Honert [1997] recommends the Spearman rank correlation test to replace the Pearson method for non-parametric variables. This method ranks each result for both sets of variables and then calculates the Pearson correlation coefficient for the two sets of rankings.

Table 5.9 shows the results of a Spearman rank correlation test run between all sets of variables. All data was aggregated to the team level of analysis using the method stipulated by Vinokur-Kaplan [1995], Guinan et al [1998] and Janz et al [1997] and described in section 5.3. Marked correlations (*) are significant at the 5% level. Unless otherwise stated, all further references to '*significant*' correlation coefficients will imply a significance level of 5%. It is important to note that not all the relationships that were significant at the 5% level were significant at the 1% level.

	Team Size	Length in Team	No of Other Projects	Back-ground Heterogeneity	Skill Heterogeneity	Task Cohesion	Social Cohesion	General Effectiveness	Constraints Effectiveness	Team Role Balance
Team Size	1									
Length in Team	-0.01	1								
No of Other Projects	0.01	0.17	1							
Background Heterogeneity	0.17	0.04	-0.06	1						
Skill Heterogeneity	0.03	-0.26	0.20	0.04	1					
Task Cohesion	-0.31*	-0.17	0.25	-0.03	0.52*	1				
Social Cohesion	-0.01	-0.18	0.15	-0.06	0.43*	0.57*	1			
General Effectiveness	-0.03	-0.12	0.37*	-0.11	0.54*	0.77*	0.73*	1		
Constraints Effectiveness	0.15	-0.18	0.20	-0.21	0.46*	0.34*	0.53*	0.51*	1	
Team Role Balance	0.09	0.17	0.24	-0.15	0.08	0.29	0.11	0.33*	0.22	1

TABLE 5.9: CORRELATION COEFFICIENTS BETWEEN ALL MEASURED VARIABLES
* = 95% LEVEL OF SIGNIFICANCE

5.4.1 Relationship Between Independent Variables and Effectiveness

This section will explore the relationships between all the independent variables and the two dimensions of the *effectiveness* construct. Where appropriate, findings will be contrasted to those from other relevant research.

In order to examine the relationship between *team role balance* and *team effectiveness*, it was necessary to derive a method for calculating the *team role balance* within each team. This was done in accordance with the work of Senior [1997], who examined the variation of each team's team role scores. Thus, the variance amongst the 9 average team role scores in each team was calculated (see Appendix E). In isolation, these values would represent team role diversity (or imbalance) rather than *team role balance*. The variance in each team's role scores was therefore ranked in reverse order so that the rankings would reflect *team role*

balance and not the variation between team role scores. The rankings were then correlated to the other variables using the Spearman method.

Belbin's team role theory allows one to assume that teams with a low variation in their average team role scores have all roles well represented. This assumption can be made as the BTRSPI, on which the role scores are based, only allows respondents to distribute a fixed number of points between roles. Thus, if one team role is over-represented, it implies that another is inadequately represented.

EFFECTIVENESS VS. TEAM SIZE

There was almost no apparent correlation between the size of teams and *general effectiveness*, while there was an insignificant correlation between *size* and *constraints effectiveness*. This is consistent with the findings of Campion et al [1996] who reported an insignificant correlation between *size* and *effectiveness* in their sample. Guzzo & Dickson [1996] and Campion et al [1993] reported findings that suggested that larger teams were more effective than their smaller counterparts, although these findings were not derived from teams of knowledge workers, so their applicability to IS development teams is questionable.

Belbin [in Fisher & Hunter, 1998 & Dulewicz, 1995] suggests that the optimal *team size* is 5 or 6 members. The concept of an optimal *team size* is supported by Cohen & Bailey [1997] who hypothesise that *team size* has a curvilinear relationship with *effectiveness*. This suggestion was tested using another non-parametric technique, the Mann-Whitney Test. The test is used to test if two population means are the same [van den Honert, 1997]. The teams were divided into 2 populations: '*optimal*' (team size of 5 or 6) and '*non-optimal*' (all other team sizes). The test was used to test for significant differences in both *general* and *constraints effectiveness* across the 2 populations. The test results (see Appendix F) showed that the two population means were not significantly different across either of the effectiveness dimensions. Another Mann-Whitney Test was performed, this time using the criteria of '*small*' (size less than 6) and '*large*' (team size of 6 or more). Again there was no significant difference between the effectiveness means across the 2 populations.

This data therefore does not support the notion of a curvilinear relationship between *team size* and *team effectiveness*. Nor does it support the suggestion that teams of 5 or 6 members are more likely to be effective than smaller or larger teams.

EFFECTIVENESS VS. LENGTH OF TIME IN TEAM

The correlation between the average length of time that members had been in a team and both *general* and *constraints effectiveness* was insignificant. The relationship did nevertheless tend towards the negative side, implying that teams that had been together for shorter periods of time viewed themselves as more effective than longer standing teams. This could also imply that teams with newer projects tend to be more positive about their team's effectiveness and constraints performance. However, because of the insignificant correlation coefficients, these potential patterns cannot be confirmed with any certainty.

Examining the correlation between the within team standard deviations of the *length of membership* (see Appendix D) and the *effectiveness* dimensions did not reveal any significant coefficients. This signifies that there was no difference in effectiveness between teams whose members had been with the team for a range of different periods, and those teams whose members had been with the team for similar lengths of time.

EFFECTIVENESS VS. TASK PRIORITY

The number of other projects on which team members worked during their term in the team under scrutiny was used as a proxy for measuring *task priority*. Although not a completely accurate reflection of *task priority*, the measure acts as a rough indication of the priority each member placed on the project.

Surprisingly, there was significant correlation between the number of other projects worked on, and *general effectiveness* (0.37). This suggests a negative relationship between *task priority* and *general effectiveness*: i.e. teams whose members worked on numerous projects simultaneously judged themselves to be more effective than those teams whose members worked on fewer simultaneous projects. The correlation coefficient between *task priority* and *constraints effectiveness* (0.20) was also positive, but was not significant.

This finding is in contrast to the hypothesis proposed by Jones & Harrison [1996], who predicted that tasks with perceived high priority would increase perceived IS project team performance. Although their data did not support their hypothesis, it did not suggest a negative relationship between the two constructs either.

EFFECTIVENESS VS. BACKGROUND HETEROGENEITY

There was no significance in the correlation between *background heterogeneity* and either of the dimensions of *team effectiveness*. The correlation coefficients were slightly negative, indicating a tendency for teams whose members have similar areas of expertise, backgrounds

and experience to be more effective than their heterogeneous counterparts. This trend cannot be substantiated due to the insignificant correlation coefficients (-0.11 for *general effectiveness* and –0.21 for *constraints effectiveness*).

Although similar research has been conducted using a variety of teams, the impact of experience spread on a team's performance has not been examined in the field of IS [Guinan et al, 1998].

Of the research examining non-IS teams, Campion et al [1996] only found significant correlation between heterogeneity and one of six effectiveness criteria, although they note that some authors recommend heterogeneity as it can increase the range of competencies in the group.

EFFECTIVENESS VS. SKILL HETEROGENEITY

The Spearman rank correlation coefficient for *general effectiveness* and *skill heterogeneity* was 0.54, while the value for *constraints effectiveness* and *skill heterogeneity* was 0.46. Both these values are significant, even at the 1% level. This suggests that individuals with a diverse range of skills and abilities form more effective teams than individuals who possess a homogeneous set of these attributes.

This is consistent with the findings of Bowers [2000], who established that heterogeneous teams performed better than homogeneous teams for high-difficulty tasks. It must be noted that his definition of heterogeneity only shared one component (ability level) with *skill heterogeneity* as operationalised in this research.

Verma [1997] explains the reasoning behind this relationship, stating that projects have dramatically increased in complexity, requiring individuals with a diverse mix of skills and functional specialities.

The recorded correlation shows that teams with a high degree of *skill heterogeneity* view themselves as effective units, and perform well in terms of meeting budgetary requirements and delivering products timeously.

EFFECTIVENESS VS. TASK COHESION

A significant correlation was found between *task cohesion* (the extent of motivation towards achieving the team's goals and objectives [Carless & de Paola, 2000]) and *general effectiveness* (0.77), and between *task cohesion* and *constraints effectiveness* (0.34).

The correlations show that *task cohesion* has a far stronger relationship with *general effectiveness* than with *constraints effectiveness*, although both relationships are significant. This suggests that *task cohesion* has a positive relationship with all three of the major project variables (quality, cost, and time [McLeod & Smith, 1996]), with an emphasis on the quality component. It also suggests that the construct has a positive influence on Hackman's [1990] two remaining dimensions of effectiveness: the degree to which the project work enhances the capabilities of members to work together interdependently in the future, and the degree to which the group experience contributes to the growth and personal well-being of team members.

Cohen & Bailey [1997] note that team members tend to rate the team's performance highly if the team is engaged in healthy internal processes. This may explain the higher correlation between the construct (an internal process) and *general effectiveness*, which is a more subjective measurement of effectiveness than *constraints effectiveness*.

EFFECTIVENESS VS. SOCIAL COHESION

The Spearman rank correlation coefficient for *general effectiveness* and *social cohesion* (the motivation to develop and maintain social relationships within the team [Carless & de Paola. 2000]) was 0.73, while the value for *constraints effectiveness* and *social cohesion* was 0.53. These values are similar to the values obtained for the equivalent correlations using *task cohesion*, except that the correlation with *constraints effectiveness* is higher in this case.

It seems therefore, that *social cohesion* has a strong influence on the effectiveness of the team in terms of meeting budgets and meeting deadlines. Although the influence is strong, as is the case with *task cohesion*, the influence on *general effectiveness* is even stronger.

As was the case with *task cohesion*, the higher levels of subjectivity permissible when answering the *general effectiveness* questions may have been the driving factor behind the correlation being more significant than that of *constraints effectiveness*. High levels of internal processes, such as *team cohesion*, lend themselves to higher perceptions of performance [Cohen & Bailey, 1997].

These findings are in slight disagreement with the findings of Carless & de Paola [2000], who cite evidence that indicates that *task cohesion* is more closely related to work performance than *social cohesion*. The discrepancy may be due to the fairly subjective nature of the effectiveness measures used in this research. Teams whose members are socially cohesive

may be inclined to feel that their team is effective merely because they have strong relationships with other team members.

The high correlations between *team effectiveness* and *team cohesion* (both task and social) provide support for the team effectiveness models proposed by Cohen & Bailey [1997], Guinan et al [1998], Gladstein [1984], Barrick et al [1998] and Campion et al [1996] (see Table 2.3). These models state that team processes (*team cohesion*) have a positive impact on outputs (*effectiveness*). Other authors who have found a similar relationship between *team effectiveness* and *team cohesion* include Vinokur-Kaplan [1995] & Guzzo & Dickson [1996].

EFFECTIVENESS VS. TEAM ROLE BALANCE

Team role balance correlated significantly with *general effectiveness*, achieving a correlation coefficient of 0.33. The correlation of the same construct with *constraints effectiveness* was 0.22, which was not significant at the 5% level, but which nevertheless indicates that there might be a positive relationship between the two variables.

These findings are in agreement with those of Senior [1997], who reported some support for Belbin's team role theory by finding an association between *team role balance* and team performance. This research also responds to Senior's [1997] call for the team role theory to be tested on a larger sample (her sample only included 11 teams).

The support that this data provides for Belbin's team role theory is in contrast to the findings of Broucek & Randell [1996]. They contend that Belbin's team role theory is supported by anecdotal evidence alone, and that no statistical data supports it. Furthermore, they claim that little support has been given to the theory in other academic literature.

Despite these claims, these findings support Belbin's team role theory in the context of IS project teams. Not only does this data provide anecdotal support for the presence of the team roles stipulated by Belbin [1997], but it also verifies his claim that teams possessing a balanced set of team roles are likely to be highly effective.

5.4.2 Significant Relationships Between Independent Variables

TASK COHESION VS. TEAM SIZE

There was a significant negative correlation between these 2 variables, with the coefficient being calculated as –0.31. This suggests that smaller teams are more successful at motivating themselves towards achieving the team's goals and objectives.

This makes intuitive sense, as smaller teams have a greater ability to communicate goals and objectives to one another due to the lower number of interactions in the team [Fried, 1991]. It is also easier for project managers to convey collective performance goals to smaller teams, and to convey how each team member's tasks contribute to the project as a whole.

TASK COHESION VS. SKILL HETEROGENEITY

Significant correlation was found between *task cohesion* and *skill heterogeneity*, with the coefficient of 0.52 being significant even at the 0.5% level. This correlation shows that teams within the sample that were heterogeneous in terms of skills and abilities demonstrated a high level of combined motivation towards achieving their goals and objectives.

This relationship could be attributable to the fact that team members are more likely to see the contribution that their work is making to the team if their skills and abilities are different to those of other members. Furthermore, team members should be able to appreciate the work being performed by their fellow members if it is being executed using skills and abilities that they themselves do not possess. These two factors should enhance the team's cohesiveness in terms of achieving their goals and objectives.

SOCIAL COHESION VS. SKILL HETEROGENEITY

The social dimension of the *team cohesion* construct also demonstrated a significant positive relationship with *skill heterogeneity*, this time at the 1% level. Teams with a diverse range of skills and abilities showed significantly more motivation to develop and maintain social relationships within the team.

The reason behind this relationship may be similar to the hypothesised reasons behind the relationship between *task cohesion* and *skill heterogeneity*: the differences in skills and abilities within the team encourage members to recognise the positive attributes of one another, thereby increasing the desire to develop intra-team social relations.

SOCIAL COHESION VS. TASK COHESION

As expected, there was a significant positive relationship between the two dimensions of the *team cohesion* construct. The relationship was significant at the 0.5% level, and is an indication of the fact that the two measures were originally attempting to measure the same construct along one dimension.

5.5 COMBINED EFFECTS: INDEPENDENT VARIABLES ON DEPENDENT VARIABLES

Multiple regression analysis was performed for both dimensions of the dependent variable: *general effectiveness* and *constraints effectiveness*. Multiple regression is an extension of simple linear regression and is used when two or more explanatory variables are to be taken into consideration [van den Honert, 1997]. Multiple regression analysis is designed to be used with parametric data, but Emory [1985] argues that it is common to find the method being applied where, under strict interpretations, only non-parametric tests should be used.

Firstly, an analysis was run against all independent variables using *general effectiveness* as the dependent variable (see Appendix G). This produced an adjusted R-square value of 0.64. This indicates that the independent variables explain approximately 64% of the variation in *general effectiveness* (significant at the 0.5 % level). The adjusted R-square value is based on the standard R-square value, which is then adjusted to take into consideration the number of explanatory variables in the model [van den Honert, 1997].

Secondly, the same analysis was performed, except *constraints effectiveness* was used as the dependent variable (see Appendix G). The analysis produced an R-square value of 0.40, indicating that approximately 40% of the variation of *constraints effectiveness* can be explained by the independent variables. The model is significant at the 2.5% level.

The multiple regression analyses that were performed give a rough indication of the overall effect that all the independent variables have on the dependent variables. However, because the method applied grouped all independent variables together, and ignored any mediating effects that may have been present, these figures merely serve as a rough approximation of the total effects. For the same reason, beta values (or regression coefficients) obtained from the regression (see Appendix G) were not a true reflection of the relationships between the variables. The following section includes details on statistical methods used to take mediating effects into account.

5.6 IMPLICATIONS OF FINDINGS FOR TEAM EFFECTIVENESS THEORY

In order to verify the relationships represented in the research model derived in Chapter 3, and compare the results to other recognised models from the literature, it was necessary to perform path analysis on the observed relationships.

Everitt & Dunn [1991] question the relevance of structural models, arguing that they do not provide any direct test of causal relationships. Rather, they describe the investigator's belief about the causal structure of a set of variables. They assert that the only way to demonstrate causality would be through the active control of variables. Despite this criticism, path analysis is a method that is widely used for identifying direct and indirect effects in models that include a mediating variable [Duncan, 1985].

Everitt & Dunn's [1991] recommendation that causality should be demonstrated through the active control of variables implies the use of controlled experiments. Cohen & Bailey [1997] have questioned the use of such methods in research of this nature, as they ignore important organisational features external to the team.

Multiple regression techniques were used to analyse the proposed model. The analysis was performed merely to ascertain if there were mediation effects between the variables. The direct and indirect effects of the independent variables on the dependent variables were measured, although, due to the above-mentioned criticism, the actual values should be treated with caution.

Independent variables that did not show correlation with the process variables (*task cohesion and social cohesion*) and the output variables (*constraints effectiveness and general effectiveness*) were excluded from the analysis. Thus, *team size*, *length of time in team*, and *task priority* were not included. Similarly, *background heterogeneity*, which was included as part of the *heterogeneity* construct in the original model (see Chapter 3), was excluded. This is in accordance with the suggestions of Baron & Kenny [1986]. Furthermore, according to their guidelines, *skill heterogeneity* and *team role balance* should relate to both *team cohesion* (task and social dimensions) and *team effectiveness*. These relationships were all present (Table 5.9), although it must be noted that the relationship between *team role balance* and *constraints effectiveness* was not significant, even at the 10% level.

Following the path analysis technique used by Igbaria et al [1994], Barrick et al [1998] and Adwani et al [2001], *general effectiveness* was first regressed on *skill heterogeneity and team role balance*, and then regressed on *skill heterogeneity*, *team role balance*, *social cohesion* and *task cohesion*. The same method was used for *constraints effectiveness*.

Table 5.10 shows the direct, indirect, and total effects of the independent variables on the dependent variables. The beta value of the variable when it first enters the regression analysis

indicates the total effect on the dependent variable, while the value obtained once all variables have been added indicates the direct effect of the variable [Igbaria et al, 1994]. The indirect effect of the variable is reflected in the difference between the total effect and the direct effect.

Because path analysis was performed in order to discover the presence of mediation effects (rather than the extent of the effects), a 10% significance level was adopted. This ensured that the presence of possible mediating effects was not overlooked due to rigid statistical constraints that are designed to quantify relationships.

	Task Cohes.	Social Cohes.	General Effectiveness			Constraints Effectiveness		
	Direct	Direct	Direct	Indir.	Total	Direct	Indir.	Total
Skill Heterogeneity	0.53*	0.46*	0.21	0.32	0.53*	0.30*	0.14	0.44*
Team Role Balance	0.22	0.13	0.19*	0.11	0.30*	0.15	0.01	0.16
Task Cohesion			0.23	0	0.23	-0.27	0	-0.27
Social Cohesion			0.46*	0	0.46*	0.62*	0	0.62*
R-square	0.37	0.25	0.71			0.46		
All marked values (*) are significant, at least at the 10% level								

TABLE 5.10: MULTIPLE REGRESSION SUMMARY

The relationships between the inputs (*skill heterogeneity* and *team role balance*) and the outputs (*constraints effectiveness* and *general effectiveness*) become weaker when processes (*task cohesion* and *social cohesion*) are entered into the model. This is indicated by the differences in the values presented in the 'Total' columns and those presented in the corresponding 'Direct' columns.

These findings show support for the mediation hypothesis (H_4), as it is clear that *social cohesion* mediates the effects that the input of *skill heterogeneity* has on the outputs.

Duncan [1985] suggests that the total effects ('Total' columns in Table 5.10) of the exogenous variables (*skill heterogeneity* and *team role balance*) should be compared to the original correlations (Table 5.9) to test the accuracy of the model. These figures show only minor discrepancies, and it can therefore be assumed that the model is a fairly accurate representation of the observed data.

The final effectiveness model is depicted in figure 5.8, with path-coefficients indicated by the labels on each arrow. The R-square values indicate that the model explains approximately 71% of the variation in *general effectiveness*, while approximately 46% of the variation in *constraints effectiveness* is explained. The model shows that the following significant (at the 10% level) relationships become apparent once interaction effects have been taken into consideration: *skill heterogeneity* was found to be a significant predictor of *constraints effectiveness*, *social cohesion*, and *task cohesion*; *team role balance* is a significant predictor of *general effectiveness*; *social cohesion* is a significant predictor of both *general effectiveness* and *constraints effectiveness*.

A discussion on the relevance and implications of each of the path coefficients is incorporated in section 5.8, which details the practical implications of the research findings.

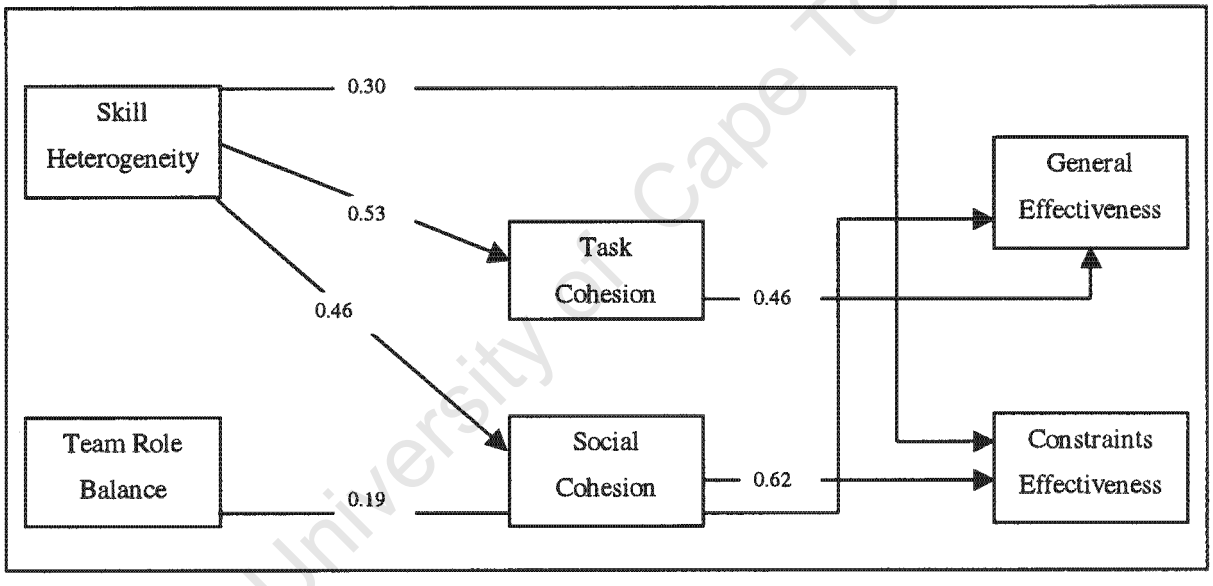

FIGURE 5.8: FINAL PATH COEFFICIENTS:
A GRAPHICAL REPRESENTATION OF THE SIGNIFICANT EFFECTS IN TABLE 5.10

The link between *task cohesion* and each of the *effectiveness* dimensions was not significant in the path analysis. This is despite the high correlation between *task cohesion* and the dependent variables (see Table 5.9). This apparent contradiction can be explained by the high correlation between *task cohesion* and *social cohesion* (see Table 5.9), which indicates that the 2 dimensions are in fact similar measures. Because of this close association, much of the relationship between *task cohesion* and *team effectiveness* is explained by the regression of the *effectiveness* dimensions on *social cohesion*.

The data clearly shows support for the input-process-output model of *team effectiveness* cited by, Gladstein [1984], Cohen & Bailey [1997], Barrick et al [1998], and Guinan et al [1998]. Bowers [2000] maintains that this model is widely supported in the literature. This research also indicates that the model is applicable to IS project teams.

Inputs have been shown to have both direct and indirect effects on *team effectiveness*, with processes (measured using *social cohesion* and *task cohesion*) mediating the effects of certain inputs on the outputs. The model does however suggest that some inputs or design factors can have a direct influence on *team effectiveness* without being mediated by processes. This appears to be the case with the relationship between *team role balance* and *general effectiveness*.

The model derived in this research supports the adaptation of the input-process-output model that is proposed by Cohen & Bailey [1997]. Their model depicts design factors (inputs) having both direct and indirect (via group processes) effects on outcomes. The older, more widely adopted model appears to be invalid in the context of IS project teams. This is due to the fact that it does not demonstrate the direct effects between inputs and outputs. This research has indicated that the direct effects are in fact present.

5.7 IMPLICATIONS OF FINDINGS FOR THE RESEARCH HYPOTHESES

The results of the hypotheses presented in section 3.2 and revised in section 4.6.3 are:

$H_{1\,a}$) *Information Systems project teams with high levels of skill heterogeneity display higher levels of constraints effectiveness than teams consisting of homogeneous members.*

> This hypothesis was supported. IS project teams that were heterogeneous in terms of skills and abilities showed a greater ability to work effectively in terms of budgetary and time constraints.

$H_{1\,b}$) *Information Systems project teams with high levels of skill heterogeneity display higher levels of general effectiveness than teams consisting of homogeneous members.*

This hypothesis was supported. IS project teams that were heterogeneous in terms of skills and abilities showed higher levels of *general effectiveness* than their homogeneous counterparts.

$H_{1\,c}$) *Information Systems project teams with high levels of background heterogeneity display higher levels of constraints effectiveness than teams consisting of homogeneous members.*

This hypothesis was not supported.

$H_{1\,d}$) *Information Systems project teams with high levels of background heterogeneity display higher levels of general effectiveness than teams consisting of homogeneous members.*

This hypothesis was not supported.

$H_{2\,a}$) *Information Systems project teams that exhibit a balanced set of team roles display higher levels of constraints effectiveness than teams with an unbalanced set of roles.*

This hypothesis was not supported.

$H_{2\,b}$) *Information Systems project teams that exhibit a balanced set of team roles display higher levels of general effectiveness than teams with an unbalanced set of roles.*

This hypothesis was supported. Those IS project teams that did display a balanced set of team roles showed higher levels of *general effectiveness* than those teams with an unbalanced set of roles

$H_{3\,a}$) *Information Systems project teams with high levels of task cohesion display higher levels of constraints effectiveness than teams that demonstrate low levels of task cohesion.*

This hypothesis was supported. Those teams that demonstrated a high level of cohesion that was centred on the team's tasks tended to be effective in terms of the team's budgetary and time constraints.

$H_{3\,b}$) *Information Systems project teams with high levels of task cohesion display higher levels of general effectiveness than teams that demonstrate low levels of task cohesion.*

This hypothesis was supported. Those teams that demonstrated a high level of cohesion that was centred on the team's tasks reported high levels of *general effectiveness*.

$H_{3\ c}$) *Information Systems project teams with high levels of social cohesion display higher levels of constraints effectiveness than teams that demonstrate low levels of social cohesion.*

This hypothesis was supported. Those teams that demonstrated high levels of *social cohesion* tended to be effective in terms of the team's budgetary and time constraints.

$H_{3\ d}$) *Information Systems project teams with high levels of social cohesion display higher levels of general effectiveness than teams that demonstrate low levels of social cohesion.*

This hypothesis was supported. Those teams that demonstrated high levels of *social cohesion* reported high levels of *general effectiveness*.

H_4) *Team processes mediate the relationships between team inputs and team outputs.*

This hypothesis was supported by the mediating role that *social cohesion* played in the relationship between *skill heterogeneity* and both *general effectiveness* and *constraints effectiveness*. Neither of the dimensions of the *cohesion* construct played a role in the relationship between *team role balance* and *general effectiveness*, indicating that the hypothesis is not upheld for all team inputs.

5.8 IMPLICATION OF FINDINGS FOR PRACTICE

Two team composition variables have emerged as having an important influence on the effectiveness of Information Systems project teams. These are *skill heterogeneity* and *team role balance*. The former is a measure of the diversity of team members in terms of their skills and abilities, while the latter refers to a team's ability to field members who, as a group, represent all natural team roles at reasonably high and balanced levels.

The other constructs under consideration varied in the nature and magnitude of their impact on IS project *team effectiveness*. *Skill heterogeneity* was found to be highly correlated to both effectiveness measures. This finding has extremely practical implications for the formation and composition of IS project teams. To maximise the effectiveness of IS project teams, the data suggests that project managers should form teams consisting of individuals who vary in

their skills and who have abilities that complement each other. The need for varying skills and abilities within IS project teams is easily explained when one considers the complex nature of most projects [Verma, 1997]. Without complementary skills and abilities, it is unlikely that team members would be able to fulfil all the specialised requirements of IS projects. *Skill heterogeneity* impacts on IS *team effectiveness* directly, and also indirectly by increasing the *cohesion* amongst team members.

The data from this research indicates that an IS team's composition in terms of members' backgrounds, areas of expertise and experience (*background heterogeneity*) has no significant impact on the team's *effectiveness*. The implications are that teams comprising a set of individuals with similar experience are no more likely to be effective than teams composed of members with a diverse range of experience. In the same way, the range of backgrounds and areas of expertise within teams seems to have little influence on the team's *effectiveness*. The correlation between the *background heterogeneity* data and the *effectiveness* data was slightly negative, but not significant enough to suggest that teams with homogeneous backgrounds, areas of expertise, and experience were more effective.

There was no significant link between IS project *team size* and *team effectiveness*, although smaller teams were significantly more cohesive than larger teams with regards to the team's tasks and goals. These findings should discourage project managers from adding additional human resources to teams to try and improve the team's effectiveness. Although there appear to be no detrimental effects as a result of increasing a team's size, there are no apparent associations between *size* and *general effectiveness*, nor between *team size* and *effectiveness* in terms of the project's budget and schedule. Some authors have in fact found an inverse relationship between *team size* and *effectiveness* for technically complex projects [Fried, 1991]. Campion et al [1996] add that teams perceived to be too large for their task are less effective than smaller teams.

Bearing in mind that each additional team member adds skills and abilities to the team, it may seem logical that larger teams would be more effective than teams comprising fewer members. This logic is denounced by Fried [1991], who argues that as the number of IS project team members increase, so do the possible number of interactions between team members. The frequency of communications between members depends on the number of these interactions. Smaller IS project teams (up to 10 members) consume 10% to 30% of their time on task-orientated communication, while extremely large teams may reach an upper limit of 90% [Fried, 1991].

The data suggests that neither the average length of time nor the variation in length of time that team members have worked in a team has any influence on the team's effectiveness. This implies that adding new team members or replacing team members might have little impact on a team's perceptions of their effectiveness. Consequently, the indications are that the effects of the high staff turnover rates in the IS industry that have been reported by Igbaria et al [1994] may not be that detrimental to *team effectiveness*. The findings also add credibility to Verma's [1997] suggestion that project managers need to change the project team by adding or removing team members to suit the phases in the project lifecycle.

Teams whose members worked on numerous projects simultaneously judged themselves to be more effective than those teams whose members worked on fewer simultaneous projects. Thus, there appears to be no harm in assigning IS human resources to multiple projects, as the priority they place on each of the tasks seems to have no effect on their perception of their team's effectiveness.

Task cohesion (the extent of motivation towards achieving the team's goals and objectives) was positively related to IS *team effectiveness*. This finding stresses the value of project managers emphasising collective performance, team goals, and team objectives to all team members. It also suggests that identifying and stating how each member's work contributes to the team's goals is an important factor in creating an effective team. Emphasising the role and importance that the complete information system will/does play in its operational environment should also contribute towards increasing the levels of *task cohesion* within the team. *Task cohesion* can be improved by creating teams that combine individuals with heterogeneous skills and abilities.

The close link between *social cohesion* (the motivation to develop and maintain social relationships within the team) and *team effectiveness* suggests that team-building exercises may be of great value to Information Systems project teams. Building team 'spirit' should lead to higher levels of *social cohesion*, which, as has been demonstrated, increases the chance that a team will be effective. *Social cohesion* can also be improved by creating teams that combine individuals that possess a diverse range of skills and abilities.

The significant relationship between *team role balance* and *team effectiveness* has important implications for both practice and theory in the field of Information Systems. In order to be effective, teams should consist of members whose team roles complement each other in such a manner that, at the team level, all team roles are evenly represented. This should provide the

team with the full range of natural psychometric traits that are necessary to perform complex tasks such as the analysis, design, implementation, and/or maintenance of an information system.

When forming an IS project team, there appears to be significant value in first determining the natural team roles of all the potential members of the team. This will allow the project manager or team leader to select team members whose team role scores combine to form a team-level role profile that represents all team roles as evenly as possible. Obviously the potential members should have the required technical skills, as the fulfilment of required team roles is of little value if they do not possess the mandatory skills to operate within those roles.

When analysing the team role scores of all individual respondents, it became clear that the creative team roles are not as well represented as the roles associated with the completion of predefined tasks. The implication of this, combined with the demonstrated advantages of having a team with a balanced set of team roles, is that IS project managers should place more emphasis on people who naturally fulfil creative roles when they are selecting IS project team members.

One further possible implication of this research is that Information Systems projects have budgets and schedules that are often unrealistic. This is manifested in the large majority of responses that indicated *general effectiveness* scores that were considerably higher than the corresponding *constraints effectiveness* scores. IS project teams have the perception that they are working effectively, yet these '*effective*' team efforts are not producing products within the required time period or budget.

6. CONCLUSION

6.1 CONCLUDING REMARKS

The Information Systems industry is characterised by the high proportion of projects that either deliver products that do not meet specified requirements, or do not produce useable systems at all. Since the technology and skills required to complete these projects are assessed during the requirements definition stage of the Information Systems project, it can be assumed that projects will only commence if these initial requirements can be satisfied. DeMarco & Lister [1999] have noted that of all the failed IS projects they have witnessed, there has not been a single technological issue to explain the failures.

Thus, the focal point of these project failures has moved away from the technological issues, towards sociological issues. DeMarco & Lister [1999] have argued that the eventual success of IS projects depends on management's skill at selecting team members.

This research has therefore examined issues that, through the literature, have been highlighted as having a possible influence on the effectiveness of Information Systems project teams. The impact of these issues on IS team effectiveness has been observed, thereby affording IS project managers some insight as to which issues need to be considered when selecting team members.

Skill heterogeneity and *team role balance* were found to be very influential in determining the effectiveness of IS project teams. A project manager wishing to select team members that are likely to form an effective team should therefore select people who are competent in terms of the project's technical requirements, and are diverse in terms of their skills and abilities. The members should also fulfil natural team roles that combine to give the team a team role profile that is balanced i.e. all team roles should be well represented. *Skill heterogeneity* improved *team effectiveness* both directly and indirectly. The indirect improvement was facilitated through the increased levels of *team cohesion* (both *task cohesion* and *social cohesion*) that were shown to be present in teams with high *skill heterogeneity*.

Background heterogeneity did not influence *team effectiveness* significantly. The implications of this are that project managers need pay less regard to the areas of expertise, backgrounds, and experience of potential team members, as this research was unable to confirm these as important team composition variables.

Despite the perceptions that a team's size will have an impact on its effectiveness, there was no evidence to support any significant relationship between these two variables. There was also no evidence to support the notion that stable teams, or teams whose members had been affiliated to the team for a long period of time, are more effective than teams with less stable membership, or shorter affiliations.

A team effectiveness model was established that confirms that inputs or team composition variables can have both a direct and indirect effect on outputs or *team effectiveness*. The indirect effects were manifested through the mediating role that *social cohesion* played in the relationships between inputs and outputs. *Cohesion* was used a summary measure for team processes, which include communication, conflict and supportiveness.

These findings are based on data gathered from companies with significant involvement in Information Systems development, all of which had multiple IS teams working on multiple projects. All companies were situated in Cape Town, South Africa. The findings in this research are not necessarily applicable to companies with smaller IS contingents, mainly due to the fact that they do not usually have a wide range of choices when selecting members for IS project teams. There are no apparent reasons to suggest that this research is not applicable to similar organisations in other countries.

This research has added substance to the comments of DeMarco & Lister [1999], who state: "*Your skill at selecting new team members will determine to a large extent your eventual success*". It has been shown that those skilled at selecting IS team members with the correct mix of skills and team roles will increase the effectiveness of their IS project teams. More effective teams lead to greater levels of project success, and ultimately greater customer satisfaction and financial reward.

6.2 LIMITATIONS OF THIS RESEARCH

This research suffers under many of the limitations associated with survey-based quantitative research. The sample in terms of teams was relatively small (n=29), despite the individual responses numbering 163. The sample size limited the statistical techniques that could be applied to the data, and also undermined the reliability of the results of analyses that were performed.

Non-parametric statistical techniques had to be adopted as most of the variables were of the ordinal scale. Given similar sample sizes and significance levels, non-parametric techniques

often yield lower correlation coefficients than their equivalent parametric counterparts [van den Honert, 1997]. This, combined with the reduction in the statistical power of analysis when aggregating individual responses to team responses [Vinokur-Kaplan 1995], increased the chances of committing Type II errors. These are errors that occur when relationships that do exist in the data are not exposed during statistical analysis. This also enforced the interpretation of certain results at the 10% level of significance, whereas the 5% level is usually accepted as standard [Underhill, 1987].

The questionnaire distribution method that was adopted prevented the calculation of a meaningful response rate. Thus, comparison with response rates achieved in other research of this nature was not possible.

Another limitation was the assumption that all team members of participating IS project teams received and returned questionnaires. This assumption was based on a request of this nature to, and commitment from, contact people at each of the six organisations used in the survey. The validation of this assumption was not possible.

Due to the difficulties in finding a large number of IS project teams, the moderating effects of the following could not be reliably determined.

1. Project type (e.g. maintenance, new development)
2. Task type predominating within project (e.g. decision-making, design, idea generation, or communication)
3. Project phase (e.g. early, middle, or late)

The study is also limited by the fact that the findings are not applicable to all organisations in which IS project teams are utilised. The applicability of a large portion of the findings is limited to organisations that have a pool of IS human resources from which to choose IS project team members. If such a pool of resources is not available, then many of the explicit and implied recommendations cannot be adopted without the need for the employment of new IS staff.

A possible limitation of this research was the use of *team cohesion* as a summary variable for team processes. Although *cohesion* was shown to be linked to the majority of process variables that appear in the literature, it could not be used to demonstrate relationships between specific processes and both input and output variables.

The factors examined in this research are by no means the only factors that can influence *team effectiveness*. Numerous other input variables have been identified in the literature. However, attempting to isolate the influence that each of these has on *team effectiveness* would be impractical when examining relationships at the level undertaken in this research.

6.3 AREAS FOR FUTURE RESEARCH

Gorla [1989] stresses the importance of identifying areas for future research in order to guide research efforts and accumulate a single body of knowledge.

Because of the well defined systems development life cycle stages within IS projects, team membership might be specific to certain project lifecycle stages. This implies that a team's profile changes according to project phase. Future research could examine the model developed in this research in the context of specific stages of the systems development lifecycle.

Team role theory particularly would benefit from research that was specific to the stages of the IS project. The early stages of IS projects are more likely to require members who fulfil creative or idea generative roles, while the latter stages could be better suited to individuals who are task driven and who fulfil roles related to completing tasks. Research efforts could also look at other team role theories apart from Belbin's [1997], and see if they are applicable to Information Systems project teams.

The results of this research have suggested that IS team members who work on multiple projects simultaneously tend to have higher perceptions of their team's effectiveness than those who are assigned to only one project. The reasons for this are unclear, and these results contradict the work of Jones & Harrison [1996] who suggested that *task priority* is positively associated with IS *team effectiveness*. Future research could examine this relationship more closely, and develop an accurate measure for *task priority*.

Team role balance was found to have a positive effect on *general effectiveness*, although the path analysis revealed that this relationship did not manifest itself through *team cohesion*. Future research could try to ascertain how the combination of team roles within an IS project team influences *general effectiveness*. Process variables such as communication and conflict could be taken into consideration.

The model developed in this research indicates a strong relationship between *skill heterogeneity* and both *team cohesion* (task and social dimensions) and *team effectiveness*. This research adopted a fairly limited definition of *skill heterogeneity*. To make the research more applicable to IS practitioners, future research could apply more specific dimensions or definitions to *skill heterogeneity*, for example by determining the specific skills and abilities that respondents possess.

Previous research that has examined the impact of *background heterogeneity* on *team effectiveness* has produced mixed results. This research found no evidence of a significant link between the two constructs. It is recommended that future research examine this relationship more closely as the increasing global movement of knowledge workers will ensure that this issue will be one of the key issues facing Information Systems management in the future. It is also recommended that future researchers consider the effects that *background heterogeneity* has on the effectiveness of virtual teams, or teams in which members have limited physical contact.

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APPENDIX A: SURVEY INSTRUMENT

UNIVERSITY OF CAPE TOWN

Department of Information Systems

Leslie Commerce Building
Engineering Mall · Upper Campus
OR Private Bag · Rondebosch 7701
Tel: 650 2261
Tel. Add.: ALUMNI, Cape Town
Fax No: (021) 650-2280

RE: Research for Master of Commerce Dissertation

28th September 2000

Dear Team Member

I am currently studying towards a Master of Commerce degree in Information Systems (IS) at the University of Cape Town. As part of the degree I am researching the viability of creating effective IS project teams based on the diversity of skills, backgrounds, and team roles of the individuals that could potentially be included in an IS project team.

I am seeking your help in providing data for my analysis. My research requires that I gather data from currently operational IS project teams. I am focussing on the IS departments of 5 major companies in the Cape Town area. From the data I shall ascertain if there is any difference in perceived team effectiveness between those IS project teams that display a wide variety of the above mentioned characteristics, and those that don't.

The data needs to be gathered from all permanent members of IS project teams which consist of three or more permanent members. Permanent members are those members who devote at least one third of their working time to the project for the duration of the project. The team should be working towards the common goal of analysing, planning, developing, maintaining, or adapting an information system or software product. In order to derive useful information from the data, the team must have been in existence for a period of at least 3 weeks.

I ask that you please complete the attached questionnaire, which should take no longer than 15 minutes to complete. All returned questionnaires will remain anonymous and will be treated with the strictest confidence. The data gathered from the research will be used purely for academic purposes, and after having been analysed, will be archived with only restricted access being allowed.

If you have any questions, please do not hesitate to contact me on 083 3440907 (email: wkrlio001@mail.uct.ac.za), or my dissertation supervisor, Prof. Derek Smith, Head of Department of Information Systems, University of Cape Town (phone (021) 6502261; email: dsmith@commerce.uct.ac.za).

Thank you for your time.

Lionel Waker

Derek Smith

INSTRUCTIONS FOR QUESTIONNAIRE:

- The questionnaire has 2 sections:
    - Section 1 measures the diversity of skills, backgrounds and experiences within the group, the team's perceived effectiveness, and the cohesion amongst team members.
    - Section 2 is designed to measure the natural team roles of the team members. Please read the instructions of this section carefully, as the method of answering is not as straight forward as the first section.

- Please complete **all** questions in both **sections**. If you are not sure about the answer to a question please still answer it to the best of your ability. E.g. if you are unsure if your project is running according to budget just give an answer based on your assumptions. Unanswered questions could render the whole team's data as unusable.

- Every permanent member of the project team (see cover letter for definition of permanent) is requested to complete a separate copy of the questionnaire. It is vital that all members contribute, as the results need to give a true reflection of the team's diversity and effectiveness.

- In cases where you may be working on multiple projects or in large project teams which can be broken down into sub-teams, please ensure that you are answering in the context of the correct team / sub-team.

- Once you have completed the questionnaire, the completed sheets can be returned to your project leader/manager, sealed in the envelope that has been provided.

- Please complete the questionnaire by Friday October 6th. Once all members have returned their sealed envelopes, the completed questionnaires will be collected from the project leader/manager

All responses will be kept confidential, and can in no way be traced back to the respondent. Questionnaires are numbered purely for the sake of associating the responses from members of the same team. The instrument used in Section 2 has kindly been provided by Dawie Gouws Associates, a Cape Town based consulting firm specialising in team work. They shall have no special privileges with regard to accessing the data, nor shall they be given any information regarding the source(s) of data.

Thank You

Section 1

Please enter the following information:

Number of months you (personally) have been working on the project in which the team is involved: _____

The number of other projects (if any) you have been heavily involved in during the above-mentioned period: _____

Please respond to the following statements by circling the appropriate response:

1 = strongly disagree
2 = disagree
3 = disagree to a certain extent
4 = possibly agree
5 = agree to a certain extent
6 = agree
7 = strongly agree

1. The members of my team vary widely in their areas of expertise

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

2. Our team is united in trying to reach its performance goals

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

3. I'm unhappy with my team's level of commitment to the task

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

4. The members of my team have a variety of different backgrounds and experiences

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

5. I am satisfied with my job

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

6. I am satisfied with the quality of work completed by my team thus far

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

7. The members of my team have skills and abilities that compliment each other

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

8. Our team members have conflicting aspirations about the team's performance

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

9. This team does not give me enough opportunities to improve my personal performance

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

10. The project is being completed according to schedule

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

11. The project is being completed according to budget

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

12. I feel a sense of belonging to this team

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

13. I am enthusiastic about working with this team

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

14. I feel that we are providing good service to our customer / end user

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

15. The team has a high level of productivity

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

16. I would like to work in this team on other projects in the future

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

17. My team's current project will/has enhance(d) the potential of this team to work effectively on future projects

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

18. The team is providing innovative products or services

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

19. The team responds quickly to problems or opportunities

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

20. My confidence and social skills have improved from my interactions with my team

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

21. Working in this team has lead to the growth and personal well being of team members

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

22. Team members are satisfied with their jobs

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

23. The overall performance of the team is good

1	2	3	4	5	6	7
strongly disagree	disagree	disagree to certain extent	possibly agree	agree to certain extent	agree	strongly agree

Belbin Associates

Section 2

Dawie Gouws Associates
Dawie Gouws-Genote

The Role of Team Heterogeneity and Team Role Diversity in Creating Effective Information Systems Project Teams

THE BELBIN SELF-PERCEPTION INVENTORY

BELBIN SE SELFPERSEPSIE-VRAELYS

DIRECTIONS

In each section please distribute 10 points among the statements which you think most accurately describe your behaviour. First tick off the statements in a section that do apply to you and then distribute the 10 points among these so that statements which are more descriptive of your behaviour get more points. The 10 points may therefore be distributed among several sentences. In EXTREME cases you may even allocate all 10 points to a single sentence, or 1 point to each of the 10 sentences.

AANWYSINGS

In elke afdeling moet u asseblief 10 punte verdeel tussen dié stellings wat, volgens u mening, u gedrag die beste beskryf. Merk eers die stellings in 'n afdeling wat wel op u van toepassing is en verdeel dan die 10 punte tussen hulle sodat die stellings wat meer beskrywend van u gedrag is meer punte kry. U kan die 10 punte dus tussen 'n aantal stellings verdeel. In UITSONDERLIKE gevalle kan u selfs al 10 punte aan een stelling toeken, of een punt aan elk van die 10 stellings.

PLEASE READ SECTION HEADING BEFORE ANSWERING EACH SECTION

SECTION I: WHAT I BELIEVE I CAN CONTRIBUTE TO A TEAM:

AFDELING I: WAT EK DINK EK TOT 'N SPAN KAN BYDRA:

ITEM NO		Allocated Points	ITEMNR	
10.	I think I can quickly see and take advantage of new opportunities.	10	10.	Ek kan nuwe geleenthede gou raaksien en benut.
11.	My comments on both general and specific points are well received.	11	11.	My kommentaar op sowel algemene as spesifieke punte word goed ontvang.
12.	I can work well with a very wide range of people.	12	12.	Ek kan goed met 'n groot verskeidenheid van mense saamwerk.
13.	Producing ideas is one of my natural assets.	13	13.	Die uitdink van idees is een van my natuurlike bates.
14.	My ability rests in being able to draw people out whenever I detect they have something of value to contribute to group objectives.	14	14.	Ek het die vermoë om ander mense aan die praat te kry sodra ek agterkom dat hulle iets nuttigs tot die groep-doelwitte kan bydra.
15.	I can be relied upon to finish any task I undertake.	15	15.	Daar kan op my gereken word om enige taak wat ek aanpak af te handel.
16.	My technical knowledge and experience is usually my major asset.	16	16.	My tegniese kennis en ervaring is gewoonlik my grootste bate.
17.	I am prepared to be blunt and outspoken in the cause of making the right things happen.	17	17.	Ek is bereid om reguit en uitgesproke te wees om die regte dinge te laat gebeur.
18.	I can usually tell whether a plan or idea will fit a particular situation.	18	18.	Ek kan gewoonlik sê of 'n plan of idee by 'n spesifieke situasie sal inpas.
19.	I can offer a reasoned and unbiased case for alternative courses of action.	19	19.	Ek kan 'n beredeneerde en onbevooroordeelde saak uitmaak vir alternatiewe maniere van optrede.
		10		

SECTION II: IF I HAVE A POSSIBLE SHORTCOMING IN TEAM WORK, IT COULD BE THAT:

AFDELING II: AS EK 'N MOONTLIKE BEPERKING HET WANNEER DIT BY SPANWERK KOM, KAN DIT WEES DAT:

ITEM NO		Allocated Points	ITEMNR	
20.	I am not at ease unless meetings are well structured and controlled and generally well conducted.	20	20.	Ek ongemaklik voel as vergaderings nie goed gestruktureer, gekontroleer en gelei word nie.
21.	I am inclined to be too generous towards others who have a valid viewpoint that has not been given a proper airing.	21	21.	Ek neig om te tegemoetkomend te wees teenoor ander spanlede wat 'n geldige siening het wat nog nie behoorlik gestel is nie.
22.	I am reluctant to contribute unless the subject deals with an area I know well.	22	22.	Ek huiwerig is om insette te lewer tensy dit gaan oor 'n gebied wat ek goed ken.
23.	I have a tendency to talk a lot once the group gets on to a new topic.	23	23.	Ek neig om baie te praat sodra die groep 'n nuwe onderwerp aanpak.
24.	I am inclined to undervalue the importance of my own contributions.	24	24.	Ek geneig is om die waarde van my eie bydraes te onderskat.
25.	My objective outlook makes it difficult for me to join in readily and enthusiastically with colleagues.	25	25.	My objektiewe benadering dit vir my moeilik maak om gemaklik en entoesiasties saam met my kollegas betrokke te raak.
26.	I am sometimes seen as forceful and authoritarian when dealing with important issues.	26	26.	Ek soms as kragdadig en outoritêr beskou word wanneer belangrike aangeleenthede ter sprake kom.
27.	I find it difficult to lead from the front, perhaps because I am over-responsive to group atmosphere.	27	27.	Ek dit moeilik vind om sterk leiding te neem omdat ek miskien oorgevoelig is vir die groep-atmosfeer.
28.	I am apt to get too caught up in ideas that occur to me and so lose track of what is happening.	28	28.	Ek neig om só verdiep te raak in idees wat by my opkom dat ek die draad van die gesprek verloor.
29.	I am reluctant to express my opinions on proposals or plans that are incomplete or insufficiently detailed.	29	29.	Ek huiwerig is om my opinie te lug oor voorstelle of planne wat nog onvoltooid is of te vaag en algemeen gestel is.
		10		

SECTION III: WHEN INVOLVED IN A PROJECT WITH OTHER PEOPLE:

AFDELING III: AS EK SAAM MET ANDER MENSE BY 'N PROJEK BETROKKE IS:

ITEM NO		Allocated Points	ITEMNR	
30.	I have an aptitude for influencing people without pressurising them.	30	30.	Het ek die vermoë om hulle te beïnvloed sonder om druk uit te oefen.
31.	I am generally effective in preventing careless mistakes or omissions from spoiling the success of an operation.	31	31.	Kan ek gewoonlik voorkom dat die sukses van die projek bederf word deur nalatige foute of vergissings.
32.	I like to press for action to make sure that the meeting does not waste time or lose sight of the main objective.	32	32.	Hou ek daarvan om te druk vir aksie om te verseker dat die vergadering nie tyd mors of die hoofdoelwit uit die oog verloor nie.
33.	I can be counted on to contribute something original.	33	33.	Kan op my gereken word om iets oorspronklik by te dra.
34.	I am always ready to back a good suggestion in the common interest.	34	34.	Is ek altyd bereid om 'n goeie voorstel in die gemeenskaplike belang te steun.
35.	One can be sure I will just be my natural self.	35	35.	Kan jy daarop staatmaak dat ek net my natuurlike self sal wees.
36.	I am quick to see the possibilities in new ideas and developments.	36	36.	Herken ek gou die moontlikhede van nuwe idees en ontwikkelings.
37.	I try to maintain my sense of professionalism.	37	37.	Probeer ek my sin vir professionalisme handhaaf.
38.	I believe my capacity for judgment can help to bring about the right decisions.	38	38.	Glo ek dat my oordeelsvermoë sal help dat die regte besluite geneem word.
39.	I can be relied on to bring an organised approach to the demands of the job.	39	39.	Kan op my gereken word om die taakvereistes op 'n georganiseerde manier te benader.
		10		

SECTION IV: MY CHARACTERISTIC APPROACH TO GROUP WORK IS THAT:

ITEM NO		Allocated Points
40.	I maintain a quiet interest in getting to know colleagues better.	40
41.	I contribute where I know what I am talking about.	41
42.	I am not reluctant to challenge the view of others or to hold a minority view myself.	42
43.	I can usually find a line of argument to refute unsound propositions.	43
44.	I think I have a talent for making things work once a plan has to be put into operation.	44
45.	I prefer to avoid the obvious and to open up lines that have not been explored.	45
46.	I bring a touch of perfectionism to any job I undertake.	46
47.	I like to be the one to make contacts outside the group or the firm.	47
48.	I enjoy the social side of working relationships.	48
49.	While I am interested in hearing all views I have no hesitation in making up my mind once a decision has to be made.	49
		10

AFDELING IV: MY KENMERKENDE BENADERING TOT GROEPWERK IS DAT:

ITEMNR	
40.	Ek stilweg probeer om my kollegas beter te leer ken.
41.	Ek insette lewer as dit gaan oor 'n onderwerp waarmee ek goed vertroud is.
42.	Ek nie huiwer om ander se sienings te bevraagteken, of om self 'n minderheidstandpunt in te neem nie.
43.	Ek gewoonlik argumente kan vind om ongegronde voorstelle te weerle.
44.	Ek dink ek die slag het om dinge te laat werk as 'n plan in bedryf gestel moet word.
45.	Ek verkies om die klaarblyklike te vermy en nuwe benaderings wat nog nie verken is nie onder die aandag te bring.
46.	Take wat ek onderneem van 'n tikkie perfeksionisme getuig.
47.	Ek graag die een is wat kontakte buite die groep of firma maak.
48.	Ek die sosiale aspek van werkverhoudings geniet.
49.	Alhoewel ek daarin belang stel om eers almal se sienings te hoor, ek nie huiwer om tot my eie gevolgtrekkings te kom wanneer 'n besluit geneem moet word nie.

SECTION V: I GAIN SATISFACTION IN A JOB BECAUSE:

ITEM NO		Allocated Points
50.	I enjoy analysing situations and weighing up all the possible choices.	50
51.	I am interested in finding practical solutions to problems.	51
52.	I like to feel I am fostering good working relationships.	52
53.	I can have a strong influence on decisions.	53
54.	I have a chance of meeting new people with different ideas.	54
55.	I can get people to agree on priorities and objectives.	55
56.	I feel in my element where I can give a task my full attention.	56
57.	I can find an opportunity to stretch my imagination.	57
58.	I feel that I am using my special qualifications and training to advantage.	58
59.	I usually find a job gives me the chance to express myself.	59
		10

AFDELING V: EK PUT BEVREDIGING UIT WERK OMDAT:

ITEMNR	
50.	Ek daarvan hou om situasies te analiseer en al die moontlike keuses teen mekaar op te weeg.
51.	Ek daarvan hou om praktiese oplossings vir probleme te vind.
52.	Ek graag voel dat ek goeie werkverhoudings bevorder.
53.	Ek 'n sterk invloed op besluite kan uitoefen.
54.	Dit my die geleentheid bied om nuwe mense met ander idees te ontmoet.
55.	Ek mense sover kan kry om saam te stem oor prioriteite en doelwitte.
56.	Ek in my element is wanneer ek my onverdeelde aandag aan 'n taak kan wy.
57.	Dit my die geleentheid beld om my verbeelding te benut.
58.	Ek voel dat ek my spesiale kwalifikasies en opleiding voordelig kan benut.
59.	Dit my gewoonlik die geleentheid bied om uitdrukking aan myself te gee.

SECTION VI: IF I AM SUDDENLY GIVEN A DIFFICULT TASK WITH LIMITED TIME AND UNFAMILIAR PEOPLE:

ITEM NO		Allocated Points
60.	I usually succeed in spite of the circumstances.	60
61.	I like to read up as much as I conveniently can on the subject.	61
62.	I would feel like devising a solution of my own and then trying to sell it to the group.	62
63.	I would be ready to work with the person who showed the most positive approach.	63
64.	I would find some way of reducing the size of the task by establishing how different individuals can best contribute.	64
65.	My natural sense of urgency would help to ensure that we did not fall behind schedule.	65
66.	I believe I would keep cool and maintain my capacity to think straight.	66
67.	In spite of conflicting pressures I would press ahead with whatever needed to be done.	67
68.	I would take the lead if the group was making no progress.	68
69.	I would open discussions with a view to stimulating new thoughts and getting something moving.	69
		10

AFDELING VI: AS EK SKIELIK 'N MOEILIKE OPDRAG KRY MET BEPERKTE TYD EN ONBEKENDE MEDEWERKERS:

ITEMNR	
60.	Slaag ek gewoonlik ten spyte van die omstandighede.
61.	Hou ek daarvan om soveel as doenlik oor die onderwerp na te lees.
62.	Sal ek geneig wees om my eie oplossing te vind en dit dan aan die groep te probeer verkoop.
63.	Is ek bereid om saam te werk met die persoon wat die mees positiewe benadering toon.
64.	Sal ek die taak meer hanteerbaar maak deur te bepaal hoe verskillende individue elk die beste bykrae kan lewer.
65.	Sal my natuurlike gevoel vir dringendheid help verseker dat ons nie agter raak by ons program nie.
66.	Dink ek dat ek kalm sal bly en my vermoë tot logiese denke sal behou.
67.	Sal ek, ten spyte van botsende menings, vooruitbeur met wat ookal nodig is om te doen.
68.	Sal ek die leiding neem as die groep nie vorder nie.
69.	Sal ek samesprekings begin om nuwe gedagtes te stimuleer en om dinge aan die gang te kry.

SECTION VII: WITH REFERENCE TO THE PROBLEMS I EXPERIENCE WHEN WORKING IN GROUPS

ITEM NO		Allocated Points
70.	I am apt to over-react when people hold up progress.	70
71.	Some people criticise me for being too analytical.	71
72.	My desire to check that we get the important details right are not always welcome.	72
73.	I tend to show boredom unless I am actively engaged with stimulating people.	73
74.	I find it difficult to get started unless the goals are clear.	74
75.	I am sometimes poor at putting across complex points that occur to me.	75
76.	I am conscious of demanding from others the things I cannot do myself.	76
77.	I find others do not give me enough opportunity to say all I want to say.	77
78.	I am inclined to feel I am wasting my time and would do better on my own.	78
79.	I hesitate to express my personal views in front of difficult or powerful people.	79
		10

AFDELING VII: DIE PROBLEME WAT EK ONDERVIND WANNEER EK MET 'N GROEP SAAMWERK HET DAARMEE TE DOEN DAT:

ITEMNR	
70.	Ek geneig is om te oorreageer wanneer mense vordering vertraag.
71.	Sommige mense my kritiseer as synde te analities.
72.	My behoefte om te kontroleer dat ons al die belangrike besonderhede reg het, nie altyd welkom is nie.
73.	Ek neig om my verveeldheid te wys tensy ek aktief betrokke is met stimulerende mense.
74.	Ek dit moeilik vind om aan die gang te kom as die doelwitte nie duidelik is nie.
75.	Ek kompiekse idees wat by my opkom soms swak oordra.
76.	Ek daarvan bewus is dat ek van ander dinge verwag wat ek nie self kan doen nie.
77.	Ek vind dat ander my nie genoeg tyd gee om my gedagtes volledig te stel nie.
78.	Ek neig om te voel dat ek eintlik my tyd mors en beter op my eie sal funksioneer.
79.	Ek huiwerig is om my persoonlike sienings te lug in die teenwoordigheid van moeilike mense of sterk persoonlikhede.

END OF QUESTIONNAIRE
Thank you for you time

APPENDIX B: REQUEST FOR PARTICIPATION

Subject: Research into Effective IS Project Teams
Date: Tue, 19 Sep 2000 11:27:30 +0200
From: Lionel Waker <wkrlio001@mail.uct.ac.za>
Organization: UCT
To:

Subject: (Fwd) Research into Effective Project Teams
Date: Mon, 18 Sep 2000 16:10:02 SAST-2
From: "Smith, D, Derek, Prof - HOD Information Syst" <dsmith@commerce.uct.ac.za>

Hi
Mr Waker is a Masters student and his thesis is on the effectiveness of IS project teams. Together with me as his supervisor, we have decided to focus our attention on 5 companies - including yourselves. At the moment all we are asking is for you to agree in principle to Mr Waker carrying out a survey with some of your IS project teams in your company. Can he please proceed? If you agree he will be in touch with you shortly to determine which project team leaders he can approach.

Thank you.

(Prof) Derek Smith

RE: Research into Effective IS Project Teams

I am currently studying towards a Master of Commerce degree in Information Systems (IS) at the University of Cape Town. As part of the degree I am researching the viability of creating effective IS project teams based on the diversity of skills, backgrounds, and team roles of the individuals that could potentially be included in an IS project team.

I am seeking your help in providing data for my analysis. My research requires that I gather data from currently operational IS project teams. I am focussing on the IS departments of 5 major companies in the Cape Town area. From the data I shall ascertain if there is any difference in perceived team effectiveness between those IS project teams that display a wide variety of the above mentioned characteristics, and those that do not.

I am trying to reach as many IS project teams in your company as possible. With your assistance I am hoping to get in contact with all project managers/leaders (within your company) that would be willing to let themselves and each of their team members complete a 15 minute long questionnaire.

The questionnaire needs to be completed by all the permanent members ofIS project teams, where teams should consist of three or more permanent members. Permanent members are those that devote at least one third of their working time to the project for its duration. An IS project is any project in which the primary goal is analysing, planning, developing, maintaining, or adapting an information system or software product.

All individual data will be treated confidentially, and will remain anonymous. An envelope will be provided with each questionnaire to ensure the confidentiality of the answers. I will collect these envelopes once all members of all participating teams at your company have completed the questionnaire.

Results of the research will be forwarded to you once the study has been completed. The research should be extremely valuable to a company with a large IS contingent such as

yourselves, as it may shed light on alternatives to skill based selection, in which the individual's technical skill is the only basis for his/her appointment to a team.

If you are not in a position to provide the requested information (names and contact details of project managers/leaders), I would appreciate it if you could put me in contact with the relevant person. If you have any queries please do not hesitate to mail me (wkrlio001@mail.uct.ac.za) or my dissertation supervisor, Prof Derek Smith, Head of Department of Information Systems, University of Cape Town (dsmith@commerce.uct.ac.za).

Thank you for your time.

Yours faithfully
Lionel Waker

APPENDIX C: EXAMPLE OF BELBIN SELF PERCEPTION INVENTORY RAW SCORE REPORT

SELF PERCEPTION INVENTORY RAW SCORES

Organisation : UCT5

UCT5

	PL	RI	CO	SH	ME	TW	IMP	CF	SP	DR
26	5	4	11	5	6	8	8	2	13	8
27	2	3	4	1	1	16	13	13	6	11
28	13	5	5	5	8	5	7	7	9	6
29	5	2	8	14	11	5	7	10	2	6

SUMMARY

Number of Candidates: 4

	PL	RI	CO	SH	ME	TW	IMP	CF	SP	DR
TOTAL	25	14	28	25	26	34	35	32	30	31
AVERAGE	6.25	3.5	7.0	6.25	6.5	8.5	8.75	8.0	7.5	7.75

APPENDIX D: WITHIN TEAM ANOVA FOR ALL VARIABLES (EXCLUDING TEAM ROLE SCORES)

Analysis of Variance

Team	SIZE Means	SIZE Std.Dev.	LENGTH Means	LENGTH Std.Dev.	OTHER Means	OTHER Std.Dev.	BACK_HET Means	BACK_HET Std.Dev.	SKILL_HE Means	SKILL_HE Std.Dev.	TASK_COH Means	TASK_COH Std.Dev.	SOC_COH Means	SOC_COH Std.Dev.	GEN_EFFE Means	GEN_EFFE Std.Dev.	CON_EFFE Means	CON_EFFE Std.Dev.
#1	4.0	0.0	16.5	13.4	11.0	15.4	5.8	0.9	5.5	0.6	6.0	0.0	6.1	0.3	6.0	0.1	5.9	0.3
#2	6.0	0.0	23.5	17.2	4.5	3.1	4.4	1.2	5.5	1.0	5.7	0.8	5.6	0.9	5.5	0.5	5.6	0.7
#3	7.0	0.0	5.9	2.9	2.7	1.5	5.2	0.9	5.6	1.1	5.0	1.1	5.4	0.6	5.5	0.4	5.4	0.7
#4	5.0	0.0	2.2	0.4	1.8	1.3	4.9	0.7	6.4	0.5	6.1	0.5	6.4	0.4	6.1	0.3	5.0	1.5
#5	4.0	0.0	13.0	12.6	1.5	1.0	5.5	0.7	5.8	1.3	5.4	0.9	5.4	1.3	5.5	1.4	4.8	0.9
#6	4.0	0.0	4.8	1.3	0.8	1.0	4.9	0.9	4.8	1.5	4.3	1.3	5.5	0.7	5.1	0.4	4.8	0.5
#7	4.0	0.0	6.8	4.5	1.5	2.4	5.5	0.7	5.0	2.0	5.9	0.2	5.8	0.3	5.8	0.3	4.4	1.1
#8	4.0	0.0	2.8	0.5	0.0	0.0	5.8	0.3	5.8	0.5	6.3	0.3	6.3	0.3	5.6	0.3	5.8	0.6
#9	5.0	0.0	2.0	0.0	2.0	0.0	5.8	0.8	6.2	0.4	6.0	0.8	5.9	0.7	6.1	0.5	5.9	0.9
#10	20.0	0.0	16.3	10.7	1.8	6.7	5.7	1.0	5.6	0.9	4.8	0.9	5.3	0.8	5.3	0.7	6.1	0.6
#11	12.0	0.0	7.3	2.9	0.3	0.9	6.1	0.6	4.7	1.7	3.8	1.2	4.3	1.3	4.0	1.1	2.9	1.7
#12	9.0	0.0	6.3	2.1	0.0	0.0	5.4	0.8	6.0	0.7	5.7	0.5	6.3	0.4	6.0	0.4	6.1	0.5
#13	9.0	0.0	13.6	9.2	2.7	4.7	5.4	1.1	6.3	0.7	5.7	0.4	6.0	0.8	5.9	0.6	5.4	0.7
#14	4.0	0.0	4.5	3.3	2.5	0.6	5.4	0.5	6.0	0.0	4.9	0.8	5.6	0.9	5.5	0.9	4.9	1.3
#15	3.0	0.0	30.7	9.2	1.7	1.5	5.0	0.5	5.7	0.6	4.7	1.5	4.8	0.8	5.2	0.2	5.0	0.5
#16	6.0	0.0	14.2	17.6	0.0	0.0	5.3	1.3	5.0	0.6	4.6	0.7	4.8	0.7	5.0	0.4	3.1	1.2
#17	3.0	0.0	5.0	0.0	1.0	1.7	4.7	2.3	6.3	0.6	6.1	0.2	5.8	0.3	6.0	0.7	6.0	0.0
#18	4.0	0.0	14.5	4.1	0.3	0.5	5.8	1.3	5.0	2.2	4.8	0.8	5.8	0.3	4.7	1.0	4.0	1.8
#19	6.0	0.0	2.7	1.8	1.3	0.8	6.3	0.5	6.2	0.4	4.9	1.2	5.6	0.7	5.3	0.7	6.2	0.7
#20	4.0	0.0	8.0	0.8	4.8	4.3	6.4	0.5	6.3	0.5	5.8	0.9	5.5	1.0	5.3	0.5	3.4	1.1
#21	5.0	0.0	24.0	7.3	1.4	1.1	6.2	0.8	6.4	0.5	5.5	0.8	6.2	0.4	5.6	1.0	6.2	0.6
#22	4.0	0.0	4.0	0.8	1.0	0.8	5.9	0.6	5.3	1.0	5.2	0.4	5.0	0.9	3.9	0.4	5.0	0.8
#23	7.0	0.0	5.9	3.1	0.4	0.8	6.0	0.5	6.1	0.4	4.7	1.5	4.8	1.1	4.9	1.0	3.9	1.5
#24	5.0	0.0	8.6	8.6	2.4	2.5	6.1	0.7	5.2	1.3	4.6	0.9	5.5	1.5	5.1	1.0	4.5	1.3
#25	4.0	0.0	4.8	1.3	1.8	1.0	4.6	1.6	6.0	0.0	5.8	0.4	5.4	0.9	5.3	0.8	6.3	0.5
#26	3.0	0.0	14.7	2.5	1.7	1.2	6.3	0.3	5.7	0.6	6.2	0.2	5.2	1.9	5.7	1.1	3.0	0.9
#27	4.0	0.0	13.3	7.6	1.8	0.5	5.3	0.9	5.5	0.6	4.7	0.7	5.6	0.5	5.1	0.8	5.3	0.9
#28	4.0	0.0	16.0	14.7	1.3	1.5	5.1	0.6	5.8	0.5	5.7	0.7	5.5	0.6	5.1	0.9	4.6	1.0
#29	4.0	0.0	5.5	4.8	1.5	1.3	5.0	0.7	5.8	0.5	5.3	0.3	5.3	0.5	5.1	0.8	4.5	0.4
Avrg	**5.6**	**0.0**	**10.2**	**5.7**	**1.9**	**2.0**	**5.5**	**0.8**	**5.7**	**0.8**	**5.3**	**0.7**	**5.5**	**0.8**	**5.3**	**0.7**	**4.9**	**0.9**

Size = Number of Team Members
Length = Length of Time in Team (Months)
Other = Number of Other Projects Worked on During Period
Back_Het = Background Heterogeneity
Skill_Het = Skill Heterogeneity
Task_Coh = Task Cohesion
Soc_Coh = Social Cohesion
Gen_Effe = General Effectiveness
Con_Effe = Constraints Effectiveness

APPENDIX E: WITHIN TEAM ANOVA OF TEAM ROLE SCORES

Analysis of Variance

Team \ Role	Plant (PL) Resource Investigator (RI)	Co-ordinator (CO)	Shaper (SH)	Monitor Evaluator (ME)	Teamworker (TW)	Implementer (IMP)	Completer (CF)	Specialist (SP)	Variance	Ranking	Reverse Ranking
	Average Team Role Scores in Team										
#1	5.5	7.0	8.0	5.0	7.5	7.0	8.0	5.3	9.5	2.2	29	1
#2	5.7	7.3	4.2	5.8	7.3	6.3	10.7	7.8	9.0	3.7	25	5
#3	5.1	6.7	6.4	5.3	6.4	6.0	9.6	9.3	7.3	2.5	28	2
#4	5.0	8.0	7.8	6.0	4.0	6.6	11.0	5.2	9.6	5.2	18	12
#5	6.3	3.5	7.0	6.3	6.5	8.5	8.8	8.0	7.5	2.5	27	3
#6	5.3	4.3	2.5	4.8	3.8	9.5	8.3	7.0	12.5	10.2	10	20
#7	5.5	6.0	5.3	6.8	4.8	6.5	8.0	6.5	12.0	4.7	20	10
#8	2.5	4.5	4.3	1.3	4.8	15.3	9.8	7.8	10.3	19.8	3	27
#9	5.8	2.4	4.8	5.2	6.6	7.0	14.4	8.2	8.6	11.2	8	22
#10	4.1	4.4	4.0	5.7	5.6	8.9	10.5	10.9	9.2	8.0	15	15
#11	3.7	5.2	3.3	5.2	14.3	4.3	16.7	3.7	9.4	25.1	2	28
#12	4.9	5.6	4.9	5.8	5.6	7.0	9.7	7.2	10.0	3.8	23	7
#13	2.8	2.9	2.2	5.2	4.7	8.4	10.6	12.3	12.0	16.7	4	26
#14	1.8	3.3	4.3	5.3	6.5	3.5	17.0	11.8	10.8	25.2	1	29
#15	5.7	2.3	4.0	5.0	7.0	6.0	11.7	8.7	12.0	10.9	9	21
#16	3.8	4.4	4.0	3.8	6.6	8.8	12.6	11.2	9.0	11.6	7	23
#17	4.7	7.7	6.0	4.7	4.3	9.3	8.0	9.7	9.0	4.6	21	9
#18	4.0	4.0	5.5	9.3	5.8	4.8	15.0	9.5	6.5	12.8	6	24
#19	4.7	4.3	7.7	7.7	6.8	8.5	9.2	6.3	9.8	3.6	26	4
#20	2.0	4.3	6.0	6.3	12.5	6.5	10.5	8.0	9.0	10.2	11	19
#21	5.6	2.6	8.8	8.4	9.4	3.4	12.0	10.2	6.0	10.0	12	18
#22	2.5	5.3	3.0	4.8	3.5	10.3	7.0	10.8	13.8	15.8	5	25
#23	3.5	5.3	4.0	9.0	8.8	6.0	10.5	8.3	8.0	5.9	17	13
#24	4.4	5.8	2.8	4.0	5.6	8.4	9.2	7.8	12.2	8.8	13	17
#25	4.0	7.5	11.8	7.8	8.5	6.0	8.3	5.0	4.0	6.3	16	14
#26	5.0	4.7	6.0	4.3	9.0	7.3	7.7	9.7	8.0	3.8	24	6
#27	3.3	6.8	6.0	8.5	6.3	8.0	8.0	5.5	10.3	4.1	22	8
#28	4.8	3.8	5.3	7.0	6.8	7.8	11.0	9.3	6.5	5.1	19	11
#29	3.8	6.0	5.0	4.8	6.5	7.5	11.5	8.5	12.0	8.5	14	16

APPENDIX F: MANN-WHITNEY TEST FOR OPTIMAL TEAM SIZE

Mann-Whitney U Test
Effectiveness of Optimal size of 5 or 6 (y) vs other sizes (n)
By variable OPTIMAL
Group 1: n Group 2: y

	Rank Sum n	Rank Sum y	U	Z	p-level	Z adjusted	p-level	Valid N n	Valid N y	2*1sided exact p
GEN	314	121	61	-0.82	0.41	-0.82	0.41	22.00	7.00	0.44
CON	307	128	54	-1.17	0.24	-1.17	0.24	22.00	7.00	0.26

Gen = General Effectiveness
Con = Constraints Effectiveness

Mann-Whitney U Test
Effectiveness of teams classified as small (less than 6 members) vs teams classified as large (6 or more members)
By variable CLASSIFICATION
Group 1: small Group 2: large

	Rank Sum small	Rank Sum large	U	Z	p-level	Z adjusted	p-level	Valid N small	Valid N large	exact p
GEN	311.00	124.00	79.00	0.52	0.60	0.52	0.60	20.00	9.00	0.63
CON	294.00	141.00	84.00	-0.28	0.78	-0.28	0.78	20.00	9.00	0.80

Gen = General Effectiveness
Con = Constraints Effectiveness

APPENDIX G: REGRESSION ANALYSIS

Regression Summary for Dependent Variable: GENERAL EFFECTIVENESS
R= .86119979 R^2= .74166507 Adjusted R^2= .63833110
F(8,20)=7.1774 p<.00017 Std.Error of estimate: .32122

	BETA	St. Err. of BETA	B	St. Err. of B	t(20)	p-level
Intercept			0.999	1.104	0.905	0.376
TEAM SIZE	0.100	0.122	0.016	0.019	0.823	0.420
LENGTH IN TEAM	0.055	0.122	0.004	0.009	0.450	0.658
NO OF OTHER PROJECTS	0.082	0.128	0.021	0.033	0.643	0.527
BACKGROUND HETERO	-0.130	0.119	-0.127	0.117	-1.092	0.288
SKILL HETERO	0.218	0.143	0.231	0.152	1.519	0.144
TASK COHESION	0.249	0.177	0.202	0.144	1.403	0.176
SOCIAL COHESION	0.442	0.156	0.469	0.166	2.834	0.010
TEAM ROLE BALANCE	0.147	0.126	0.012	0.011	1.165	0.258

Regression Summary for Dependent Variable: CONSTRAINTS EFFECTIVENESS
R= .75739550 R^2= .57364794 Adjusted R^2= .40310711
F(8,20)=3.3637 p<.01317 Std.Error of estimate: .79261

	BETA	St. Err. of BETA	B	St. Err. of B	t(20)	p-level
Intercpt			-0.912	2.723	-0.335	0.741
TEAM SIZE	0.241	0.156	0.072	0.047	1.543	0.139
LENGTH IN TEAM	-0.007	0.157	-0.001	0.022	-0.044	0.965
NO OF OTHER PROJECTS	0.080	0.164	0.039	0.080	0.488	0.631
BACKGROUND HETERO	-0.276	0.153	-0.520	0.288	-1.807	0.086
SKILL HETERO	0.307	0.184	0.628	0.376	1.671	0.110
TASK COHESION	-0.214	0.228	-0.334	0.356	-0.939	0.359
SOCIAL COHESION	0.585	0.201	1.192	0.409	2.916	0.009
TEAM ROLE BALANCE	0.088	0.162	0.014	0.026	0.545	0.592