

DEVELOPMENT OF AN INTEGRATED FRAMEWORK FOR SATISFACTION ASSESSMENT OF CONSTRUCTION PROJECT TEAMS

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ABSTRACT

With increasing competitive pressures in today's market, it has become critical for businesses to recognise the significance of satisfying their customers so as to ensure their economic stability. Various studies have emphasised on the need for customer focus and project satisfaction in the construction industry sector. The industry, however, has not fully embraced the practice of project satisfaction, which is grounded on meeting the needs of the customer. Though most research on project satisfaction has focussed on the client, it is essential that the satisfaction of the project delivery team and in the wider context, the stakeholders be considered. In this case, the client is the centre of gravity of the project team. In order to satisfy the project team, there are challenges in assessing their requirements. This necessitates the need to develop a unique and robust method for capturing and analysing the level of integrated project team satisfaction.

In this research, the project delivery team and the stakeholders have been lumped together as an integrated project team. Therefore, integrated project team satisfaction entails recognising the client and project participants' requirements that guarantees project successful completion and acceptance by the team. In view of this, this research presents a framework, which has been developed to plug these needs and challenges. The framework, known as the Satisfaction Assessment Integrated Framework (SAIF) involves an integrated approach that considers the participants of a construction project as a tree structure, and each member of that tree as an intermediate or top element. Relationships and interactions of the elements, and how these affect the overall satisfaction levels of a single project, are analysed based on understanding their requirements and invoking modern satisfaction attainment theory. The framework includes a method for understanding and identifying the satisfaction attributes; multi-attribute analysis for prioritising the satisfaction attributes of the clients and project participants; fault tree analysis strategy for defining the satisfaction relationship in a particular project team; and an assessment scoring system (a combination of multi-attribute analysis, and failure mode and effects analysis methodical approach) that evaluates how much each member of the project team meets the requirements or satisfaction attributes of other participants.

Hence, SAIF, a novel assessment methodology, investigates and identifies possible links and the influence of integrating the construction project team and their satisfaction attributes with the aim of improving their satisfaction levels as a team. Through the findings of this research, recommendations are made to further explore the implications of satisfying a given participant against dissatisfying the participant; and subsequently improve the satisfaction assessment process.

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DEDICATION

To Excel, Christabel and Mikel

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ABBREVIATIONS USED IN THIS RESEARCH

AC: Assessment Criteria
AS: Assessment Score
CG: Client Group
CQST: Cost, Quality, Safety, Time
FMEA: Failure Mode and Effects Analysis
FTA: Fault Tree Analysis
HTML: Hypertext Mark-up Language
IPT: Integrated Project Team
II: Importance Index
MC: Main Contractor
MySQL: My Server Query Language
PHP: Hypertext Pre-processor
PM: Project Manager
PMG: Project Management Group
RDBMS: Relational Database Management System
RII: Relative Importance Index
SAIF: Satisfaction Assessment Integrated Framework
SA: Satisfaction Attribute
SAN: Satisfaction Assessment Number
SC: Sub Contractor
SG: Supply Group
SIN: Satisfaction Importance Number
SQL: Server Query Language
SS: Satisfaction Score
WMCCE: West Midlands Centre for Constructing Excellence

NOTATIONS USED IN THIS RESEARCH

aci	Assessment Criteria
sai	Satisfaction Attributes
C_{aci}	Cost Assessment Criteria
C_{sai}	Cost Satisfaction Attributes
Csa_{cg}	Cost Satisfaction Attributes for participants' of the client group
Csa_{pmg}	Cost Satisfaction Attributes for participants' of the project management group
Csa_{sg}	Cost Satisfaction Attributes for participants' of the supply group
Q_{aci}	Quality Assessment Criteria
Q_{sai}	Quality Satisfaction Attributes
Qsa_{cg}	Quality Satisfaction Attributes for participants' of the client group
Qsa_{pmg}	Quality Satisfaction Attributes for participants' of the project management group
Qsa_{sg}	Quality Satisfaction Attributes for participants' of the supply group
S_{aci}	Safety Assessment Criteria
S_{sai}	Safety Satisfaction Attributes
Ssa_{cg}	Safety Satisfaction Attributes for participants' of the client group
Ssa_{pmg}	Safety Satisfaction Attributes for participants' of the project management group
Ssa_{sg}	Safety Satisfaction Attributes for participants' of the supply group
T_{aci}	Time Assessment Criteria
T_{sai}	Time Satisfaction Attributes
Tsa_{cg}	Time Satisfaction Attributes for participants' of the client group
Tsa_{pmg}	Time Satisfaction Attributes for participants' of the project management group
Tsa_{sg}	Time Satisfaction Attributes for participants' of the supply group

CHAPTER 1: BACKGROUND

1.0 INTRODUCTION

Satisfaction is defined as the result of ‘things not going wrong’ (Feçiková 2004). It has widely been identified by researchers as one of the key challenges facing the construction industry (Torbica and Stroh 2000; Constructech 2001; Chan *et al.* 2003; Kärnä 2004; Constructech Sept 2005; Dulaimi 2005; Kujala and Ahola 2005). According to Cheng *et al.* (2006), satisfaction is achieved or exceeded if a product or service outcome meets or exceeds the customer’s expectation. Maloney (2002) further explains that satisfaction entails recognising the customer needs, requirements and devising measures to meet the requirements.

Several studies (discussed in the succeeding chapter) have highlighted the need for focus to be placed on attaining satisfaction in the construction sector based on the identification of the clients’ satisfaction attributes. Shown in table 1.1 is a summary of the performance of the construction industry in relation to client satisfaction from 2003 to 2007. This indicates that inconsistency exists in the industry in its effort to fully embrace the practice of satisfaction improvement. In addition, it can be seen in the table that there is decrease in both product and service satisfaction from 2006 to 2007.

Table 1.1: Summary of Client Satisfaction in the Construction Industry from 2003 to 2007

Headline KPI Measure	2003	2004	2005	2006	2007
Client Satisfaction – Product Scoring	78%	80%	83%	84%	82%
Client Satisfaction – Service Scoring	71%	74%	77%	79%	75%

Source: BERR (2007)

The user's or client's intention and decision to continually invest in the construction sector corresponds to having his/ her needs (or satisfaction attributes) met. Client satisfaction is the foundation for long-term success and client-organisation relationship (Reichheld 1996; Huber *et al.*, 2001; Cheng *et al.*, 2006). Te-King *et al* (2003) assert that the economic status of a business is defined by how well it recognises and satisfies its customers. Liu and Walker (1998) argue that the degree of satisfaction experienced determines the weight or extent of the project success. Atlas and Özsoy (1998) on their discussion on residential environment explain satisfaction as a condition for quality evaluation and the measurement of the influence of perception and the environment upon satisfaction. Kujala and Ahola (*ibid.*) confirm that satisfaction is necessary in any project-based environment. Therefore, this research argues that the construction industry, which is project-based, needs to put not just its clients', but also other participants' satisfaction parameters at the priority list of its business and organisational strategy. In order to attain high project team satisfaction (client and participant satisfaction), it is vital that the industry maintains a long-lasting commitment of the criticality of satisfaction from the highest (top) to the lowest (bottom) level. Colin (2006) demonstrates this ideology, where the author explains the need to integrate satisfaction throughout the different facets and activities of an organisation.

1.1 PROJECT TEAM SATISFACTION

The construction project team is a collection or group of individuals or organisations that come together to achieve a given goal or deliver a project. Uher and Loosemore (2003) define a team as a 'collection of committed people with specific skills, abilities, and independent roles who work together in an environment of trust, openness and co-operation towards achieving common goals' (p.32). An illustration of participants that make up a construction project team and their functions in the team is shown in figure 1.1.

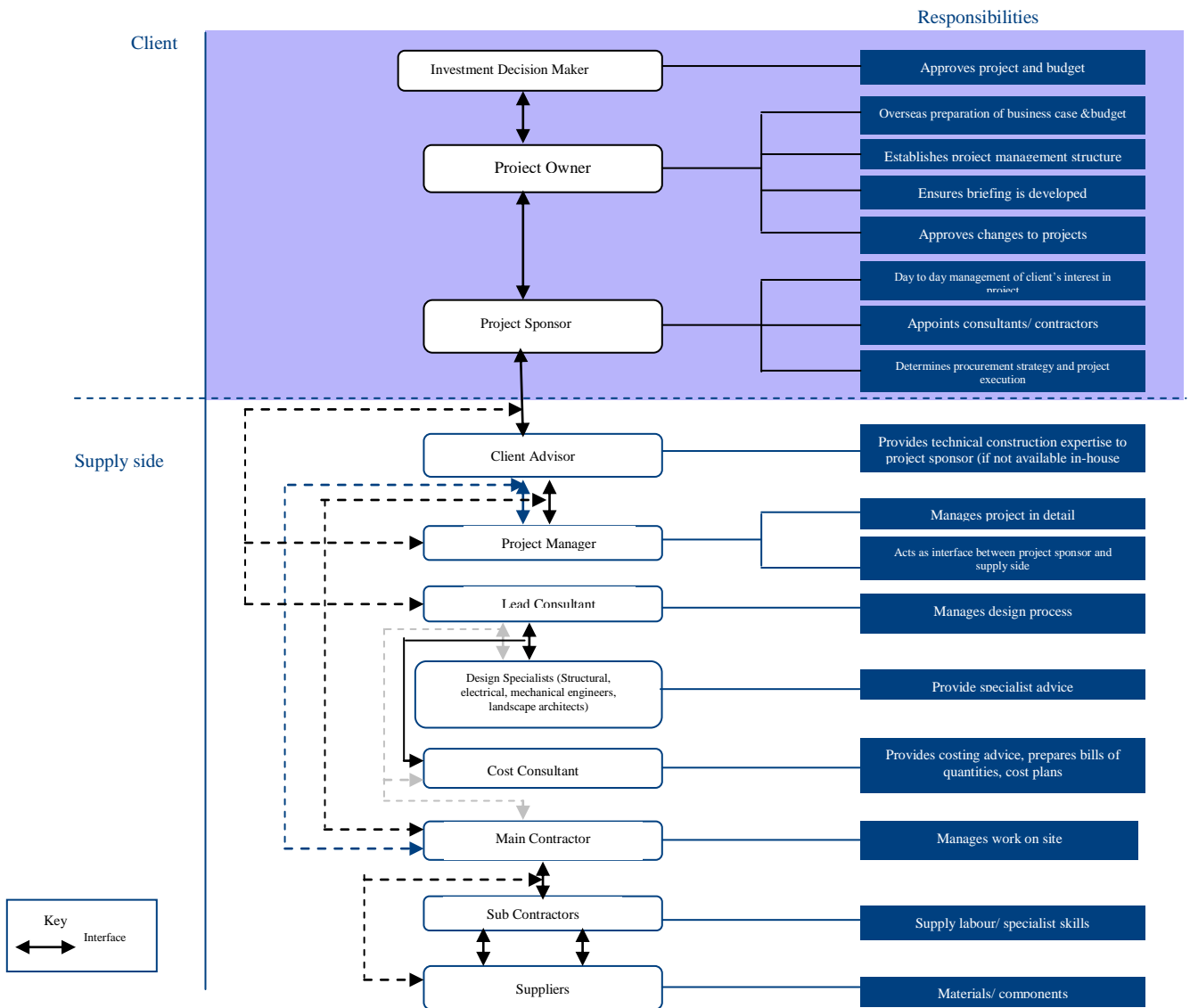


Figure 1.1: Participants of a Traditional Construction Project

Source: National Audit Office (2001)

The project participants and requirements are determined by the nature and type of construction project. In addition, the construction project team varies in its make-up depending on the given stage of the project. However, some participants are present at almost all the stages of the project. According to Uher and Loosemore (2003), the main client and the project manager remain in the project process from beginning to the end.

In order to ensure the satisfaction of the client, the requirements of every participant involved in the project need to be recognised and understood. Furthermore, researchers have over the last decade proposed the satisfaction of other project participants as an important measure and indicator for success in the construction sector (Parfitt and Sanvido 1993; Cheung *et al.*, 2000; Chan and Chan 2004). Similarly, the annual report of the Construction Industry Development Board (2008) highlights contractor satisfaction as one of the key indicators for measuring completed projects. The report further highlights the perceptions of contractors in terms of how satisfied they are with the clients and the projects in general. This indicates that the satisfaction requirements of other project participants, example contractors (in this case) are now being considered as indicators for measuring the construction industry's performance.

Therefore, an acknowledgement of each participant and their requirements is essential to improving project satisfaction in the construction sector. To achieve this, assessment frameworks and systems that would directly measure the satisfaction link between the project owner and other project participants need to be explored. This would require analysing the impact of integrating these participants and their satisfaction attributes, with the aim of improving the satisfaction levels of the project team throughout the project life cycle.

1.2 RESEARCH OUTLINE

The aim of this research project is to develop an integrated framework for assessing satisfaction levels of members of a construction project team in different stages of the project life cycle. In order to carry out this research, task-oriented methods need to be adopted and these are listed as follows:

- Literature review on satisfaction would be conducted to identify the satisfaction requirements and attributes of members of the project team
- The stages and participants that make up the construction project would be explored to identify the link between the participants
- Statistical techniques would be investigated to select an appropriate one for prioritising the satisfaction attributes of the project team
- Relevant satisfaction models and engineering systems would be analysed to select the ones most suitable for the development of the satisfaction assessment integrated framework
- Software techniques would be applied for the design and implementation of the framework

1.3 STRUCTURE AND OUTLINE OF THESIS

The structure and outline of this thesis consists nine chapters. Figure 1.2 presents the pictorial and logical relationship between the different chapters of the thesis.

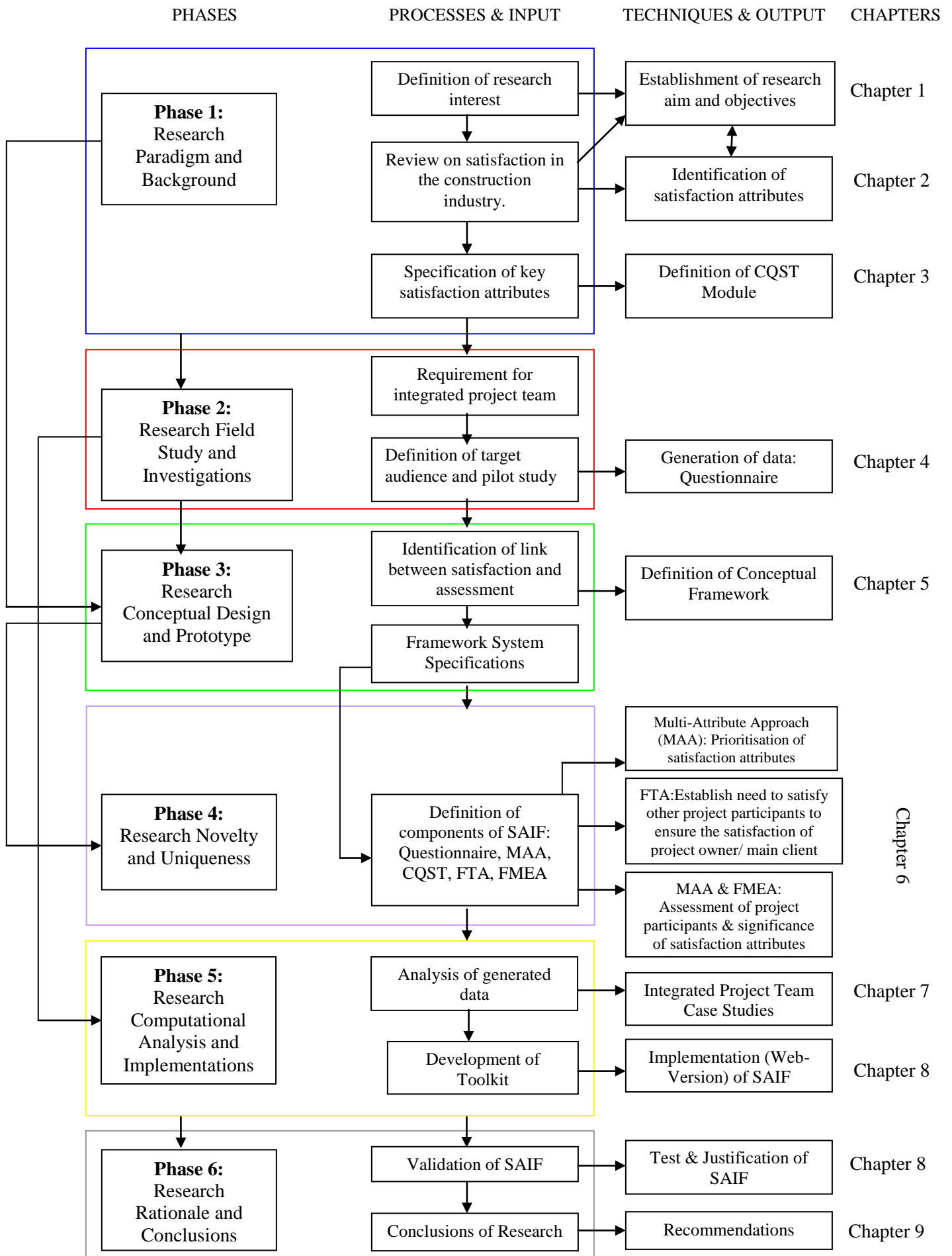


Figure 1.2: Research Outline and Layout of Thesis

1.3.1 Phase 1: Research Paradigm and Background

- *Chapter 1 – Background*

This chapter presents the perspective within which this research is undertaken. In addition, the scope and methodology of the research are outlined and briefly discussed.

- *Chapter 2 – Review on Satisfaction and Theoretical Basis of Research*

The research commences with an in-depth literature review on satisfaction in the construction industry. The review further consists of the comparative exploration of different engineering techniques and satisfaction models by identifying their benefits and highlighting their limitations. The need for the development of the Satisfaction Assessment Integrated Framework (SAIF) is highlighted from the limitations of these existing models. Several implications and suggestions relating to client and participant satisfaction were derived from the literature review. Here, ideas, discoveries, surveys, experiments and frameworks of several researchers in the construction industry over a period of time are reviewed and carefully analysed.

- *Chapter 3 – Development of Satisfaction Attributes*

Considering that cost, quality and time were mainly identified in the literature review as requirements from construction clients and project participants for their satisfaction, the research defined these three factors, including an additional factor: safety, as the key categories of satisfaction attributes. Hence, this chapter distinguishes these four factors (or categories) by their dimensions (called satisfaction attributes in the context of this research). This was done to identify the extent to which satisfaction is an issue required by every participant involved in the delivery of a construction project.

1.3.2 Phase 2: Research Field Study and Investigations

- *Chapter 4 –Analysis of Integrated Project Team and Pilot Study*

With a view to understand the structure of the relationship between the project owner or main client and the project participants, an investigation on the construction project team, the stages of the project life cycle and the participants involved are carried out. In addition, this chapter discusses how primary data relating to satisfaction and assessment attributes were collected from construction clients and project participants. Additional attributes were generated (secondary data) from relevant existing statistics, reports and survey results. The chapter elucidates the approach adopted in collecting and generating data. With an aim to capture the participants, clients and stakeholders in a construction project team, the survey sample was divided into three recognised groups in the industry: client group, project management group, supplier group.

1.3.3 Phase 3: Research Conceptual Design and Prototype

- *Chapter 5 - System Specifications and Conceptual Framework for Satisfaction Assessment*

In order to explore the relationship between satisfaction and assessment of the construction project team and the importance associated with the team's satisfaction attributes, a conceptual framework that logically integrates the clients and participants, as well as their satisfaction attributes, is developed using the system specifications of the proposed framework.

1.3.4 Phase 4: Research Novelty and Uniqueness

- *Chapter 6 – Framework Design and Development*

The chapter is devoted to a discussion on the different techniques and approaches adopted in developing the proposed framework, as well as how the different techniques link to each other. Given that the representation of the satisfaction relationship between the project participants is a key objective of this research, and the emphasis that has been placed on the need to integrate the project team, the fault tree analysis strategy is adopted by the research to incorporate these issues in the development of the framework. Furthermore, the satisfaction assessment of the project participants by the project owner and vice versa is considered fundamental in the developmental strategy of the framework. In view of this, a proactive technique, the failure mode and effects analysis is employed in conjunction with a statistical technique, multi-attribute approach to define a method that enables the assessment of the satisfaction of the different project participants.

1.3.5 Phase 5: Research Computational Analysis and Implementations

- *Chapter 7 – Integrated Project Team: Satisfaction Assessment*

This chapter discusses the computational data analysis of the framework through the use of satisfaction assessment scenarios. Through the analysis, weights and values are allocated to the attributes using the multi-attribute approach or analysis. Here, the importance associated with the attributes as perceived by the respondents is highlighted and discussed. In addition, the need for integrated project team and assessment of the project participants are highlighted using fault tree analysis and failure mode and effects analysis respectively.

- *Chapter 8 –Implementation of Toolkit*

This chapter presents the implementation of the framework as a web-based tool, integrating all the different analyses carried out in developing the framework. The analyses are done in conjunction with the findings from the literature searches, pilot studies and the WMCCE's (West Midlands Centre for Constructing Excellence) business assist programs.

1.3.6 Phase 5: Research Rationale and Conclusions

- *Chapter 8 – Framework Validation*

Here, a validation of the different components and techniques of the framework is carried out so as to justify the reasons for adopting the techniques, and to ensure the validity of the overall research.

- *Chapter 9 – Conclusions and Recommendations*

This chapter wraps up the discussions and major findings of the research. The contribution of this research work to the enhancement of client and participant satisfaction in the construction sector is also detailed in this chapter. It further presents the recommendations of the research to academia and to the industry. In addition, the recommendations for further research are highlighted.

1.4 SUMMARY

This chapter introduced the interest and background of this research. It also presented a brief discussion of the construction project team. In addition, the chapter highlighted the need to recognise the requirements of every participant represented in the project team so

as to improve project team satisfaction. In doing this, the need for a robust method, system or framework that captures and analyses the level of the integrated project team satisfaction was proposed. Therefore as stated in this chapter, this research is primarily based on the development of an integrated framework for assessing satisfaction levels of members of a construction project team and analysing integrated project team satisfaction. The methodology adopted by the research to fulfil its aim were also highlighted and briefly discussed. Subsequently the structure and layout of the thesis was presented and discussed. The succeeding chapter presents a review on the trend of satisfaction and relevant satisfaction models in the construction sector.

CHAPTER 2: LITERATURE REVIEW ON SATISFACTION

2.0 INTRODUCTION

Construction team satisfaction is a measure of how much or the extent to which the needs, desires, requirements and expectations of clients and project participants for a product or service are met. This chapter primarily presents the review on satisfaction in the construction industry. However, in order to acquire adequate knowledge of satisfaction, considering the insufficient or dearth research on the subject in the construction sector, the chapter starts by investigating satisfaction research from other fields of study (example, marketing and psychology). In addition, the theoretical foundation and basis of satisfaction as viewed by different researchers will be discussed, with insights drawn from different fields of study, indicating that this research is an eclectic study. Pertinent satisfaction models, mathematical models, and reliability techniques will also be investigated, exploring their benefits and highlighting the limitations associated with the satisfaction models. Subsequently, the aim and objectives of this research, protracted from the review, are presented and briefly discussed.

2.1 SATISFACTION THEORY

Cardozo (1965)'s satisfaction theory, being amongst the first, indicates that customer effort and expectation for a product have significant impact on and could be used to evaluate satisfaction. Cardozo emphasised on the criticality of understanding two key factors (customer effort and expectation) as the major component of customer behaviour, which results from satisfaction. He asserts that customer effort comprises the physical, mental and financial inputs of a customer before the purchase of a product. He explained that

customer expectations are however formulated and influenced by the information available to the customer. To further explain the relationship between effort, expectation, evaluation, and satisfaction, Cardozo used the 'contrast theory' and the 'dissonance theory'. The results of his study show that:

- Where more effort is expended to obtain a product, it results in a more favourable evaluation of the product
- Evaluation of the product is also done based on the customer's expectations
- Customer expectations can be influenced via adequate sales campaign of product

Hence Cardozo concluded that evaluation of satisfaction goes beyond product evaluation and purchase experience. This indicates that satisfaction can be assessed or evaluated based on several parameters and attributes.

Hanna and Wagle (1989) further explored the relationship between satisfaction and expended effort. They termed satisfaction theory as 'Effort/Satisfaction theory'. According to Hanna and Wagle, the effort/satisfaction theory implies that there is a relationship between the effort a customer expends in purchasing a product and the satisfaction the customer experiences from the product. However, they focussed on the 'flaw' of the theory such that the theory lacked the capability of explaining why different customers who have expended equal effort for a given product, experience different levels of satisfaction. The authors addressed this issue and enhanced the effort/satisfaction theory by introducing the 'optimal stimulation level' (OSL). OSL is based on the optimal stimulation theory. The optimal stimulation theory states that 'every individual seeks an optimal stimulation level' (Hanna and Wagle *ibid.*). Optimal stimulation level indicates that different people have diverse stimulation or excitement levels that are most favourable (optimal) for them. This is to say that different people have different things that stimulate, excite and are best for them. Hanna and Wagle, showed in their study that the amount of

effort expended by an individual and the level of satisfaction experienced are influenced by the individual's optimal stimulation level.

In the context of this study, the research explores the attributes that stimulate or excite the construction project participants in terms of improving their satisfaction level. In addition, this research explores how the ability (effort) of the clients and participants to understand and focus on one another's satisfaction attributes enhances the team's satisfaction level.

2.2 TREND OF SATISFACTION IN THE CONSTRUCTION SECTOR

In an overview of research issues relating to client and participant satisfaction in the construction industry, Wilemon and Baker (1983) identified cost, time, quality, customer orientation, communication skills and response to complaints as parameters for client satisfaction. Twelve years later, a survey carried out by Ahmed and Kangari (1995) using the statistical correlation matrix, elucidates that a relationship exists amongst these six client-satisfaction factors. Holt *et al.* (1995) identified time, cost and quality as the basic requirements for client satisfaction as well as the parameters for contractor selection. Kometa *et al.* (1995) recognised four vital clients' needs in the built environment, which are Functionality, Safety, Quality, and Completion Time. Chinyo *et al.* (1998) assert that a comprehensive analysis of clients' needs would facilitate greater clients' satisfaction. Here, 34 clients' needs grouped into eight main classes of needs: Aesthetics, Economy, Functionality, Quality, Working Relationships, Safety, Surprises (i.e. lack of:) and Time were identified. The authors further ranked the clients' needs into 50 aspects. Their study conducted on 42 clients in the construction industry identified 'project/ work to be built to its intended purpose' as the clients' most important need. Egemen and Mohamed (2006) specifically identified 18 satisfaction needs of clients from contractors. The authors ranked these needs to indicate their level of importance to the clients, as well as serve as a point of

focus for the contractors. With respect to the project manager as a participant in construction projects, Jang *et al.* (2003) elucidates five factors for creating satisfaction for the project manager. These are personnel, material flow, schedule adherence, contractor's organisation and information flow.

Proverbs and Holt (2000), having identified cost as the most essential parameter required by construction clients, presented a model to meet clients' demand for lowest cost. However, Maloney (2002) emphasises on the importance of the physical product and service delivery when assessing customer satisfaction in the construction industry. Tang *et al.* (2003) highlighted eight key factors for evaluating customer satisfaction: professionalism of service; competitiveness of service; timeliness of service; quality of design; degree of innovation; completeness of other considerations; availability of support for client; and, supervision at implementation. Most recently, Yang and Peng (2008), in their study on customer requirements for construction project management service, highlighted cost, quality, time, communication, amongst other factors as dimensions for evaluating satisfaction. The authors present a customer satisfaction evaluation model that provides an appraisal system for generating client needs during service transactions.

Quality evaluation, in terms of satisfaction assessment in the construction industry has been a subject of much empirical and theoretical analysis by researchers (Barrett 2000; Maloney, 2002; Yasamis *et al.*, 2002; Tang *et al.*, 2003; Kärnä 2004; Kärnä *et al.*, 2004). Al-Momani (2000) and Ling and Chong (2005) identified quality of service as the major factor or need for addressing and assessing client satisfaction. Tang *et al.* (*ibid.*) present quality of service, quality of product and quality of manner to customers as the quality elements for creating client satisfaction. In addition, studies in the marketing sector have indicated that quality has a positive effect on satisfaction (Fornell 1992; Anderson *et al.*, 1994). In identifying service quality as an antecedent for client satisfaction, Love *et al.*

(2000) and Palaneeswaran *et al.* (2006) emphasise that contractors and firms need to implement the ISO 9000 quality assurance standards. ISO 9000 represents series of quality systems or standards that deal with the method of quality management in organisations and industries. The aim of the ISO 9000 standards is to enable the supply for quality assurance and to present a common and widely accepted standard for quality evaluation and reliability. Client satisfaction has been included in the 2000 version of ISO 9000 quality standards (Tang *et al.*, 2003).

According to Ahmed and Kangari (1995), there stands a better chance for satisfying customers when their perception of service equals or is greater than their expectations. However, it is worth noting that the client’s perception for service differs from that of say, the contractor or any other project participant, therefore a clear understanding and distinction of both is essential.

In his study on ‘Examining Service Quality Within Construction Processes’, Al-Momani (2000) found 15 attributes or factors relating to the project owner and contractor that influence client satisfaction as shown in table 2.1 below:

Table 2.1: Attributes for Client Satisfaction

	Attributes Content	Mean Expectation	Mean Performance	GAP
1	Project must be completed on time	2.95	2.34	-0.61
2	Project must be carried out within budget	3.67	2.39	-1.28
3	Project planning and construction is carried out correctly	3.51	2.30	-1.21
4	Considering unforeseen physical and weather conditions in project schedule	2.40	2.20	-0.20
5	Project must be flexible to accommodate the primary purpose and new uses at any time	3.65	2.41	-1.24
6	Project has good details and quality design	3.25	2.30	-0.95
7	Considering contractual arrangement, exculpatory clauses and legal issues of the contract were a major problem	3.10	2.25	-0.85
8	There is an adverse relationship and mistrust between contract team	3.45	2.49	-0.96
9	Ensuring that a right people and proper skills are hired on the project	3.10	2.75	-0.35
10	Contractors always seek easy alternative solution and tries to save money by using cheap materials	3.51	2.26	-1.25
11	There are many rework and deficiencies during construction	3.59	2.40	-1.19
12	Considering the Contractors’ experience and number of completed projects are very important	3.35	2.58	-0.77

13	Considering financing arrangement is a problem	3.20	2.62	-0.58
14	Decisions are based on cost not on value of work	2.95	1.90	-1.05
15	The services and technical ability of the contractor will	3.22	2.50	-0.72

Source: Adapted from Al-Momani (*ibid.*)

Examining the data shown in table 2.1, the (*client*) expectation level (mean expectation) of each attribute is higher than the actual (*project*) performance (mean performance) resulting in negative ‘gap’ values on each case. This indicates that focus has not been placed on the satisfaction attributes.

Maloney (2002) elucidates how service quality facilitates client satisfaction. He identified nine determinants that need to be adopted and deployed by the contractor to exhibit service quality. These determinants include access, communication, competence, courtesy, credibility, reliability, service, tangibles, and understanding and knowing the customer. His identified determinants are the same with the ten customer criteria used for developing the SERVQUAL instrument discussed later in this chapter. According to Parasuraman *et al.* (1988a), SERVQUAL is an instrument developed for assessing customer perceptions of service quality in retail firms. Ling and Chong (2005) conducted a survey study on the estimation of service quality to investigate the expectations of public-sector clients on project service quality of D&B contractors; and then to assess the performance of D&B contractors, as perceived by the clients. Here, the authors identified the gap (known as the service quality score) between the client expectation (weighted expectation score) and performance of the contractors (weighted perceived score). The authors’ study based on the SERVQUAL strategy elucidates that a negative gap indicates that the contractor’s performance or assessment is below the client’s expectation, and vice versa.

Based on the findings of Al-Momani (2000), and Ling and Chong (2005), there is necessity for the construction industry to adopt strategies that are aimed at improving the satisfaction levels of its clients and project participants.

2.3 MATHEMATICAL MODELS ASSOCIATED WITH SATISFACTION

As a strategic approach towards achieving high satisfaction, it is important to measure satisfaction levels because according to Ho (1995), anything that needs to be managed requires to be measured. In addition, measuring satisfaction helps to keep organisations focussed on evaluating their customer relationships (Reichheld 1996). In effect, good client relationship will result in organisational success and stability.

Maloney (2002)'s study on perceived service quality as a function of the relationship between expected service and the perceived service was expressed mathematically as:

$$\text{Perceived Service} - \text{Expected Service} = \text{Perceived Service Quality.} \quad (2.1)$$

Maloney (*ibid.*) defines perceived service as 'the customer's perceptions of the actual service that has been provided; and expected service as the 'expectations the customer has for the service to be provided'. Based on the above mathematical expression, Maloney stated that perceived service quality can be viewed based on two quality zones (Q1, and Q2) such that:

If :

$$\begin{aligned} \text{Expected service} - \text{Perceived service} < Q1, & \text{ it implies that Perceived Service Quality is poor or low} \\ \text{Expected service} - \text{Perceived service} > Q2, & \text{ it implies that Perceived Service Quality is good or high} \\ \text{Expected service} - \text{Perceived service} > Q1 \text{ but } < Q2, & \text{ it implies that the Perceived service} \\ & \text{quality is acceptable} \end{aligned} \quad (2.2)$$

Where Q1 and Q2 are Quality zones

Kärnä *et al.* (2004) emphasise that perceived service quality is a function of customer satisfaction

Based on Fečíková (2004)'s 'Index method for the measurement of customer satisfaction', the following formula was defined:

$$CS: \underbrace{\{\text{Level of satisfaction} - (\text{Level of importance})\}}_a * \underbrace{(\text{Type of customers}) * (\text{Type of method used})}_{b} * 2$$

where if $a < 1$, it implies insufficient understanding of customers' demands (2.3)

$a > 1$, it implies sufficient satisfaction of customers, but high number of index 'a' means

that organisation is oriented at no strategic features of product and financial resources

b is the index that represents customers and used method

Improving certain areas or identifying critical sections in an organisation is a useful approach towards improving client satisfaction. In view of this, Mbachu and Nkado (2006) defined the critical index (CI) for prioritising areas of improvement. Here, the authors explain that CI depends on the level of clients' importance and the perceived level of satisfaction delivered by the organisation. This was mathematically represented as:

$$CI = \frac{\Pi}{PI} \quad (2.4)$$

Where CI = critical index, Π = importance index, PI = performance index

The multi-attribute approach or analysis, defined as an approach for applying objective standards to subjective assessment has been adopted by different researchers for measuring satisfaction. According to Fellows *et al.*, (1983) and Love *et al.* (1998), it is a technique used for evaluating the requirements and criteria of clients in a most objective way.

Skitmore and Marsden (1988) illustrated the multi-attribute approach in their analysis on a set of client procurement path criteria, where they defined a relative importance for each criterion.

Similarly, Chang and Ive (2002) applied the approach with respect to procurement route selection. Here, the authors outlined four steps involved in the application of the multi-attribute approach, which are:

- An identification of the priority variables
- Fixing the coefficients in relation to achievement of priority variables
- Determining the value of priority variable according to the client's preference
- A summation of the weighted priority variables of each procurement route and choosing the one with highest score.

Furthermore, Mbachu and Nkado (2006) applied the approach to measure satisfaction based on a combination of attributes, where the mean ratings and ranks for the attributes were obtained.

2.4 SATISFACTION MODELS

Walker (1995) developed a satisfaction model, which focuses on the criticality of understanding and rendering adequate service to customers as a measure of satisfying the customers. However, the technique towards measuring customer satisfaction was first introduced by Kano.

2.4.1 KANO Satisfaction Model

The KANO satisfaction model was first developed in 1984 by Dr Noriaki Kano (Kano *et al.*, 1984, cited in Shahin 2004) for quality management and marketing approach. However, it has been applied in other fields of study besides marketing. The model is based on six factors and attributes, which are categorised under the following:

- **Basic Factors:** These are the minimum requirements which if not met would result in customer dissatisfaction
- **Excitement Factors:** These are the factors that customers do not necessarily expect but would please (excite) the customers if provided.
- **Performance Factors:** These factors relate to the product's performance so will result in satisfaction if the performance is high, and dissatisfaction if the performance is low.
- **Indifferent Attributes:** These are the attributes that the customers do not particularly care about whether present or not.
- **Questionable Attributes:** These are the attributes that are unclear if the customers require them or not
- **Reverse Attributes:** These are the attributes that are reverse of the features of the product and are expected by the customer.

The above satisfaction factors and attributes are represented in figure 2.1

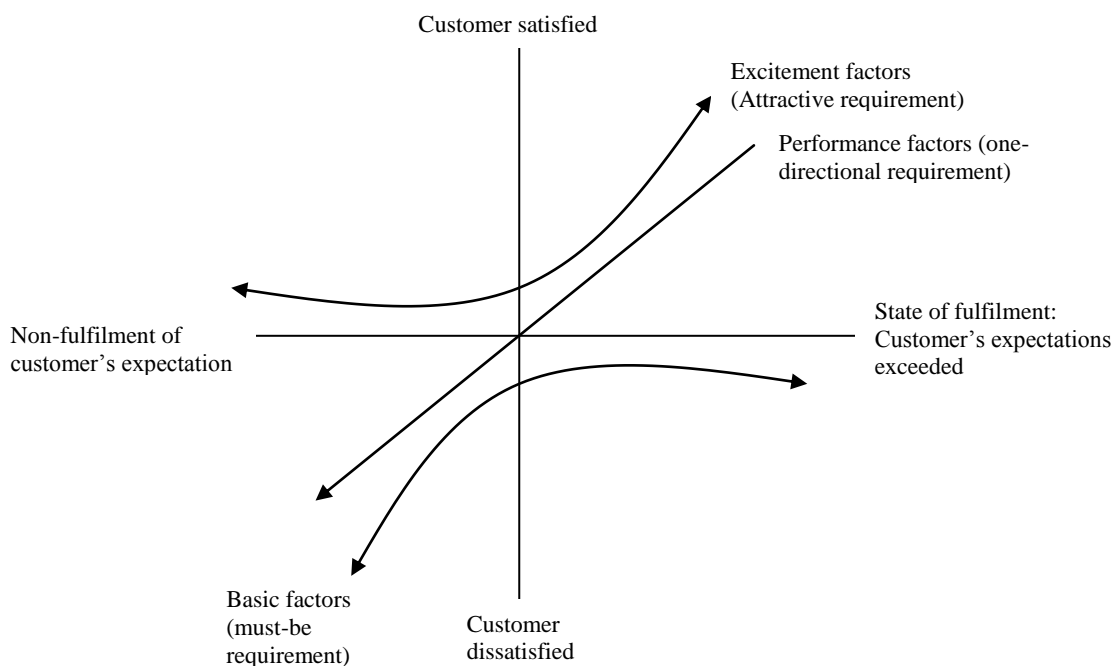


Figure 2.1: KANO Satisfaction Model

Source: Revised from Matzler and Hinterhuber 1998

2.4.1.1 Benefits

Matzler and Hinterhuber (*ibid.*) presented a number of benefits associated with the KANO's model, some of which include:

- KANO's model presents a better understanding of product requirements. The criteria that have the greatest influence on customer satisfaction can be identified.
- It provides valuable guidance in trade-off situations in the development stage. If two product criteria cannot be promoted concurrently due to technical or financial reasons, the criterion that has greater influence on customer satisfaction can be determined
- The use of KANO's model can lead to developing a wide range of product differentiation by examining the attractive criteria. The attractive criteria are key to beating the competition in the market place.
- KANO's model can be integrated with other quality tools such as the Quality Function Deployment (QFD)
- It enables the possibility to establish the importance of the features of products in terms of creating customer satisfaction

2.4.1.2 Limitations

The limitations of the KANO's model as highlighted by Tan and Pawira (2001) include:

- KANO's model does not quantify but classifies the performance of the attributes
- Customers do not just need basic needs and performance needs to satisfy them especially in today's competitive market. They added that customers need specific exciting needs in order to satisfy them
- The model lacks an explanation of what attributes drive a customer's perceptions, why certain attributes are more important to customers, and what the customers' behavioural actions are.

2.4.2 SERVQUAL Model

The SERVQUAL model was first developed with the aim, and is widely used in evaluating service quality. It was first initiated by Parasuraman; however, Zeithaml *et al.* (1983, cited in Tan and Pawira 2001) improved the model by analysing and presenting the relationship between service quality and customer satisfaction (Tan and Pawira *ibid.*). SERVQUAL had a major influence on Love *et al.* (2000), and Ling and Chong (2005)'s studies and findings.

The main dimensions of SERVQUAL are:

- *Tangible*: Physical facilities, equipment, and the appearance of personnel
- *Reliability*: Ability to perform the promised service dependably and accurately
- *Responsiveness*: Willingness to help customers and promote prompt service
- *Assurance*: Knowledge and courtesy of employees and their ability to inspire trust and confidence
- *Empathy*: Caring, individualised attention the firm provides its customers

Source: Adapted from Parasuraman *et al.* (1988b)

The authors state that Assurance and Empathy contain seven items, which represent the original dimensions. These items are communication, credibility, security, competence, courtesy, understanding/ knowing the customer, and access. They emphasise and conclude that the model contains five distinct dimensions (as earlier mentioned) and captures ten conceptualised dimensions.

2.4.2.1 Benefits

- It is good at eliciting the views of customers regarding service encounters, e.g. customer relative importance, expectations, and satisfaction
- It is able to alert management to consider the perception of both management and customers
- Addressing the service gaps can serve as a basis for formulating strategies and tactics in order to ensure the fulfilment of expectations
- SERVQUAL is able to identify specific areas of excellence and weaknesses
- It is able to prioritise areas of service weaknesses
- It provides benchmarking analysis for organisations in the same industry
- SERVQUAL can trace the trend of customer relative importance, expectation, and perception if applied periodically

2.4.2.2 Limitation

- Though SERVQUAL tool is a recognised industry standard (Llosa *et al.* 1998), it still requires additional improvement (Tan and Pawira 2001). Tan and Pawira (*ibid.*) suggest the need to integrate SERVQUAL with other service quality tools given that it lacks the ability to determine how the gap between predicted/ expected service and perceived/ received service can be bridged.

2.4.3 HOMBSAT Model

The HOMBSAT model was first developed in 1997 (Torbica and Stroh 2000) for measuring the satisfaction of the home-buyer. It is focussed on how satisfied the client (home-buyer) is and consists of 51 measures or items grouped under three dimensions (design, house and service) for creating satisfaction.

2.4.3.1 Benefits

- HOMBSAT model defines its capability such that it states that it can be applied in home buying situations and for measuring the satisfaction of the home-buyer (customer)
- It cuts across the different requirements of the customer; it does not only assess customer satisfaction in relation with the product features and functionalities, but also evaluates how satisfied the customer is with the *contractor*
- The HOMBSAT model assumes that the items for assessing satisfaction are inexhaustible.

2.4.3.2 Limitation

- Focus is placed on just the requirements and satisfaction criteria of the buyer (client).

2.4.4 CLIENTPRO

Kamara and Anumba (2001) presented a prototype software known as ClientPro, developed for processing client requirements in construction processes. ClientPro is based on a model known as the Client Requirements Processing Model (CRPM), which was developed by construction professionals (Kamara *et al.*, 1999). CRPM was developed mainly from the concepts and processes of the Quality Function Deployment (QFD) tool. QFD is a design tool used to enhance the quality of products and/ or services with focus on the requirements of the customer.

2.4.4.1 Benefits

- Can be integrated with other quality tools such as the QFD
- Clear identification of client requirements, thereby eliminating any misconceptions

- Structured and organised representation of the client requirements
- Creates teamwork amongst team members so as to ensure that focus is placed on the client
- Enables the processing of several clients and project types
- Allows the ability to trace the requirements in the different development and processing stages

2.4.4.2 Limitation

- Though the CLIENTPRO model enables team work amongst the project team, it lacks the capability to identify what the team requires in order to ensure the authenticity of the focus placed on the client by the team

2.4.5 Mbachu and Nkado's Satisfaction Framework

Mbachu and Nkado (2006) developed a framework for assessing client needs and evaluating client satisfaction levels in the building process. The framework is focussed on identifying client expectations from the design, management and construction services (figure 2.2). The identified needs and expectations were then prioritised using the quantitative research method (surveys). The authors' framework is based on two approaches for assessing satisfaction:

- Satisfaction assessment based on single evaluative responses. It involves satisfaction scores derived from the client's evaluative ratings of the performance of a particular group, with no consideration of an identified requirement.
- Satisfaction based on multi-attribute evaluation. This approach of satisfaction assessment provides an indication of the satisfaction level derived from the clients'

perceived levels of importance given to a combination of their requirements from a particular group.

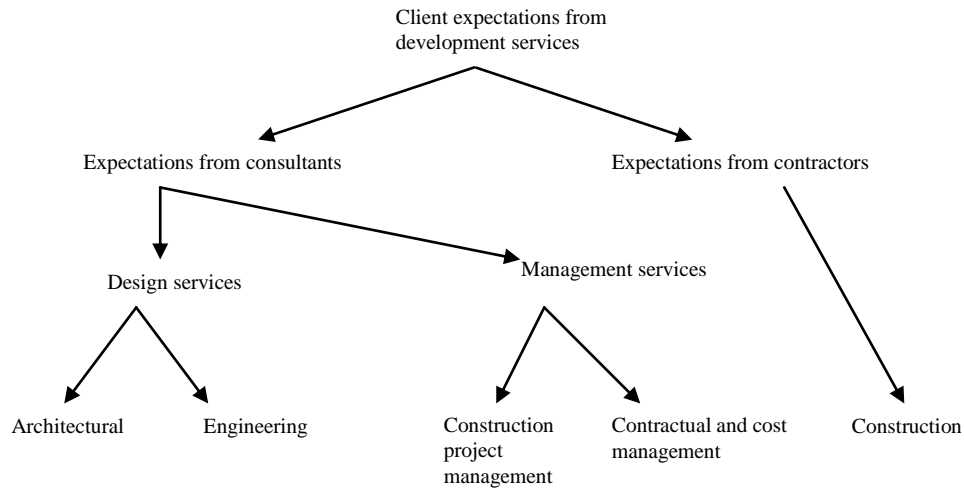


Figure 2.2: Satisfaction Framework - Adapted from Mbachu and Nkado (2006)

2.4.5.1 Benefits

- The framework adopts dynamism in its design such that it provides the means to identify the satisfaction attributes (requirements) of construction clients from different sections (or departments) of the construction process.
- It enables the prioritisation of the client needs and expectations using relevant statistical approaches

2.4.5.2 Limitation

- As in the HOMBSAT model, the framework places focus on only the construction clients or project owner. This is to say that emphasis is not placed on the requirements of other construction participants, e.g. contractors, engineers, or architects, etc.

2.5 RELIABILITY TECHNIQUES FOR SATISFACTION ASSESSMENT

Though there exists awareness on the need to satisfy the client or project owner in the construction industry as discussed above, in most cases, the industry lacks the ability to look at the effect the satisfaction of other project participants has on the satisfaction of the project owner. Therefore, a proactive technique or method that graphically represents the integration and satisfaction relationship between different project participants is required. Subsequently, a methodical or logical process that can be used to strategically enable the assessment of the participants and their requirements during the different stages of a construction project while highlighting the importance associated with the satisfaction attributes of the project participants is necessary.

This research therefore explores and invokes the theory of reliability so as to capture their use and technicalities in the design and development of a framework for capturing and analysing the level of integrated project team satisfaction. The techniques being explored are:

- Fault Tree Analysis (FTA)
- Failure Mode and Effects Analysis (FMEA)
- Quality Function Deployment (QFD)




2.5.1 Fault Tree Analysis (FTA)

H.A. Watson of Bell Telephone Laboratories developed the concept of fault tree analysis in 1962 (Dhillon and Singh 1981) for the United States Air force. The fault tree analysis is a deductive approach or structure (Wong and Yeh 2007) that provides significant data used to facilitate the reliability evaluation of systems. It is a logic block analysis represented by


a system called the *top event*, which is determined and dependent on its components called the *basic and intermediate events*. This is to say that FTA is a qualitative approach that provides information on the causes of the top event; and a quantitative approach that provides information on the probability of the top event occurring and the importance of the causes (events) of the top event (Vesely *et al.*, 2002). It aids in decision-making processes based on the details of information it reveals.


Fault tree analysis is represented and illustrated graphically with symbols, which indicate the type of events and relationships that exist in the fault tree (Vesely *et al.*, 2002). FTA uses what is known as *gates* to indicate or define the relationship between the events. According to Vesely *et al. (ibid.)*, the events are known as *faults* if they are instigated by other events; and known as *failures* if they are the fundamental or basic instigating events. The most common gates used in a fault tree analysis are the ‘and’ and ‘or’ gates:

2.5.1.1 Fundamental Event Symbols

- **Rectangle Event:** This is an event that results from a combination of more events through the input of the aforementioned logic gates. It is represented by: 
- **Circle Event:** This is an event that cannot be developed any further. It is a basic event and can only occur once. It is represented by: 
- **Diamond Event:** This is an event that may not be developed any further. It becomes a basic event because it may not be analysed any further. This is to say that the diamond event may not have been fully developed due to lack of adequate information or interest (Dhillon 2003). It is represented by: 

2.5.1.2 Fundamental Gate Symbols

- **And Gate:** This signifies that all the modes linked to it must occur for a top event or failure to occur. It is represented by: 

- **Or Gate:** This indicates that at least one of the events linked to it must occur for the top event to occur. It is represented by: 

In the context of this research, the above event and gate symbols could be used to represent the project participants and their satisfaction attributes because the symbols focus on combining and linking several factors or elements, which is fundamental in the objective of this research. Details of how the symbols are used in this research are discussed in chapter 6.

2.5.1.3 Applications of Fault Tree Analysis

Research show that FTA has been applied in aircraft systems (Cummings, 1975; Wong and Yeh, 2007); robotics (Khodabandehloo, 1996); nuclear studies (Smith and Schwarzbiat, 1994); and automation (Faghri and Egyhaziová, 1999; Zhao *et al.*, 2000; Jetter *et al.*, 2001). Jetter *et al.* (*ibid.*) used FTA to calculate the number of refrigerant exposures of service technicians and vehicle occupants.

The FTA approach has also been applied in medical/ health studies (Dhillon, 2003; Ndunguru *et al.*, 2005; Fujita and Kubo, 2006). Fujita and Kubo (*ibid.*) applied FTA methodology in the extraction of DNA from sperm derived from a mixture of semen and body fluids; while Dhillon (*ibid.*) showed an application of FTA using illustrations relating to the administration of wrong medication.

Though there is little application of the concept of FTA in construction projects, there is evidence of its application to satisfaction studies (Watanabe and Yokoyama 2003; Yokoyama 2004; Strelcová 2007). Yokoyama (2004) used FTA technique in determining satisfaction where fundamental incidents of dissatisfaction were identified using questionnaire analysis and an evaluation of importance of probability. The author states

that delivering stratified service to customers and FTA evaluation are effective measures towards improving customer satisfaction. Strelcová (2007) applied the FTA strategy in the study of causes (defined as the quality criteria) of satisfaction of passengers, who use public transport. The author determined a desirable incident (satisfaction of the customer) rather than the common usage of FTA technique for determining undesirable incidents. The studies by Yokoyama and Strelcová flag the potential of the FTA technique as an approach to adopt in order to determine the satisfaction of other partners besides the customer and how their satisfaction impact on that of the customer.

With respect to construction or project management, Karaulova *et al.* (2008) used the FTA method in identifying and estimating the risk factors in a project-life-cycle.

2.5.1 Failure Mode and Effects Analysis (FMEA)

Failure Mode and Effects Analysis, developed in the 1950s by the US Navy's Bureau was first called 'Failure Analysis', and then renamed to 'Failure Effects Analysis' (Dhillon 2003). It is an inductive approach used to identify failure points or areas in a design or process, thereby preventing errors in the design, product or process. It is a methodology used to identify potential failures or failure modes for a product, system or process, and to evaluate the risks associated with the failures, and to rank the outcome in terms of importance, thereby specifying corrective actions to address the outcome based on the hierarchy or criticality.

The failures are prioritised based on how severe their consequences or effects are, as well as the frequency of the failure occurrence. FMEA is a continuous process for improving quality (Cohen *et al.*, 1994) that identifies known or likely faults (Guimarães and Lapa 2004b), and alleviates the occurrence of such faults (Sankar and Prabhu 2001; Rhee and

Ishii 2003). The application of FMEA goes beyond failure mode and effect detectability. According to O'Connor (1995), FMEA can be carried out from perspectives such as safety, mission success, repair cost, reliability, etc. Hence it is a technique used to enhance safety and reliability of system.

FMEA is usually combined with other techniques, such as FTA to solve a problem. This is because FMEA is failure oriented while FTA is event oriented (Dhillon 2002, pg.201). Though Vesely *et al.* (2002) argue that it is inappropriate to combine FMEA to produce a fault tree, the authors elucidate that FMEA can be used to verify a fault tree. For example, Sankar and Prabhu (2001) first implemented the FTA strategy in their study to identify the item or function to be analysed; the authors then applied the FMEA approach in identifying the failures, effects and risks associated with the function.

2.5.2.1 Lexis in Failure Mode and Effects Analysis

FMEA is a process for identifying where and how a system might fail, and to assess the relative impact or effect of the different failure modes so as to identify the parts of the system that are most in need of change.

The procedure for using traditional FMEA is based on the following steps:

- **Item (s)**: Describe the product, process or system that is under consideration
- **Function**: Develop a block diagram of the system showing the relationship between the different components or parts of the system
- **Failure (s)**: Each component of a system or product is analysed to determine failure modes. A potential failure mode is an explanation of the manner in which a product, process or system could fail to carry out its expected purpose. Anker (2002) defines failure as ‘the inability of any asset to do what its users want it to do’.

- Effect (s) and Cause (s) of Failure (s): The potential causes and effects of each failure mode are then determined. A potential effect of a failure mode is a consequence or result that a customer, process or operation might encounter.
- Risk Priority Number (RPN): The risk priority number (product of the frequency of occurrence, detection ability of failure, and severity of the effect failure mode) for each failure is computed so as to establish numerical ranking for the effects of the failures. The occurrence rating is concerned with the rate at which a cause of a failure mode would take place (occur). The detection rating is concerned with probability that a current control will identify (detect) a failure mode before it takes place. The severity rating in the FMEA methodology is concerned with the seriousness (severity) of an effect of a failure mode. According to Pillay and Wang (2003), severity is an ‘assessment of how serious the effect of the potential failure mode is on the customer’
- Ranking: The failure modes are then prioritised based on their risk priority numbers
- Current Control (s): Hence, any modifications is based on the RPN
- Recommended Action (s): Define actions to address failures with very high RPN
- Execute recommended actions, then re-assess the RPN

2.5.2.2 Applications of Failure Mode and Effects Analysis

Though Failure Mode and Effects Analysis was first applied in the aerospace industry, research shows that for over a decade, FMEA has been applied in other and different fields of study. There exists vast amount of its application in the manufacturing (Hawkins and Wollons 1998) and automotive sector (Aldridge *et al.*, 1991; Price and Taylor, 2002; Xu *et al.*, 2002; Guimarães and Lapa, 2004a; Toeh and Case, 2004). Price and Taylor (2002) applied automated FMEA in electrical systems so as to obtain not just multiple failure modes but also the single failure modes. The authors used this approach to obtain a

simulation of good and faulty versions of a circuit design, and presented a report on the difference between the two versions.

Pillay and Wang (2003) applied FMEA in the marine sector. The authors first applied the fuzzy logic approach to express the three factors in traditional FMEA (severity, occurrence and detection), after which they applied the grey theory approach to rank the events (failures).

With respect to the application of FMEA in the construction sector, Teng and Ho (1996) applied the technique in order to evaluate and facilitate reliability and failure mode analysis in a product's design and manufacturing stages. Anker (2002) extended the application of the technique in his study for better solution for moisture proof buildings. Anker (*ibid.*) states that FMEA provides a better understanding of failures in buildings, as well as the effects and corrective methods for the failures.

There is also evidence of FMEA application in the service sector (Rotondaro and de Oliveira 2001; Vermilion 2002; Rhee and Issi 2004; Chuang, 2007). Rotondaro and de Oliveira (*ibid.*) used FMEA to improve service quality. The authors used the technique to identify how service (possible errors and effects) could fail in achieving its intended purpose. They then prioritised each error based on their RPN. The authors define the Risk Priority Number as:

$$\text{RPN} = S * O * D * R$$

where S = severity (importance of the error or effect on the customer requirements)

O = occurrence (frequency at which a certain cause occurs and generates failure)

D = detection (system capacity to detect the failure before the customer)

R = recuperation (process capacity to correct the service before the customer perceives the failure)

Vermilion (2002) states that with the use of FMEA in the service industry, possible failures in the service process are identified and eliminated, thereby resulting in highly minimised customer dissatisfaction. Rhee and Issi (2004) applied FMEA approach in the service sector in terms of measuring failures and risks in costs. The authors, with an aim to address the shortcomings in the traditional evaluation of the Risk Priority Number in FMEA, propose a new approach (life cost-based FMEA) to weigh the expected life cost of failure in the preliminary stage of design. More recently, Chuang (2007) applied FMEA technique in the service delivery system of a hypermarket store. The author used a service blueprint, which was first developed to determine the potential failures in the service activities of the store. According to Chuang (*ibid.*), a service blueprint is a ‘map or flowchart that shows all transactions constituting the service delivery process’. FMEA was then applied to prioritise the critical failures of the system and to adopt required actions so as to improve the performance of the service design.

Zhou and Stålhane (2004) show an evidence of the application of the FMEA approach to IT and Web research. The authors used FMEA to identify robust critical elements or failures, which form part of the application logic that are prone to failure as a result of external errors. They further used the technique to prioritise the likely causes of the failures, and then developed actions to either eliminate or minimise the effects of the failures.

The health and medical sectors are no exception in the application of the FMEA technique (Radermacher *et al.* 2004; Tellefsen 2005). Radermacher *et al.* (2004) applied FMEA technique to identify the failure modes and effects of the problems encountered by users in

the application of technical equipment in medicine. They adopted FMEA method by classifying the problems or errors into five groups and defining criticality for each problem based on its impact on the final result. The criticalities were:

- At what point of the process does the consequence of the error occur and how hard/how likely is it to correct the problem?
- If it is possible to correct the error, how hard/how likely is it to detect this?
- Is it possible to compensate the consequences of the error, hence error correction is not necessary?

Scipioni *et al.* (2005) applied FMEA methodical approach by identifying anomalies (failures) in the ingredients/ food chain (system), and evaluated the incidence of the anomalies on the finished product. The authors then analysed the ingredients by assessing their risk using the formula:

$$\text{Risk} = \text{Likeness} * \text{Severity}$$

The risk of ingredients was then grouped into significant (RS) and non-significant (RNS).

This then led to the definition of corrective/ preventive actions to prevent the occurrence and control the effects of the anomalies.

2.5.2.2.1 Benefits and Relevance of FMEA to Satisfaction Research

In this present research, FMEA has been identified to have the potential for analysing satisfaction attributes. This is supported by other studies that directly or indirectly show the potentials for FMEA. These include the following:

- Increased customer satisfaction (Teng and Ho 1996; Vermilion 2002; Dhillon 2003; Smith 2008)
- Increased consistency in service quality (Vermilion 2002)
- Reduction of costly design changes
- Increased product and process reliability (Teng and Ho 1996; Smith 2008)
- Reduction of transaction costs
- Facilitation of continuous improvement (Teng and Ho 1996)
- Creation of common language amongst team members (Vermilion 2002)
- Improves quality and safety of the process (Teng and Ho 1996; Dhillon 2003; Smith 2008)
- Consolidation of customers' key requirements (Shahin 2004)
- Reduction of process development time and cost (Teng and Ho 1996; Smith 2008)
- Documentation of risk reduction activities (Teng and Ho 1996; Smith 2008)
- Improves communication in design process (Dhillon 2003)

2.5.3 Quality Function Deployment (QFD)

QFD was developed by Yoji Akao in the 1960s for translating customer requirements into engineering or technical requirements using market research (Menon 1992). It is a functional planning technique used to ensure the deployment of the customer's voice throughout the different stages of the product-life-cycle (Franceschini 2002). Crowe and Cheng (1995); and Hunt and Xavier (2003) elucidate that QFD can be used for strategic formulation and planning purposes. According to Han *et al.* (2001), it is a structured approach that starts by matching customer requirements with corresponding design specifications as well as other necessary corresponding requirements to ensure that customer needs are met.

QFD provides a systematic and informal approach of communication between the customer and the organisation or developer (Herzwurm and Schockert 2003). Menon (1992) states that the effective implementation of QFD requires three key factors, which are correct and timely information, knowledgeable individuals, and a disciplined manufacturing process. In addition, Franceschini (*ibid.*) argues that the implementation of QFD requires the collaboration of all the staff in an organisation. Research show that several successful organisations such as IBM, Hewlett-Packard, Unisys, Motortola, NTT Data Communication, SAP, Siemens, Toyoto have applied and implemented the QFD technique (Franceschini 2002; Herzwurm and Schockert 2003). In addition, Crowe and Cheng (1995) state that the application of QFD results in cost reductions, better designs, better product-life cycle and improved product quality.

2.5.3.1 QFD Procedure

The QFD procedure or approach involves the translation of customer requirements into specifications for different planning processes and quality control (figure 2.3).

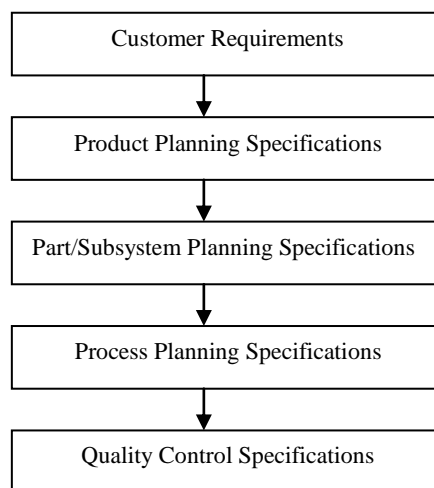


Figure 2.3: The QFD Approach

Source: Franceschini (2002)

The procedure usually involves the use of matrices, also known as the *House of Quality* (HOQ): figure 2.4. During the QFD process and through the use of the matrices, customer requirements are translated into design and component features as well as into operational instructions (Crowe and Cheng 1995).

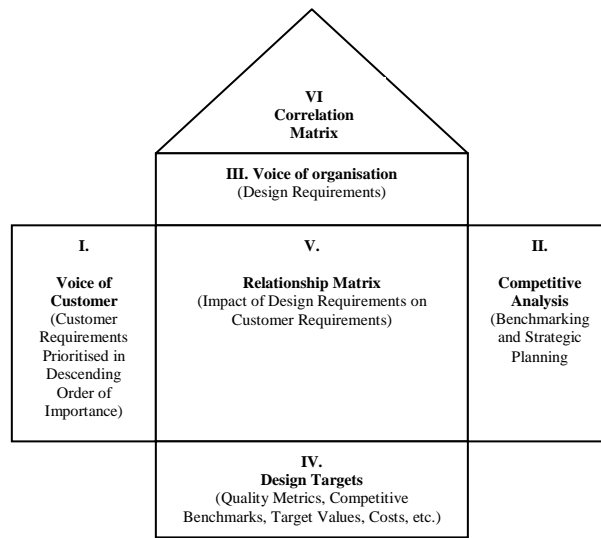


Figure 2.4: QFD House of Quality

Source: Franceschini (2002)

- **I. Voice of Customer:** This, also known as ‘*whats*’, includes the factors that are required by the customers.
- **II. Competitive Analysis:** This shows the relative competitive performance of the product.
- **III. Voice of Organisation:** This, also known as ‘*hows*’, includes the different design characteristics, which incorporates customer requirements within the product.
- **IV. Design Targets:** These represent the technical assessment of the product/ service, as well as the importance of each design characteristics.

- **V. Relationship Matrix:** This section presents the link and relationship between the voice of customer (*whats*) and voice of organisation (*hows*).
- **VI. Correlation Matrix:** This includes any correlational information regarding the design characteristics.

Source: Modified from Slack *et al.* (2001)

2.5.4 Rationale for Adopting Reliability Techniques in Research

To further relate the three aforementioned reliability techniques to satisfaction, a comparison is made between the three techniques with respect to the scope and objectives of this research. This is to establish the rationale for employing the techniques in this research. The comparison shown in table 2.2 would help to select the most appropriate techniques required for developing the proposed framework illustrated in chapter 6.

Table 2.2: Comparison between FTA, FMEA and QFD in Relation to Research Objectives

Research Interests/ Objectives	FTA	FMEA	QFD	Sources
Structured and logical	√	√	√	Plata and Olsen (1976); Ericson II (2000); Han <i>et al.</i> (2001); Herzwurm & Schockert (2003)
Focus on main element (customer)	√	√	√	Menon (1992); Crowe and Cheng (1995); Franceschini 2002); Rausand and Hoyland (2004); Chen <i>et al.</i> (2007)
Focus on organisation (other participants in a project team)	√	√	√	Chen <i>et al.</i> (2007); Strelcová (2007)
Enables and facilitates planning/ decision making	√	√	√	Ericson II (2000); Hunt and Xavier (2003)
Creates link(s) between customer needs and organisation's requirements	√	×	√	Slack <i>et al.</i> (2001); Vesely <i>et al.</i> (2002)
Enables integration/ combination of different elements/ attributes	√	√	×	Teng and Ho (1996); Price and Taylor (2002); Vesely <i>et al.</i> (2002); Papadopoulos <i>et al.</i> , (2004); Zhou and Stålhane 2004
Enables ranking of attributes/ elements in a system	√	√	√	Sankar and Prabhu (2001); Anker (2002); Radermacher <i>et al.</i> (2004);
Highlights critical elements or areas in a system	√	√	×	Dhillon and Singh (1981); Rotondaro and de Oliveira (2001); Vermilion (2002); Chuang (2007)
Specifies corrective actions for a system	×	√	×	Rhee and Ishii (2003); Zhou and Stålhane (2004)
Can be integrated with other reliability tools e.g. FTA, FMEA, QFD	√	√	×	Sankar and Prabhu (2001); Vesely <i>et al.</i> (2002)

2.6 NEED FOR A SATISFACTION ASSESSMENT INTEGRATED FRAMEWORK

The above findings and arguments show that past research have demonstrated focus on the satisfaction requirements of the client or project owner, indicating that little emphasis has been placed on the requirements of other members of the construction project team. Recognition and understanding of the requirements of the participants in a given phase of the life cycle of a construction project is an important measure and indicator for success (Parfitt and Sanvido, 1993; Cheung *et al.*, 2000; Chan and Chan 2004).

Furthermore, the above satisfaction models show that the satisfaction relationships amongst the project participants so far have been widely addressed in a one-directional manner. This is a situation where satisfaction attributes of the main client, and the attributes between the main client and the main contractor are extensively addressed with little research on satisfaction issues relating to other project participants. In addition, the need for an approach or system that will bring different groups or parties together in order to improve the productivity and success as well as reduce dissatisfaction in the construction sector have been highlighted by researchers (Howell 1996; Akintoye *et al.*, 2000; Payne *et al.*, 2003; Kärnä *et al.* 2004; Baiden *et al.*, 2006; Mbachu and Nkado 2006).

Therefore, in order to ensure optimal and efficient project delivery and sustainability, it is essential that the satisfaction of the project delivery team and in the wider context, the project owner and other project participants be considered. This identified need was therefore used to protract the research aim and objectives stated in the next section.

2.7 RESEARCH AIM AND OBJECTIVES

In order to address the above literature review findings, a satisfaction assessment integrated framework (SAIF) is hereby proposed and afterwards developed. The framework intends to provide a mechanism for capturing the satisfaction attributes of the main client and other participants involved in a construction project; a method for weighing the attributes as a procedure for placing focus and defining hierarchy for the attributes. Furthermore, the framework endeavours to provide a platform for ensuring an integration of the participants and their satisfaction attributes; as well as provide adequate strategy for assessing the participants.

The main aim of this research is to develop an integrated framework that can be used to assess satisfaction levels of members of a construction project team in different stages of the project life cycle. In order to achieve this aim, five key objectives were defined as follows:

- To explore the structure of construction project teams, and identify satisfaction attributes that may affect their performance during the delivery of a project
- To identify and analyse relevant satisfaction models, and formal systems engineering techniques most suited for representing the satisfaction relationships of members of a construction project team
- To design a mechanism/ conceptual framework for capturing and prioritising the importance of each satisfaction attribute for different members of a construction project team.
- To devise a method that enables the rating of the assessment of different members of the project team in relation to satisfaction

- To implement the framework in the form of a ready-to-use web-based toolkit by integrating the system engineering techniques

2.8 SUMMARY

This chapter presented the satisfaction theory as viewed by different researchers and philosophers. In addition, perceptions of several researchers and studies were explored from the marketing and psychological sectors. The arguments and investigations presented in this chapter show that this research is an eclectic study. This is to say that the theoretical base for satisfaction lies in the marketing and psychological fields, which aids understanding by providing the essential underpinnings behind satisfaction and its constructs. This chapter further reviewed the state of satisfaction and its attributes in the construction sector. Subsequently, relevant satisfaction models and frameworks were explored, highlighting their strengths and weaknesses. Furthermore, pertinent reliability techniques were explored in order to exploit the most suitable techniques for developing a framework for assessing integrated project team satisfaction. The gap identified from the review formed the basis upon which the aim and objectives of this research were defined as stated in this chapter.

CHAPTER 3: DEVELOPMENT OF SATISFACTION ATTRIBUTES

3.0 INTRODUCTION

Having identified several satisfaction attributes required by clients and participants of the construction project team, it becomes necessary to define an approach that enables adequate management of the attributes. The review carried out in the preceding chapter show that cost, quality, and time have long been highlighted (for almost three decades now) as basic satisfaction requirements of the project participants. Furthermore, the safety of the construction site and the project team has also been identified as a vital satisfaction requirement though not as much as the three aforementioned requirements. This chapter defines the approach or module, which categorises and groups the satisfaction attributes under these four key requirements (or groups). The module contributes to the novel assessment system developed in this research.

3.1 KEY SATISFACTION CATEGORIES & SATISFACTION ATTRIBUTES

Researchers have identified satisfaction as a complex and multi-dimensional concept (Linder-Pelz 1982; Oliva *et al.*, 1992; Bendall-Lyon and Powers 2004; Lovaglio 2004), indicating that satisfaction can be understood and improved upon based on its attributes and parameters. For instance, each project has its own distinctive customer requirements (g4c 2006). Therefore, it is important that the contractor, for instance, recognises and understands clients' factors and parameters for satisfaction (bearing in mind that clients' needs vary) and then attempt to exceed these parameters by constant review and measurement (Torbica and Stroh 2000; Kärnä 2004) of the satisfaction levels. The same also goes for the client to understand what the contractor requires. This is to say that, a

properly-defined list of clients, project participants and their requirements (*satisfaction attributes*) is a good starting point for success of construction projects and headway to high client and participant satisfaction. Egemen and Mohamed (2006) state that a thorough identification of clients' hierarchy of needs is now considered a prerequisite for success in the construction sector. Furthermore, though Smyth (1999, cited in Dulaimi 2005) argues that constant observation of client requirements is not a practice in the construction industry, constant review of these satisfaction attributes is essential to ensure improved satisfaction of the clients and participants. This is because these attributes or requirements for satisfaction are subject to change as the project progresses. In addition, the importance assigned to the satisfaction attributes varies with the types of client (Egemen and Mohamed 2006).

Satisfaction attributes form a frame of reference through which satisfaction measures and strategies are created. The construction sector needs to evaluate the different satisfaction attributes to ensure total or complete satisfaction. This is because according to Kärnä *et al.* (2004), though a customer is satisfied with the overall purchase or project delivery, he may be dissatisfied with a specific service encounter. More so, customer satisfaction is produced through a combination of response to, meeting of the customers' needs (or satisfaction attributes) and constant improvement of the product (Jonsson and Zineldin 2003). Therefore, adequate and timely knowledge of which attributes affect satisfaction would lead to maximum satisfaction (Torbica and Stroh 2001; Kärnä 2004).

3.2 CQST MODULE

The satisfaction attributes, considered as the central concept of this research framework are synthesised and conceptualised into four key categories or classes (figure 3.1). These are cost, quality, safety and environment, and time. These categories are collectively called the *CQST Module*. Several researchers have identified quality, time and cost as critical parameters required by construction clients and participants (example see Rwelamila and Hall 1995). In the categorisation of the satisfaction attributes, the research made an inclusion of an essential factor (safety and environment), which helps to consider the life and wellbeing of the project team. Subsequently, this helps to capture and present a more detailed picture about the satisfaction requirements of construction clients and the project participants. These four categories are distinguished by their dimensions (called satisfaction attributes, in the context of this research), as illustrated in table 3.1, which help to determine their relative importance and correlation.

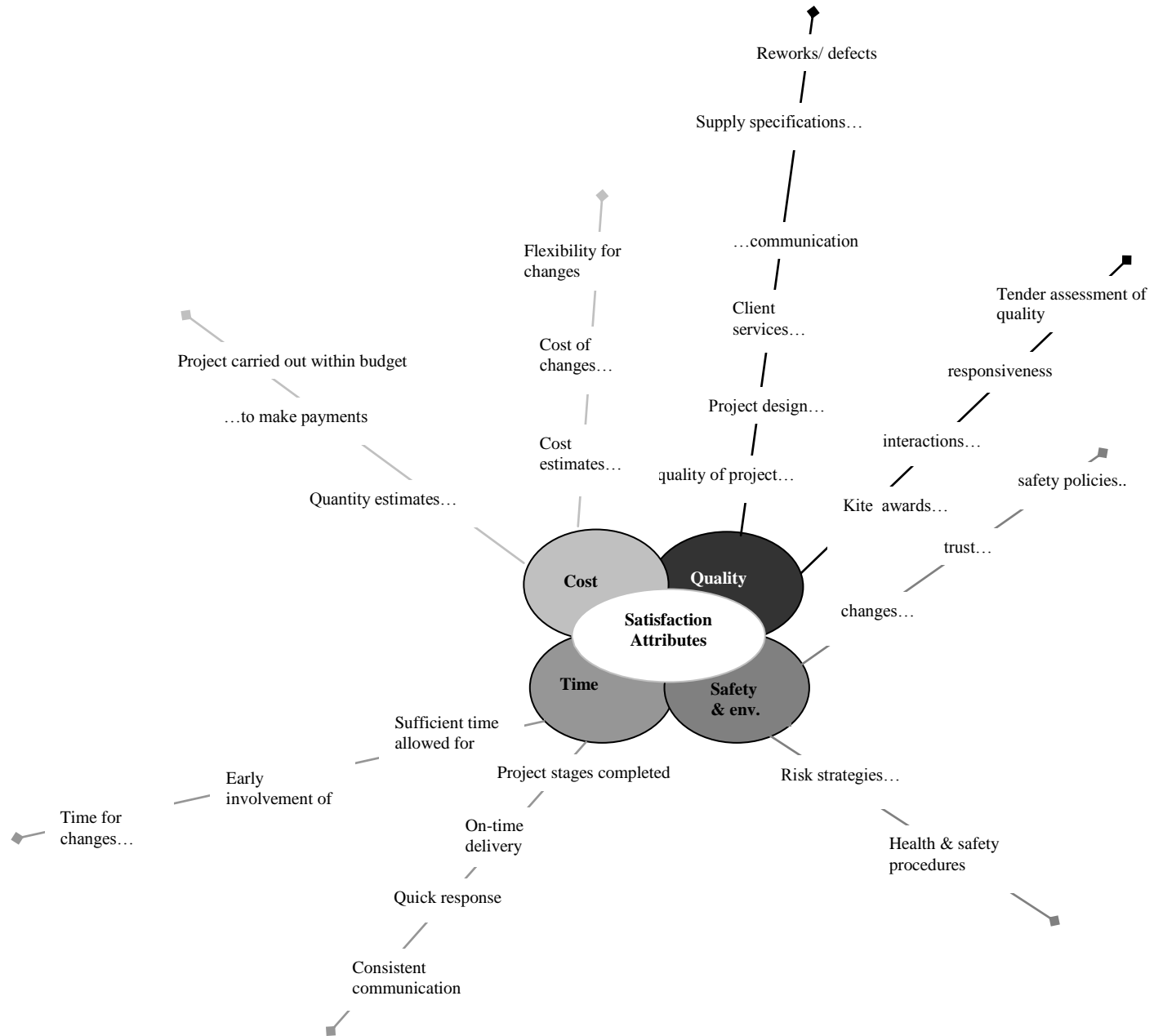


Figure 3.1: Categories or Classes of Satisfaction Attributes

3.2.1 Cost Category

The cost class or category C comprises the satisfaction attributes and assessment criteria that relate to budget, cost of variations or changes. It is defined as:

C_{sai} where C_{sai} represent the satisfaction attributes that fall into the cost class
 sai represent satisfaction attributes

AND

C_{aci} , where C_{aci} represent the assessment criteria that fall into the cost class
 aci represent assessment criteria

3.2.2 Quality Category

The quality class or category Q comprises the satisfaction attributes and assessment criteria that relate to features, design, and services. It is defined as:

Q_{sai} where Q_{sai} represent the satisfaction attributes in the quality class

AND

Q_{aci} where Q_{aci} represent the assessment criteria that fall into the quality class

3.2.3 Safety and environment Category

The safety and environment class or category S comprises the satisfaction attributes and assessment criteria that relate to risk, & secure working environment. It is defined as:

S_{sai} where S_{sai} represent the satisfaction attributes that fall into the safety and environment class

AND

S_{aci} where S_{aci} represent the assessment criteria that fall into the safety and environment class

3.2.4 Time Category

The time class or category T comprises the satisfaction attributes and assessment criteria that relate to consistency, duration, and instance. It is defined as:

T_{sai} where T_{sai} represent the satisfaction attributes in the time class

AND

T_{aci} where T_{aci} represent the assessment criteria that fall into the time class

Table 3.1: Classification of Satisfaction Attributes into Key Categories

Key Categories	Satisfaction Attributes
COST	Project is carried out within contractually agreed budget
	Cost of changes are fairly priced
	Ability of client to make payments
	Payment for project is made as contractually agreed
	Ensures that cost estimates are in accordance with my requirements
	Allows flexibility for changes or modifications
	Project quantity estimates are accurately billed
QUALITY	Quality of project is of the desired standard
	Project design contains sufficient and accurate details
	Good client service
	Effective communication
	Contracting body has a record of recognised kite awards (credibility & reliability)
	Client actions and interactions
	Tender assessment of quality, not just price
	Project consultants are responsive to questions & clarifications
	Minimal reworks & defects
	Project supply specifications contains sufficient details
SAFETY and environment	Health & safety procedures are with no incidents
	Strategies for managing and assessing any project risks are in place
	Trusts my capability to deliver
	Ensures that there is minimal defects in supply
TIME	Project schedules are detailed & easy to understand
	Each phase of the project process is completed on time
	Ability to meet deadlines/ on-time delivery
	Communication flow is consistent
	Response to complaints is quick & productive

	Changes and cost of changes are introduced as early as possible
	Early involvement of contractor
	Sufficient time is allowed for tender

3.3 COST

According to Bubashait and Almohawis (1994), and Chan and Chan (2004), cost is the extent to which the general conditions buttress the project completion within the estimated budget. Hatush and Skitmore (1997a) assert that cost has remained a critical requirement of clients over the years. The relationship of cost to satisfaction is analysed from a cost curve shown in figure 3.2.

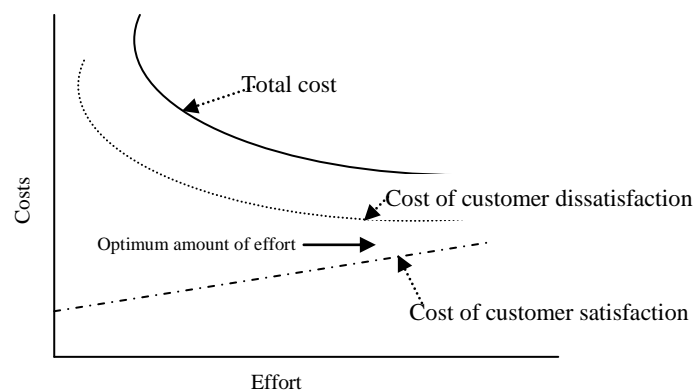


Figure 3.2: Customer Satisfaction Cost Curve

Source: Modified from Slack *et al.* (2001) p684

The customer satisfaction cost curve (figure 3.2) shows that the total cost and the cost of customer dissatisfaction decrease as the cost of satisfaction increases. This indicates that the costs of recovering unsatisfied customers, wasted and defected products can be minimised when emphasis and focus is placed on the customer needs and the necessity to satisfy them (cost of satisfaction). This in effect increases the company gain and profit margin (customer retention and investment). In addition, the empirical findings presented

by Love *et al.* (2000) elucidate that lack of recognition of the needs of the client and the project participants contributed to cost overruns.

This research use the concept explained in figure 3.2 to explore and analyse cost in relation to satisfaction based on the attributes that have been identified as (cost) requirements by construction clients and the project participants. These are:

- Ability to make payments
- Project is carried out within contractually agreed budget
- Payment for project is made as contractually agreed
- Ensures that cost estimates are in accordance with my requirements
- Allows flexibility for changes or modifications

3.3.1 Ability to make Payments

It is not every job that comes that a contractor bids for (Odusote and Fellows 1992). The authors' analyses show that the 'client's ability to pay for the work' is the most important and highly ranked requirement of contractors before they can actually choose a particular project or client. In addition, Kometa *et al.* (1996) show that the financial ability of the client or project owner has a significant influence on the performance and satisfaction of the contractor.

3.3.2 Contractually Agreed Budget

Carrying out projects within specified or expected budget is usually one of the major requirements of clients and project owners. Fellows *et al.* (2002) elucidate that clients usually use budgeting techniques that are aligned to their needs and requirements. This is

to say that, given that client requirement has a significant impact on client satisfaction, doing a project as much as possible within a project owner's budget terms has an impact on their satisfaction. The findings of Egemen and Mohamed (2006) show that clients consider 'Price that the contractor firm offers (compared to the client's estimate)' as their most important satisfaction need or requirement from contractors. This is to say that clients in the construction sector place very high importance on the price offered to them, especially in relation to their budget. More so, a survey carried out by Soetanto *et al.* (2001) showed that clients recorded a high priority on project adherence to budget.

3.3.3 Flexibility for Changes or Modifications

Researchers have suggested the need to allow flexibility for changes made in projects as an approach to examining clients' requirements (Love *et al.*, 1998b). In addition, considering that the clients' and participants' requirements change, especially depending on the phase of the project, there is the need to allow flexibility in the project to adopt such changes, in order to ensure satisfaction of the clients and participants.

3.3.4 Accurately billed Project Quantity Estimates

In a construction project setting, the designer is usually expected to compile the estimate of the project construction quantities (SCDOT 2006). Adequate preparation and verification of the quantity estimate document has a significant impact on the satisfaction of the project participants.

3.4 QUALITY

Arditi and Gunaydin (1997) define quality as ‘meeting the legal, aesthetic and functional requirements of a project’. The authors argue that attainment of the required level of quality is an issue in the construction sector. According to Kiesow (1995), quality is about what customers want and not just about meeting specifications. Fornell (1992) identifies quality as an antecedent of client satisfaction, while Palaneeswaran *et al.* (2006) considers quality as an element of satisfaction. Scholtes *et al.* (1996) state that quality can be defined as an understanding of customer needs and usage for a product or service. In addition, achieving quality in construction projects can be regarded as satisfying or fulfilling the expectations of the project participants (Barrett 2000).

The concept of quality can further be understood within a theoretical study on quality presented by Weihrich (1994). Here the author presented quality based on two factors (Reliability and Salability). The reliability dimension/ factor of quality as discussed by Weihrich is aimed at eliminating defects and satisfying customers while the salability factor is aimed at motivating customers to invest based on their perception of and benefit from the product.

This research discusses quality based on the following dimensions or satisfaction attributes as shown in table 3.1:

- Quality of the Project is of the Desired Standard
- Project Design and Supply Specifications contain Sufficient Details
- Good Client Services
- Effective Communication
- Client Actions and Interactions

- Tender Assessment of Quality, not just Price
- Minimal Reworks & Defects

3.4.1 Quality of the Project

In their study on quality performance, Torbica and Stroh (1999) pointed out two approaches to quality: conformance to requirements approach and customer satisfaction approach. The first approach explains quality in relation to meeting the criteria or specifications of a facility. The second approach explains quality in relation to meeting the requirements of the customer. The two approaches are considered essential for this research because the first approach places emphasis on the requirements of say the designer or contractor (other members of the construction project team) while for the second approach, emphasis is placed on the requirements of the customer (main client or project owner, in the context of this research). This is to say that quality is an attribute that is required not just by the customer but also by other construction stakeholders (or project participants). In addition, considering that both approaches have strengths and weaknesses (Torbica and Stroh 1999) associated with them, it is important that the quality requirements of the client and other construction participants be adequately acknowledged and understood.

3.4.2 Project Design contains Sufficient Details

Research has shown that over 50% of faults or errors in construction are as a result of deficiencies in design (Oyedele and Tham 2007). Significant quality plans and decisions are usually made in the design phase. Decisions made for designs or in the design phase of the construction process has an influence on rework, change orders, and budget (Love *et al.*, 1998a); delivery time and quality (Smith *et al.*, 1998). Smith *et al.*, (*ibid.*) argue that

problems such as late delivery, poor quality that arise due to inadequate design, do so because focus is not placed on the requirements of the designers. Quality needs to be viewed with respect to its conformance to the project design specifications and customer requirements. Therefore, since the utmost desire and aim of any industry is to retain its customers and spend less on its customer acquisition, it is important that the design requirements be planned such that they actively incorporate the user (customer) requirements. For example, the level of service given to the main client is determined by the designer's ability to produce and provide appropriate project design information between the participants. In his discussion on quality in design, McConachy (1996) carefully considered and incorporated assessment of the requirements of the customer and the project team members.

3.4.3 Good Client Services

Service is an important factor required by clients from any organisation. The pressure and demand generated by construction customers or clients for quality and improved service (Bresnen *et al.*, 1990, cited in Smith *et al.*, 2001; Zheng *et al.*, 2004) has challenged the industry to become more effective, devising and integrating means to meet, improve and possibly exceed its customer requirement and satisfaction. Services rendered by an organisation, or contractor has a significant impact on client retention. According to Maloney (2002), the services provided by a contractor to the customer provide an avenue for contractors to enhance their satisfaction strategies to the customers. He further argues that the positive or negative service encounter of the customer would result in high or low satisfaction. In addition, Yasamis *et al.* (2002) state that project owners expect the provision of quality service from the contractors. However, it is vital that goals and strategies for client service in the construction industry be set such that it incorporates all

the project participants, the industry policies and the participants' satisfaction attributes, indicating that adequate service is an attribute required by all project participants.

3.4.4 Effective Communication

Communication is a key factor that links or connects two or more individuals together. It entails keeping someone or project participants informed, and listening to one another. Maloney (*ibid.*) emphasises on the need for workers of a company to communicate with one another in a language they understand, even if it means adjusting one's language. Keeping the project participants informed of any change or modification in project specifications for instance is critical to avoid defects, time and cost overruns. Effective communication helps to minimise the client's uncertainty and hence improve their satisfaction (Maloney 2002), as well as enhance the assessment of the project participants by the client. Research has shown that there is significant relationship between communication and satisfaction (Ganesan 1994; Jonsson and Zineldin 2003; Leung *et al.*, 2004). This is because enhanced communication amongst construction participants provides clients with the necessary information required to make safer and better decisions. The findings by Jonsson and Zineldin (2003) show that companies with high satisfaction levels have their suppliers communicating more than companies with low satisfaction levels. Furthermore, in a study by Done (2004), the author shows that construction teams with better communication experienced better results. Dozzi *et al.* (1996); Cheng *et al.* (2001) and Smith and Love (2001) further state that communication generates benefits in the performance of the construction project in areas relating to reduced cost, reduced re-work and quality time. As would be seen in the computational analyses discussed in chapter 7, communication is a fundamental satisfaction attribute required by key participants of the construction project (main contractors, engineers, designers). Furthermore, effective and frequent communication helps to eliminate any misconceptions

that could result in project defects. Josephson and Hammarlund (*ibid.*) add that defects can be linked to the project participants having the lack of coordination and communication amongst them.

3.4.5 Client Actions and Interactions

Clients' actions during the duration of a project have a significant impact on the capability of contractors and consultants (Kometa *et al.*, 1996). Dun and Bradstreet (1986, cited in Kometa *et al. ibid.*) posit that the construction client is one of the key causes of failure in projects. This indicates that the client's influence on the performance of the project or satisfaction of other project participants depends on the client's reactions and inputs (tangible and intangible) to the project. More so, studies in construction have argued and stressed the need for construction clients to recognise and understand what other participants require to perform better (Kometa *ibid.*; Soetanto 2002) and to be satisfied. Devlin and Bleackley (1988) elucidate that interaction between clients and participants is essential so as to fortify the understanding, capability and relationship structure of the project team.

3.5 SAFETY AND ENVIRONMENT

For sometime now, the safety of construction project participants or workers has become an issue of critical concern. This is likely because of the high costs associated with say workers' compensation, criminal prosecutions as a result of unsafe working environment (Gambatese and Hinze 1998). Gambatese and Hinze (*ibid.*) further state that project contracts are usually given to contractors or consultants with a record of safe projects delivery. McVeigh and Hoey (2006) point out that safety improvement measure is an

approach towards reassuring customers, thereby improving their satisfaction. Though several researchers have identified accident investigations or causes, and risk management as an approach towards addressing and improving safety issues in the work/ project environment (Litske 1997; Einarsson 1998; Dyreborg and Mikkelsen 2003), little research has been done on how safety impacts on satisfaction. With an aim of improving the safety measures in the construction sector, this research relates safety to satisfaction based on a number of attributes required by the construction clients and participants, which are:

- Health & Safety Procedures are with no Incidents
- Strategies for managing and assessing any Project Risks are in place
- Trusts my capability to deliver

3.5.1 Health & Safety Procedures

Health and safety has become an issue of criticality for construction clients and the project participants because accidents and injuries, which arise due to poor health and safety measures, have a detrimental effect not just on the project, but also on the lives of the participants. Bubashait and Almohawis (*ibid.*) define health and safety as the extent to which the general conditions buttress the project completion without major accidents or injuries. Researchers have recognised health and safety as a requirement of construction clients (Dozzi *et al.*, 1996).

3.5.2 Project Risk Strategies

Projects are undertakings, which involve some degree of risk and uncertainty (Conroy and Soltan 1998; Mak *et al.*, 1998). Construction projects are no exception, considering that risks have long been identified in the construction industry (Mak *et al.*, *ibid.*). Project risk

is the probability of an event occurring that is likely to have a negative effect on the project goals and is assessed in relation to its effects (Widerman 1992, cited in Buccarini *ibid.*). Though it can be argued that risks cannot be eliminated but minimised (Burchett *et al.*, 1999), if not properly addressed, risk can have a damaging effect on the performance of the construction industry (Mills 2001). Consequently, where the industry fails to perform as expected and required by the client or the project team, it results in the client or participants not being satisfied.

3.5.3 Trust

Das and Teng (2001, cited in Eriksson and Laan 2007) define trust as the positive expectation in relation to the other party in an uncertain condition. Bennis and Nanu (2003, cited in Welch 2006) assert that trust is the lubricant required by organisations to work. Similarly, trust is an attribute required by contractors for example from the client or project owner for them to function properly. According to Zaghoul and Hartman (2003), and Wong *et al.* (2008), trust helps to strengthen willingness amongst participants and overcome risks, thereby improving safety. More so, trust plays a fundamental role in the development of long-term relationships (Williamson 1985, cited in Anderson and Weitz 1989) of construction participants. In view of this, Jonsson and Zineldin (2003) add that it is absolutely necessary for any group or relationship to operate in an environment of trust so as to achieve satisfaction. The authors' survey findings show that companies with high level of trust (and commitment) had significantly higher satisfaction.

3.6 TIME

Time is a critical parameter in people's lives irrespective of the industry or environment. It is a measurable factor, which should be utilised well, so as to improve productivity and maximise efficiency (Fried and Slowik 2004). Time, in the construction setting, is the period taken to accomplish a construction project. Chan (1997) defines construction time as the difference between the project commencement date and the practical completion date. To emphasise how important the time factor is to construction clients (as well as project participants), Hatush and Skitmore (1997a) assert that some clients include a bonus in the contracts as a measure to encourage timely completion of projects.

Time is an important measure, which has been identified by construction clients and participants as a requirement for their satisfaction, therefore, this research relates time with satisfaction based on the following attributes:

- Project Schedules are detailed and easy to understand
- Each Phase of the Project Process is completed on time
- Ability to meet deadlines/ on-time delivery
- Communication Flow is consistent
- Response to Complaints is quick & productive
- Change Orders and Cost of Changes are introduced as early as possible
- Sufficient time is allowed for tender

3.6.1 Project Schedules

Project schedule entails the plan and management of a project from inception to completion. The schedule of any project contains the different stages and/ or phases of the

project, the project participants, as well as the roles and functions of the participants. Francis-Smythe and Robertson (1999) state that time can be matched with tasks (or functions) via adequate planning and scheduling. Considering that clients' needs vary for different projects (Maloney 2002) or at different phases of a single project, it is critical to understand the clients and project participants' requirements at each phase. This is to say that understanding what each client (project participant) requires and focusing on these requirements in carrying out tasks and responsibilities (project schedules) will satisfy the participant. According to Jang *et al.* (2003), adequate planning and understanding of the project (known as 'project schedule' in the context of this research) are important factors required to increase the satisfaction of the construction customer and the company or other construction participants. In addition, Love and Edwards (2004) argue that it is essential to examine the satisfaction levels of the project team (or participants) because they have a significant impact on the project's schedule.

3.6.2 On-time Delivery

The Latham report (Latham 1994) highlighted delivery time of projects as one of the major needs of construction clients. In addition, other researchers have identified untimely completion (e.g. Rwelami and Hall 1995; Wright 1997) and delay in the delivery time of projects as having negative effect on cost and quality. On-time completion is not an attribute that is required by just the project owner; other participants of the project team also need each phase of the project to be completed on time such that they would not be faced with situations where they would have to be delayed in carrying out their functions. Hence, Cox *et al.* (2003) confirmed on-time completion as one of the top ranked indicator by construction project managers. In addition, in their empirical study, Leung *et al.* (2004) elucidate that construction participants rate 'project completed on-time' as being more

important for their satisfaction than ‘project completed within budget’, indicating the value placed on time by the participants.

3.6.3 Consistent Communication Flow

The construction project team requires *consistent* communication amongst the participants, which would enable and create change (improvement of their satisfaction attributes). In addition, consistent and improved communication has a significant effect on building the team (Wright 1997), and improving the satisfaction of the client, especially if the client is generally involved in the project process (Love and Mohamed 1996; Masterman and Gameson 1994, cited in Love et al 1998b). Furthermore, the problem of inconsistency in the prediction of tasks’ duration times (Francis-Smythe and Robertson 1999) can be addressed by promoting and facilitating communication flow amongst the project participants. Hence, improving consistency in the communication of the project participants will help to minimise overestimation (Burt and Kemp 1994) and underestimation (Buehler *et al.*, 1994) of project duration times. Consistent communication is the binding force, link or relationship between the different and several project participants. Jonsson and Zinedin (2003) add that the essence of any relationship is communication or interaction between the people or groups. Anderson and Weitz (1989) emphasise that intensive communication results in the parties being better informed and exhibiting more confidence. Etgar (1979) assert that much of communication builds trust and eliminates conflicts. In addition, consistent communication helps for proper monitoring of the project by detecting and correcting any deviations at an early stage (Wright 1997). Consistency in the communication network of the project team ensures effective project schedule (Constructech, Aug 2005), enables a better understanding of client requirements (Kärnä, 2004), as well as minimise and even eliminate errors thereby adding value to the satisfaction level.

3.6.4 Early Change Orders and Cost of Changes

Where changes, change orders and cost of changes are declared or introduced late in the project process, they have a significant effect on the schedule and delivery of the project. The survey conducted by Al-Momani (2000) identified change orders, amongst other issues, as factors that cause delays in construction projects. This creates the necessity for construction clients to get involved in the plan, management, and delivery of the project. This is because Love and Edwards (2004) assert that engaging clients in the design process, for instance, has a positive effect on change orders. Love *et al.* (1998b) stressed the need for clients to get involved and to contribute to the construction process. This is to say that when the change orders are positively impacted upon and introduced early in the project as a result of involving the client group, this has an effect on the performance and satisfaction of the project team.

3.7 SUMMARY

This chapter presented a discussion on the satisfaction attributes under four key categories: cost, quality, safety, and time. The discussions revealed the need for focus to be placed on the requirements (satisfaction attributes) of the participants. Therefore, in order to improve the quality of construction projects, the requirements of construction professionals at the different project levels need to be adequately captured.

Considering that the construction project process involves several phases that link different professionals, adequate recognition and understanding of the requirements of the project participants in a given stage is critical. Though some of the needs/ requirements are

interrelated (Ashworth 1991; Ward *et al.*, 1991), an identification of each participant's needs is critical for creating high satisfaction for the clients and participants, and success for the entire project. The succeeding chapter discusses the stages of the construction project, and the participants involved in the different stages through the analysis of the integrated project team.

CHAPTER 4: ANALYSIS OF INTEGRATED PROJECT TEAM AND PILOT STUDY

4.0 INTRODUCTION

The preceding chapters show that this research is an eclectic study, indicating that insights were drawn from different fields of study on what the clients and participants of the construction project team require from one another to ensure their satisfaction. Though different participants may require the same satisfaction attributes at the beginning of a project, the attributes may differ at different stages of the project life cycle, or may be required by an entirely different project participant. This reveals the need to ensure that the satisfaction improvement and relationship between the project participants are considered from both sides of the spectrum. This chapter is devoted to the design of project team satisfaction by investigating the stages of the construction project and the concept of the integrated project team.

Furthermore, in order to adequately capture the perceptions of the project team in terms of how they rate or value their requirements (satisfaction attributes), as well as validate the categories of satisfaction attributes discussed in the preceding chapter, the research conducted a pilot study. Hence, this chapter also discusses the steps adopted in conducting the pilot study and how the results of the study impact on the overall research process.

4.1 STRUCTURE AND STAGES OF THE CONSTRUCTION PROJECT

A construction project involves a team of participants and progresses through a number of stages: concept, design, bidding or tendering, contracting/ pre-construction, construction,

service or commissioning, and maintenance/ asset management (Uher and Loosemore 2003). Each project stage has its specifications, requirements, and project participants. Though the sequence of the project stages may vary, however an identification of these stages and the participants involved in the different stages, alongside their requirements (satisfaction attributes) helps to improve the satisfaction levels of the participants. Figure 4.1 presents an illustration of the stages of the construction project and the different participants involved in these stages.

4.1.1 Concept Stage

The concept stage is the first stage of a construction project where the main client or project owner defines his/ her needs with respect to expectations, scope, feasibility, and available budget or funds for the project. At this stage, the environmental assessments are conducted. In addition, the project owner selects and hires key project participants such as the architect, project manager, etc (Gould 2005). Here, the design requirements of the project are also specified and compiled with the already defined scope and requirements into a brief (Uher and Loosemore 2003). The brief also contain information relating to the project's conceptual layouts and engineering.

4.1.2 Design Stage

The design stage requires a translation of the client's (design) requirements into an overall design schematic plan (Bennett 2003) containing the project size, orientation, and site specification by an architect or designer appointed by the client. It is also at this stage that the participants or project team are mobilised and put in place. Here, the quantity surveyor prepares the project cost estimates; the civil engineer weighs the structural inputs; the electrical engineer determines the electrical inputs, mechanical engineer specifies the

mechanical inputs for the project. However, the team does not proceed without an approval by the client. Once accepted by the client, the design schematic plan is then converted into a more logical design plan containing detailed sketches and specifications of the architectural, structural and services aspect of the project (Bennett 2003; Jackson 2004). Finally, the design certifications are put in place after the local authority has approved the project.

4.1.3 Bidding/ Tendering Stage

At this stage of the project process, the client, with help of the architect makes a selection for a contractor based on the design specification, documentation, and a number of selection and performance criteria (contained in the tender document) (Jackson 2004). Here, a number of pre-qualified and selected contractors then present their bids, which show their cost and timeframe for the project, to the client, who makes a final decision for the contractor.

4.1.4 Contracting/ Pre-construction Stage

The contracting stage is the stage in the project process where a contractor is awarded the contract to supervise and carry out the project. In addition, a contract document containing the contract award, bidding letter, and signatures of the client and contractor, and design documentations, is prepared (Gould 2005). It is the pre-construction stage because at this stage, the contractor does not particularly start construction, but prepares the site for construction and accustoms himself with the site characteristics. Here, the project schedules and resources are outlined and organised by the project manager. In addition, the time-plan and budget are ascertained. This is to say that the framework of the project is finally defined for initial implementation.

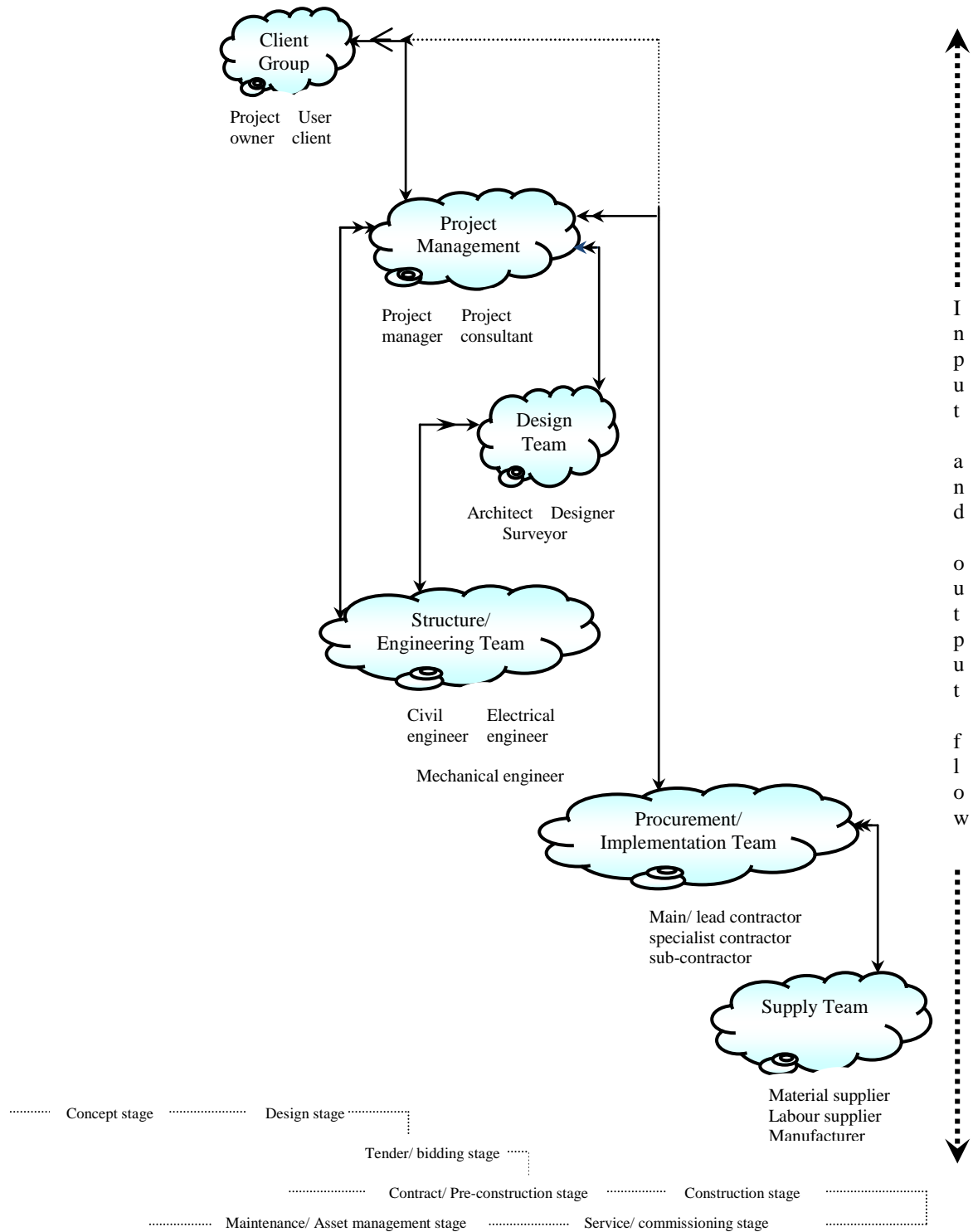


Figure 4.1: Generic Configuration of the Construction Project Team and the Project Stages

4.1.5 Construction Stage

The construction stage commences as soon as the contractor is in charge of the site. It involves the implementation of the design plans envisaged by the architect/ designer and engineer. Here, the contractor deploys the pre-planned schedules and resources and ensures adequate delivery of the project within proposed budget plans. The construction stage involves making use of various resources ranging from equipment, materials, finance and human resources (Shen *et al.*, 2007). At this stage, the different organisations and professionals get involved, including subcontractors, specialist contractors, labour & material suppliers, consultants, etc. working towards a common and *shared* goal. According to Gould, (2005), given that this stage entails the actual physical construction of the project, this stage requires the participation of the entire project team.

4.1.6 Service/ Commissioning Stage

It is at this stage of the project that the project officially comes to an end, and the contractor is expected (under the contract terms) to commission the services of the project, and correct any faults in terms of satisfying the client or project owner.

4.1.7 Maintenance/ Asset Management Stage

Considering that the completed project is an asset, it is necessary that the project consultant or project manager have in place strategies for maintaining and managing the project (asset) on a long-term basis as well as for future economic capability. This stage of the project process is essential because it involves the maintenance and the periodic assessments, which are conducted to confirm the functionality of the structure (Pan 2006).

4.2 INTEGRATED PROJECT TEAM (IPT) AND SATISFACTION

Integration of construction professionals can take different forms as can be seen from several studies and investigations. This research draws its concept on integration of the construction project team from studies on integration, collaboration and partnering.

The integrated project team is a team ‘in which all the members have the same opportunity to contribute and all the skills and capabilities on offer can be utilised to maximum effect’ (Strategic Forum 2008). This implies that the integrated project team requires every member of the project team to value the contributions and capabilities of one another so as to ensure utmost output.

Integration of the construction project team exists where there is mutual support existing amongst all the members of the team and the team members listening to one another. According to Scholtes *et al.* (1996), the success of a team depends largely on the team’s ability to listen to and understand each other. Integration of the project team goes beyond just the project owner and contractor organisations as stated by Larson, (1995) but includes all the project participants (Chua *et al.*, 1999).

Baiden *et al.* (2006) points out the need for collaboration of project participants in order to address problems associated with time and cost issues. Barratt (2004) states that collaboration, amongst other elements, includes developing relationships, integrating processes between supply-chain functions. According to Harmon (2003), the construction process involves a collaboration of the team and individuals working together to achieve a common goal.

With respect to partnering or partnership, Pinnell (1999) explains partnering as a process of creating teamwork amongst the construction stakeholders. Black *et al.* (2000) define partnering as a situation where construction project participants work together with trust and openness, and without conflict to produce an efficient project. Harding (2001) asserts that partnership adoption in construction is a step towards creating a better understanding of customer needs. Crouse (1991) elucidates that partnership is an approach that needs to be adopted so as to meet and satisfy customers. According to Appel (1993), partnering creates an edifice for building teams that develop open communications, mutual respect and trust. The construction National Audit Office (2001) presents two forms of partnering, which are project partnering and strategic partnering. Project partnering entails the client organisation and the main contractor working as a team on a project, while Strategic partnering is a situation where the client organisation and main contractor work together on several projects so as to facilitate incessant improvement.

The need for integration in the construction project team can be traced to as far back as the 60s (Emerson 1962; Banwell report 1964). The Latham, (1994) and Egan, (1998; 2002) reports emphasise the need for integration at the project site level, as well as with the suppliers and clients. The report on 'modernising construction' by Bourn (2001) elucidate that the entire supply chain needs to be integrated in order to apply and manage value to the construction process.

Goodman and Chinowsky (1996) elucidate that the construction team is built through a complex integration of issues with diverse participants, with different roles, functions and goals. These diverse disciplines and the different stages involved in a construction project have contributed to the fragmented nature of the construction industry. Amor and Anumba (1999), in their study identified lack of integration and inadequate implementation of client needs amongst other factors as the consequences associated with fragmentation in

industries. According to Anumba (2000), not until recently, the varied disciplines involved in a construction project tend to work independent of each other. Egan (*ibid.*) highlights integrated team and processes as parameters for client satisfaction. In view of this, according to Scholtes *et al.* (1996), the expertise and viewpoints of a team must be brought together so as to succeed in today's competitive environment. Subsequently, Harding (2001) argues that in order to develop better understanding of customer requirements and expectations, there is need to adopt partnering in the construction process. The closest study to the impact of integration to satisfaction is the study by Fawcett and Cooper (2001) where the authors elucidate the importance of enabling process integration so as to meet customers' needs and to improve competitive success.

An illustration of the construction project team, shown in figure 4.1, indicates that there is a relationship between the participants. For adequate undertaking of the tasks and attainment of satisfaction of the team, each participant needs reliance and dependence on the information and resources provided by other participants. In the construction process, the tasks and/or processes carried out in one phase or by one partner could most likely be the driver or satisfaction parameter for another phase or partner. This is to say that the outcome of a particular project phase has an effect on the succeeding phase. For example, a study carried out by Jang *et al.* (2003) identified contractor's organisation, material and information flow as the most important satisfaction parameters for the project manager. In the perspective of this research, these satisfaction attributes for one participant (project manager) emphasise the importance of the tasks and responsibilities of another participant (main contractor). Through this research, attempts have been made to encourage and facilitate project team integration by analysing and highlighting its impact on cost, quality, safety, and time issues.

This is to say that the level and extent of integration existing in the project team has an impact on the satisfaction level of team. Therefore, in order to evaluate the impact of the integrated project team on satisfaction, this research used a number of attributes as presented in table 4.1.

Table 4.1: Illustration of Attributes Used to Weigh the Impact of the Integrated Project Team on Satisfaction

Categories	Satisfaction Attributes	Symbol for Attributes
Cost (C)	Flexibility: Opportunity to offer alternatives and innovation	FLX
	A greater value in project delivery	VAL
Quality (Q)	Better management of a complaint & response system	RSP
	Improved image of the contractor	IMG
	Fewer defects in delivery & future processes	DFT
	Less generation of wastes	WST
Safety (S)	Improved transition into the different project stages	TRN
	Safer working conditions	SFR
Time (T)	Consistency in techniques and procedures	CNS
	On time delivery of projects	OTM
CQST	Mutual benefits for the entire project team	BNF
	Environment where individuals can work together efficiently & effectively	ENV
	Focus on shared goals and ideas	GOL
	Better alignment of the entire project team	ALN
	Better decision-making strategies due to open & vast ideas	DCN
	Continuous improvement of processes and results	CTS
	Opportunity to learn from own and others' mistakes	LRN

4.3 FIELD INVESTIGATIONS AND RESEARCH METHODS

The quest to identify the perceptions of not just construction clients but other participants of the construction project team in terms of their priorities for the identified satisfaction attributes, drove this research to engage in a pilot study. Therefore, the reasons for conducting a pilot study include:

- To generate and populate data for the proposed framework targeting three key groups of the construction industry discussed later in this section
- To allocate values to the identified satisfaction attributes

- To identify how the satisfaction perceptions of the project participants affect the requirements and expectations of the client at different stages of the project life cycle
- To highlight the satisfaction attributes that every participant represented in a given construction project team indicate as being most critical at any given project stage and how this impacts on the entire project team
- To enable a comparative analysis on the perceptions of the project team based on the level of importance assigned to each satisfaction attribute by the participants
- To identify how integrated project team positively impacts on satisfaction

Two key research methods/ approaches (interview and questionnaire) were adopted for the pilot study process. The process diagram for the pilot study is shown in figure 4.2.

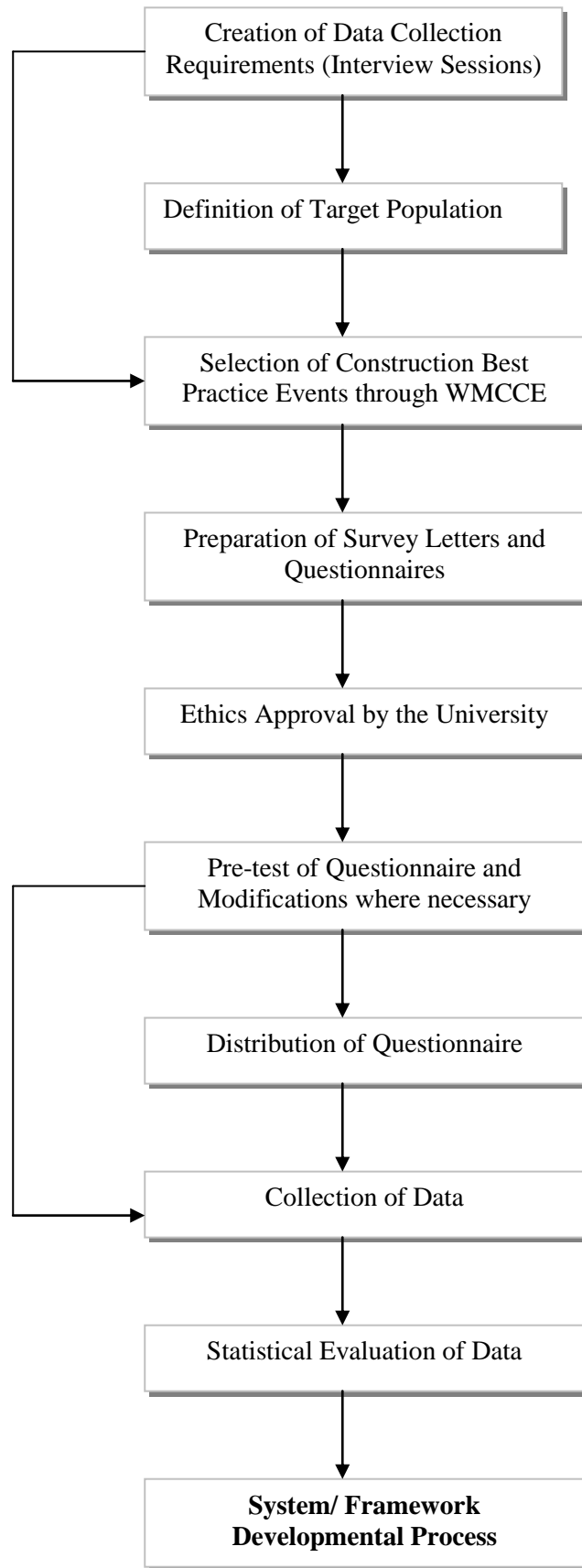


Figure 4.2: Process Diagram of Pilot Study

4.3.1 Target Population

For the purpose of this research, the target population is the construction clients and project participants (as defined in chapters 1 and 2). However, given that it is impossible to cover every single client and project participant involved in construction projects in this research, it becomes essential to sample the population through a targeted approach. The stratified sampling approach was adopted where the research divided the sample population into three strata or groups (target respondents) and then an investigation was carried out on the three strata (Triola 1995). The three broad groups are the Client Group, Project Management Group, and Supply Group. Subsequently, the respondents used for the pilot study were drawn from the database of construction organisations involved in the West Midlands Centre for Constructing Excellence (WMCCE) business assist events. This is to say that the pilot study benefitted from inputs ranging from diverse industrial associates in the UK construction industry. These include Women in Construction, UK; Birmingham City Council; Wolverhampton City Council; GCA (UK) Limited; West Midlands Centre for Constructing Excellence (WMCCE); Edmund Nuttall Limited; WSP Group; Birse Civils Limited; Atkins; AMEC, Ecolac, Costain Limited, Moss Construction; The Wilkes Partnership etc. In addition, the invaluable inputs generated from these companies through the pilot study involved different participants and professionals in the construction sector, ranging from main contractors, project managers, suppliers, designers, engineers, architects, and sub-contractors.

4.3.1.1 Client Group

The first group of the target audience relates to the client group. These are individuals that are the actual initiator and owner of the project. The requirements of the client group are considered as the driving force to the construction project concept and instigation. In view of this, constant focus on their requirements would facilitate and enhance the sustainability

of the industry. The client group pays for the project. This includes the main client or project owner, the client advisor, and/ or the project consultant.

4.3.1.2 Project Management Group

The second group of the target audience known as the project management group, includes the actual participants and workers involved in the construction project. The group includes the project manager, the architect / designer, surveyor, engineers, lead or main contractor, specialist contractor (s), and sub-contractor (s).

4.3.1.3 Supply Group

The third group of the target audience known as the supply group, includes the manufacturer, material and labour suppliers.

4.3.2 Interview Approach

The first approach for the pilot study process involved successions of unstructured and informal interview sessions with professionals in the construction sector. The interview process involved 5 Senior Engineers/ Contractors and Senior/ Project Managers with consulting and academic experience in construction. The information obtained using the interview approach helped in defining the target population for the pilot study. The interview sessions were conducted in such a way where the 5 participants were approached directly and on a face-to-face basis. On average the interviews lasted circa 60 minutes.

The outcome of the interview sessions resulted in the development of the questions used in the survey discussed in the following section. This is to say that the data generated from the interview were analysed and interpreted under common themes, in terms of the four categories of satisfaction attributes, discussed in the preceding chapter.

Particularly, the interview approach was employed to acquire in-depth knowledge of the construction industry, the participants that make up the construction project team, the relationship between them, and to capture a sense of what satisfaction attributes are perceived to be to the project participants. In addition, the inductive or interview method was employed to identify reasons why certain satisfaction attributes are specifically required by a certain group of the target population (Collis and Hussey 2003).

4.3.3 Survey Approach/ Method

In order to allocate values to and verify the importance of the satisfaction attributes, the self-administered survey approach was adopted where the respondents were presented with questions, and afterwards their responses were collected using the questionnaire collection method. The self-administered survey is a research process of gathering information about any subject area in order to obtain vital information and gain deeper understanding of the proposed study. Kujala and Ahola (2005) elucidate that customer satisfaction survey is one of the most common ways of obtaining information regarding customer needs and satisfaction.

4.3.3.1 Questionnaire Approach

The questionnaire approach is a technique in which individuals (known as the respondents) are asked and required to respond to a set of questions in a predestined manner (de Vaus 1996). Questionnaire is one of the most feasible and realistic approaches for obtaining information from respondents. This is to say that the second approach (questionnaire) adopted for the pilot study enabled the research to quantify the attributes (Collis and Hussey 2003), thereby creating a platform for weighing and relating the satisfaction

attributes. In addition, the questionnaire approach enabled the research to measure satisfaction objectively, thereby reducing any uncertainty (Unrau *et al.*, 2005).

Through the pilot study, a satisfaction-focussed questionnaire was designed to seek information from the target respondents. The questionnaire design was based on a combination of an extensive and careful review on satisfaction in the construction industry, construction best practice events organised by WMCCE, and detailed information as identified by the Construction Strategic Forum, Constructing Excellence and Construction Online.

A pre-test of the questionnaire was conducted using experts with a minimum of ten years experience in the construction industry who are part of construction best-practice events. This was done to measure the questionnaire's coherence and structure and its relevance to the context of the study. The responses gathered from the experts led to some modifications as well as the validation of the questionnaire. The questionnaire was then administered to 30 participants of the research sample, who reside within the different regions of the United Kingdom. The questionnaire was administered to the respondents through WMCCE's construction best practice events, after which the responses were collated. Three questionnaires targeting the three groups (sample) of the construction project team were developed. Details of the contents of the questionnaires used for the pilot study are contained in Appendix C of this thesis. Each questionnaire also requested that the respondents indicate what role they occupy in the construction project team. This helped to carefully analyse the satisfaction requirements, and opinions of the respondents so as to determine whether their responses varied with the roles or positions they occupy.

The first section of each questionnaire investigated the respondents' perceptions for the satisfaction attributes. Through this section, the study evaluated the perceived or rated

importance of the satisfaction attributes. These attributes were identified from previous studies on satisfaction. A likert scale of 1-5 was provided for each attribute to note down the respondents' level of importance where 5 was 'strongly agree', 4 was 'agree', 3 was 'somewhat agree', 2 was 'disagree', 1 was 'strongly disagree'. Tables 4.2, 4.3, and 4.4 show the satisfaction attributes required by the three groups. Details of what these satisfaction attributes entail and how they fit into the four categories: cost, quality, safety and time have been discussed in chapter 3.

Table 4.2: Illustration of the Satisfaction Attributes of Client Group

Categories	Satisfaction Attributes	Symbol for Attributes
Cost (C)	Project is carried out within contractually agreed budget	Csa1 _{cg}
	Ensures that the cost of changes are fairly priced	Csa2 _{cg}
	Allows flexibility for changes or modifications	Csa3 _{cg}
Quality (Q)	Project design contains sufficient details	Qsa1 _{cg}
	Client services are open & friendly	Qsa2 _{cg}
	Project Management group has a record of recognised kite awards (e.g. ISO, Investor-in-people, Construction Line, Business Improvement, Best Practice awards)	Qsa3 _{cg}
	Open and honest communication	Qsa4 _{cg}
	Minimal reworks & defects	Qsa5 _{cg}
	Implements and deploys ICT tools & processes in its operations (e.g. CRM, ERP, Database Management, Web-based tools, etc)	Qsa6 _{cg}
Safety (S)	Health & safety procedures are with no incidents	Ssa1 _{cg}
	Strategies for managing any project risks are in place	Ssa2 _{cg}
Time (T)	Project is completed on time	Tsa1 _{cg}
	Project schedules are detailed & easy to understand	Tsa2 _{cg}
	Communication flow in the team is consistent	Tsa3 _{cg}
	Response to complaints, or changes is quick & productive	Tsa4 _{cg}
	Cost of changes are introduced as early as possible	Tsa5 _{cg}
	Ability to meet my deadlines	Tsa6 _{cg}

Where Csa1_{cg}, Csa2_{cg}, and Csa3_{cg} stand for cost satisfaction attributes 1, 2, and 3 belonging to the client group (cg).

Similarly, Qsa1_{cg} Qsa2_{cg} Qsa3_{cg} Qsa4_{cg} Qsa5_{cg} and Qsa6_{cg} stand for quality satisfaction attributes 1, 2, 3, 4, 5,6 belonging to the client group, etc.

Table 4.3: Illustration of the Satisfaction Attributes of the Project Management Group

Categories	Satisfaction Attributes	Symbol for Attributes
Cost (C)	Payment for project is made as contractually agreed (Ability to make payments)	Csa1 _{pmg}
	Changes are fairly introduced	Csa2 _{pmg}
	Cost estimates are in accordance with my requirements	Csa3 _{pmg}
	Allows flexibility for changes or modifications	Csa4 _{pmg}

Quality (Q)	Project design contains sufficient details	Qsa1 _{pmg}
	Project consultants are responsive to questions & clarifications	Qsa2 _{pmg}
	Open and honest communication	Qsa3 _{pmg}
	Client interactions are open & friendly	Qsa4 _{pmg}
	Minimal defects (in supply)	Qsa5 _{pmg}
	There exists tender assessment of quality, not just price	Qsa6 _{pmg}
Safety (S)	Health & safety procedures are with no incidents	Ssa1 _{pmg}
	Strategies for managing and assessing any project risks are in place	Ssa2 _{pmg}
	Trusts my capability to deliver	Ssa3 _{pmg}
Time (T)	Each phase of the project process is completed on time	Tsa1 _{pmg}
	Communication flow in the team is consistent	Tsa2 _{pmg}
	Response to complaints, changes, or clarifications is quick & productive	Tsa3 _{pmg}
	Changes are introduced as early as possible	Tsa4 _{pmg}
	Ability to meet my deadlines	Tsa5 _{pmg}
	Project schedules are detailed & easy to understand	Tsa6 _{pmg}
	Sufficient time is allowed for tender	Tsa7 _{pmg}
	There exists early involvement of contractor	Tsa8 _{pmg}

Where pmg stand for project management group

Table 4.4: Illustration of the Satisfaction Attributes of the Supply Group

Categories	Satisfaction Attributes	Symbol for Attributes
Cost (C)	Payment for supplies are made as contractually agreed	Csa1 _{sg}
	Changes are fairly introduced	Csa2 _{sg}
	Allows flexibility for changes or modifications	Csa3 _{sg}
Quality (Q)	Project supply specifications contain sufficient details	Qsa1 _{sg}
	Project consultants are responsive to questions & clarifications	Qsa2 _{sg}
	Open and honest communication	Qsa3 _{sg}
Safety (S)	Health & safety procedures are with no incidents	Ssa1 _{sg}
Time (T)	Communication flow in the team is consistent	Tsa1 _{sg}
	Project schedules are detailed & easy to understand	Tsa2 _{sg}
	Changes are introduced as early as possible	Tsa3 _{sg}

Where sg stands for supply group

The second section investigated the respondents' perceptions on the integrated project team and the impact of the integration of the project team on satisfaction. This section investigated how the integrated team impacts on satisfaction using a likert scale of 1-5 to evaluate the respondent's level of agreement of each factor.

It is important to note that this research is not solely based on the survey; therefore the questionnaire technique does not drive the research or the proposed framework. The questionnaire technique was used as the first component of the proposed framework to collect the user requirements. In addition, the questionnaire technique was used to verify and validate the four categories of the satisfaction attributes, discussed in the previous chapter. This is to say that the questionnaire technique served as pedestal for defining the specifications of the proposed framework, discussed in the following chapter.

4.3.3.1.1 Ethical Considerations

Ethical approval was sought and obtained from the Ethics Committee of the University. In addition, each questionnaire, divided into two sections, was preceded by a covering letter, which explained the study's objectives and explained the potential benefits of the questionnaire to the respondent or participant (Appendix B). Participation was completely voluntary. Furthermore, as stated in the covering letter, issues of strict confidentiality were established by ensuring the use of project team roles and not respondent's name.

4.3.4 Application of Results of Pilot Study and Data Evaluation

Considering that there exist different project stages and project participants, the satisfaction attributes of these participants also vary. Similarly, the participants in one project stage could still be involved in succeeding project stages, indicating that the satisfaction attributes required by one participant could still be required by another participant. Results of the pilot study show that other project participants besides the main client perceive satisfaction as being an essential requirement for successful project delivery. Furthermore, results from the pilot study indicate that the level of importance rated for the satisfaction attributes by the respondents vary. For example, the results (figure 4.3) reveal that over 60% of the respondents belonging to the project management

group perceived ‘csa1’, ‘qsa3’, ‘qsa4’, ‘qsa5’, ‘ssa1’, ‘ssa2’, ‘tsa2’, and ‘tsa4’ as their most important satisfaction attributes indicated by their recordings for ‘strongly agree’ for the afore-mentioned attributes.

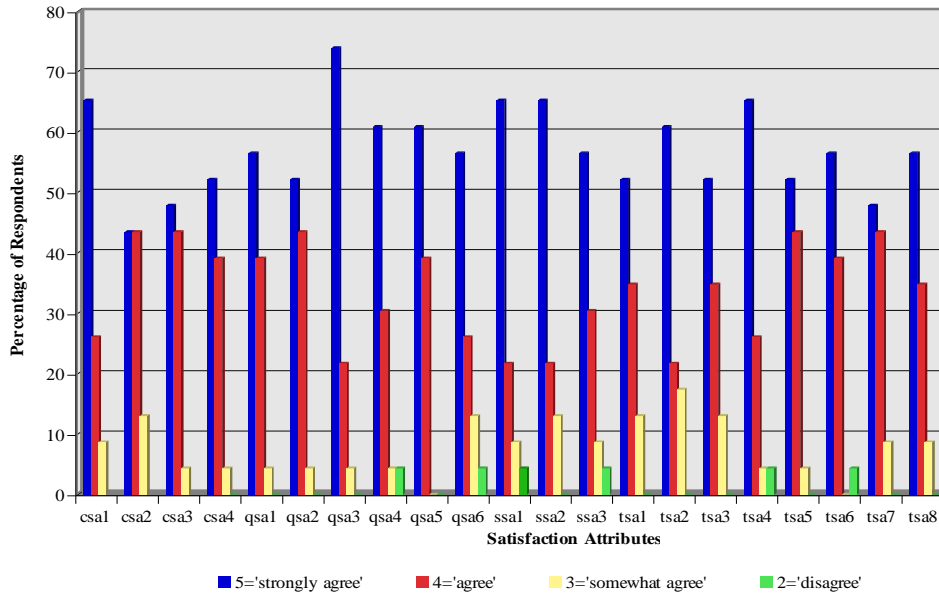


Figure 4.3: Percentage Response Rate for the Satisfaction Attributes (PMG)

A small percentage (less than 5%) of the respondents disagree that ‘qsa4’, ‘qsa6’, ‘ssa1’, ‘ssa3’, ‘tsa4’, and ‘tsa6’ are attributes for their satisfaction. However, in general, more than 50% of the respondents strongly agree that all the listed 21 attributes are required for their satisfaction.

In order to ensure adequate purification and validity of the data generated from the pilot study, a pre-test of the questionnaire was carried out as earlier mentioned in section 4.3.3.1. The validity of the data is discussed in details in chapter 8. Additional analyses, in terms of the findings of the pilot study, and generation of outcomes for the proposed framework of this research, are conducted in chapter 7. Furthermore, using the results of the pilot study, the research was able to identify how the integrated project team impacts

on satisfaction. In addition, the outcomes reveal the importance associated with the category of satisfaction attributes as perceived by the project team.

4.4 SUMMARY

This chapter started by discussing the different stages of the project life cycle and the participants involved in these stages. The arguments presented in this chapter show that integrated project team has been identified and stressed upon by several researchers as one of the key challenges facing the industry. The chapter also presented evidence on the need for the integration of the project team as a means for placing focus on, and meeting the satisfaction requirements of the project participants.

Furthermore, having stated the reasons for engaging in a pilot study for this research, the chapter detailed the approach employed in conducting a pilot study. The main data collection tool adopted was the questionnaire, which involved administering the designed questions to the sample population. In order to capture the different sectors and categories of participants involved in construction projects, the study divided the sample population into three strata comprising the client group, project management group, and the supply group. The questionnaire technique and findings of the pilot study helped to define the functional and modular specifications of the proposed framework discussed in the following chapter.

Furthermore, the pilot study findings and concepts underpinning the development of proposed framework prompted and enabled the design of a conceptual framework discussed in the succeeding chapter.

CHAPTER 5: SYSTEM SPECIFICATIONS AND CONCEPTUAL FRAMEWORK FOR SATISFACTION ASSESSMENT

5.0 INTRODUCTION

Preceding chapters have highlighted the acknowledgement of each participant and their requirements as being vital to improving project satisfaction in the construction sector. In order to explore the satisfaction relationship between participants of the construction project team and the importance associated with the team's satisfaction attributes, a conceptual framework that logically integrates the different clients and participants, and captures the importance associated with their satisfaction attributes, is developed through this research.

This chapter presents a conceptual framework that considers and highlights the need to satisfy different members of a construction project team by ensuring an integration of the different project participants and their satisfaction attributes. Here the basic concepts underlying the proposed framework and its systems specifications are discussed. This is to say that this chapter discusses what the proposed framework would do through the system specifications, and how the framework would be developed through the conceptual framework.

5.1 SYSTEM SPECIFICATIONS

Following the definition of the satisfaction attributes and the development of the integrated project team, the research defined the systems specification of the proposed framework to address the requirements of the framework including the following issues (figure 5.1):

- Functional and modular specifications of proposed framework
- Interface Specifications: Attributes or parameters of satisfaction
- Performance and integrated specifications of framework

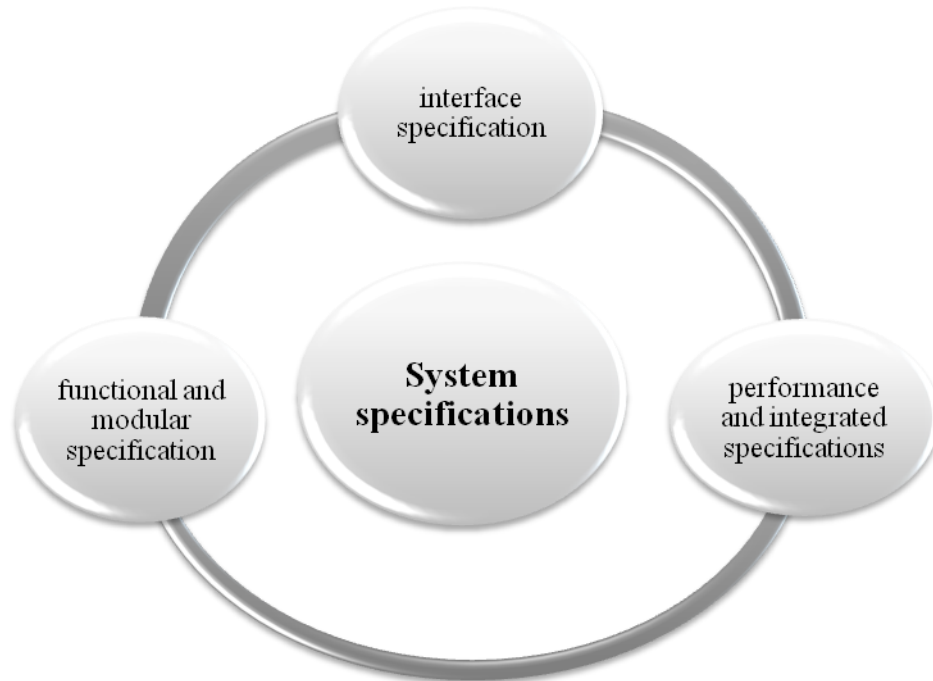


Figure 5.1: System Specifications

5.1.1 Functional and Modular Specifications of Proposed Framework

The framework is aimed to carefully observe and measure the concept of satisfaction, and assessment of construction clients and project participants. The entire framework will be formulated using tree-structure analogy represented by elements. The elements include project participants like the main client, project manager, contractor, architect, designer, etc. Each element will have processes and satisfaction parameters associated with it. The processes are the varied tasks and responsibilities carried out by the elements. The parameters are the needs and requirements for satisfaction improvement in construction.

Subsequently, the framework will employ an ability to define the needs and requirements for satisfaction, that is, the possibility to add values to the needs. It would also entail a collaboration of the project participants, their tasks and satisfaction requirements by providing an integrated structure for assessing the satisfaction levels of the clients and project participants. Through the provision of a pedestal for determining the extent of the practice of team integration in the project team, the framework would measure the dynamics of satisfaction and quality in the construction sector. This is to say that the framework allows dynamism and flexibility such that satisfaction can be evaluated and enhanced based on the team's individual and collective satisfaction and assessment attributes.

5.1.2 Interface Specification: Attributes or Parameters of Satisfaction

Satisfaction has over three decades been used as an evaluation technique (Guttek, 1978). This is to say that in trying to understand satisfaction, its features, parameters or attributes need to be carefully investigated. For instance, Lovaglio (2004.), in his study identified a number of parameters or variables for estimating satisfaction. The author allocated weights to these variables such that a comparison could be made on the effects of the variables on satisfaction. However, some other researchers assert that satisfaction can be measured as a singular overall construct (Czepiel and Rosenberg 1977, cited in Mbachu and Nkado 2006). Zikmund (1994), and Mbachu and Nkado (*ibid.*), on the other hand argue that satisfaction is evaluated based on a combination of attributes, which determine the overall satisfaction. To view and understand how the satisfaction attributes could be used to assess satisfaction, the framework attempts to capture client and project participants' needs, while discussing satisfaction and assessment (performance) of members of the construction project team. This is to say that the proposed framework provides a means for identifying the needs (satisfaction attributes) of construction clients from different participants and vice versa of the construction process. It further

enables the categorisation and prioritisation of the satisfaction attributes. The categorisation helps to ensure adequate management of the attributes while the prioritisation helps to create a hierarchy of the attributes.

5.1.3 Performance and Integrated Specifications of Framework

The performance specification of the proposed framework addresses the mathematical approaches and implementation capabilities of the framework. The mathematical architecture of the framework is such that the participants' needs and requirements are scaled at different stages of the project life cycle. As earlier mentioned in the functional specification, the mathematical model enables the ability to weigh the importance or value of the needs or satisfaction attributes of participants. The recognition of the importance given to the satisfaction attributes by the participants is necessary so as to improve the satisfaction level of the project team.

In its implementation, the framework applies the idea behind tree structure analyses in evaluating the integrated project team. This is to say that based on network of participants involved in the construction project, the framework ensures that a sequential flow exists amongst the participants. This is because where for example, the sub-contractors (assumed to be at the lower level of the project network) do not have their requirements fully acknowledged or met, their tasks and commitment/ loyalty to the work is affected thereby affecting the entire project. This could afterwards result in the dissatisfaction of other participants, including the main or user client.

The integrated specification and design of the proposed framework involves a detailed evaluation of the different components of the framework. The components are afterwards organised into a sequential approach and programmed into a web-based format using the

hypertext mark-up language (HTML), Hypertext Preprocessor (PHP) and Server Query Language (MySQL) database. The web-based format, which entails the development of a prototype platform through which the framework would be tried out, ensures the reliability, validity and robustness of the framework.

5.2 A CONCEPTUAL FRAMEWORK FOR SATISFACTION ASSESSMENT IN THE CONSTRUCTION SECTOR

A conceptual framework or model is a set and map of ideas and concepts, and the interrelationships between the ideas. Through this research, a conceptual framework that provides a sound and systematic foundation for developing and linking the different perceptions and specifications of the proposed framework is developed. The conceptual framework combines the concepts of satisfaction, satisfaction attributes and satisfaction assessment, with an aim to determine to what extent the *clients** meet one another's satisfaction attributes when being assessed. Though the need for satisfaction in the construction industry has been emphasised by researchers (Egan 1998; Torbica and Stroh 2000; Kärnä 2004; Constructech 2005), the industry has not fully embraced the practice of satisfaction (see figure 5.2).

*clients** = construction clients and project participants

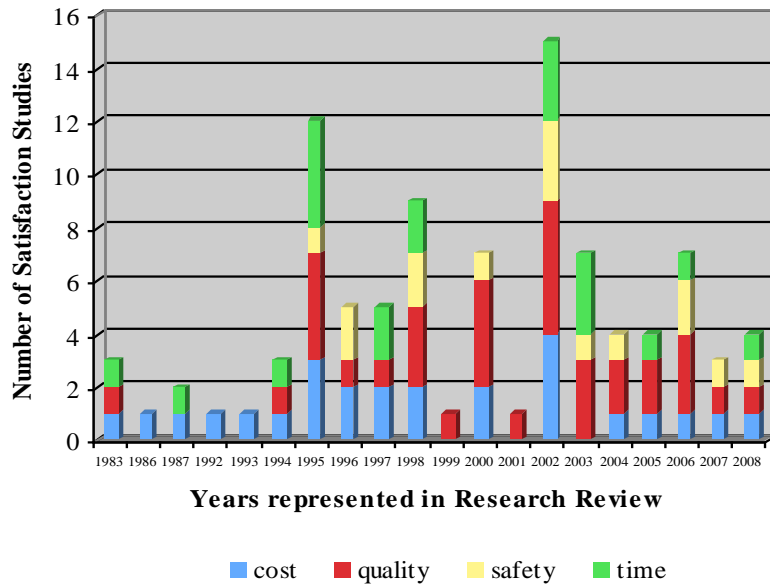


Figure 5.2: Satisfaction Trend in the Construction Industry

The graph, which was produced (figure 5.1) from the review conducted by this research on satisfaction (chapter 2) shows that the issue of satisfaction is still at an evolutionary stage in the construction sector (Torbica and Stroh 2001), and has not been fully embraced by the industry. This is probably because of the fragmented nature of the industry. In order to address the issue of fragmentation in the industry, an assessment tool that enables integration with some sort of incentive for the participants is required.

Hence, the conceptual framework, shown in figure 5.3, by enabling adequate integration of the project team, and their satisfaction attributes, aims to enhance the assessment ratings of the clients and project participants and subsequently improve their satisfaction levels. The framework is designed to assist project owners and project participants to systematically identify their satisfaction attributes, the relative importance of the attributes, and to assess one another based on the extent at which their satisfaction attributes are met.

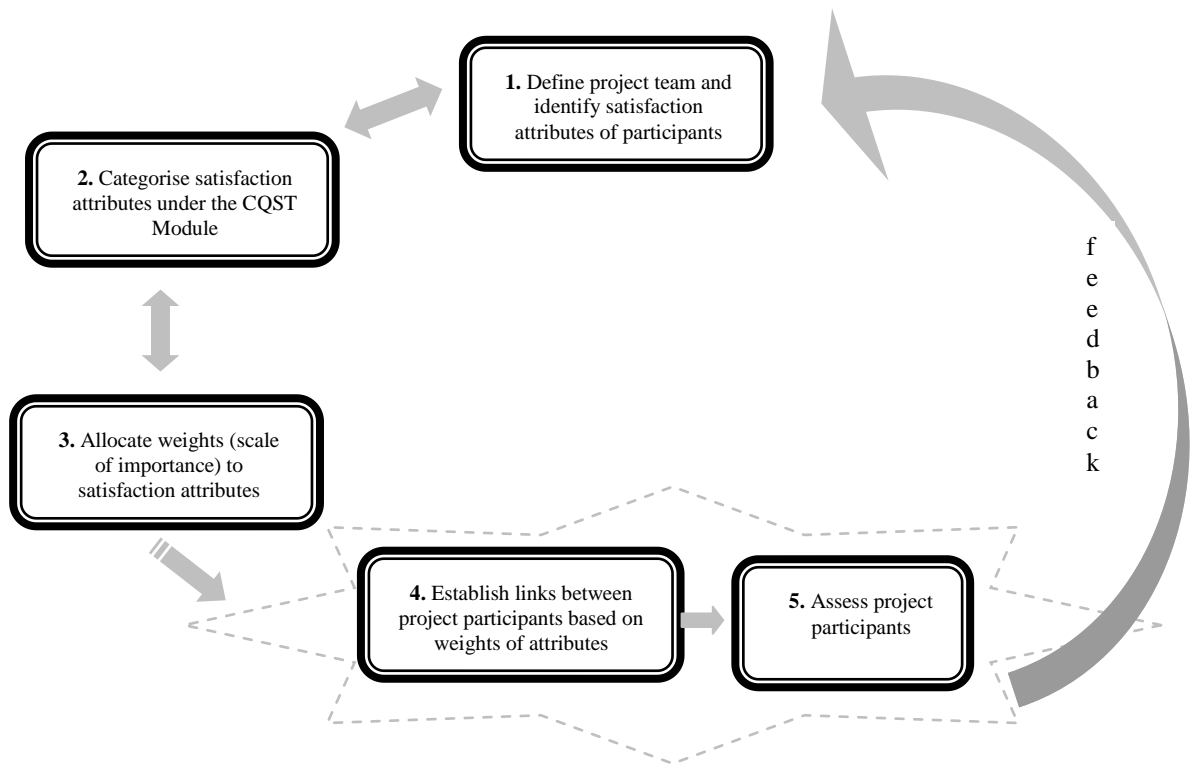


Figure 5.3: Conceptual Framework for Satisfaction Assessment in the Construction Sector

5.3 DEFINE PROJECT TEAM AND IDENTIFY SATISFACTION ATTRIBUTES OF PARTICIPANTS

As earlier mentioned in chapter 4, a construction project is a significant effort involving large dedicated construction professionals that make up a team, and mainly requires the association of several stakeholders. The construction project team consists of professionals, including the main client/ project owner, project manager, main contractor, architect, engineers, surveyor, sub contractors, suppliers, etc. Each member has a responsibility, though the overall function of the project depends on the entire team.

Just as defining the nature of a project is necessary and significant, so also is the definition of the participants. This is to say that the definition and creation of the project team distinguishes from project to project. According to Nordqvist *et al.* (2004), the complexity of tasks and processes for the project team differs. Therefore, defining the participants and their satisfaction attributes is a critical requirement of the framework because it forms the platform on which the framework is put into operation. Moreover, the dynamics and complexities of construction projects vary, so also do the participants. In addition, it can be argued that the clients may not be aware of their needs and attributes for satisfaction at the initiation of the project (Turner 1993), therefore a system that enables the definition of satisfaction attributes at each stage of the project process, again considering that participants at each project stage vary is needed.

5.4 CATEGORISE SATISFACTION ATTRIBUTES UNDER THE CQST MODULE

In order to create a balance in the four most identified satisfaction requirements of construction clients and project participants, which are cost, quality, safety, and time, the research embraces these four categories (distinguished by their dimensions known as satisfaction attributes and assessment criteria, in the context of this research) in its conceptual framework. These four requirements or categories, already discussed in chapter 3, are collectively called the CQST Module. Grouping or categorising the attributes helps to present an overall blueprint of the satisfaction attributes. Since there is a considerable response of studies on the need for these four categories, it is therefore important that all factors and phases of the construction project embrace these four categories.

5.5 ALLOCATE WEIGHTS TO SATISFACTION ATTRIBUTES

In order to associate some measure of importance to the satisfaction attributes, a technique that defines values for the attributes becomes necessary. This is to say that applying some level of importance to the satisfaction attributes helps to create a hierarchy for the attributes, thereby ensuring that priority is placed on meeting them. Defining importance indices for the attributes helps to improve satisfaction, given that focus is placed on the hierarchy of satisfaction attributes. Figure 5.4 shows a matrix between importance index of an attribute and satisfaction.

Effect on Satisfaction	Evident	<ul style="list-style-type: none"> • Better project deliveries • Trust and confidence between client and project participants 	<ul style="list-style-type: none"> • Improved project processes and project performance • New project and market development
	Perceived	<ul style="list-style-type: none"> • Improved communication & information flow • Improved client-project participant relationship 	<ul style="list-style-type: none"> • Better integration of the project team • Enhanced task performance
		Initial	Future/ Strategic

Importance Indices for Satisfaction Attributes

Figure 5.4: Relationship between Importance Index of Satisfaction Attribute and Satisfaction

5.6 ESTABLISH LINKS BETWEEN PROJECT PARTICIPANTS

Having defined values for the *team's** satisfaction attributes, a proactive method or technique that enables the integration of the construction clients and project participants by creating links between the team members based on the hierarchy of their satisfaction attributes is required. Zaccaro *et al.* (2001) state that the ability of the team members to integrate their individual tasks creates an effective performance of the team. This further helps to ensure that emphasis is placed on every participant's requirements, with the aim of improving the project delivery. In addition, the links between the participants indicate that the satisfaction level of the participants is interdependent. Litwak and Hylton (1962, cited in Li *et al.*, 2002) state that interdependency is defined as when two or more groups must take one another into account as a prerequisite to accomplishing their goals. Thus, Nordqvist *et al.* (2004) state that there exists interdependency among participants of a team, in terms of achieving greater satisfaction. Therefore, in order to meet the requirements of the client, interdependencies need to exist in the team, indicating the need for a tool or approach that enables interdependency.

5.7 ASSESS PROJECT PARTICIPANTS AND DETERMINE SATISFACTION

Though there currently exists methods for assessing the performance of key participants (client, architect, main contractor) of a construction project team (e.g. Soetanto 2002), there is still dearth of comprehensive assessment process that takes into consideration the several construction project participants and their flexible number of satisfaction attributes. Given that performance of each project participant is interdependent, it is then essential

*team's = clients and project participants

that the participants assess one another at the end of a project stage, at completion of work, and most essentially before the commencement of the project based on previous performance.

In view of the above, a logical structure for the assessment of the project owner and project participants with regards to satisfaction and satisfaction attributes is needed to ensure that focus is placed on each participant's requirements. Through the assessment, the assessment score for each participant is derived. This is to say that the assessment score of a client/participant is determined by assessing the functioning of the client/participant through the range of the satisfaction attributes specified by the assessor (another client/participant) involved in the project. A client/participant has one satisfaction score, such that the client/participant's requirements or satisfaction attributes are defined right at the beginning of the project or stage of the project for other client/participants that directly link to them to focus on and vice versa. The number of client/participants that a particular client/participant reports to and that report to the client/participant determines the number of assessment scores (AS) the client/participant compares their satisfaction score (SS) against. For example as can be seen in figure 5.5, there are three participants (P1, P4, P5) linked to participant, P2, which implies that P2 has 3AS. This indicates that P2 needs to assess the three participants based on the participant's (P2) defined satisfaction attributes.

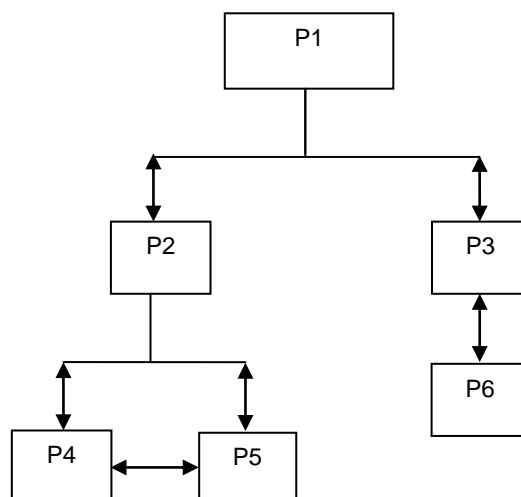


Figure 5.5: Project Participants Tree/ Network

5.7.1 Assessment Criteria

In the context of this research, assessment criteria for project participants are rules or satisfaction attributes through which the satisfaction of construction clients and project participants can be evaluated or tested (figure 5.6). It is essential that the clients or project participants assess one another that at the completion of the project, using the predefined criteria (satisfaction attributes) or a modification of the criteria. The review presented in chapter 2 outlines a list of satisfaction factors and selection/ assessment criteria, indicating that the participants are assessed based on the satisfaction factors or attributes.

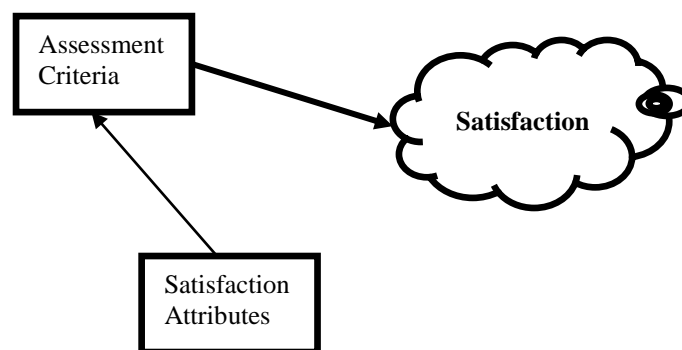


Figure 5.6: Pictorial Representation of Relationship between Satisfaction Attributes and Assessment Criteria with Satisfaction

Through this research, the need for effective assessment of construction clients and project participants on construction projects, and the limitations in the data collection strategies on the requirements of these project participants have prompted calls for the use of assessment models or frameworks. Though assessment of project owners has not generated as much keenness as the assessment of other project participants, it has been identified as being integral in improving the satisfaction level of the project team (Kometa *et al.*, 1996). Again, though Soetanto *et al.* (2001) highlight the need for key participants (main clients, architects, and contractors) in a construction project to regularly assess one another's

performance so as to improve the overall project performance; it is imperative that every other participant concerned in the project be included and involved in the assessment exercise. This is because no matter how insignificant the role of a participant may seem, every participant's input and function is required for the successful delivery of the project. In addition, an indication of assessment procedure or criteria for satisfaction by the project participants creates awareness and facilitates avenue for improvement. This can be seen in the survey conducted by Jennings and Holt (1998) where the authors indicate that the contractors agree with the clients' importance levels of multi-criteria issues. Hence, this would enable contractors to focus more on the clients' expectations and vice versa.

In investigating the assessment criteria, this research draws knowledge from the selection criteria for construction clients and other project participants. Several construction studies have discussed assessment of project participants with reference to the selection and performance criteria of the participants. For example some of the selection criteria of consultants/ contractors for the client as presented by Kometa *et al.*, (1996) emphasising on the financial capability of the client comprised the following issues: financial checks made through specialist agencies, credit checks and business performance checks carried out by independent financial consultants, bank references, check on stability and history of client company, and questioning other consultants who have worked with the client before. Researchers have also identified assessment criteria while dealing with performance attributes. Soetanto (2002) and Cheng *et al.* (2006) for instance, identified a number of performance attributes for construction clients, contractors and architects. This is to say that the project participants could also use their prequalification and selection criteria in the satisfaction assessment process.

Like the satisfaction attributes, the assessment criteria are also synthesised and conceptualised into the four key aforementioned classes (CQST Module). The assessment

criteria form the frame of reference through which each participant is assessed based on their ability to meet the satisfaction attributes of the participant(s) that directly report to them as well as those they report to. The assessment criteria span through varied criteria used by construction project participants for assessing one another's functions, in terms of meeting their satisfaction attributes.

5.8 FEEDBACK

The feedback loop in figure 5.3 indicates that the participants assess one another based on the satisfaction attributes, which they specify at the start of the project stage. The assessment process enables participants (assessor) to identify the disparity between the satisfaction score of an attribute and the assessment score for another participant (*assessee*) for the attribute. The variance highlights focus points for the clients and project participants.

5.9 SUMMARY

This chapter was devoted to a discussion of the different concepts of this research and their relevance in the development of the proposed framework through its conceptual design. Prior to the conceptual framework, the system specifications of the proposed framework were carefully outlined and discussed. The system specifications captured and discussed the essential capabilities and explicit potentials of the proposed framework. In discussing the system specifications, the functional and modular specifications, interface specifications, and performance and integrated specifications were considered. The conceptual framework systematically provides the platform for developing and connecting

the different system specifications and insights of this research. Basically, the conceptual framework include six concepts, which are definition of the project team and satisfaction attributes, categorisation of the attributes, allocation of weights to satisfaction attributes, establishment of links between the participants in the project team, assessment of the participants, and the feedback loop. The system specifications and conceptual framework reveal that different techniques are required in order to provide the robust Satisfaction Assessment Integrated Framework (SAIF).

CHAPTER 6: FRAMEWORK DESIGN AND DEVELOPMENT

6.0 INTRODUCTION

The preceding chapter presented the system specifications and conceptual framework that informed the development of a robust satisfaction assessment framework. This chapter therefore presents detailed discussion on the design and development of the proposed framework, known as the Satisfaction Assessment Integrated Framework (SAIF) by integrating all the arguments and discussions presented in preceding chapters of this thesis. SAIF is designed as a tool that enables communication and interaction between project participants for enhanced satisfaction assessment in the project team. The framework would demonstrate a better and more efficient means of ensuring the satisfaction of not just construction clients but also every participant represented in the project team.

6.1 THE SATISFACTION ASSESSMENT INTEGRATED FRAMEWORK (SAIF)

The Satisfaction Assessment Integrated Framework (SAIF), which is proposed through this research, is defined as an integrated system or framework that collects data, analyses the data, enables collaboration of construction clients and professionals, and provides valuable information for the professionals in terms of assessing them and improving their satisfaction levels. An overview of the SAIF is shown in figure 6.1. The resources and techniques of the SAIF operate through an integrated structure, where there exists a common link, which promotes teamwork and collaboration amongst construction clients and project participants.

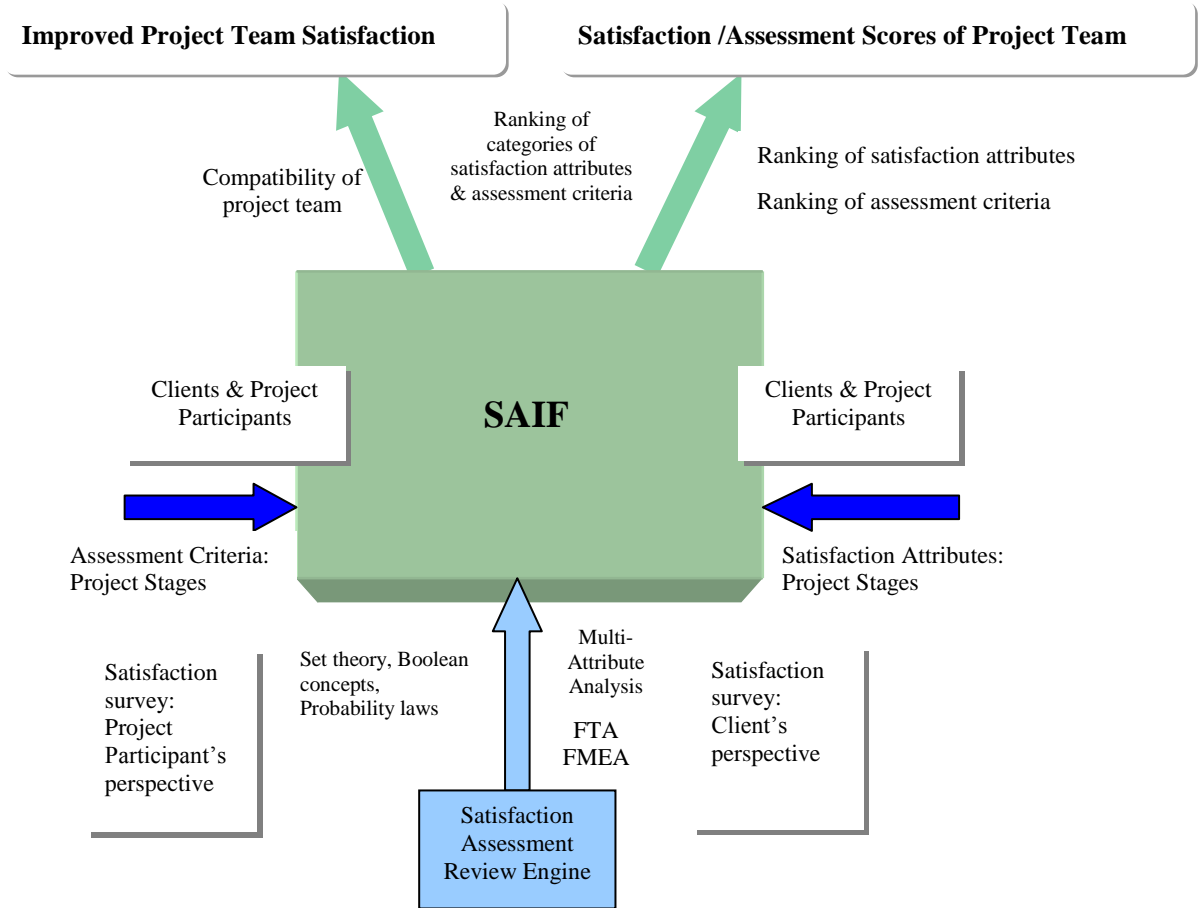


Figure 6.1: Satisfaction Assessment Integrated Framework

The Satisfaction Assessment Integrated Framework (SAIF), which comprises an integrated suite of research, statistical models, engineering techniques, empirical data analysis, mathematical and Boolean logic is designed to:

- scale the satisfaction attributes of the project participants at each project level in the construction project setting. This idea of scaling client needs can be seen in the CQST module discussed in chapter 3.
- measure the satisfaction of the project owner or main client while assessing the relationship and integration between the project participants and their satisfaction attributes (chapter 7).

- enable periodic assessment of client and participant satisfaction by staying focussed on their satisfaction attributes. Regular or periodic assessment of satisfaction will keep the framework in line with its motivational effects on the project team as well as help it review the effect(s) of previously applied changes (chapter 7).

6.2 UNDERLYING PRINCIPLES OF FRAMEWORK

SAIF is based on five key principles, which complement and reinforce each other. The principles, though are independent still connect to one another during application of the framework. These principles include:

- Every construction project participant is considered as a client. The framework considers and recognises every participant involved in the construction project process.
- Satisfaction is a multi-dimensional concept, which is evaluated based on a number of attributes or requirements. In order to improve the satisfaction levels of construction clients and participants, the framework provides a platform for defining flexible number of satisfaction attributes.
- The perceptions and level of importance for any parameter or attribute vary for different individuals. The framework enables the possibility to allocate weights to the satisfaction attributes so as to prioritise them, and ensure a better management of the attributes.
- Alignment of requirements and goals is essential for progress and efficiency. The satisfaction attributes of one participant could be the function or responsibility of another participant; hence the framework ensures proper integration of the project participants and their satisfaction attributes.

- Satisfaction needs to be assessed for it to be improved. In view of this, the framework places focus on improving the satisfaction levels of construction clients and project participants by enabling the assessment of the participants at different stages of the project life cycle.

6.3 FRAMEWORK IMPLEMENTATION

The SAIF needs to be used primarily at the inception or early stages of the different stages/ phases of the construction project in order to utilise its functionalities and benefits. More so, it is at the early stages of a project that important decisions, which influence and affect the quality, delivery time, safety, and value of the project are made (Smith *et al.*, 2001).

The framework implementation involves the functionality of the framework based on the following stages:

- Definition Stage
- Evaluation Stage
- Transformation Stage

A pictorial representation of the implementation flowchart of the framework is shown in figure 6.2.

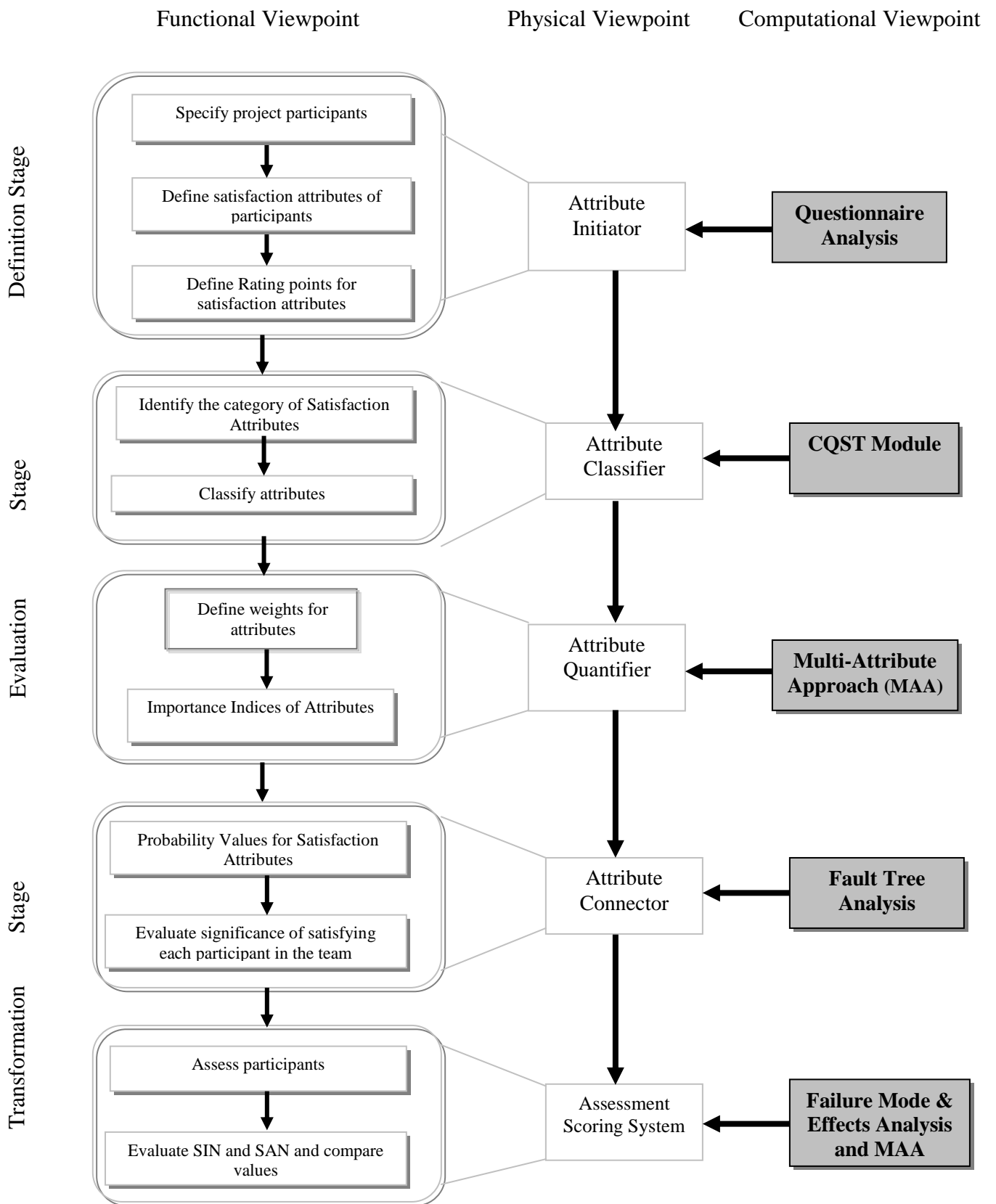


Figure 6.2: Implementation Flowchart of SAIF

6.3.1 Definition Stage

As earlier stated in chapter 5, a clear definition of the clients and project participants is required for each construction project. This is because the natures of projects vary based on their simplicities or complexities. Satisfaction is influenced by the roles and functions of individual participants of the project team with respect to interests, goals, and decision process (Brockmann 2002). Therefore, it is vital and fundamental that a precise definition of the participants' satisfaction attributes in the project is undertaken. This is necessary in order to pre-identify “enabling agents” for successful completion of project. Hence, in this stage of the framework implementation, the project team members are clearly identified, after which their different satisfaction attributes and/ or assessment criteria are defined. Also, definition of the attributes is vital to ensure that they are within the project's capability. Therefore, this stage of the framework implementation includes the Attribute/Intelligence Initiator component.

6.3.1.1 Component 1: Attribute/Intelligence Initiator: Questionnaire Analysis

The definition stage of the framework implementation involves recognition of the satisfaction attributes of the clients and participants involved in a project. A list of satisfaction attributes have been highlighted and discussed in chapter 3. According to Ireland (1992, cited in Al-Momani 2000), a well-defined list of customers and their requirements increases the chances of meeting their requirements and satisfying them. To obtain these attributes, a tool is required to do so. The framework utilises the survey technique to generate data on the satisfaction attributes. The survey type being adopted is the questionnaire. Here, the team members state the attributes they require to ensure their satisfaction in the project process, recording a rating point for each satisfaction attribute. Details of how the questionnaire was used as the first component of the framework for

generating the satisfaction requirements of the project team have been discussed in chapter 4.

6.3.2 Evaluation Stage

At this stage, each client's and participant's satisfaction attributes are allocated values. These values are known as the importance indices. In addition, this stage enables constant analyses and review of the satisfaction attributes and/ or assessment criteria throughout the project life cycle to avoid misinterpretations and deviations. This stage of the framework implementation includes the Attribute/ Module Classifier and the Attribute/ Importance Quantifier components.

6.3.2.1 Component 2: Attribute/ Module Classifier: CQST Module

This stage and component of the framework implementation entails the classification and grouping of the satisfaction attributes under the cost, quality, safety and environment, or time category (CQST Module: see chapter 3). This helps to properly manage the flexible number of attributes as well as identify which category of satisfaction attributes really matter to each client and project participant so as to ensure that adequate emphasis and effects are considered for the participants.

6.3.2.2 Component 3: Attribute/ Importance Quantifier

It is not enough or even adequate to identify the satisfaction attributes (Feçiková 2004) without knowledge of the worth of each attribute; it becomes more productive when these attributes have some measure of importance associated with them. Hence, this stage of the framework implementation involves the utilisation of a statistical technique known as the multi-attribute approach or analysis to define values for the attributes, thereby ensuring that focus is placed on the satisfaction attributes according to their order of urgency or

importance indices. The multi-attribute analysis provides hints for scheduling the requirements of the project participants.

6.3.2.2.1 Multi-Attribute Approach or Analysis

The ability to determine satisfaction is fundamental to total satisfaction and success in any organisation. This is to say that devising a measurement strategy to determine satisfaction is vital in the management process of clients and project participants in the construction industry. The multi-attribute analysis or approach is adopted by this research for this purpose.

The multi-attribute approach is selected as part of the proposed framework (SAIF) for evaluating the project participants' satisfaction attributes and allocating weights to the attributes in the most objective manner. By defining the relative importance for each satisfaction attribute, it is then possible to define a hierarchy for these attributes based on the participants' perceptions.

Using the multi-attribute approach, the satisfaction measurement for a group or category of satisfaction attributes is computed as the sum of the satisfaction scores of all the attributes. It provides a view of the level of satisfaction derived from the attributes belonging to different categories of attribute, which are Cost, Quality, Safety and environment, and Time.

Therefore, the theoretical expression for the multi-attributes estimation for satisfaction measurement is given by:

$$S = S_C + S_Q + S_S + S_T \quad (6.1)$$

$$= C \sum_{i=1}^{N_c} c_{sai} S_{c_{sai}} + Q \sum_{i=1}^{N_q} q_{sai} S_{q_{sai}} + S \sum_{i=1}^{N_s} s_{sai} S_{s_{sai}} + T \sum_{i=1}^{N_t} t_{sai} S_{t_{sai}} \quad (6.2)$$

where S = overall or total satisfaction

S_c = level of satisfaction with respect to cost-related satisfaction attributes

S_q = level of satisfaction with respect to quality-related satisfaction attributes

S_s = level of satisfaction with respect to safety and environment-related satisfaction attributes

S_t = level of satisfaction with respect to time-related satisfaction attributes

S_c comprises satisfaction ($S_{c_{sai}}$) with a number of cost-related attributes (c_{sai}) ranging from 1 to N as perceived by the project participants

Similarly,

S_q comprises satisfaction ($S_{q_{sai}}$) with a number of quality-related attributes (q_{sai}) ranging from 1 to N as perceived by the project participants

S_s comprises satisfaction ($S_{s_{sai}}$) with a number safety and environment-related attributes (s_{sai}) ranging from 1 to N as perceived by the project participants

S_t comprises satisfaction ($S_{t_{sai}}$) with a number of time-related attributes (t_{sai}) ranging from 1 to N as perceived by the project participants

C, Q, S, and T are the relative importance indices assigned to the four categories (cost, quality, safety and environment, and time) in accordance with the project participants' perceived and rated importance associated with the attributes.

The multi-attribute approach used in this research was used to compute three fundamental terms, which are:

- Importance Index of a satisfaction attribute
- Relative Importance Index

- Satisfaction score

By using the multi-attribute analysis, the satisfaction attributes and assessment criteria are prepared statistically for implementation in the SAIF; after which priority (ranking) for the attributes and criteria is established. The allocated values are known as Satisfaction Score (SS) associated with the satisfaction attributes and Assessment Score (AS) associated with the assessment criteria. Figure 6.3 shows an illustration of the research logic for the multi-attribute analysis and its use in defining the relevant values for the Satisfaction Assessment Integrated Framework.

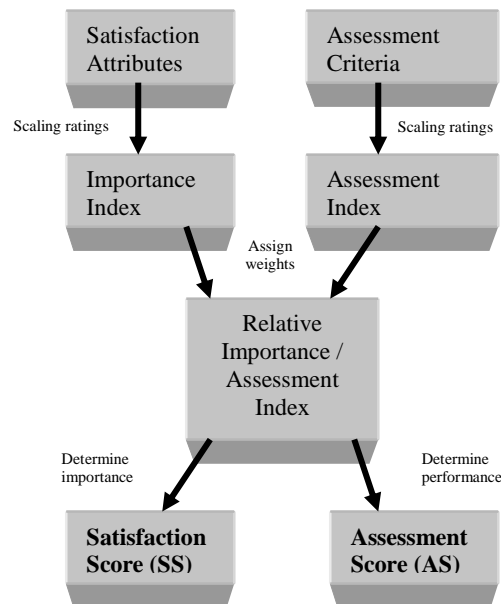


Figure 6.3: Research Logic of the Multi-Attribute Approach/ Analysis

6.3.2.2.1.1 Importance Index

The importance index of a satisfaction attribute is defined as the sum of the product of the rating point R_{sa} , of an attribute and the percentage response or rating point of the attribute ($PR_{sa}\%$) out of the total number of responses or participants involved in the rating of the attribute. It is mathematically given by:

$$II_{sai} = \sum_{a=1}^5 R_{sa} \times PR_{sa} \% \quad (6.3)$$

where II_{sai} = importance index of a satisfaction attribute

R_{sa} = rating point of satisfaction attribute

$PR_{sa} \%$ = percentage response to rating point, a

a lies from 1 to 5, i.e. $1 < a < 5$ (considering that the scale used in the questionnaire analysis was a five-point scale).

In a case where a given project participant is being assessed by another participant, the importance index is known as the assessment index of an assessment criteria. This indicates that equation 6.3 in the case of assessment criteria becomes:

$$AI_{aci} = \sum_{a=1}^5 R_{ac} \times PR_{ac} \% \quad (6.4)$$

where AI_{aci} = assessment index of an assessment criteria

R_{ac} = rating point of assessment criteria

$PR_{ac} \%$ = percentage response to rating point, a

The importance indices for the attributes are carried out for individual participants, therefore a summation as shown in equation 6.3 is not required.

6.3.2.2.1.2 Relative Importance Index

The relative importance of a satisfaction attribute is defined as the importance index of an attribute over the sum of the importance indices of the attributes belonging to a given category, e.g. cost. It is mathematically given by:

$$RII_{sai} = \frac{II_{sai}}{\sum_{i=1}^N II_{sai}} \quad (6.5)$$

Like the importance index, the relative importance index is also known as the relative assessment index in the case of assessment criteria, hence equation 6.5 becomes:

$$RAI_{aci} = \frac{AI_{aci}}{\sum_{i=1}^N AI_{aci}} \quad (6.6)$$

6.3.2.2.1.3 Satisfaction Score

The satisfaction score is defined as the product of the importance index and the relative importance index of the attribute. The satisfaction score provides information on the satisfaction derived by a participant based on their perceived importance of the satisfaction attributes and their assessment of other participants. It is mathematically given by:

$$SS = II_{sai} \times RII_{sai} \quad (6.7)$$

Subsequently, the Assessment Score is given by:

$$AS = AI_{aci} \times RAI_{aci} \quad (6.8)$$

6.3.3 Transformation Stage

Here the relationship or link between the clients and participants is then defined in a tree structure. This is based on the satisfaction scores and importance indices of the satisfaction attributes so as to determine the effect of each participant on determining the satisfaction of another participant or attribute under consideration. This stage further

requires participants to assess the participant(s) that directly report to them so as to determine to what extent their satisfaction attributes would likely be met (at the start of the project) and/ or have been met (at the end of the project). This stage of the framework implementation is dynamic because it enables an integration of a combination of project participants, strategically arranged in a tree-structure format, which does not assume a static or stereotyped structure, but is subject to change based on the participants' satisfaction attributes, the weightings (values) associated with the attributes, as well as any other specifications defined by the participants.

The transformation stage includes the Attribute /Criticality Connector, and the Assessment Scoring System.

6.3.3.1 Component 4: Attribute/ Criticality Connector

To determine and show that in order to improve the satisfaction level of participants at higher levels of the project tree (e.g. project owner) or to improve the chances of meeting their satisfaction attributes, the satisfaction level and/ or satisfaction attributes of the participants at lower levels of the tree need to be improved, the framework adopts the strategies of the fault tree analysis, discussed extensively in chapter 2. Through this component, the framework expresses the construction project team structurally using interrelated tree elements known as the project participants.

6.3.3.1.1 Fault Tree Analysis Strategy

FTA is employed by this research to enable integration of the construction project team and facilitate the flow of communication in the team. In addition, the fault tree analysis strategy was adopted to represent the satisfaction relationships of members or participants of a construction project.

Precisely, the framework endeavours to provide a platform for ensuring an integration of the participants and their satisfaction attributes using the fault tree analysis methodology. In particular, SAIF uses the complement of fault tree analysis known as the success tree analysis so as to enable the satisfaction assessment of the project team. According to Vesely *et al.* (2002), fault tree can be translated into its success tree equivalent, considering that there exists a relationship between success and failure. Therefore since fault tree analysis assumes the occurrence of the top event, consequently, the success tree is concerned with the non-occurrence of the top event. Hence, in the context of this research, given that fault tree is concerned with the occurrence of dissatisfaction (a failure or fault) of a client or project participant, it implies that the success tree (complement of the fault tree) will be concerned with the non-occurrence of dissatisfaction, or the occurrence of satisfaction (a success) of the client or project participant. Therefore, the success tree identifies the participants that must have their satisfaction attributes met to ensure the occurrence of satisfaction of the participant under consideration.

Using the FTA methodological approach, the research defines and identifies the participants in the project team (in a given project stage) that are linked based on a given satisfaction attribute and the satisfaction scores associated with the attribute. This implies that the necessary participants and/ or satisfaction attributes required to ensure the satisfaction of a participant or the achievement of a satisfaction attribute considered as the 'top element' are identified with the application of FTA evaluation procedure. Hence, in the framework implementation, FTA technique is used to determine the probability of meeting the satisfaction attribute of say the main client based on the probability of meeting the satisfaction attributes of participants concerned. Hence, where the probability to satisfy the other participants (meeting their satisfaction attributes) is high, it invariably improves the chances of meeting the main client's requirements. Furthermore, the effect

of the integrated project team on the satisfaction of the client and the project participants is determined using the FTA strategy.

The techniques applied using the success tree analysis and in the context of this research are:

- Mathematical set theory operations
- Boolean Algebra Reductions
- Probability laws and concepts

6.3.3.1.1.1 Mathematical Set Theory Operations

The satisfaction relationships between the project participants are defined using mathematical set operations. The set operations enable the output from the construction project tree to be more ordered and well structured so as to determine the correct probabilities. The operations used are the union (\cup), which is the mathematical representation for the OR gate; and intersection (\cap), which is the mathematical representation for the AND gate. The OR gate or union operation is used to represent all the project participants and/ or satisfaction attributes that are required to satisfy the participant connecting them together; while the AND gate or intersection operation is used to represent the project participants and/ or satisfaction attributes below the operation that are jointly and mutually required to satisfy the participant connecting them. This is to say that the OR gate is used to link satisfaction attributes as well as a combination of project participants and their attributes; while the AND gate is used to link just project participants (see chapter 7).

6.3.3.1.1.2 Boolean Algebraic Reductions

Based on the mathematical set operations specified above, the Boolean reduction used for the union operation is ‘+’ while the Boolean reduction used for the intersection operation is ‘.’.

6.3.3.1.1.3 Probability Laws

The probability evaluations used for the union (+) and intersection (.) mathematical operations in this research for satisfaction assessment of the project team are respectively:

$$P^+ = 1 - \prod_{i=1}^n \{1 - P_i\} \quad (6.9)$$

where: P^+ is the union output element; n is the total number of input elements,

P_i is the probability of occurrence of the union input element P_i , for $i = 1, 2, 3, \dots, n$

$$P^\bullet = \prod_{i=1}^n P_i \quad (6.10)$$

where: P^\bullet is the intersection output element; n is the total number of input elements,

P_i is the probability of occurrence of the intersection input element P_i , for $i = 1, 2, 3, \dots, n$

The importance indices derived using the multi-attribute approach define the probability values of the satisfaction attributes used in the satisfaction assessment process.

6.3.3.1.1.4 Procedure for applying FTA Strategy in framework

6.3.3.1.1.4.1 STAGE 1: Identify the probability of satisfying the client or project participant under consideration

- Step 1: Identify and specify the participant (s) or requirement under consideration. Given that the framework assesses satisfaction at different stages of the project life cycle, more than one analysis may be needed; thus requiring an identification of the probabilities of satisfying more than one project participant.
- Step 2: Determine all the project participants required to satisfy the identified requirement or participant in step 1. This requires specifying the participants that report to the participant under consideration and vice versa.
- Step 3: Define the satisfaction attributes required by the participants in order to satisfy the participant(s) under consideration. Then define the satisfaction relationships/ link between these participants using the mathematical set notations (union and intersection).

6.3.3.1.1.4.2 STAGE 2: Quantitative Evaluation of the Project Tree

- Step 4: Estimate the probabilities of all the satisfaction attributes by determining the importance indices for the attributes using the multi-attribute analysis
- Step 5: Identify the probability or likelihood of satisfying the client or participant under consideration, which is based on the satisfaction levels of participants at lower levels of the tree, using the Boolean Algebraic reductions and probability laws.

6.3.3.1.1.4.3 STAGE 3: Qualitative Evaluation of the Project Tree

- Step 6: Identify the criticality of the satisfaction attributes represented on the tree. Sort the criticalities (also known as success modes, in the context of this research),

which are defined as the satisfaction attributes with high satisfaction scores and are most required by the project participants in a given project stage. At this stage of the FTA approach, the FMEA methodology is adopted.

6.3.3.2 Component 5: Assessment Scoring System

The assessment scoring system is based on the values of the assessment criteria, which form part of the building blocks for successful and high satisfaction rating (chapter 5). The assessment scoring system involves a process (the multi-attribute analysis and the methodical approach of the failure modes and effects analysis) that is based on determining and assessing construction project participants on the extent to which other members of the project team meet their satisfaction attributes. The system helps to define values for the assessment criteria. This is to say that the assessment score (AS) is compared with the satisfaction score (SS) of a given attribute.

6.3.3.2.1 Satisfaction Assessment using FMEA Strategy

Failure Mode and Effects Analysis (FMEA) is a methodical approach that has been investigated in this research. From the investigation carried out in this research, it was found that FMEA is a logical process used to highlight the risk and consequences associated with failures. It was also found that it could be used to assess risks associated with single failures as well as a combination of failures (multiple failures) in the integrated project team. Therefore, FMEA methodical strategy is employed by this research to define an approach for assessing the clients and project participants. It is further used to highlight the impact of the participants' identified satisfaction attributes on not just the satisfaction of a single participant but on the entire project team.

Failure modes, as discussed in chapter 2, refer to the ways through which something might fail. Subsequently effect analysis is concerned with consequences of the failure modes. In the case of satisfaction assessment and in the context of this research, the term Success Modes is used, instead of Failure Modes. Hence, success modes refer to the ways through which something might succeed. This implies that success modes refer to the satisfaction attributes through which satisfaction might improve. Likewise, effect analysis refers to the significance or the importance associated with the satisfaction attributes as perceived by the project participants. Therefore, the satisfaction attributes (success modes) are prioritised according to their importance (effects), how frequently they are required by the project team (causes) and how easily they can be identified by the team (detection).

The multi-attribute approach was used in defining two parameters (occurrence and severity) used in the FMEA technique with respect to satisfaction attributes, while the concept of the integrated project team was used to define the third parameter (detection). The three parameters were afterwards used to determine the impact or significance of the attributes on the satisfaction of the project team.

6.3.3.2.1.1 Occurrence Element

The occurrence element investigates and evaluates the probability and rate at which the satisfaction attributes of the participants are met. It is defined as the importance indices of the attributes derived using the multi attribute analysis: see section 6.3.2.2.1.1.

6.3.3.2.1.2 Severity Element

The severity element investigates the seriousness or severity of the attributes necessary to satisfy the project participants. It is concerned with the importance or significance (effects) of the satisfaction attributes as perceived by the participants. It is therefore defined as the satisfaction scores associated with the attributes: see section 6.3.2.2.1.3.

6.3.3.2.1.3 Detection Element

The detection element investigates the likelihood that the current control for improving satisfaction, which is ‘the integrated project team’, will take place. Chapter 4 discussed the role and significance of the integrated project team on the satisfaction of the project participants; so as a means to incorporate the practice of the integrated project team in the framework development and implementation, an integration of the total number of participants (in a given project stage) that require a particular satisfaction attribute is taken into consideration. This implies that considering a given participant e.g. the main contractor, the practice of integrated project team involves the total number of participants that report to the main contractor and the participant (s) that the main contractor reports to. Hence the detection element is taken to be the ‘Number of Participants involved in a project stage that require a given attribute’.

6.3.3.2.1.4 Determine the Significance of Attributes on Satisfaction of the Project Team

The significance of the attributes required to satisfy each participant on the project tree structure or hierarchy is differentiated by evaluating the Satisfaction Importance Number, SIN. The satisfaction attributes are then classified according to their SIN (criticality).

This is computed as:

$$\text{SIN} = \text{Importance Index of Attribute} * \text{Satisfaction Score} * \text{Number of Participants involved in a project stage requiring the attribute}$$

Subsequently, having assessed the project participants using the multi-attribute approach, the Satisfaction Assessment Number, SAN is computed and compared with the SIN value.

SAN is computed as:

$SAN = \text{Assessment Index of Attribute} * \text{Assessment Score} * \text{Number of Participants}$
involved in a project stage requiring the attribute

6.3.4 Using the Satisfaction Assessment Integrated Framework

As shown and discussed above, SAIF was primarily designed for clients and participants that make up construction project teams, with the aim to improve the satisfaction levels of construction clients and the project participants. In terms of its application, SAIF could be applied at the different stages of the project life cycle. It is applied before the start of the project to define the satisfaction attributes of the clients and project participants and the link between them. In addition, it is applied during the project process, at different project phases, so as to ensure that focus is placed on the defined satisfaction attributes. Subsequently, it could be applied after the project to ensure the achievement of total satisfaction. Where this has not been met, reasons for this are identified and highlighted in order to avoid any faults and/ or correct any errors.

6.4 RATIONALES FOR TECHNIQUES USED IN FRAMEWORK

The rationales for adopting the four key techniques used in this research are outlined in tables 6.1 to 6.4. A general perception of the validation and rationales for using the techniques are presented on the left-hand columns while the rationales are narrowed down to the context of this research (research scenario) on the right-hand columns of the tables.

Table 6.1: Rationale for Adopting the Questionnaire Analysis/Technique

GENERAL PERCEPTION	RESEARCH (SATISFACTION) SCENARIO
Inexpensive and fast process of generating information	Diversity in the administration of the questionnaire (face-face and online, for this research)
Ensures confidentiality of the respondents	With adequate time-frame and convenience, each questionnaire was filled by an individual participant thereby ensuring confidentiality and avoiding bias
Possibility to statistically analyse data generated with questionnaire	The closed format and likert scale were used in designing the questionnaire to enable statistical analysis of the generated data
Ability to store the questions on a database and use as often as required	The data generated was stored using MySQL database and can be retrieved as at when required

Table 6.2 Rationale for Adopting the Multi-Attribute Approach

GENERAL PERCEPTION	RESEARCH (SATISFACTION) SCENARIO
It is an approach used for analysing the importance of data	Defines importance indices for the satisfaction attributes
Used for determining the performance associated with a set of data	Estimates the satisfaction attributes and assessment criteria of the project participants
Provides a platform for integrating different factors or criteria for making decisions	Integrates all the attributes used in the satisfaction assessment process by defining their relative importance indices
Identify priority of factors being evaluated	Defines a hierarchy for the attributes based on their importance indices

Table 6.3: Rationale for Adopting the Fault Tree Analysis

GENERAL PERCEPTION	RESEARCH (SATISFACTION) SCENARIO
It is an analysis technique, which is methodical, structured, graphical and quantitative	It is a decision making tool that can be used for assessment purposes, thereby helping to improve understanding of the project team through visual representations
Helps to create links or define the relationship between the different elements or components of a system	Helps to establish sub-links between different participants as well as an overall link for the entire project team
Enables an integration of different	Enables an integration of flexible project

elements or events that are required to ensure the occurrence of the event under consideration (top event)	participants and satisfaction attributes by defining the satisfaction relationship between the participants
Identifies the significance of the different elements or events in a given system	Helps to highlight the importance of satisfaction to every participant of a given construction project team. In addition, establishes that focus is on every participant represented on the project team by investigating and identifying the effect of satisfaction of lower level participants on higher-level participants of the project team or supply chain
Ensures that focus is placed on the top event by identifying the cut sets in a tree or system	Ensures that focus is not taken off the client or project owner by defining the critical path(s) existing in the project team
Places further emphasis on the top event by identifying the minimal cut sets in a tree	Identifies participants and satisfaction attributes that require focus and more emphasis

Table 6.4: Rationale for Adopting the Failure Mode and Effects Analysis

GENERAL PERCEPTION	RESEARCH (SATISFACTION) SCENARIO
It is a proactive technique, which is used to highlight the risk or significance associated with failures	Used for strategically highlighting and prioritising the importance associated with the satisfaction attributes
Enables a combination of multiple failures	Enables the combination and integration of the project participants and their satisfaction attributes
Ranks the outcomes of an evaluation process and specifies corrective actions to address the outcomes based on the hierarchy or criticality	Used in conjunction with the multi-attribute approach to devise a means for assessing the project participants and the significance of their satisfaction attributes
Is usually used to verify fault tree analysis	Used to validate the critical path (attributes) identified using FTA by highlighting the impact that such attributes have on the satisfaction of the entire project team

6.5 SUMMARY

This chapter presented the Satisfaction Assessment Integrated Framework (SAIF), which is developed through this research. SAIF was developed and is based on five key components: questionnaire analysis/ technique, CQST module, multi-attribute approach, fault tree analysis, and failure mode and effects analysis. This chapter presented the different components of SAIF, which comprise the techniques adopted in the development of the framework. The discussions presented in this chapter show that there is a link and relationship between the five components or techniques that make up the framework. The questionnaire analysis, known as the attribute or intelligence initiator of the framework, was used to capture the rated importance that each participant places on the satisfaction attributes. The CQST module, known as the attribute or module classifier, was used to group the attributes into categories (cost, quality, safety or time). The multi-attribute approach, known as the attribute or importance generator of the framework, was used to evaluate the project participants' satisfaction attributes and allocate weights to the attributes. The fault tree analysis, known as the attribute or criticality connector, was used to define the satisfaction relationship between the project participants and the significance of focussing on one another's satisfaction attributes. The fifth component known as the assessment scoring system, was used to define a method for assessing the project participants (using multi-attribute approach), and identify the significance of the satisfaction attributes on the overall satisfaction of the project team (using failure mode and effects analysis).

The pilot study, conducted using the questionnaire technique, revealed that the perceptions of the project participants with respect to the importance of the satisfaction attributes vary for the different groups of the target population. The succeeding chapter discusses an implementation of the framework through an integrated project team scenario. Here, the

findings of the generated data (pilot study) conducted using the questionnaire technique are used to assess the importance associated with the satisfaction attributes, how the integrated project team impacts on satisfaction, and to what extent each participant meets the requirements of other participants based on their assessment.

CHAPTER 7: INTEGRATED PROJECT TEAM: SATISFACTION ASSESSMENT

7.0 INTRODUCTION

This chapter demonstrates the application and performance evaluation of the framework (SAIF) developed and illustrated in the previous chapter, through the analysis of satisfaction assessment scenarios. The scenarios, which form the pedestal upon which the implementation of the framework is tried, assume situations where the client requires the project to be on time and to a desired quality.

The chapter starts by highlighting the importance indices of satisfaction attributes of key construction project participants, with the quest to improve the satisfaction of not just the main client or project owner, but also the satisfaction of the entire project team. The results of the pilot study are presented, discussing the perceptions of project managers, engineers, designers, architects, and main/ sub contractors on satisfaction, considering that they occupy a pivotal position in the construction project team upstream with the client group and downstream with the suppliers (material and labour). Afterwards, this chapter provides an analysis on the impact of the integrated project team on satisfaction in relation to cost, quality, safety and time.

Subsequently, the chapter shows how the satisfaction level of one participant is influenced by the satisfaction level of another participant using the FTA technique. In addition, through the satisfaction scenarios, this chapter shows the satisfaction assessment of the project participants using a combination of the multi-attribute analysis and the failure mode and effects analysis methodical approach.

7.1 SATISFACTION OF RESPONDENTS

The importance index and relative importance index of a satisfaction attribute specify the significance associated with the attribute. The attribute with the highest importance index and relative importance index is perceived to receive the highest priority or ranking from the respondents/ project participants.

As stated earlier in chapter 4, the questionnaire was distributed to 30 participants across the construction sector during the West Midlands Centre for Constructing Excellence best practice clubs events. From the 30 questionnaires distributed for the pilot study, 24 responses were returned, giving an 80% response rate. Figure 7.1 shows the percentage of the roles of respondents represented. Over 30% of the respondents were contractors (main and sub); 25% were designers. In addition, 25% were engineers, with a small percentage of project managers (8%). Architects and suppliers recorded the least response rate (4% each).

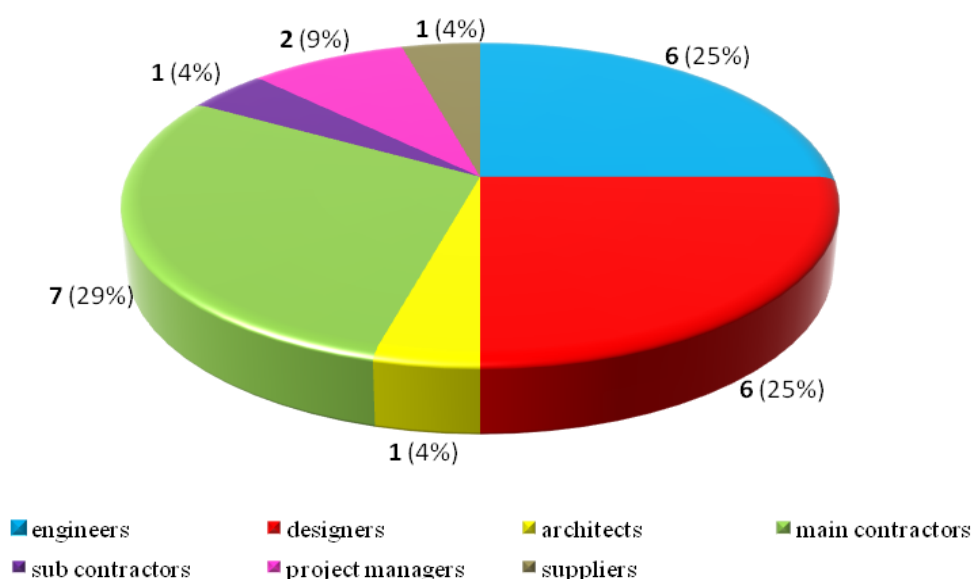


Figure 7.1: Percentage of Participants/ Respondents

7.1.1 Project Managers

7.1.1.1 Perception of the Project Manager for Satisfaction

The results shown in figure 7.2 reveal that all the project managers (100%) perceive Tsa8 ('there exists early involvement of contractor'), Ssa1 ('health & safety procedures are with no incidents'), Ssa2 ('Strategies for managing and assessing any project risks are in place'), Qsa5 ('Minimal defects (in supply)'), Qsa6 ('There exists tender assessment of quality, not just price') and Csa2 ('Changes are fairly introduced') as their most important attributes indicated by their recordings for 'strongly agree'. However, 50% of the project managers strongly agree that the rest of the attributes are important for their satisfaction. The results further revealed that the managers consider all the 22 attributes as being essential for their satisfaction. This is shown by none of the project manager recording 'disagree' or 'strongly disagree' for any of the attribute.

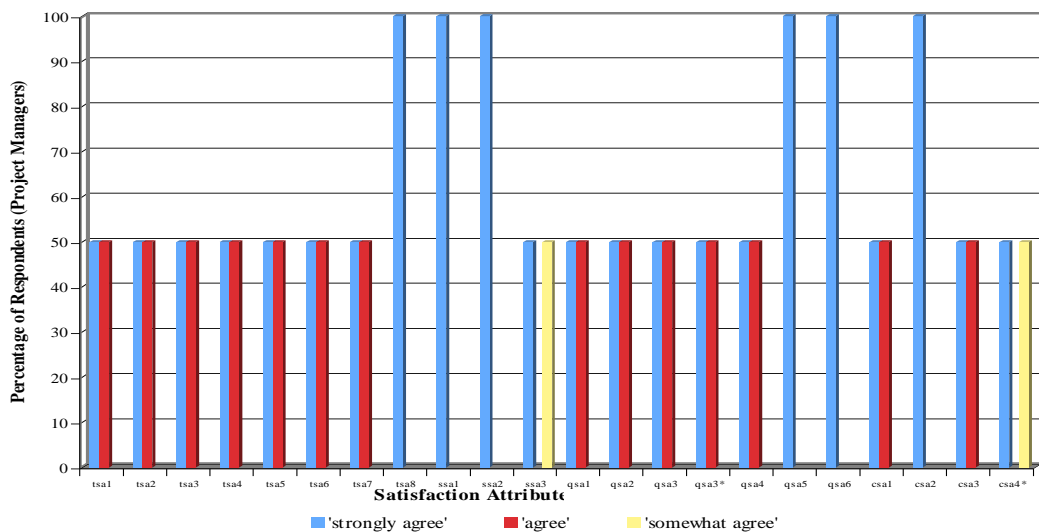


Figure 7.2: Percentage Response Rate of Satisfaction Attributes for Project Managers

7.1.1.2 Importance of Satisfaction Attributes for Project Managers

The results for the importance associated with the satisfaction attributes as perceived by the project managers show that the managers consider each attribute to have unequal

significance to their satisfaction: see table 7.1. Illustrations of how the importance indices and satisfaction scores were generated using equations 6.3, 6.5 and 6.7 are shown below:

For this research, a total of 22 attributes were considered for the participants belonging to the project management group (PMG), which implies that there will be a maximum value of 110 assuming a participant records a '5' for all attributes:

Considering project manager 1 and the satisfaction attribute $csa1$, the manager recorded a rating of 5; hence the rating point, R_{csa1} , for $csa1$ is 5 and the percentage rating or response point, $PR_{csa1}\%$, is:

$$\begin{aligned} PR_{csa1}\% &= \frac{5}{110} \times 100\% \\ &= 4.55\% \end{aligned}$$

Therefore, the importance index of $csa1$ will be:

$$\begin{aligned} II_{csa1} &= 5 * 4.55\% \\ &= 5 \times \frac{4.55}{100} \\ &= 0.2275 \\ &\approx 0.23 \end{aligned}$$

Subsequently, the importance indices for the entire 22 attributes were computed, after which the relative importance indices for the attributes were derived and shown in table 7.1. Details of the computational analyses and results are shown in Appendix E. The sum of the importance indices for the attributes shown in table 6.1 in relation to project manager 1 is:

$$\begin{aligned} \sum II &= 0.23 * 22 \\ &= 5.06 \end{aligned}$$

Therefore, the relative importance index for *csa1* is:

$$RII_{csa1} = \frac{II_{csa1}}{\sum II}$$

$$RII_{csa1} = \frac{0.23}{5.06}$$

$$= 0.0455$$

Similarly, the satisfaction score with respect to *csa1* as perceived by project manager 1 is:

$$SS = II_{csa1} * RII_{csa1}$$

$$SS = 0.23 * 0.0455$$

$$= 0.01045$$

$$\approx 0.010$$

Table 7.1: Importance of Satisfaction Attributes for Project Managers

	SA	Project Manager 1			Project Manager 2			Group Mean Value					
		II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	II	SS	II	SS
From the client grp	Csa1	0.23	0.010		0.15	0.006		0.19	0.008				
	Csa2	0.23	0.010	0.010	0.23	0.014	0.010	0.23	0.012	0.21	0.010		
From sub-ordinate	Csa3	0.23	0.010		0.15	0.006		0.19	0.008				
	Csa4		0.010	0.010	0.08	0.002	0.004						
		0.23						0.16	0.006	0.17	0.007	0.19	0.009
From the client group	Qsa1	0.23	0.010		0.15	0.006		0.19	0.008				
	Qsa2	0.23	0.010		0.15	0.006		0.19	0.008				
	Qsa3	0.23	0.010		0.15	0.006		0.19	0.008				
	Qsa4	0.23	0.010		0.15	0.006		0.19	0.008				
	Qsa6	0.23	0.010	0.010	0.23	0.014	0.008	0.23	0.012	0.20	0.009		
From sub-ordinate	Qsa3*	0.23	0.010		0.15	0.006		0.19	0.008				
	Qsa5		0.010	0.010	0.23	0.014	0.010						
		0.23						0.23	0.012	0.21	0.010	0.21	0.010
From sub-ordinate	Ssa1	0.23	0.010		0.23	0.014		0.23	0.012				
	Ssa2	0.23	0.010		0.23	0.014		0.23	0.012				
	Ssa3	0.23	0.010	0.010	0.08	0.002	0.011	0.16	0.006	0.21	0.010	0.21	0.010
From the client group	Tsa2	0.23	0.010		0.15	0.006		0.19	0.008				
	Tsa3	0.23	0.010		0.15	0.006		0.19	0.008				
	Tsa4	0.23	0.010		0.15	0.006		0.19	0.008				
	Tsa7	0.23	0.010		0.15	0.006		0.19	0.008				
	Tsa8	0.23	0.010	0.010	0.23	0.014	0.008	0.23	0.012	0.20	0.009		
From sub-ordinate	Tsa1	0.23	0.010		0.15	0.006		0.19	0.008				
	Tsa5	0.23	0.010		0.15	0.006		0.19	0.008				
	Tsa6	0.23	0.010	0.010	0.15	0.006	0.006	0.19	0.008	0.19	0.008	0.20	0.009

7.1.2 Architects

7.1.2.1 Perceptions of the Architect for Satisfaction

The analyses shown in table 7.2 indicate that the architect consider 18 attributes as being very important for determining their satisfaction shown by the high satisfaction score of 0.011. However, though the remaining 4 attributes (Csa2, Csa3, Qsa3, Ssa3) do not have satisfaction scores as high as the other 18, the architects still agree that these attributes are required for improving their satisfaction. The analyses further show that the time-related satisfaction attributes appeal to the architects more in comparison to the cost, quality and safety-related satisfaction attributes, shown by the mean satisfaction score of 0.011.

Table 7.2: Importance of Satisfaction Attributes for Architects

	Satisfaction Attributes	Architect Mean Value				II	SS
		II	SS	Mean (II)	Mean (SS)		
From the project owner	Csa1	0.23	0.011			0.18	0.007
	Csa2	0.08	0.001	0.16	0.006		
From sub-ordinates	Csa3	0.15	0.005				
	Csa4	0.23	0.011	0.19	0.008		
From the project owner	Qsa2	0.23	0.011			0.21	0.010
	Qsa3	0.08	0.001				
	Qsa4	0.23	0.011				
	Qsa6	0.23	0.011	0.19	0.009		
From sub-ordinates	Qsa1	0.23	0.011				
	Qsa3*	0.23	0.011				
	Qsa5	0.23	0.011	0.23	0.011		
From sub-ordinates	Ssa1	0.23	0.011			0.20	0.009
	Ssa2	0.23	0.011				
	Ssa3	0.15	0.005	0.20	0.009		
From the project owner	Tsa2	0.23	0.011			0.23	0.011
	Tsa3	0.23	0.011				
	Tsa4	0.23	0.011				
	Tsa7	0.23	0.011				
	Tsa8	0.23	0.011	0.23	0.011		
From sub-ordinates	Tsa1	0.23	0.011				
	Tsa5	0.23	0.011				
	Tsa6	0.23	0.011	0.23	0.011		

7.1.3 Engineers

7.1.3.1 Perception of Engineers for Satisfaction

Figure 7.3 reveals that more than 65% of respondents that were engineers perceive Tsa2 ('Communication flow in the team is consistent'), Qsa3 ('open and honest communication'), Qsa4 ('Client interactions are open & friendly'), and Csa2 ('Changes are fairly introduced') as the most important attributes for their satisfaction shown by their record for 'strongly agree' for the four attributes. The high percentage recordings for Tsa2, Qsa3 and Qsa4 show that the engineers consider communication as a fundamental requirement for their satisfaction. The high record for Csa2 could possibly be because the engineers consider that inadequate introduction of changes in the project could have detrimental effect to the structure of the project. With respect to the remaining 18 attributes, fig 7.3 shows that the percentage of engineers that agree that each attribute is fundamental for their satisfaction vary. The figure however shows that about 15% of the engineers disagree that Ssa1 ('health and safety procedures are with no incidents') is an attribute for their satisfaction.

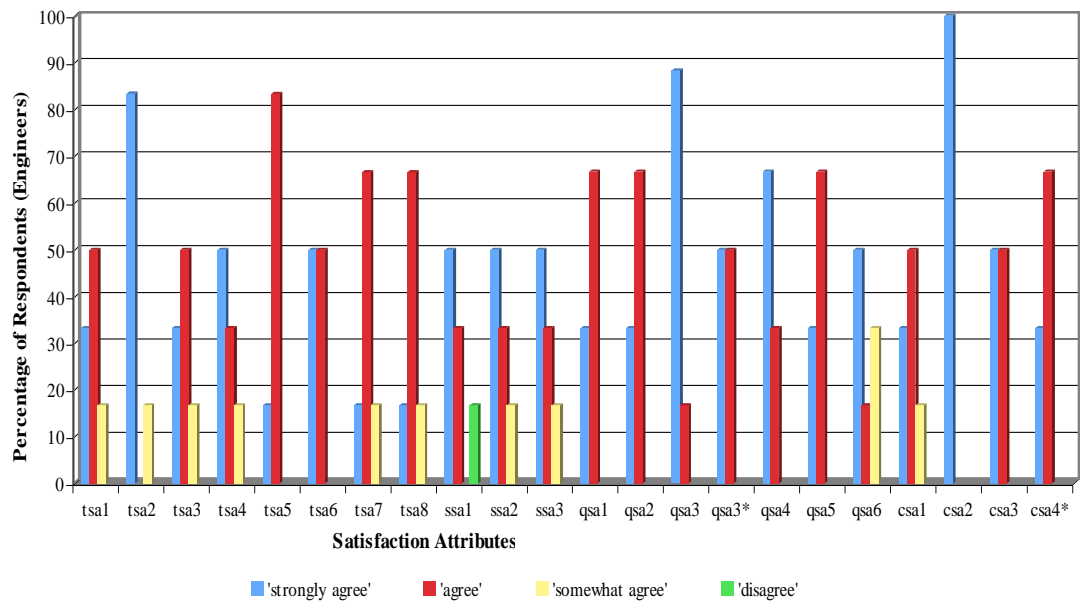


Figure 7.3: Percentage Response Rate of Satisfaction Attributes for Engineers

7.1.3.2 Importance of Satisfaction Attributes for Engineers

The analysis shown in table 7.3 indicates that on an overall basis, the engineers’ records produce high satisfaction scores for the entire satisfaction attributes. However, it is interesting to note that the engineers consider Csa2 (‘Changes are fairly introduced’) as being their most important attribute shown by its highest satisfaction score of 0.014.

Table 7.3: Importance of Satisfaction Attributes for the Engineers

	SA	Engineer 1			Engineer 2			Engineer 3			Engineer 4			Engineer 5			Engineer 6			Group Mean Value					
		II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	II	SS	II	SS
From client group/supervisor	Csa1	0.15	0.006		0.23	0.012		0.15	0.005		0.23	0.010		0.15	0.006		0.08	0.002		0.17	0.007				
	Csa2	0.23	0.015	0.011	0.23	0.012	0.012	0.23	0.013	0.009	0.23	0.010	0.010	0.23	0.015	0.011	0.23	0.016	0.009	0.23	0.014	0.20	0.010		
From subordinates	Csa3	0.15	0.006		0.15	0.005		0.23	0.013		0.23	0.010		0.23	0.015		0.15	0.007		0.19	0.009				
	Csa4	0.15	0.006	0.006	0.15	0.005	0.005	0.15	0.005	0.009	0.23	0.010	0.010	0.15	0.006	0.011	0.23	0.016	0.012	0.18	0.008	0.18	0.009	0.19	0.009
From client group/supervisor	Qsa1	0.15	0.006		0.23	0.012		0.15	0.005		0.23	0.010		0.15	0.006		0.15	0.007		0.18	0.008				
	Qsa2	0.15	0.006		0.23	0.012		0.15	0.005		0.23	0.010		0.15	0.006		0.15	0.007		0.18	0.008				
	Qsa3	0.23	0.015		0.23	0.012		0.23	0.013		0.23	0.010		0.15	0.006		0.23	0.016		0.22	0.012				
	Qsa4	0.23	0.015		0.23	0.012		0.23	0.013		0.23	0.010		0.15	0.006		0.15	0.007		0.20	0.011				
	Qsa6	0.15	0.006	0.010	0.23	0.012	0.012	0.08	0.002	0.008	0.23	0.010	0.010	0.23	0.015	0.008	0.08	0.002	0.008	0.17	0.008	0.19	0.009		
From subordinates	Qsa3*	0.23	0.015		0.15	0.005		0.23	0.013		0.23	0.010		0.15	0.006		0.15	0.007		0.19	0.009				
	Qsa5	0.15	0.006	0.011	0.15	0.005	0.005	0.23	0.013	0.013	0.23	0.010	0.010	0.15	0.006	0.006	0.15	0.007	0.007	0.18	0.008	0.18	0.009	0.19	0.009
From client group/supervisor	Ssa1	0.15	0.006		0.23	0.012		0.23	0.013		0.23	0.010		0.15	0.006		0.04	0.0004		0.17	0.008				
	Ssa2	0.15	0.006		0.23	0.012		0.23	0.013		0.23	0.010		0.15	0.006		0.08	0.002		0.18	0.008				
	Ssa3	0.08	0.002	0.005	0.23	0.012	0.012	0.15	0.005	0.010	0.23	0.010	0.010	0.15	0.006	0.006	0.23	0.016	0.006	0.18	0.009	0.18	0.008	0.18	0.008
From client group/supervisor	Tsa2	0.23	0.015		0.23	0.012		0.23	0.013		0.23	0.010		0.23	0.015		0.08	0.002		0.21	0.011				
	Tsa3	0.08	0.002		0.23	0.012		0.15	0.005		0.23	0.010		0.15	0.006		0.15	0.007		0.17	0.007				
	Tsa4	0.08	0.002		0.23	0.012		0.15	0.005		0.23	0.010		0.15	0.006		0.23	0.016		0.18	0.009				
	Tsa6	0.15	0.006		0.23	0.012		0.23	0.013		0.23	0.010		0.15	0.006		0.15	0.007		0.19	0.009				
	Tsa7	0.15	0.006		0.08	0.002		0.15	0.005		0.23	0.010		0.15	0.006		0.15	0.007		0.15	0.006				
	Tsa8	0.15	0.006	0.006	0.08	0.002	0.009	0.15	0.005	0.008	0.23	0.010	0.010	0.15	0.006	0.008	0.15	0.007	0.008	0.15	0.006	0.17	0.008		
From subordinates	Tsa1	0.15	0.006		0.23	0.012		0.15	0.005		0.23	0.010		0.15	0.006		0.08	0.002		0.17	0.007				
	Tsa5	0.15	0.006	0.006	0.15	0.005	0.009	0.15	0.005	0.005	0.23	0.010	0.010	0.15	0.006	0.006	0.15	0.007	0.005	0.16	0.007	0.16	0.007	0.17	0.008

7.1.4 Designers

7.1.4.1 Perception of Designers for Satisfaction

Unlike the architects, about 15% of respondents that were designers record that they do not consider Tsa4, Tsa6, Ssa3, Qsa3*, Qsa4, Qsa6 as attributes for their satisfaction (figure 7.4); their record for ‘disagree’ for the afore-mentioned attributes shows this. However, up to 50% of the designers agree that the entire 22 attributes are required for their satisfaction. Subsequently over 30% of the designers strongly agree that the entire 22 attributes are their fundamental satisfaction attributes. Furthermore, the analysis reveal that over 65% of the designers strongly agree that Qsa3 (‘open and honest communication’) is an important attribute for their satisfaction while over 60% of them agree that Tsa7 (‘Sufficient time is allowed for tender’), Tsa8 (‘There exists early involvement of contractor’) and Qsa5 (‘Minimal defects (in supply)’)

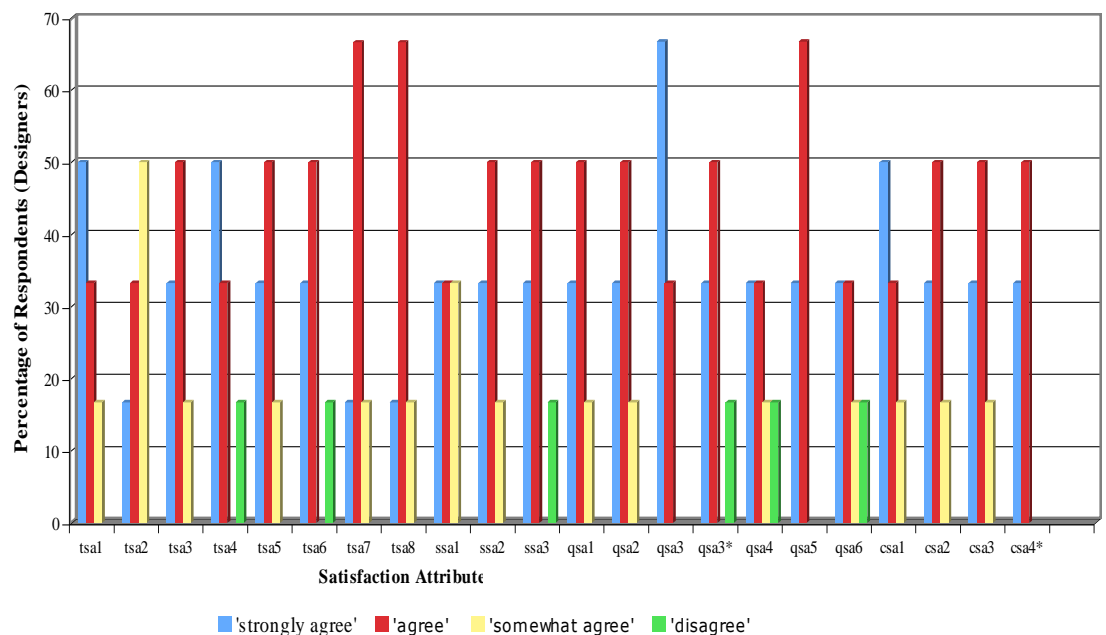


Figure 7.4: Percentage Response Rate of Satisfaction Attributes for Designers

7.1.4.2 Importance of Satisfaction Attributes for Designers

The importance associated with the attributes as perceived by the designers indicate that Qsa3 (open and honest communication) is a critical attribute for designers shown by the highest satisfaction score of 0.012 (table 7.4). This highlights the significance given to communication by designers. The record for 'communication' as the most important attribute to the designers indicates that the designers would need to communicate more in order to meet their other satisfaction attributes, help to clarify issues, as well as understand the overall requirements of the project.

Table 7.4: Importance of Satisfaction Attributes for Designers

	SA	Designer 1			Designer 2			Designer 3			Designer 4			Designer 5			Designer 6			Group Mean Value						
		II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	II	SS	II	SS	
From client group/supervisor	Csa1	0.15	0.006		0.15	0.008		0.08	0.003		0.23	0.011		0.23	0.015		0.23	0.011		0.18	0.009					
	Csa2	0.23	0.016	0.011	0.15	0.008	0.008	0.15	0.009	0.006	0.23	0.011	0.011	0.15	0.006	0.011	0.08	0.001	0.006	0.17	0.009	0.17	0.009			
From sub-ordinates	Csa3	0.15	0.006		0.15	0.008		0.08	0.003		0.23	0.011		0.15	0.006		0.23	0.011		0.17	0.008					
	Csa4	0	0	0.003	0.15	0.008	0.008	0.15	0.009	0.006	0.23	0.011	0.011	0.15	0.006	0.006	0.23	0.011	0.011	0.15	0.008	0.16	0.008	0.17	0.008	
From client group/supervisor	Qsa1	0.15	0.006		0.08	0.003		0.15	0.009		0.23	0.011		0.15	0.006		0.23	0.011		0.17	0.008					
	Qsa2	0.15	0.006		0.08	0.003		0.15	0.009		0.23	0.011		0.15	0.006		0.23	0.011		0.17	0.008					
	Qsa3	0.23	0.016		0.23	0.02		0.15	0.009		0.23	0.011		0.15	0.006		0.23	0.011		0.20	0.012					
	Qsa4	0.15	0.006		0.08	0.003		0.04	0.001		0.23	0.011		0.15	0.006		0.23	0.011		0.15	0.006					
	Qsa6	0.15	0.006	0.008	0.08	0.003	0.006	0.04	0.001	0.006	0.23	0.011	0.011	0.15	0.006	0.006	0.23	0.011	0.011	0.15	0.006	0.17	0.008			
From sub-ordinates	Qsa3*	0.15	0.006		0.15	0.008		0.04	0.001		0.23	0.011		0.15	0.006		0.23	0.011		0.16	0.007					
	Qsa5	0.15	0.006	0.006	0.15	0.008	0.008	0.15	0.009	0.005	0.23	0.011	0.011	0.15	0.006	0.006	0.23	0.011	0.011	0.18	0.009	0.17	0.008	0.17	0.008	
From client group/supervisor	Ssa1	0.15	0.006		0.08	0.003		0.08	0.003		0.23	0.011		0.15	0.006		0.23	0.011		0.15	0.007					
	Ssa2	0.15	0.006		0.08	0.003		0.15	0.009		0.23	0.011		0.15	0.006		0.23	0.011		0.17	0.008					
	Ssa3	0.15	0.006	0.006	0.15	0.008	0.005	0.04	0.001	0.004	0.23	0.011	0.011	0.15	0.006	0.006	0.23	0.011	0.011	0.16	0.007	0.16	0.007	0.16	0.007	
From client group/supervisor	Tsa2	0.15	0.006		0.08	0.003		0.08	0.003		0.08	0.001		0.15	0.006		0.23	0.011		0.13	0.005					
	Tsa3	0.15	0.006		0.08	0.003		0.15	0.009		0.23	0.011		0.15	0.006		0.23	0.011		0.17	0.008					
	Tsa4	0.23	0.016		0.15	0.008		0.04	0.001		0.23	0.011		0.15	0.006		0.23	0.011		0.17	0.009					
	Tsa6	0.15	0.006		0.15	0.008		0.04	0.001		0.23	0.011		0.15	0.006		0.23	0.011		0.16	0.007					
	Tsa7	0.15	0.006		0.08	0.003		0.15	0.009		0.23	0.011		0.15	0.006		0.15	0.005		0.15	0.007					
	Tsa8	0.15	0.006	0.008	0.08	0.003	0.005	0.15	0.009	0.005	0.23	0.011	0.009	0.15	0.006	0.006	0.15	0.005	0.009	0.15	0.007	0.15	0.007			
From sub-ordinates	Tsa1	0.15	0.006		0.08	0.003		0.15	0.009		0.23	0.011		0.23	0.015		0.23	0.011		0.18	0.009					
	Tsa5	0.15	0.006	0.006	0.15	0.008	0.006	0.08	0.003	0.006	0.23	0.011	0.011	0.15	0.006	0.011	0.23	0.011	0.011	0.17	0.008	0.17	0.008	0.16	0.007	

7.1.5 Main Contractors

7.1.5.1 Perception of Main Contractors for Satisfaction

The perception of the main contractors is slightly different from that of other participants of the project management group discussed above. This is because, as can be seen from figure 7.5, all the respondents that were main contractors agree that the entire 22 attributes are required for their satisfaction; over 70% of them strongly agree that the entire attributes are important. The analyses also show that 100% of the main contractors strongly agree that Tsa8 ('There exists early involvement of contractor'), Ssa3 ('Trusts my capability to deliver'), Qsa1 ('Project design contains sufficient details'), Qsa3 (open and honest communication), Qsa5 ('Minimal defects (in supply)'), and Csa1 ('payment for the project is made as contractually agreed') as being significant in determining their satisfaction. Their record for Qsa1 could possibly be because the contractors perceive that unclear and inappropriate designs result in errors, time overruns, and mismanagement of schedules. Unlike the other afore-mentioned participants, the contractors consider Csa1 as being critical for ensuring their satisfaction. Fig 7.5 further shows that over 80% of the main contractors 'strongly agree' that attributes relating to safety (Ssa1, Ssa2, Ssa3) are essential for their satisfaction. This is because of the pressures faced by contractors from clients and other project participants regarding their safety measures and/ or risk strategies. In addition, Gambatese and Hinze (1998) state that project contracts are usually given to contractors or consultants with a record of safe projects delivery.

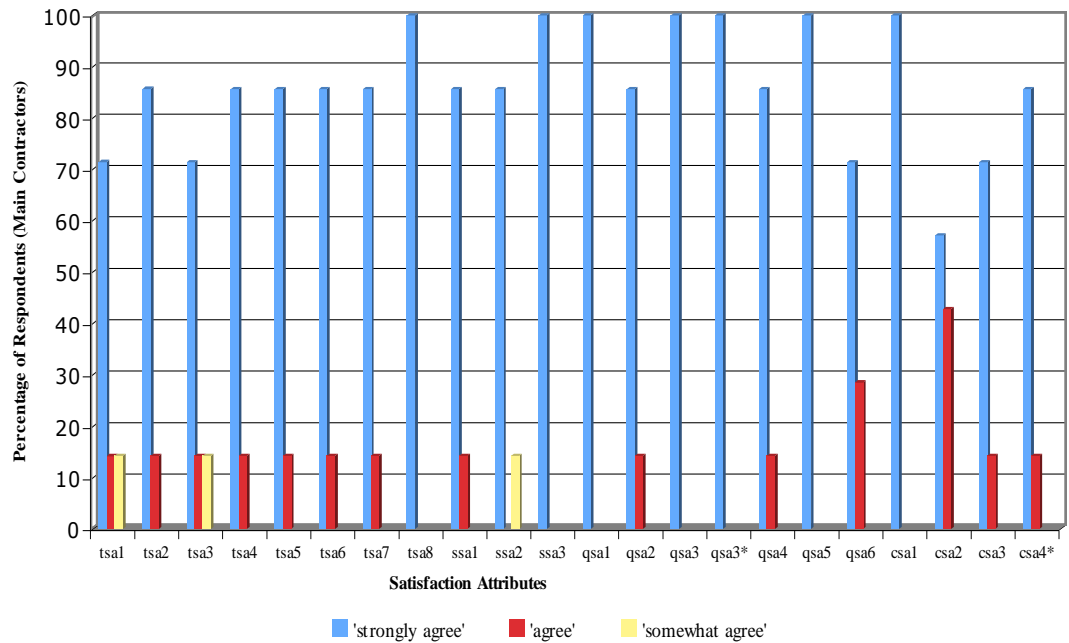


Figure 7.5: Percentage Response Rate of Satisfaction Attributes for Main Contractors

7.1.5.2 Importance of Satisfaction Attributes for Main Contractors

The analysis shown for the main contractors in table 7.5 with respect to the importance associated with the attributes indicate that the contractors consider the entire attributes as being very important; shown by their high satisfaction scores ranging from 0.008 to 0.011. However, the results reveal that the main contractors perceive Csa1, Qsa1, Qsa3, Qsa5, Ssa3, and Tsa8 as being more important considering that these attributes have the high-margin satisfaction score (0.011).

Table 7.5: Importance of Satisfaction Attributes for Main Contractors

	SA	Main Contractor 1			Main Contractor 2			Main Contractor 3			Main Contractor 4			Main Contractor 5			Main Contractor 6			Main Contractor 7			Group Mean Value						
		II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	Mean (SS)	II	SS	II	SS	II	SS	
From client group	Csa1	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.23	0.014		0.23	0.011		0.23	0.011					
	Csa2	0.23	0.011	0.011	0.15	0.004	0.008	0.23	0.01	0.01	0.23	0.01	0.01	0.23	0.01	0.01	0.15	0.006	0.01	0.15	0.004	0.008	0.20	0.008	0.21	0.009			
From sub-ordinates	Csa3	0	0		0.18	0.007		0.23	0.01		0.23	0.01		0.23	0.01		0.15	0.006		0.23	0.011		0.18	0.008					
	Csa4	0.23	0.011	0.006	0.23	0.011	0.009	0.23	0.01	0.01	0.23	0.01	0.01	0.23	0.01	0.01	0.15	0.006	0.006	0.23	0.011	0.011	0.22	0.010	0.20	0.008	0.21	0.009	
From client group	Qsa1	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.23	0.004		0.23	0.011		0.23	0.011					
	Qsa2	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.15	0.006		0.23	0.011		0.22	0.010					
	Qsa3	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.23	0.004		0.23	0.011		0.23	0.011					
	Qsa4	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.23	0.004		0.15	0.004		0.22	0.01					
	Qsa6	0.23	0.011	0.011	0.23	0.011	0.011	0.23	0.01	0.01	0.23	0.01	0.01	0.23	0.01	0.01	0.15	0.006	0.011	0.23	0.011	0.010	0.22	0.010	0.22	0.010			
	Qsa3*	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.23	0.004		0.23	0.011		0.23	0.011					
From sub-ordinates	Qsa5	0.23	0.011	0.011	0.23	0.011	0.011	0.23	0.01	0.01	0.23	0.01	0.01	0.23	0.01	0.01	0.23	0.004	0.014	0.23	0.011	0.011	0.23	0.011	0.23	0.011	0.23	0.010	
	Ssa1	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.15	0.006		0.23	0.011		0.22	0.010					
From client group	Ssa2	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.08	0.002		0.23	0.011		0.21	0.010					
	Ssa3	0.23	0.011	0.011	0.23	0.011	0.011	0.23	0.01	0.01	0.23	0.01	0.01	0.23	0.01	0.01	0.23	0.004	0.007	0.23	0.011	0.011	0.23	0.011	0.22	0.010	0.22	0.010	
	Tsa2	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.15	0.006		0.23	0.011		0.22	0.010					
From client group	Tsa3	0.15	0.005		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.08	0.002		0.23	0.011		0.20	0.008					
	Tsa4	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.15	0.006		0.23	0.011		0.22	0.010					
	Tsa7	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.15	0.006		0.23	0.011		0.22	0.010					
	Tsa8	0.23	0.011	0.010	0.23	0.011	0.011	0.23	0.01	0.01	0.23	0.01	0.01	0.23	0.01	0.01	0.23	0.004	0.007	0.23	0.011	0.011	0.23	0.011	0.22	0.010			
	Tsa1	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.08	0.002		0.15	0.004		0.20	0.008					
	From sub-ordinates	Tsa5	0.23	0.011		0.23	0.011		0.23	0.01		0.23	0.01		0.23	0.01		0.15	0.006		0.23	0.011		0.22	0.010				
Tsa6		0.23	0.011	0.011	0.23	0.011	0.011	0.23	0.01	0.01	0.23	0.01	0.01	0.23	0.01	0.01	0.15	0.006	0.005	0.23	0.011	0.009	0.22	0.010	0.21	0.009	0.21	0.010	

7.1.6 Sub Contractors

7.1.6.1 Importance of Satisfaction Attributes for Sub Contractors

Like the main contractors, the sub contractors consider Csa1 and Tsa8 as being fundamental for their satisfaction shown by the high satisfaction score of 0.013 (table 7.6). The analyses also show that the sub contractors consider Ssa1 ('Health & safety procedures are with no incidents'), Ssa2 ('Strategies for managing and assessing any project risks are in place'), Tsa3 ('Response to complaints, changes, or clarifications is quick & productive'), Tsa4 ('Changes are introduced as early as possible'), Tsa5 ('Ability to meet my deadline'), and Tsa7 ('Sufficient time is allowed for tender') as being essential for their satisfaction shown again by the high satisfaction score of 0.013 for these attributes. The record for 'changes introduced early' as one of the most important satisfaction attribute for the sub contractors means that where changes, change orders and cost of changes are declared or introduced late in the project process, they have a significant effect on the schedule and delivery of the project. Al-Momani (2000) identified change orders, amongst other issues as factors that cause delays in construction projects. As earlier stated in chapter 2, early introduction of change orders in the project process has an impact on the satisfaction of the project participants example, the sub contractor.

Table 7.6: Importance of Satisfaction Attributes for Sub Contractor

Satisfaction Attribute	Sub Contractor		Mean Values	
	II	SS	II	SS
Csa1	0.23	0.013		
Csa2	0.15	0.005		
Csa3	0.15	0.005		
Csa4	0.15	0.005	0.17	0.007
Qsa1	0.15	0.005		
Qsa2	0.15	0.005		
Qsa3	0.15	0.005		
Qsa3*	0.15	0.005		
Qsa4	0.15	0.005		
Qsa5	0.15	0.005		
Qsa6	0.15	0.005	0.15	0.005
Ssa1	0.23	0.013		
Ssa2	0.23	0.013		
Ssa3	0.15	0.005	0.20	0.010
Tsa1	0.15	0.005		
Tsa2	0.15	0.005		

Tsa3	0.23	0.013		
Tsa4	0.23	0.013		
Tsa5	0.23	0.013		
Tsa6	0.15	0.005		
Tsa7	0.23	0.013		
Tsa8	0.23	0.013	0.20	0.010

7.1.7 Supplier

The data in table 7.7 show the perceptions of the supplier. An examination of the analysis shown in table 7.7 suggest that the suppliers consider all the 10 satisfaction attributes relating to the supply group as being significantly important shown by their high satisfaction scores of 0.023.

Table 7.7: Importance of Satisfaction Attributes for Supplier

Satisfaction Attribute	Sub Contractor		Mean Values	
	II	SS	II	SS
Csa1	0.23	0.023		
Csa2	0.23	0.023		
Csa3	0.23	0.023	0.23	0.023
Qsa1	0.23	0.023		
Qsa2	0.23	0.023		
Qsa3	0.23	0.023	0.23	0.023
Ssa1	0.23	0.023	0.23	0.023
Tsa1	0.23	0.023		
Tsa2	0.23	0.023		
Tsa3	0.23	0.023	0.23	0.023

7.2 COMPARISON OF THE PERCEPTIONS OF THE PROJECT PARTICIPANTS

Though different roles were identified in the pilot study as seen from the responses on the above tables, the analyses show some common characteristics, which include:

- All the participants recorded their satisfaction attributes from the client group or the participants they report to (e.g. supervisor/ project consultant) and their subordinates (participants that report to them).

- The recordings for 'Qsa3'/'Qsa3*' (open and honest communication) show higher satisfaction scores more for the respondents' requirement from the client group or supervisor than from their subordinates. This indicates that the project participants would need to communicate more with their superiors in order to clarify issues, understand each other's and the overall project's requirements; thereafter communicate the project requirements to their subordinates as well as understand the subordinates' satisfaction attributes.

However, with respect to the participant's role or position of responsibility, the analyses reveal that:

- The engineers individually (all) recorded Csa2 (Changes are fairly introduced) as their most important satisfaction attributes from the client group. Up to 75% of the engineers recorded Tsa2 (Communication flow is consistent), Qsa3 (Open and honest communication) and Qsa4 (Client interactions are open & friendly) as their most important satisfaction attributes from the client group. This is shown by the consistent high satisfaction scores for the three attributes. These results suggest that the engineers consider communication and interaction on a consistent basis from their superiors (client group) as being fundamental for them to deliver the project as expected. However, as a group they consider their cost satisfaction attributes as their most important requirement from the client group, shown by the highest satisfaction score (group mean value) of 0.010. Subsequently, the analyses show that the group of engineers perceive their cost and quality satisfaction attributes as their most important requirement from their subordinates (participants that report to them).

- More than half of the respondents that were designers recorded high satisfaction score for Qsa3 from the client group. Just like the engineers, the designers expect and consider 'open and honest communication' with the client group as being vital for them to deliver the project as expected by the project owner. However, as a group, the designers consider their cost satisfaction attributes as their most important requirement from the client group, shown by the group mean satisfaction score of 0.009. On the other hand, the analyses show that the designers perceive equal importance for their quality and time satisfaction attributes from their subordinates.
- In the case of the contractors, the main contractors individually (all) indicated high satisfaction scores for Csa1 (payment for project is made). The sub contractor also recorded Csa1 as one of their most important attribute shown by the high satisfaction score of 0.013 in comparison to other attributes. The data analyses indicate that the group of main contractors indicate the quality satisfaction attributes as their most important category of attribute in comparison to their cost, safety and time satisfaction attributes shown by the high importance index (group mean value) of 0.23. This could possibly be because the contractors perceive that having their Q_{sai} met has a significant impact on their reputation for future contracts/ projects. Furthermore, the consistently high importance indices and satisfaction scores for the Ssa1 (health and safety procedures are with no incidents) and Ssa2 (strategies for managing and assessing any project risks are in place) for the main and sub contractors suggest that the contractors consider a safe working environment as being critical for them to deliver the project as expected. It is also interesting to note that the contractors consider that Ssa3 (trust my ability to

deliver) from the client group as being fundamental in determining their satisfaction, again shown by the consistent high satisfaction score for the attribute.

The above results and findings reveal that the outcome of a particular project phase has an effect on the succeeding phase. Therefore adequate recognition and understanding of the requirements of the project participants in a given phase is critical because where there is a flaw in meeting these requirements, it would most likely affect the satisfaction of the participants. This subsequently inhibits the possibility of satisfying the participants in the succeeding phase. For instance, problems such as late delivery, poor quality that arise due to inadequate design do so because focus is not placed on the requirements of the designers for open and honest communication from the client group.

In addition, some of the satisfaction attributes required by one project participant could also be required by another participant; for instance as can be seen from the analyses, the project manager, engineers, designers, and main contractors recorded high importance values for 'open and honest communication (Qsa3)' from the client group. The architect also recorded a high importance index for 'Qsa3' but from their subordinates (designers and engineers). Hence there is the need for the recognition and adequate understanding of one another's satisfaction attributes through open and honest communication.

7.3 INTEGRATED PROJECT TEAM SATISFACTION

In discussing the integrated project team satisfaction, the research demonstrates how the integration of the project participants impacts on the specified key satisfaction attributes. For instance, Pheng and Omar (1997) emphasise the need for construction participants and departments to communicate and integrate more so as to avoid quality defects, cost and

time overruns, and compromises. The authors further state that adopting an integrative approach creates an avenue for information exchange, transfer of fresh ideas, thereby providing better decision and directional strategies for the industry. It is important to note that this will also enable construction participants to go beyond their normal ability irrespective of their level or placement in the construction project team. Bourn (2001) explains that construction team integration will enable reduction in operational costs, project time, and accidents in construction. This is to say that poor quality, time and cost overruns arise due to the lack of integration amongst construction participants. Moreover, Mohamed (2003) points out that teamwork and integration in construction help to minimise errors, save time and enable effective acquisition of project resources. According to Baiden *et al.* (2006), time and cost overruns have resulted in poor project performance due to lack of integration and collaboration of the project participants.

Pheng and Omar (*ibid.*) explain how enabling integration in the construction environment will have a positive impact and improvement on quality. They elucidate that an integrative approach creates an environment where communication amongst the participants is encouraged thereby facilitating a unified and safe environment. This is because where every participant's ideas and views are considered, and their processes or tasks are well integrated, it helps to motivate and positively challenge the participants. This, in effect, enables the construction industry as a whole to tap and benefit from the participants' invaluable contributions (Pheng and Omar 1997.). Akintoye *et al.* (2000) further highlighted nine key objectives of contractors in developing collaboration or integration with the clients and suppliers in relation to the aforementioned satisfaction attributes. The objectives are:

- Benefits to clients
- Improved customer service

- Reduced bureaucracy/ Paperwork
- Increased profitability
- Cost reductions within organisation
- Increased market competitiveness
- Benefits to the supplier
- Improved quality assurance
- Overall supply chain reduction

7.3.1 Analysis on the Impact of the Integrated Project Team (IPT) on Satisfaction Attributes

The data on table 7.8 show that IPT has an impact on all the attributes used in the pilot study and analyses. The results also show that IPT has a high and significant impact on the four key categories: cost, quality, safety and time, shown by the high mean values as recorded by the respondents (well above average). However, the respondents perceive that an integration of the project team has the highest impact on safety given by the mean value of 3.80 in comparison to cost (3.69), quality (3.74), and time (3.79). It is interesting to note that the respondents' perceptions indicate that an integration of the construction project team has the highest impact on a combination of the four key categories (CQST) given by the highest mean value of 4.0. In addition, figure 7.6 shows a high percentage impact of the integrated project team on the satisfaction attributes as perceived by the respondents in general.

Table 7.8: Impact of the Integrated Project Team on Satisfaction Attributes

Key Categories	Attributes (Symbols)	Mean Impact Value/ 5.00	Mean Value/ 5.00
C	FLX	3.83	3.69
	VAL	3.54	
Q	RSP	3.76	3.74

	IMG	3.61	
	DFT	3.83	
	WST	3.76	
S	TRN	3.54	
	SFR	4.05	3.80
T	CNS	3.68	
	OTM	3.90	3.79
CQST	BNF	4.05	
	ENV	4.36	
	GOL	3.90	
	ALN	3.98	
	DCN	3.83	
	CTS	3.98	
	LRN	3.90	4.00

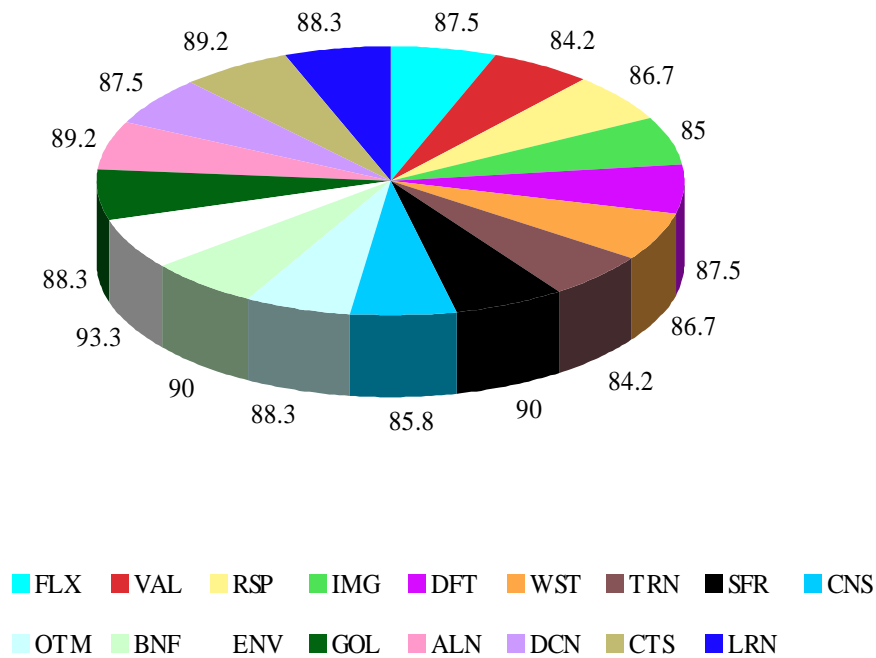


Figure 7.6: Percentage of the Impact of IPT on Satisfaction Attributes

The chart (fig 7.6) shows that IPT has similar percentage impact (over 80%) on all the attributes, indicating the necessity to promote integration in the team as a means for improving their satisfaction. A further analysis is conducted in the next section with the adoption of the fault tree analysis strategy, which involves an integration of the project team and their satisfaction attributes so as to improve the satisfaction of the project participants up the project tree.

7.4 SATISFACTION ASSESSMENT SCENARIOS

In order to demonstrate the application of FTA methodology, two scenarios are used. The project participants and values used for the scenarios are from the data generated from the pilot study and above data analyses. These scenarios are outlined in table 7.9.

Table 7.9: Scenarios for Framework Application

SCENARIO	CASE	TASK
Scenario 1	For this scenario, it is assumed that the client requires the project to be completed on time. The project being completed on time ensures the satisfaction of the client. However, in order to complete the project on time, a number of participants are needed, which are: project manager, architect, designer, engineers, main contractor, sub contractor, and the supplier.	To identify the impact of satisfying (meeting their satisfaction attributes) the project participants on the satisfaction of the client
Scenario 2	For this scenario, it is assumed that the client requires the project to be delivered to quality as desired. To do this, the same number of participants defined in scenario 1 is required. However, the satisfaction attributes of participants for this scenario are different from that of scenario 1.	To identify the impact of integrating the project participants on the satisfaction of the client and other participants. This is to say that this scenario captures and analyses the level of integrated project team satisfaction.

FTA was used to define the relationship between the eight participants considered for the satisfaction assessment process for both scenarios, each requiring the inputs of one another and their defined satisfaction attributes (figures 7.7 and 7.8).

7.4.1 Satisfaction Assessment Scenario 1

The top element (C) defined as the project being completed on time depends on the responsibilities of the project participants as shown on the project tree (fig 7.7). The project participants represented by the rectangle symbols define the intermediate elements of the process. Subsequently, the time-related satisfaction attributes of the participants represented by the oval symbols define the basic elements of the tree. The time-related satisfaction attributes comprise the satisfaction attributes that relate to consistency, duration, and instance, as discussed in chapter 3. For the purpose of this analysis, a random selection of the time-related satisfaction attributes is used. The random selection does not affect the outcome of the analyses.

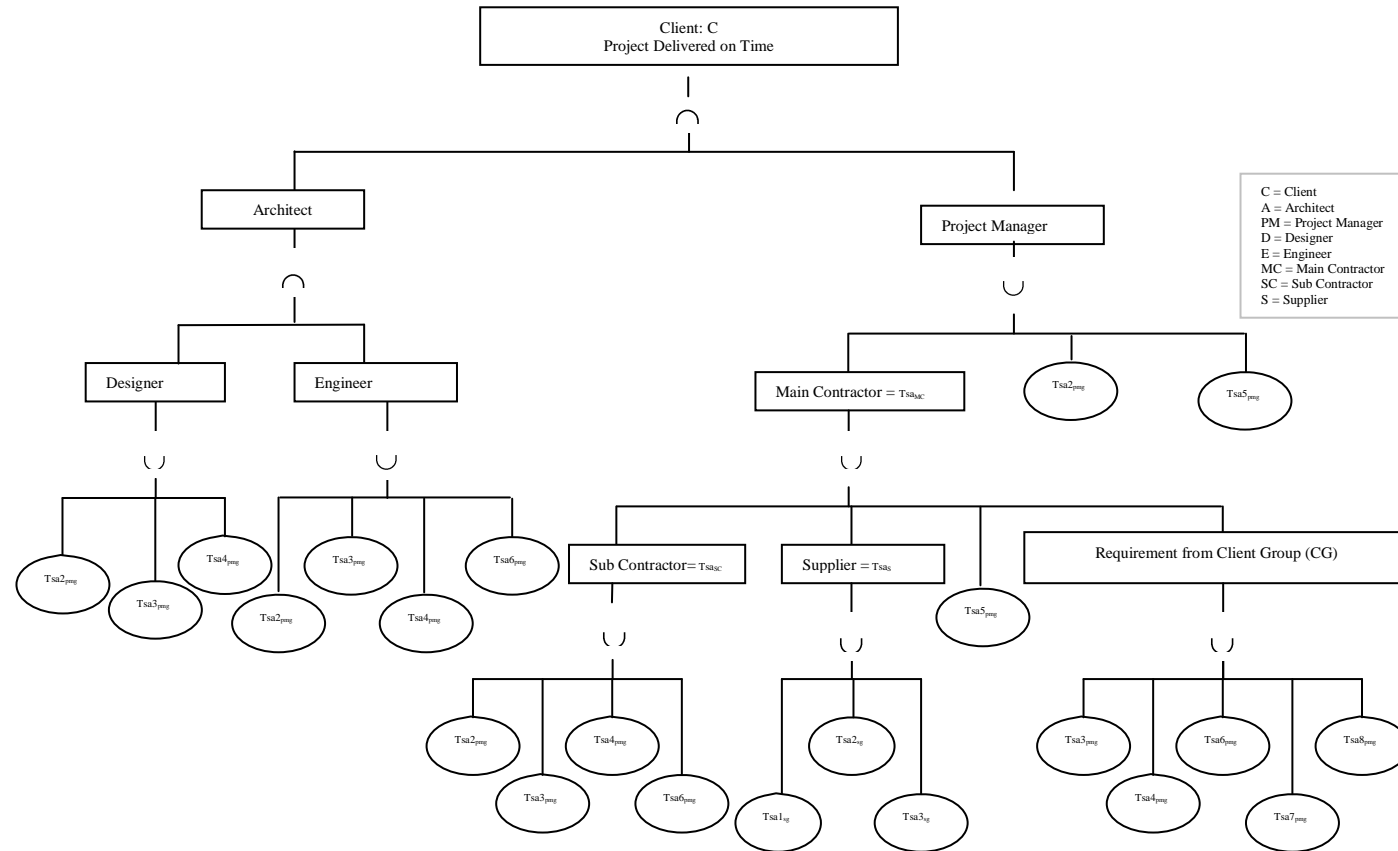


Figure 7.7: Satisfaction Relationship of Project Team (T_{sai})

In order to evaluate the probability of meeting the satisfaction attribute of the client, the probabilities of satisfying the project participants are first established by defining the probabilities of their satisfaction attributes. As earlier mentioned, the probabilities of the attributes are defined as the importance indices of the attributes, which are generated using multi-attribute approach. Illustrations of how the importance indices (probability values) were generated have been shown above (section 7.1). The importance indices of the attributes for the project participants are shown in table 7.10.

Table 7.10: Importance Indices (Probability Values) of Satisfaction Attributes of Project Team

	Tsa1 _{pmg}	Tsa2 _{pmg}	Tsa3 _{pmg}	Tsa4 _{pmg}	Tsa5 _{pmg}	Tsa6 _{pmg}	Tsa7 _{pmg}	Tsa8 _{pmg}
Project Manager		0.23						
Designer	0.23		0.23	0.23				
Engineer		0.23	0.15	0.15		0.23		
Main Contractor			0.15	0.23	0.23	0.23	0.23	0.23
Sub Contractor		0.23	0.23	0.23		0.23		
	Tsa1 _{sg}	Tsa2 _{sg}	Tsa3 _{sg}					
Supplier	0.23	0.23	0.23					

Mathematically, the above project tree (fig 7.7) is represented as:

$$C = A \cap PM \tag{7.1}$$

$$A = D \cap E \tag{7.2}$$

$$D = Tsa1_{pmg} \cup Tsa3_{pmg} \cup Tsa4_{pmg} \tag{7.3}$$

$$E = Tsa2_{pmg} \cup Tsa3_{pmg} \cup Tsa4_{pmg} \cup Tsa6_{pmg} \tag{7.4}$$

$$PM = Tsa_{MC} \cup Tsa2_{pmg} \cup Tsa5_{pmg} \tag{7.5}$$

$$MC = Tsa_{SC} \cup Tsa_S \cup Tsa_{CG} \cup Tsa5_{pmg} \tag{7.6}$$

$$SC = Tsa2_{pmg} \cup Tsa3_{pmg} \cup Tsa4_{pmg} \cup Tsa6_{pmg} \tag{7.7}$$

$$S = Tsa1_{sg} \cup Tsa2_{sg} \cup Tsa3_{sg} \tag{7.8}$$

$$CG = Tsa3_{pmg} \cup Tsa4_{pmg} \cup Tsa6_{pmg} \cup Tsa7_{pmg} \cup Tsa8_{pmg} \tag{7.9}$$

Examining figure 7.7. it shows that the top or initiating element in the project tree (fig 7.7) defined as the project being delivered on time is a satisfaction attribute of the client.

Subsequently, equation 7.1 shows that the client specifies the satisfaction attribute to the project manager and architect. For the project manager (PM) to meet the client's requirement, PM requires inputs from the main contractor (MC), a satisfaction attribute ($Tsa_{2_{pmg}}$) from the client and another attribute ($Tsa_{5_{pmg}}$) from MC as shown in equation 7.5. However, MC requires inputs from the sub contractor (SC) and supplier (S), satisfaction attributes from these subordinates ($Tsa_{5_{pmg}}$), as well as satisfaction attributes from PM (CG: $Tsa_{3_{pmg}}$, $Tsa_{4_{pmg}}$, $Tsa_{6_{pmg}}$, $Tsa_{7_{pmg}}$, $Tsa_{8_{pmg}}$) in order to meet the requirement of PM (equation 7.6).

Similarly, as can be seen in equation 7.2, the architect (A) requires the inputs of the designer (D) and engineer (E), who define their satisfaction attributes as shown (equations 7.3 and 7.4 respectively), to meet the client's satisfaction attribute (top element on the project tree: fig 7.7). The same procedure follows for the SC and S as shown in equations 7.7 and 7.8 respectively. This implies that for the supplier (S) to meet the satisfaction attributes ($Tsa_{5_{pmg}}$) of MC, the supplier's satisfaction attributes ($Tsa_{1_{sg}}$, $Tsa_{2_{sg}}$, $Tsa_{3_{sg}}$) need to be met by MC.

Applying Boolean Laws expressions, the above mathematical expressions become:

$$\begin{aligned}
 C &= A \cdot PM \\
 A &= D \cdot E \\
 D &= Tsa_{1_{pmg}} + Tsa_{3_{pmg}} + Tsa_{4_{pmg}} \\
 E &= Tsa_{2_{pmg}} + Tsa_{3_{pmg}} + Tsa_{4_{pmg}} + Tsa_{6_{pmg}} \\
 PM &= Tsa_{MC} + Tsa_{2_{pmg}} + Tsa_{5_{pmg}} \\
 MC &= Tsa_{SC} + Tsa_S + Tsa_{CG} + Tsa_{5_{pmg}} \\
 SC &= Tsa_{2_{pmg}} + Tsa_{3_{pmg}} + Tsa_{4_{pmg}} + Tsa_{6_{pmg}} \\
 S &= Tsa_{1_{sg}} + Tsa_{2_{sg}} + Tsa_{3_{sg}} \\
 CG &= Tsa_{3_{pmg}} + Tsa_{4_{pmg}} + Tsa_{6_{pmg}} + Tsa_{7_{pmg}} + Tsa_{8_{pmg}}
 \end{aligned}$$

Subsequently, applying Probability laws, the above Boolean law expressions become:

$$\begin{aligned}
 P(C) &= P[A \cdot PM] &&= P[A] \cdot P[PM] = \prod_{i=1}^n P_i \\
 P(A) &= P[D \cdot E] &&= P[D] \cdot P[E] = \prod_{i=1}^n P_i \\
 P(D) &= P[Tsa1_{pmg} + Tsa3_{pmg} + Tsa4_{pmg}] &&= 1 - \prod_{i=1}^n \{1 - P(T_{sai})\}, i=1,3,4 \\
 P(E) &= P[Tsa2_{pmg} + Tsa3_{pmg} + Tsa4_{pmg} + Tsa6_{pmg}] &&= 1 - \prod_{i=2}^n \{1 - P(T_{sai})\}, i=2,3,4,6 \\
 P(PM) &= P[Tsa_{MC} + Tsa2_{pmg} + Tsa5_{pmg}] &&= 1 - \prod_{i=1}^n \{1 - P(T_{sai})\} \\
 P(MC) &= P[Tsa_{SC} + Tsa_S + Tsa_{CG} + Tsa5_{pmg}] &&= 1 - \prod_{i=1}^n \{1 - P(T_{sai})\} \\
 P(SC) &= P[Tsa2_{pmg} + Tsa3_{pmg} + Tsa4_{pmg} + Tsa6_{pmg}] &&= 1 - \prod_{i=2}^n \{1 - P(T_{sai})\}, i=2,3,4,6 \\
 P(S) &= P[Tsa1_{sg} + Tsa2_{sg} + Tsa3_{sg}] &&= 1 - \prod_{i=1}^3 \{1 - P(T_{sai})\} \\
 P(CG) &= P[Tsa3_{pmg} + Tsa4_{pmg} + Tsa6_{pmg} + Tsa7_{pmg} + Tsa8_{pmg}] &&= 1 - \prod_{i=3}^8 \{1 - P(T_{sai})\}
 \end{aligned}$$

To weigh the impact of satisfying the project participants by meeting their requirements (satisfaction attributes) on the satisfaction of the client, the quantitative evaluation of the project tree (fig 7.7) is carried out.

Hence the quantitative evaluations of the project tree are presented below:

$$\begin{aligned}
 P(CG) &= 1 - \prod_{i=3}^8 \{1 - P(T_{sai})\} \\
 &= 1 - \{[1 - P(Tsa3_{pmg})][1 - P(Tsa4_{pmg})][1 - P(Tsa6_{pmg})][1 - P(Tsa7_{pmg})][1 - P(Tsa8_{pmg})]\} \\
 &= 1 - [1 - 0.15][1 - 0.23][1 - 0.23][1 - 0.23][1 - 0.23] \\
 &= 0.7012 \\
 P(S) &= 1 - \prod_{i=1}^3 \{1 - P(T_{sai})\} \\
 &= 1 - \{[1 - P(Tsa1_{sg})][1 - P(Tsa2_{sg})][1 - P(Tsa3_{sg})]\} \\
 &= 1 - [1 - 0.23][1 - 0.23][1 - 0.23] \\
 &= 0.5435
 \end{aligned}$$

$$P(SC) = 1 - \prod_{i=2}^n \{1 - P(T_{sai})\}, i = 2, 3, 4, 6$$

$$= 1 - \{[1-0.23][1-0.23][1-0.23][1-0.23]\}$$

$$= 1 - 0.31641$$

$$= 0.6485$$

$$P(MC) = 1 - \prod_{i=1}^n \{1 - P(T_{sai})\}, i = CG, S, SC, T5$$

$$= 1 - \{[1-P(Tsa_{CG})][1-P(Tsa_S)][1-P(Tsa_{SC})][1-P(Tsa_{5_{pmg}})]\}$$

$$= 1 - [1-0.7012][1-0.5435][1-0.6485][1-0.23]$$

$$= 0.9631$$

$$P(PM) = 1 - \{[1-P(Tsa_{MC})][1-P(Tsa_{2_{pmg}})][1-P(Tsa_{5_{pmg}})]\}$$

$$= 1 - [1-0.9631][1-0.23][1-0.23]$$

$$= 0.9781$$

$$P(E) = 1 - \{[1-P(Tsa_{2_{pmg}})][1-P(Tsa_{3_{pmg}})][1-P(Tsa_{4_{pmg}})][1-P(Tsa_{6_{pmg}})]\}$$

$$= 1 - \{[1-0.23][1-0.15][1-0.15][1-0.23]\}$$

$$= 0.5716$$

$$P(D) = 1 - \prod_{i=1}^n \{1 - P(T_{sai})\}, i = 1, 3, 4$$

$$= 1 - \{[1-0.23][1-0.23][1-0.23]\}$$

$$= 0.5435$$

$$P(A) = P[D] \cdot P[E]$$

$$= 0.5435 * 0.5716$$

$$= 0.3107$$

$$P(C) = P[A] \cdot P[PM]$$

$$= 0.3107 * 0.9781$$

$$= 0.3039$$

$$\approx 0.30$$

7.4.1.1 Results from Satisfaction Assessment Scenario 1

Results from the tree analysis indicate that there is 30% chance that the client will be satisfied by the project being completed on time

It was however observed that if the importance indices for some attributes are randomly reduced, that is lower than required by the project participants as shown in table 7.11, the quantitative evaluations reveal that the chances of completing the project on time as required by the client is reduced from 30% to 23%.

Also, considering different sections of the project tree, the following points are observed:

- Considering the project manager as the top element, the analyses show that where the importance indices for the participants' (main contractor, sub contractor, and supplier) satisfaction attributes are reduced, it invariably reduces the probability to satisfy the project manager from 0.9781 to 0.9604.
- Considering the architect as the top element, the results also reveal that the probability to satisfy the architect is significantly reduced from 0.3107 to 0.2421 if the importance indices of the satisfaction attributes for the designer and engineer are reduced.

Table 7.11: Adjusted Satisfaction Scores (Probability Values) of Satisfaction Attributes

	Tsa1 _{pmg}	Tsa2 _{pmg}	Tsa3 _{pmg}	Tsa4 _{pmg}	Tsa5 _{pmg}	Tsa6 _{pmg}	Tsa7 _{pmg}	Tsa8 _{pmg}
PM		0.15			0.23			
D	0.23		0.15	0.23				
E		0.23	0.15	0.08		0.15		
MC			0.15	0.23	0.15	0.23	0.15	0.23
SC		0.23	0.15	0.23		0.15		
	Tsa1 _{sg}	Tsa2 _{sg}	Tsa3 _{sg}					
S	0.23	0.15	0.23					

$$\begin{aligned}
 P(\text{CG}) &= 1 - \prod_{i=3}^8 \{1 - P(T_{sai})\} \\
 &= 1 - [1 - 0.15][1 - 0.23][1 - 0.23][1 - 0.15][1 - 0.23] \\
 &= 0.6702
 \end{aligned}$$

$$\begin{aligned}
 P(\text{S}) &= 1 - \prod_{i=1}^3 \{1 - P(T_{sai})\} \\
 &= 1 - [1 - 0.23][1 - 0.15][1 - 0.23] \\
 &= 0.4960
 \end{aligned}$$

Similarly, the adjusted probability evaluation for other participants is:

$$P(SC) = 0.5716$$

$$P(MC) = 0.9395$$

$$P(PM) = 0.9604$$

$$P(E) = 0.4882$$

$$P(D) = 0.4960$$

$$P(A) = 0.2421$$

$$P(C) = 0.2325$$

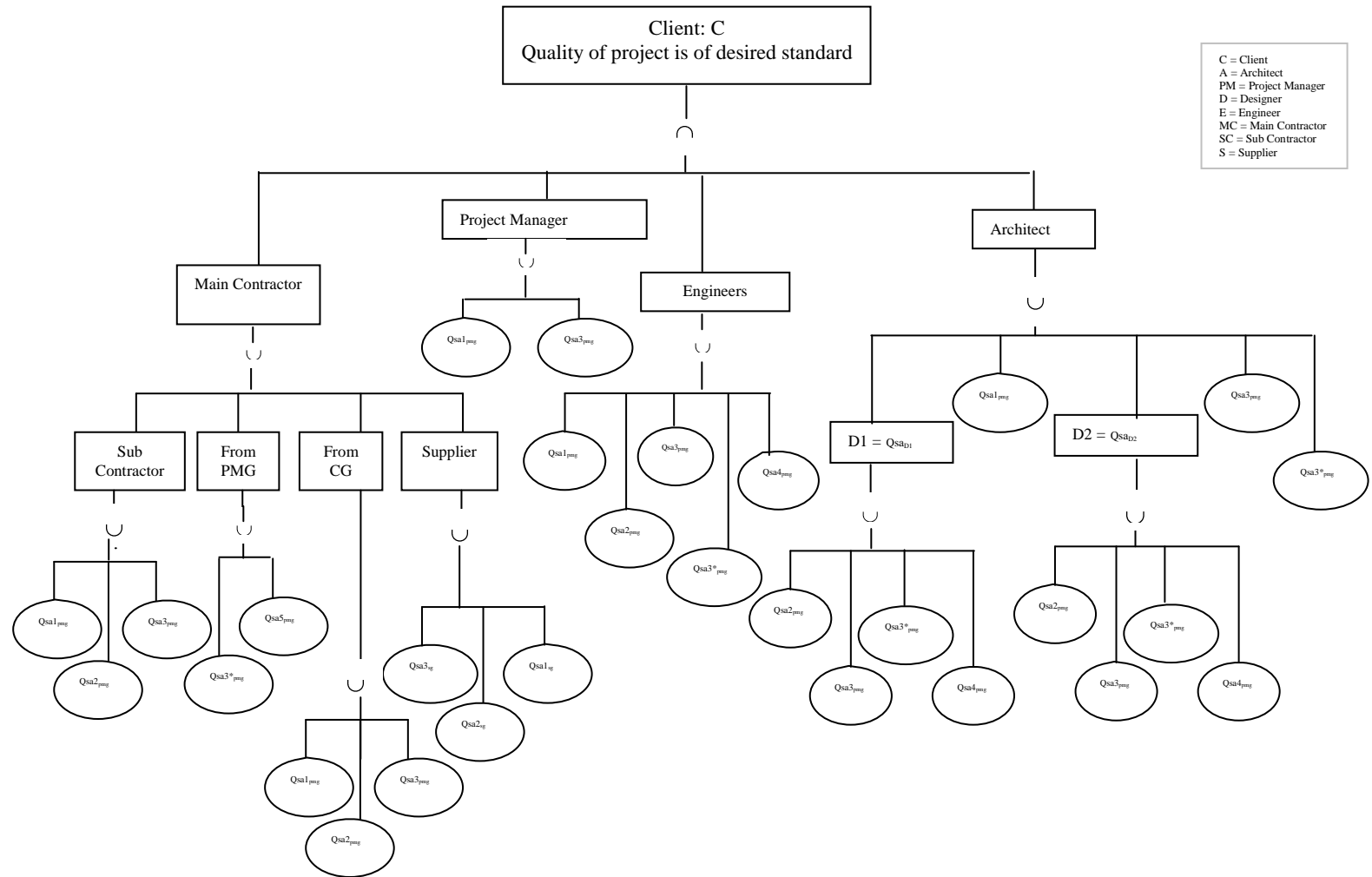
$$\approx 0.23$$

Hence there is 23% chance that the client will be satisfied.

The above results and quantitative evaluations of the project tree reveal that the satisfaction of participants at the lower levels of the project tree has a positive and significant impact on the satisfaction level of participants on higher levels of the project tree. Hence, where the probability to satisfy the other participants (meeting their satisfaction attributes) is high, it invariably improves the chances of meeting the client's requirements.

7.4.2 Satisfaction Assessment Scenario 2

The top element (C) defined as the project being delivered to quality as required by the client, again depends on the responsibilities of the project participants as shown on the project tree (fig 7.8). As in scenario 1, the project participants represented by the rectangle symbols define the intermediate elements of the process. Subsequently, the quality-related satisfaction attributes of the participants represented by the oval symbols define the basic elements of the tree. The quality-related satisfaction attributes comprise the satisfaction attributes that relate to features, design, and services. However, unlike scenario 1, scenario 2 investigates the impact of the integrated project team on the satisfaction of the project participants.



C = Client
 A = Architect
 PM = Project Manager
 D = Designer
 E = Engineer
 MC = Main Contractor
 SC = Sub Contractor
 S = Supplier

Figure 7.8: Satisfaction Relationship of Project Team (Q_{sai})

The analyses for the computations of the importance indices of the attributes for the project participants are shown in table 7.12.

Table 7.12: Importance Indices (Probability Values) of Satisfaction Attributes of Project Team

	Qsa1 _{pmg}	Qsa2 _{pmg}	Qsa3 _{pmg}	Qsa3* _{pm}	Qsa4 _{pmg}	Qsa5 _{pmg}
PM	0.23		0.23			
D1		0.15	0.23	0.15	0.15	
D2		0.15	0.15	0.15	0.15	
E	0.15	0.15	0.23	0.23	0.23	
MC	0.23	0.23	0.23	0.23		0.23
A	0.23		0.08	0.23		
SC	0.15	0.15	0.15			
	Qsa1 _{sg}	Qsa2 _{sg}	Qsa3 _{sg}			
S	0.23	0.23	0.23			

Mathematically, the above project tree (fig 7.8) is represented as:

$$C = MC \cap PM \cap E \cap A \quad (7.10)$$

$$MC = SC \cup PMG \cup CG \cup S \quad (7.11)$$

$$SC = Qsa1_{pmg} \cup Qsa2_{pmg} \cup Qsa3_{pmg} \quad (7.12)$$

$$PMG = Qsa3^*_{pmg} \cup Qsa5_{pmg} \quad (7.13)$$

$$CG = Qsa1_{pmg} \cup Qsa2_{pmg} \cup Qsa3_{pmg} \quad (7.14)$$

$$S = Qsa1_{sg} \cup Qsa2_{sg} \cup Qsa3_{sg} \quad (7.15)$$

$$PM = Qsa1_{pmg} \cup Qsa3_{pmg} \quad (7.16)$$

$$E = Qsa1_{pmg} \cup Qsa2_{pmg} \cup Qsa3_{pmg} \cup Qsa3^*_{pmg} \cup Qsa4_{pmg} \quad (7.17)$$

$$A = Qsa_{D1} \cup Qsa_{D2} \cup Qsa1_{pmg} \cup Qsa3_{pmg} \cup Qsa3^*_{pmg} \quad (7.18)$$

$$D1 = Qsa2_{pmg} \cup Qsa3_{pmg} \cup Qsa3^*_{pmg} \cup Qsa4_{pmg} \quad (7.19)$$

$$D2 = Qsa2_{pmg} \cup Qsa3_{pmg} \cup Qsa3^*_{pmg} \cup Qsa4_{pmg} \quad (7.20)$$

Examining figure 7.8, the top or initiating element in the project tree (fig 7.8) defined as ‘quality of project delivered as desired’, is a satisfaction attribute of the client. Subsequently, like in scenario 1, equation 7.10 shows that the client specifies the satisfaction attribute to the main contractor, project manager, engineer, and architect. For the project manager (PM) to meet the client’s requirement, PM requires two satisfaction

attributes ($Qsa1_{pmg}, Qsa3_{pmg}$) as indicated in equation 7.16. However, as can be seen in equation 7.11, MC requires inputs from the sub contractor (SC) and supplier (S), satisfaction attributes from these subordinates (PMG: $Qsa3^*_{pmg}, Qsa5_{pmg}$), as well as satisfaction attributes from client (CG: $Qsa1_{pmg}, Qsa2_{pmg}, Qsa3_{pmg}$) in order to meet the requirement of client.

Subsequently, equation 7.18 shows that the architect (A) requires the inputs of the designer 1 (D1) and designer 2 (D2), who define their satisfaction attributes as shown in equations 19 and 20 respectively, two satisfaction attributes from D1 and D2 ($Qsa1_{pmg}, Qsa3^*_{pmg}$), a satisfaction attribute from the client ($Qsa3_{pmg}$) in order to meet the client's satisfaction attribute. The same procedure follows for the other participants as shown in the equations and fig 7.8. This is to say that for the supplier (S) to meet the satisfaction attributes ($Qsa3^*_{pmg}, Qsa5_{pmg}$) of MC, the supplier's satisfaction attributes ($Qsa1_{sg}, Qsa2_{sg}, Qsa3_{sg}$) need to be met by MC (equation 7.15).

Applying Boolean Laws expressions, the above mathematical expressions become:

$$\begin{aligned}
 C &= MC \cdot PM \cdot E \cdot A \\
 MC &= SC + PMG + CG + S \\
 SC &= Qsa1_{pmg} + Qsa2_{pmg} + Qsa3_{pmg} \\
 PMG &= Qsa3^*_{pmg} + Qsa5_{pmg} \\
 CG &= Qsa1_{pmg} + Qsa2_{pmg} + Qsa3_{pmg} \\
 S &= Qsa1_{sg} + Qsa2_{sg} + Qsa3_{sg} \\
 PM &= Qsa1_{pmg} + Qsa3_{pmg} \\
 E &= Qsa1_{pmg} + Qsa2_{pmg} + Qsa3_{pmg} + Qsa3^*_{pmg} + Qsa4_{pmg} \\
 A &= Qsa_{D1} + Qsa_{D2} + Qsa1_{pmg} + Qsa3_{pmg} + Qsa3^*_{pmg} \\
 D1 &= Qsa2_{pmg} + Qsa3_{pmg} + Qsa3^*_{pmg} + Qsa4_{pmg} \\
 D2 &= Qsa2_{pmg} + Qsa3_{pmg} + Qsa3^*_{pmg} + Qsa4_{pmg}
 \end{aligned}$$

Subsequently, applying Probability laws, the above Boolean law expressions become:

$$P(C) = P[MC \cdot PM \cdot E \cdot A] = P[MC] \cdot P[PM] \cdot P[E] \cdot P[A]$$

$$\begin{aligned}
 P(\text{MC}) &= P[\text{SC} + \text{PMG} + \text{CG} + \text{S}] &&= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 P(\text{SC}) &= P[\text{Qsa1}_{\text{pmg}} + \text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}}] &&= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 P(\text{PMG}) &= P[\text{Qsa3}^*_{\text{pmg}} + \text{Qsa5}_{\text{pmg}}] &&= 1 - \prod_{i=3}^n \{1 - P(Q_{sai})\} \\
 P(\text{CG}) &= P[\text{Qsa1}_{\text{pmg}} + \text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}}] &&= 1 - \prod_{i=1}^3 \{1 - P(Q_{sai})\} \\
 P(\text{S}) &= P[\text{Qsa1}_{\text{sg}} + \text{Qsa2}_{\text{sg}} + \text{Qsa3}_{\text{sg}}] &&= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 P(\text{PM}) &= P[\text{Qsa1}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}}] &&= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 P(\text{E}) &= P[\text{Qsa1}_{\text{pmg}} + \text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}} + \text{Qsa4}_{\text{pmg}}] &&= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 P(\text{A}) &= P[\text{Qsa}_{\text{D1}} + \text{Qsa}_{\text{D2}} + \text{Qsa1}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}}] &&= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 P(\text{D1}) &= P[\text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}} + \text{Qsa4}_{\text{pmg}}] &&= 1 - \prod_{i=2}^n \{1 - P(Q_{sai})\} \\
 P(\text{D2}) &= P[\text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}} + \text{Qsa4}_{\text{pmg}}] &&= 1 - \prod_{i=2}^n \{1 - P(Q_{sai})\}
 \end{aligned}$$

Hence to weigh the probability of delivering the project to quality as required by the client, the quantitative evaluation of the project tree (figure 7.8) is presented:

$$\begin{aligned}
 P(\text{D2}) &= P[\text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}} + \text{Qsa4}_{\text{pmg}}] \\
 &= 1 - \prod_{i=2}^n \{1 - P(Q_{sai})\} \\
 &= 1 - [(1-0.15) * (1-0.15) * (1-0.15) * (1-0.15)] \\
 &= 1 - [0.85 * 0.85 * 0.85 * 0.85] \\
 &= 0.4780 \\
 P(\text{D1}) &= P[\text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}} + \text{Qsa4}_{\text{pmg}}] \\
 &= 1 - \prod_{i=2}^n \{1 - P(Q_{sai})\} \\
 &= 1 - [(1-0.15) * (1-0.23) * (1-0.15) * (1-0.15)] = 1 - [0.85 * 0.77 * 0.85 * 0.85]
 \end{aligned}$$

$$= 0.5271$$

$$\begin{aligned} P(A) &= P[Qsa_{D1} + Qsa_{D2} + Qsa_{1_{pmg}} + Qsa_{3_{pmg}} + Qsa_{3^*_{pmg}}] \\ &= 1 - [(1-0.5271) * (1-0.4780) * (1-0.23) * (1-0.08) * (1-0.23)] \\ &= 1 - [0.4729 * 0.5220 * 0.77 * 0.92 * 0.77] \\ &= 0.8653 \end{aligned}$$

$$\begin{aligned} P(E) &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\ &= 1 - [(1-0.15) * (1-0.15) * (1-0.23) * (1-0.23) * (1-0.23)] \\ &= 1 - [0.85 * 0.85 * 0.77 * 0.77 * 0.77] \\ &= 0.6359 \end{aligned}$$

$$\begin{aligned} P(PM) &= P[Qsa_{1_{pmg}} + Qsa_{3_{pmg}}] \\ &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\ &= 1 - [(1-0.23) * (1-0.23) *] = 1 - [0.77 * 0.77] \\ &= 0.4071 \end{aligned}$$

$$\begin{aligned} P(S) &= P[Qsa_{1_{sg}} + Qsa_{2_{sg}} + Qsa_{3_{sg}}] \\ &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\ &= 1 - [(1-0.23) * (1-0.23) * (1-0.23)] = 1 - [0.77 * 0.77 * 0.77] \\ &= 0.5435 \end{aligned}$$

$$\begin{aligned} P(SC) &= P[Qsa_{1_{pmg}} + Qsa_{2_{pmg}} + Qsa_{3_{pmg}}] \\ &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\ &= 1 - [(1-0.15) * (1-0.15) * (1-0.15)] = 1 - [0.85 * 0.85 * 0.85] \\ &= 0.3859 \end{aligned}$$

$$\begin{aligned} P(CG) &= P[Qsa_{1_{sg}} + Qsa_{2_{sg}} + Qsa_{3_{sg}}] \\ &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\ &= 1 - [(1-0.23) * (1-0.23) * (1-0.23)] = 1 - [0.77 * 0.77 * 0.77] \\ &= 0.5435 \end{aligned}$$

$$\begin{aligned} P(PMG) &= P[Qsa_{3^*_{pmg}} + Qsa_{5_{pmg}}] \\ &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\ &= 1 - [(1-0.23) * (1-0.23)] = 1 - [0.77 * 0.77] \\ &= 0.4071 \end{aligned}$$

$$P(MC) = P[SC + PMG + CG + S]$$

$$\begin{aligned} &= 1 - [(1-0.3859) * (1-0.4071) * (1-0.5435) * (1-0.5435)] \\ &= 1 - [0.6141 * 0.5929 * 0.4565 * 0.4565] \\ &= 0.9241 \end{aligned}$$

$$\begin{aligned} P(C) &= P(PM) \cdot P(A) \cdot P(MC) \cdot P(E) \\ &= 0.4071 * 0.8653 * 0.9241 * 0.6359 \\ &= 0.2070 \\ &\approx 21 \end{aligned}$$

Hence, the analyses indicate that there exists 21% chance of satisfying the client by delivering the project to the desired quality.

7.4.2.1 Results from Satisfaction Assessment Scenario 2

Taking into account the above evaluations for scenario 2, if there exists an improved integration of the project participants and their satisfaction attributes, as shown in figure 7.9, the analysis indicate a significant improvement in the chances of the project participants satisfying the client or delivering project to quality as desired by the client (from 21% to 92%).

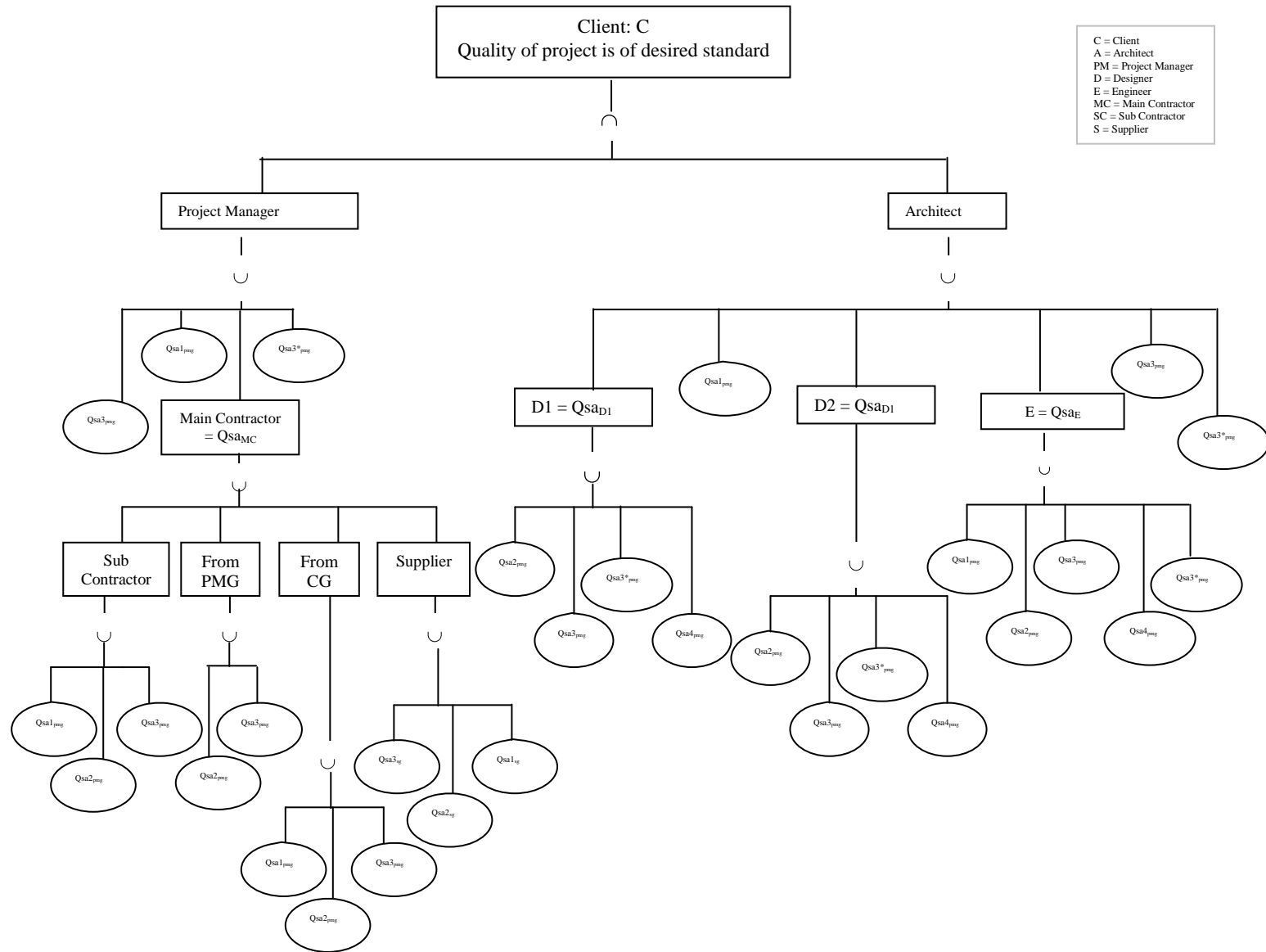


Figure 7.9: Improved (IPT) Satisfaction Relationship of Project Team (Q_{sai})

Mathematically, the above project tree (fig 7.9) is represented as:

$$\begin{aligned}
 C &= PM \cap A \\
 PM &= Qsa_{MC} \cup Qsa_{1_{pmg}} \cup Qsa_{3_{pmg}} \cup Qsa_{3^*_{mg}} \\
 MC &= SC \cup PMG \cup CG \cup S \\
 SC &= Qsa_{1_{pmg}} \cup Qsa_{2_{pmg}} \cup Qsa_{3_{pmg}} \\
 PMG &= Qsa_{3^*_{pmg}} \cup Qsa_{5_{pmg}} \\
 CG &= Qsa_{1_{pmg}} \cup Qsa_{2_{pmg}} \cup Qsa_{3_{pmg}} \\
 S &= Qsa_{1_{sg}} \cup Qsa_{2_{sg}} \cup Qsa_{3_{sg}} \\
 A &= Qsa_{D1} \cup Qsa_{D2} \cup Qsa_E \cup Qsa_{1_{pmg}} \cup Qsa_{3_{pmg}} \cup Qsa_{3^*_{pmg}} \\
 D1 &= Qsa_{2_{pmg}} \cup Qsa_{3_{pmg}} \cup Qsa_{3^*_{pmg}} \cup Qsa_{4_{pmg}} \\
 D2 &= Qsa_{2_{pmg}} \cup Qsa_{3_{pmg}} \cup Qsa_{3^*_{pmg}} \cup Qsa_{4_{pmg}} \\
 E &= Qsa_{1_{pmg}} \cup Qsa_{2_{pmg}} \cup Qsa_{3_{pmg}} \cup Qsa_{3^*_{pmg}} \cup Qsa_{4_{pmg}}
 \end{aligned}$$

Applying Boolean Laws expressions, the above mathematical expressions become:

$$\begin{aligned}
 C &= PM \cdot A \\
 PM &= Qsa_{MC} + Qsa_{1_{pmg}} + Qsa_{3_{pmg}} + Qsa_{3^*_{pmg}} \\
 MC &= SC + PMG + CG + S \\
 SC &= Qsa_{1_{pmg}} + Qsa_{2_{pmg}} + Qsa_{3_{pmg}} \\
 PMG &= Qsa_{3^*_{pmg}} + Qsa_{5_{pmg}} \\
 CG &= Qsa_{1_{pmg}} + Qsa_{2_{pmg}} + Qsa_{3_{pmg}} \\
 S &= Qsa_{1_{sg}} + Qsa_{2_{sg}} + Qsa_{3_{sg}} \\
 A &= Qsa_{D1} + Qsa_{D2} + Qsa_E + Qsa_{1_{pmg}} + Qsa_{3_{pmg}} + Qsa_{3^*_{pmg}} \\
 D1 &= Qsa_{2_{pmg}} + Qsa_{3_{pmg}} + Qsa_{3^*_{pmg}} + Qsa_{4_{pmg}} \\
 D2 &= Qsa_{2_{pmg}} + Qsa_{3_{pmg}} + Qsa_{3^*_{pmg}} + Qsa_{4_{pmg}} \\
 E &= Qsa_{1_{pmg}} + Qsa_{2_{pmg}} + Qsa_{3_{pmg}} + Qsa_{3^*_{pmg}} + Qsa_{4_{pmg}}
 \end{aligned}$$

Subsequently, applying Probability laws, the above Boolean law expressions become:

$$\begin{aligned}
 P(C) &= P[PM \cdot A] &&= P[PM] \cdot P[A] \\
 P(PM) &= P[Qsa_{MC} + Qsa_{1_{pmg}} + Qsa_{3_{pmg}} + Qsa_{3^*_{pmg}}] &&= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 P(MC) &= P[SC + PMG + CG + S] &&= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\}
 \end{aligned}$$

$$\begin{aligned}
 P(\text{SC}) &= P[\text{Qsa1}_{\text{pmg}} + \text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}}] &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 P(\text{PMG}) &= P[\text{Qsa3}^*_{\text{pmg}} + \text{Qsa5}_{\text{pmg}}] &= 1 - \prod_{i=3}^n \{1 - P(Q_{sai})\} \\
 P(\text{CG}) &= P[\text{Qsa1}_{\text{pmg}} + \text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}}] &= 1 - \prod_{i=3}^n \{1 - P(Q_{sai})\} \\
 P(\text{S}) &= P[\text{Qsa1}_{\text{sg}} + \text{Qsa2}_{\text{sg}} + \text{Qsa3}_{\text{sg}}] &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 P(\text{A}) &= P[\text{Qsa}_{\text{D1}} + \text{Qsa}_{\text{D2}} + \text{Qsa}_{\text{E}} + \text{Qsa1}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}}] &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 P(\text{D1}) &= P[\text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}} + \text{Qsa4}_{\text{pmg}}] &= 1 - \prod_{i=2}^n \{1 - P(Q_{sai})\} \\
 P(\text{D2}) &= P[\text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}} + \text{Qsa4}_{\text{pmg}}] &= 1 - \prod_{i=2}^n \{1 - P(Q_{sai})\} \\
 P(\text{E}) &= P[\text{Qsa1}_{\text{pmg}} + \text{Qsa2}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}} + \text{Qsa4}_{\text{pmg}}] &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\}
 \end{aligned}$$

The probability to satisfy the participants: MC, SC, PG, CG, S, D1 and D2 have already been computed from fig 7.8 so will not be reproduced for fig 7.9 since the aforementioned participants occupy the same position for both figures. Therefore, the modified quantitative evaluations for PM, A and C are presented below:

$$\begin{aligned}
 P(\text{PM}) &= P[\text{Qsa}_{\text{MC}} + \text{Qsa1}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}}] \\
 &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 &= 1 - [(1-0.9241) * (1-0.23) * (1-0.23) * (1-0.23)] \\
 &= 1 - [0.0759 * 0.77 * 0.77 * 0.77] \\
 &= 0.9653 \\
 P(\text{A}) &= P[\text{Qsa}_{\text{D1}} + \text{Qsa}_{\text{D2}} + \text{Qsa}_{\text{E}} + \text{Qsa1}_{\text{pmg}} + \text{Qsa3}_{\text{pmg}} + \text{Qsa3}^*_{\text{pmg}}] \\
 &= 1 - \prod_{i=1}^n \{1 - P(Q_{sai})\} \\
 &= 1 - [(1-0.5271) * (1-0.4780) * (1-0.6359) * (1-0.23) * (1-0.08) * (1-0.23)] \\
 &= 1 - [0.4729 * 0.5220 * 0.3641 * 0.77 * 0.92 * 0.77] \\
 &= 1 - 0.0490
 \end{aligned}$$

$$\begin{aligned} &= 0.9510 \\ P(C) &= P[PM] \cdot P[A] \\ &= 0.9653 * 0.9510 \\ &= 0.9180 \\ &\approx 92 \end{aligned}$$

Hence, the analyses indicate that there exists 92% chance of satisfying the client or delivering the project to the desired quality of the client.

Also, considering different sections of the project tree, the following points are observed:

- Considering the project manager as the top element, the analyses show a significant improvement of the manager's satisfaction score (from 0.4071 to 0.9653) having being integrated or linked with not just the client but also with the main contractor and other participants that relate to the main contractor.
- Considering the architect as the top element, the results also reveal that the satisfaction score of the architect increases from 0.8653 to 0.9510 if the architect's team integrated is enhanced with the inclusion of the engineer.

7.5 SIGNIFICANCE OF ATTRIBUTES ON SATISFACTION OF PROJECT TEAM

Having identified and highlighted the attributes that are required in the satisfaction relationship of the project team using FTA, a detailed analysis is then carried out to determine the effects of these attributes on the satisfaction of the project team. A matrix has therefore been prepared for the attributes (table 7.13). The data in the table was generated from the testing process of the SAIF, which is discussed in the succeeding chapter. The values used for II and SS are the combined recordings of the six group of participants (project managers, architects, engineers, designers, main & sub contractors) belonging to the PMG.

Table 7.13: Matrix for Satisfaction Assessment for Project Team

System	Attributes and characteristics				Satisfaction Rating			
	Attribute (success mode)	Causes of success modes	Effects of success modes	Controls of success modes	Satisfaction score, SS (severity)	Importance Index, II (occurrence)	No. of participants, N (detection)	Satisfaction Importance Number (SIN)
Satisfaction levels of the Construction Project Team	Csa1	VHP	HI	IPT	0.010	0.21	6	0.012
	Csa2	AAP	AAI	IPT	0.008	0.18	6	0.009
	Csa3	AAP	AAI	IPT	0.007	0.17	6	0.007
	Csa4	AAP	AAI	IPT	0.008	0.18	6	0.009
	Qsa1	VHP	HI	IPT	0.009	0.19	6	0.010
	Qsa2	VHP	HI	IPT	0.008	0.19	6	0.010
	Qsa3	AAP	AAI	IPT	0.008	0.18	6	0.009
	Qsa3*	VHP	HI	IPT	0.009	0.19	6	0.010
	Qsa4	VHP	HI	IPT	0.009	0.19	6	0.010
	Qsa5	VHP	HI	IPT	0.009	0.29	6	0.011
	Qsa6	VHP	HI	IPT	0.009	0.19	6	0.010
	Ssa1	VHP	HI	IPT	0.010	0.21	6	0.013
	Ssa2	VHP	HI	IPT	0.010	0.21	6	0.013
	Ssa3	AAP	AAI	IPT	0.007	0.17	6	0.007
	Tsa1	VHP	HI	IPT	0.008	0.19	6	0.010
	Tsa2	VHP	HI	IPT	0.008	0.19	6	0.009
	Tsa3	VHP	HI	IPT	0.009	0.20	6	0.011
	Tsa4	VHP	HI	IPT	0.010	0.20	6	0.012
	Tsa5	VHP	HI	IPT	0.010	0.20	6	0.011
	Tsa6	VHP	HI	IPT	0.008	0.19	6	0.010
	Tsa7	VHP	HI	IPT	0.0010	0.20	6	0.012
	Tsa8	VHP	HI	IPT	0.009	0.19	6	0.010

Where VHP = very high probability; AAP = above average probability

HI = high importance; AAI = above average importance; IPT = Integrated Project Team

Examining table 7.13 shows that Ssa1, and Ssa2 have the most impact on the satisfaction of the project team, shown by the high SIN value of 0.013. This indicates that safety related satisfaction attributes, if not met would have a significant effect on the satisfaction of the overall team.

However, for one participant to assess the extent at which another participant meets their satisfaction attributes, the SAN values for the attributes are computed and compared with the SIN values. Table 7.14 shows an illustration of the SIN values for the attributes as perceived by an engineer and the SAN values for the attributes based on the engineer's assessment for the client adviser. As earlier mentioned, the assessment values shown on the table were generated from the framework testing process. The framework testing process is discussed in details in the next chapter.

Table 7.14: Satisfaction Assessment of Client Adviser(CA) and Supplier by Engineer

System	Function	Attributes and characteristics				Satisfaction Rating for Engineer				Assessment Rating for CA (by E)			
		Attribute (success mode)	Causes of success modes	Effects of success modes	Controls of success modes	SS (severity)	II (occurrence)	N (detection)	SIN	AS	AI	N	SAN * 10 ⁻²
Satisfaction levels of the Construction Project Team	Satisfaction level of engineer	Csa1	VHP	HI	IPT	0.0136	0.23	6	0.019	0.0020	0.08	6	0.001
		Csa2	AAP	AAI	IPT	0.0058	0.15	6	0.003	0.0069	0.15	6	0.006
		Csa3	AAP	AAI	IPT	0.0058	0.15	6	0.005	0.0069	0.15	6	0.006
		Csa4	AP	SI	IPT	0.0136	0.23	6	0.019	0.0069	0.15	6	0.006
		Qsa1	VHP	HI	IPT	0.0136	0.23	6	0.019	0.0161	0.23	6	0.022
		Qsa2	VHP	HI	IPT	0.0136	0.23	6	0.019	0.0161	0.23	6	0.022
		Qsa3	AAP	AAI	IPT	0.0058	0.15	6	0.005	0.0069	0.15	6	0.006
		Qsa3*	VHP	HI	IPT	0.0136	0.23	6	0.019	0.0069	0.15	6	0.006
		Qsa4	AAP	AAI	IPT	0.0058	0.15	6	0.005	0.0020	0.08	6	0.001
		Qsa5	AAP	AAI	IPT	0.0058	0.15	6	0.005	0.0069	0.15	6	0.006
		Qsa6	VHP	HI	IPT	0.0136	0.23	6	0.019	0.0069	0.15	6	0.006
		Ssa1	AP	AI	IPT	0.0058	0.15	6	0.005	0.0069	0.15	6	0.006
		Ssa2	VHP	HI	IPT	0.0136	0.23	6	0.019	0.0069	0.15	6	0.006
		Ssa3	AAP	AAI	IPT	0.0058	0.15	6	0.005	0.0069	0.15	6	0.006
		Tsa1	AAP	AAI	IPT	0.0058	0.15	6	0.005	0.0161	0.23	6	0.022
		Tsa2	AAP	AAI	IPT	0.0058	0.15	6	0.005	0.0069	0.15	6	0.006
		Tsa3	AAP	AAI	IPT	0.0058	0.15	6	0.005	0.0069	0.15	6	0.006
		Tsa4	VHP	HI	IPT	0.0136	0.23	6	0.019	0.0020	0.08	6	0.001
		Tsa5	VHP	HI	IPT	0.0136	0.23	6	0.019	0.0069	0.15	6	0.006
		Tsa6	AAP	AAI	IPT	0.0058	0.15	6	0.005	0.0020	0.08	6	0.001
		Tsa7	AP	AI	IPT	0.0016	0.08	6	0.001	0.0161	0.23	6	0.022
		Tsa8	AP	AI	IPT	0.0016	0.08	6	0.001	0.0020	0.08	6	0.001

Where AP = average probability; AI = average importance

The analysis in table 7.14 still indicates that Ssa2, amongst other 9 attributes, is indeed one of the key attributes required to ensure the satisfaction of the engineer. This is shown by its high SIN value of 0.019. The assessment of client adviser by the engineer shows that the client adviser met over 50% of the expectation of the engineer's requirements shown by the higher SAN values for the attributes in comparison to their corresponding SIN values. However, the engineer will probably not be satisfied because the adviser had very low SAN values (below 40%) for the attributes that the engineer recorded very high SIN values, e.g. Csa1, Csa4, Qsa3*, Qsa6, Ssa2, Tsa4, and Tsa5.

7.6 SUMMARY

This chapter demonstrated an application of SAIF through construction project team scenarios. The analyses on the importance of the satisfaction attributes were conducted as

shown in this chapter to serve as a fundamental pedestal in the implementation of the SAIF. In order to establish a hierarchy for the attributes so that appropriate emphasis is placed on each project participant's satisfaction attributes, the multi-attribute approach or analysis was selected to define weights for the attributes. The Multi-attribute analysis, discussed in chapter 6, is the primary statistical technique used by this research to analyse the data in order to prioritise (or rank) the satisfaction attributes. This is because according to Egemen and Mohammed (2006), a thorough identification of the hierarchy of clients needs has become a thing of criticality and determinant of success in the construction industry.

The findings detailed in this chapter show that satisfaction is an issue that is not just required by construction clients but also by other participants of the project team. The chapter highlighted the satisfaction attributes most required by the project managers, architects, engineers, designers, main and sub contractors. It further defined the level of importance of each attribute based on their weighted or importance values, which were computed from the data (results) generated from the pilot study. In addition, the category of satisfaction attributes particularly required most by the respondents were identified and highlighted. The results show that it is necessary for clients and members of the construction project team to have adequate understanding of one another's satisfaction attributes, with focus placed on the participants they directly report to and vice versa.

Furthermore, the above findings and analyses show that there exists relationship and interdependencies in the satisfaction attributes of the project participants. The results revealed that 'communication' has been highlighted by every participant represented in the pilot study as being a critical factor in determining and improving their satisfaction. The idea of interdependencies existing in the project team was further shown in this chapter where the fault tree analysis (FTA) strategy is used to show the satisfaction relationship in

the project team. The fault tree analysis strategy helped to determine the effects of combinations (Papadopoulos *et al.*, 2004) and recognition of the satisfaction of different project participants on the satisfaction of a particular participant under consideration. Therefore, FTA technique utilises the probability of teamwork and the practice of the integrated project team. Hence, FTA methodology provides valuable information on the actual participants required to ensure the satisfaction of the client.

FTA methodology further helped to emphasise the importance associated with the requirements of the participants as shown especially in the satisfaction assessment process scenario 1. Furthermore scenario 2 showed how the integration of the project participants and their satisfaction attributes increased the probability of satisfying the client.

Subsequently, FMEA was then used to identify the extent of satisfaction of the participants by evaluating the Satisfaction Importance Number (SIN) (a product of the satisfaction score, the importance index of an attribute and the number of participants involved in a project stage that require the attribute) for each participant's attribute in order to ensure that priority and focus is placed in meeting the satisfaction attributes of all concerned participants (in a given project stage). After the SIN is computed, considering that this research is concerned with satisfaction of project participants and the assessment of the participants on the extent to which they meet one another's satisfaction attributes at the beginning and end of a project stage, each participant assesses the participants that report to them and vice versa, thereby producing an assessment index for each attribute and assessment score (in place of satisfaction score). Hence, the FMEA methodological approach was further used to devise a method that enables the satisfaction assessment of different members within the project team by evaluating the Satisfaction Assessment Number (SAN). The SIN serves as a platform for weighing the assessment ratings of the project participants. Hence, every SIN is equally important.

CHAPTER 8: IMPLEMENTATION OF TOOLKIT

8.0 INTRODUCTION

This chapter presents the validation and evaluation of the framework through a web-based integrated environment based on the different techniques adopted in developing the framework. Hence, this chapter presents the performance evaluation procedures adopted in validating the framework through the web-based objective.

8.1 WEB-BASED TOOL

One of the fundamental objectives of the Satisfaction Assessment Integrated Framework is to implement the framework as a ready-to-use web-based toolkit. The web-enabled SAIF was designed through the use and integration of Hypertext Mark-up Language (HTML), Hypertext Preprocessor (PHP) and Server Query Language (MySQL) database. The three programs were used for ensuring a robust and reliable web-enabled SAIF because they support a wide range of platforms and operating systems. More so, HTML and PHP support MySQL database.

The web-enabled SAIF enhanced the capability of allowing flexible on-line data entry and facilitating the generation of results/ reports. Through the web environment, the validation of the different components (discussed in chapter 6) of SAIF was established. Figure 8.1 shows the sequence of data flow of the different pages of the framework. The domain name of the framework is <http://www.saif-project.com>.

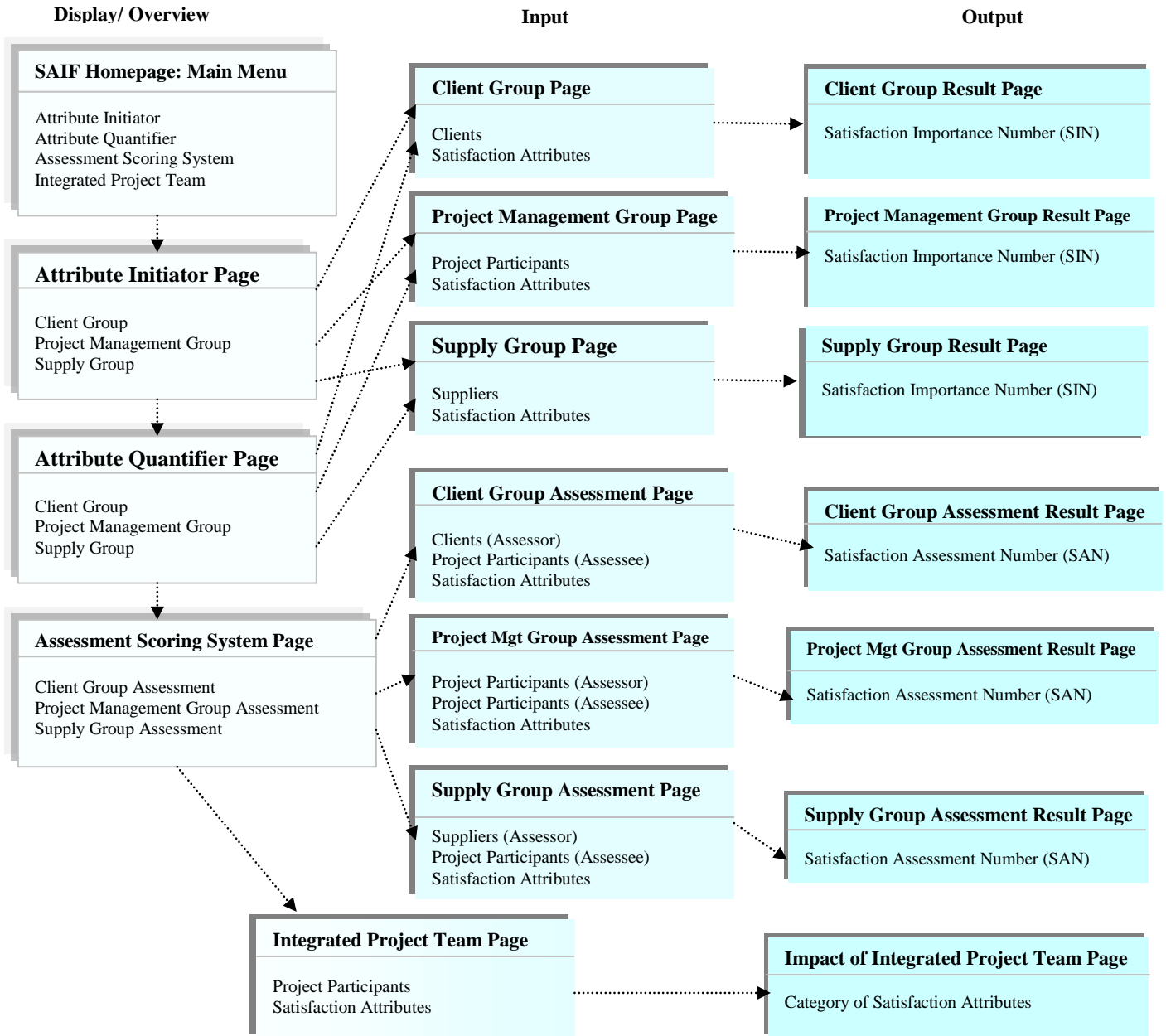


Figure 8.1: Web Pages Flowchart of the Web-enabled SAIF

8.1.1 Hypertext Mark-up Language (HTML)

HTML is a set of codes used for creating web documents. Hence, it is the recognised language of the web. This implies that it is used for displaying texts, and images on the internet. It is a client-side scripting language for creating dynamic and interactive

websites. This implies that a web user can view the HTML codes using a web browser. HTML is platform independent, so can work on any operating system.

HTML is based on tags, which is used to define the layout and structure of texts and images. Every HTML document is expected to contain the root tag, `<html>` as the opening root tag and `</html>` as the closing root tag.

HTML was used to display the contents of the display and input pages of the SAIF on the web (figs 8.3 – 8.13). It was also used to display some of the output pages of the analyses.

8.1.2 Hypertext Preprocessor (PHP)

Unlike HTML, PHP is a server-side scripting language, also for creating dynamic websites. It is used for web page processing, and resides on the server where the web server is running. The php scripting block starts with `<?php` and ends with `?>`. Given that PHP is server side, it implies that a web user cannot view or alter the codes on the internet. Hence, it was used to write the mathematical expressions used for the different analyses on the different components of the framework. PHP interacts with databases (SQL) and supports database servers (MySQL, Sybase, Oracle, etc.). This implies that PHP was used to access the web server and databases (MySQL), and so could perform sophisticated functions required in the satisfaction assessment analyses. Hence, the information displayed in the output web pages of the web-enabled SAIF were made possible through the utilisation of PHP.

8.1.3 MySQL

MySQL is a relational database management system, hence is used for storing and retrieving data. It is compatible with most operating systems. Relational database management systems (RDBMS) allow the creation and linkage of several tables, which contain different and/ or similar data. RDBMS also enable the alteration and update of data in the tables.

MySQL was therefore used to create the database and tables for capturing and storing the satisfaction attributes of the project participants, as well as the rating points recorded for the attributes. A pictorial representation of the MySQL database is shown in fig 8.2. Subsequently, the stored data were afterwards retrieved and used for defining satisfaction scores for the attributes and for assessing the participants. Hence, the tables created for the purpose of the framework are:

- **Client_group:** For storing satisfaction attributes for the participants belonging to the client group and the satisfaction rating points associated with the attributes
- **Client_assessment:** For storing and retrieving satisfaction attributes used by the participants belonging to the client group for assessing the participants belonging to the PMG and the assessment rating points associated with the attributes.
- **Project_group:** For storing and retrieving satisfaction attributes for the participants belonging to the project management group and the satisfaction rating points associated with the attributes.
- **Project_assessment_client:** For storing and retrieving satisfaction attributes used by the participants belonging to the PMG for assessing the participants belonging to the client group and PMG and the assessment rating points associated with the attributes

- **Project_assessment_supply:** For storing and retrieving satisfaction attributes used by the participants belonging to the PMG for assessing the participants belonging to the supply group and the assessment rating points associated with the attributes
- **Supply_group:** For storing and retrieving satisfaction attributes for the participants belonging to the supply group and the satisfaction rating points associated with the attributes.
- **Supply_assessment:** For storing and retrieving satisfaction attributes used by the participants belonging to the supply group for assessing the participants belonging to the PMG and the assessment rating points associated with the attributes

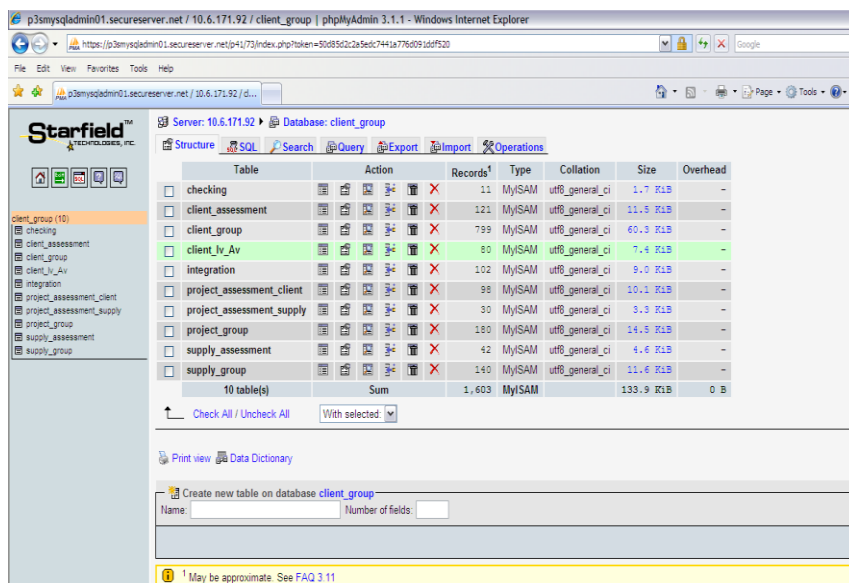


Figure 8.2: MySQL Database

8.1.4 Display/ Overview of Web-Enabled SAIF

The content of the web pages regarded as the display pages of the web-enabled SAIF were designed using HTML.

8.1.4.1 SAIF Homepage: Main Menu

The SAIF homepage, as shown in figure 8.3, highlights what the framework is and its functions. In addition, the different components of the framework presented as hyperlinks are on the homepage for easy access to the key sections of the web-enabled SAIF.



Figure 8.3: SAIF Homepage

8.1.4.2 Attribute Initiator

This page explains how the satisfaction attributes of the project team are generated. Here, the three groups of the target audience are presented as hyperlinks, such that on clicking either of them, the web pages containing the participants' satisfaction attributes are opened: see figure 8.4.

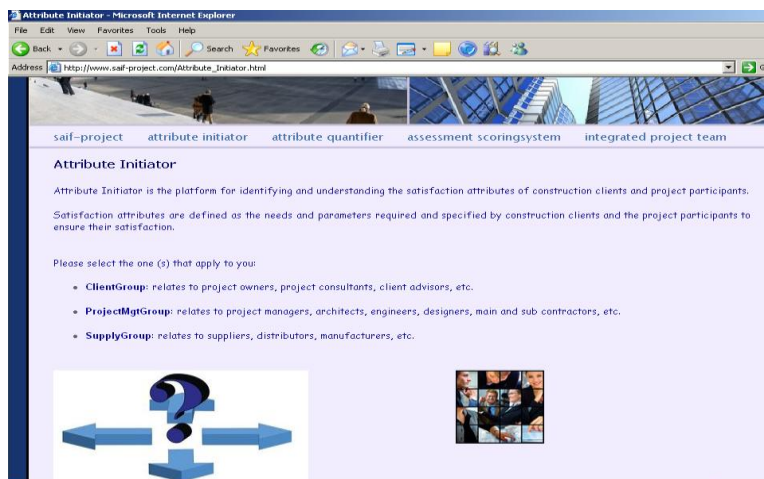


Figure 8.4: Attribute Initiator Web Page

8.1.4.3 Attribute Quantifier

The content of the ‘Attribute Quantifier’ page is similar to that of the ‘Attribute Initiator’; so again it contains the three groups of the target audience (figure 8.5).

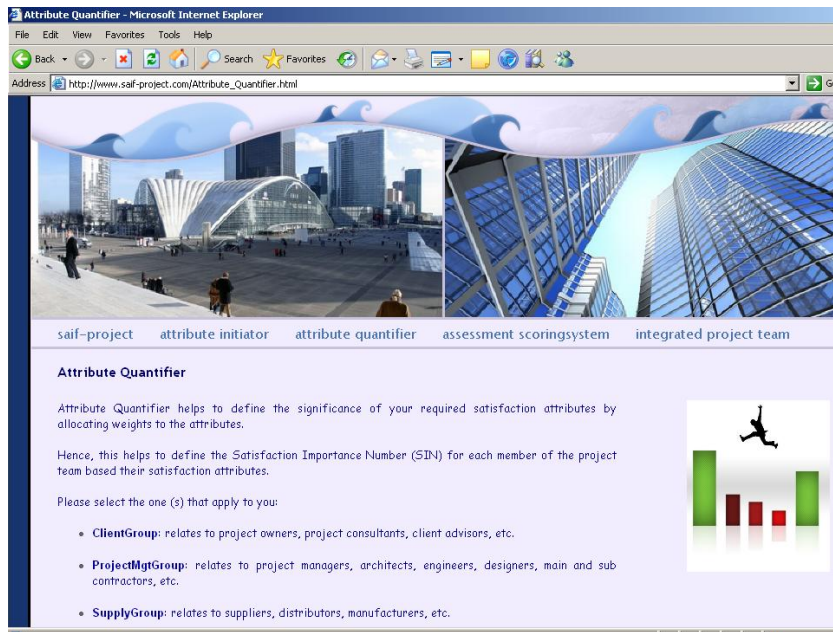


Figure 8.5: Attribute Quantifier Web Page

8.1.4.4 Assessment Scoring System

This web page presents the three groups of the target audience as hyperlinks to the pages containing the assessment of the project team. Figure 8.6 shows an illustration of the ‘Assessment Scoring System’ web page.

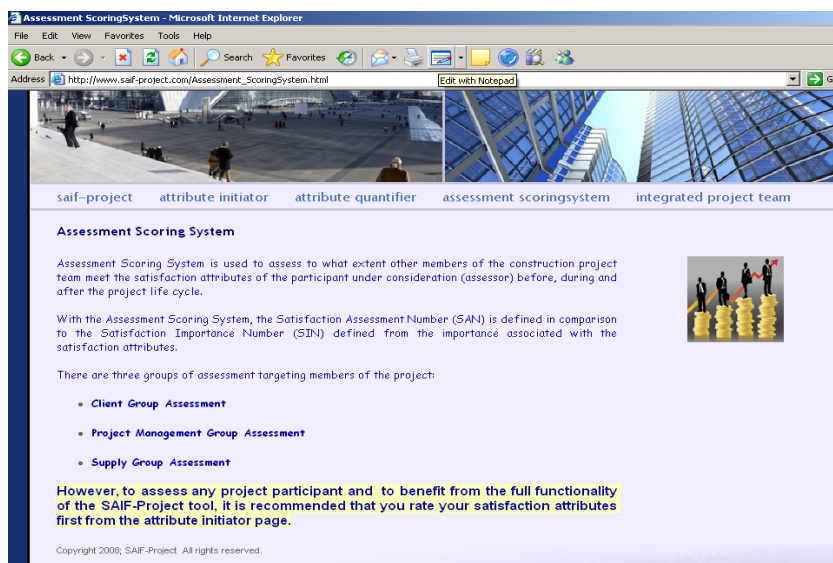


Figure 8.6: Assessment Scoring System Web Page

8.1.4.5 Integrated Project Team

This page is used to identify the impact of the integrated project team on satisfaction. As shown in figure 8.7, the participants are expected to indicate their views by recording rating points for the attributes, as well as recording the number of participants that report to them and vice versa.

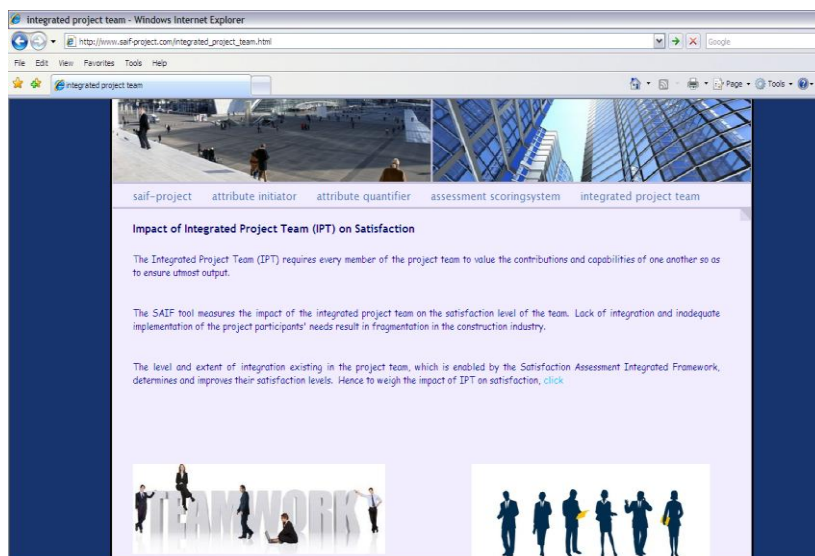


Figure 8.7: Integrated Project Team Web Page

8.1.5 Input Pages of Web-Enabled SAIF

Like the display pages, the content of the web pages regarded as the input pages of the web-enabled SAIF were designed using HTML. The data generated (using forms) from the input web pages were stored using the MySQL database.

8.1.5.1 Client Group

The client group web page is an input page used to record the views of the participants belonging to the client group on their satisfaction attributes: see figure 8.8.

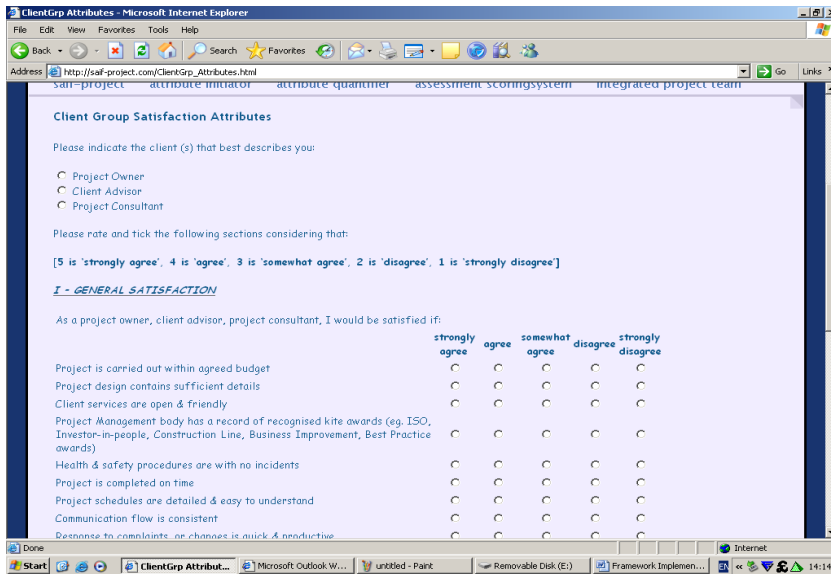


Figure 8.8: Client Group Input Page

8.1.5.2 Project Management Group

This web page, as shown in figure 8.9, is an input page used to record the views of the participants belonging to the project management group on their satisfaction attributes.

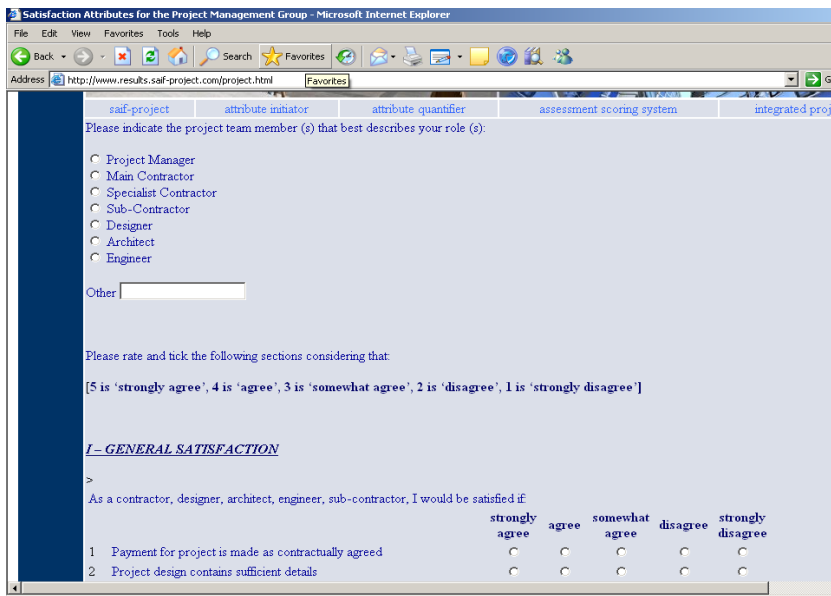


Figure 8.9: Project Management Group Input Page

8.1.5.3 Supply Group

Like the above input pages, the supply group web page is used to record the views of the participants belonging to the supply group on their satisfaction attributes. Figure 8.10 presents an illustration of the supply group web page.

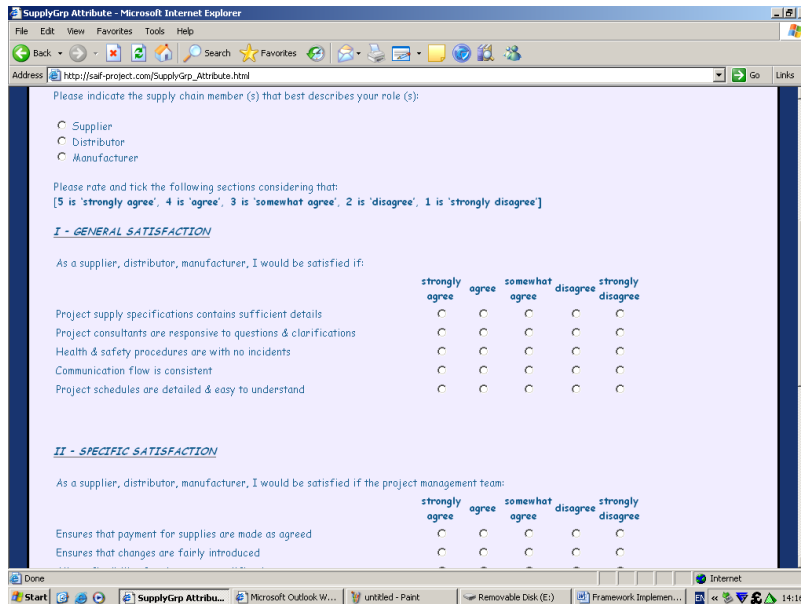


Figure 8.10: Supply Group Input Page

8.1.5.4 Client Group Assessment

The client group assessment web page as an input page is used by the participants belonging to the client group to assess project participants belonging particularly to the project management group on their satisfaction attributes: see figure 8.11.

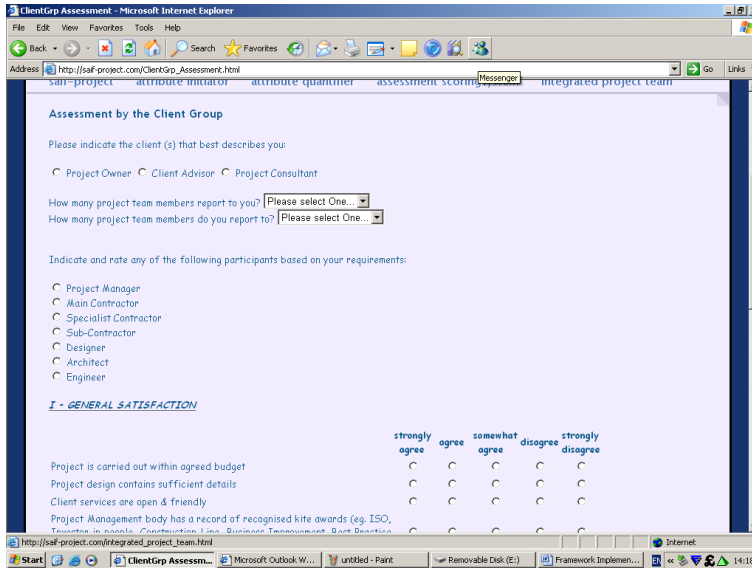


Figure 8.11: Client Group Assessment Input Page

8.1.5.5 Project Management Group Assessment

This web page, as shown in figure 8.12, also an input page is used by the participants belonging to the project management group to assess other project participants belonging to any of the three groups of the target audience on their satisfaction attributes.

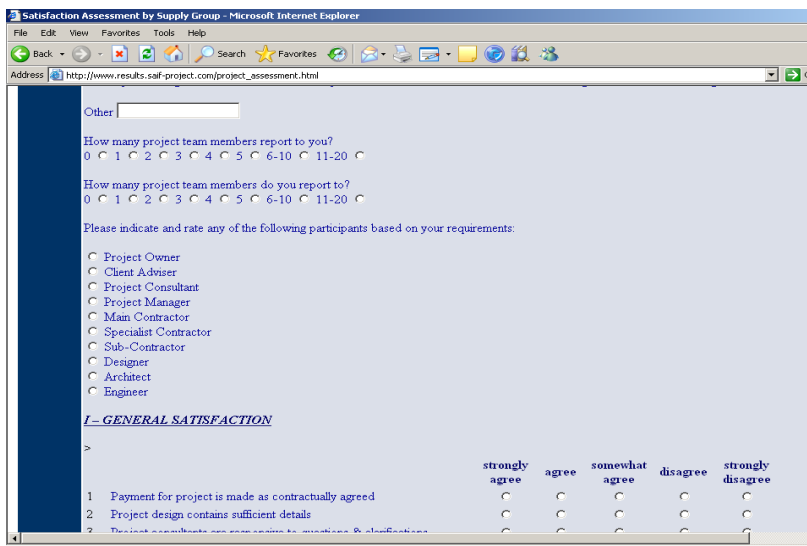


Figure 8.12: Project Management Group Assessment Web Page

8.1.5.6 Supply Group Assessment

Like the above input pages on assessment, the supply group assessment web page is used by the participants belonging to the supply group to assess the project participants

belonging particularly to the project management group on their satisfaction attributes.

Figure 8.13 presents an illustration of the supply group assessment web page.

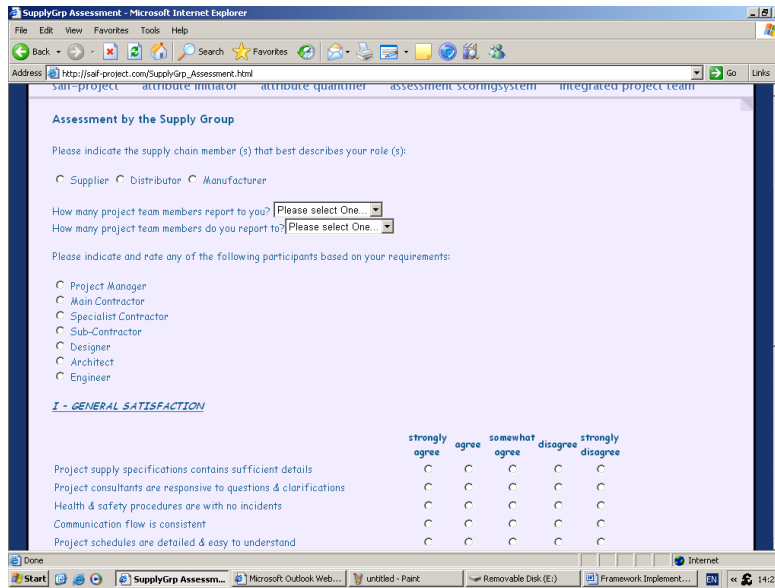


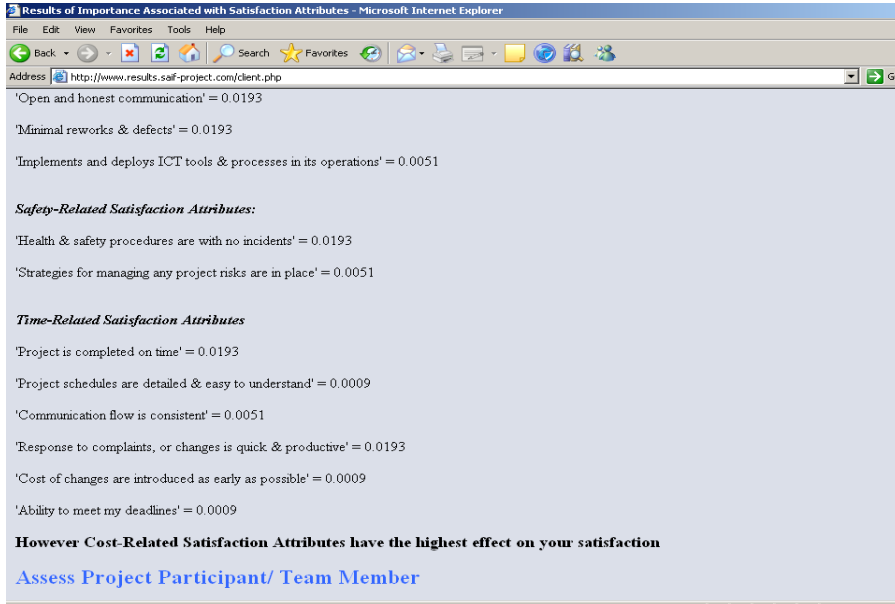
Figure 8.13: Supply Group Assessment Input Page

8.1.6 Output Pages of the Web-Enabled SAIF

The output pages of the web-enabled SAIF were predominantly designed using PHP. However, the data used for the analyses carried out using PHP were generated from data stored in the MySQL database and web server.

8.1.6.1 Client Group Results

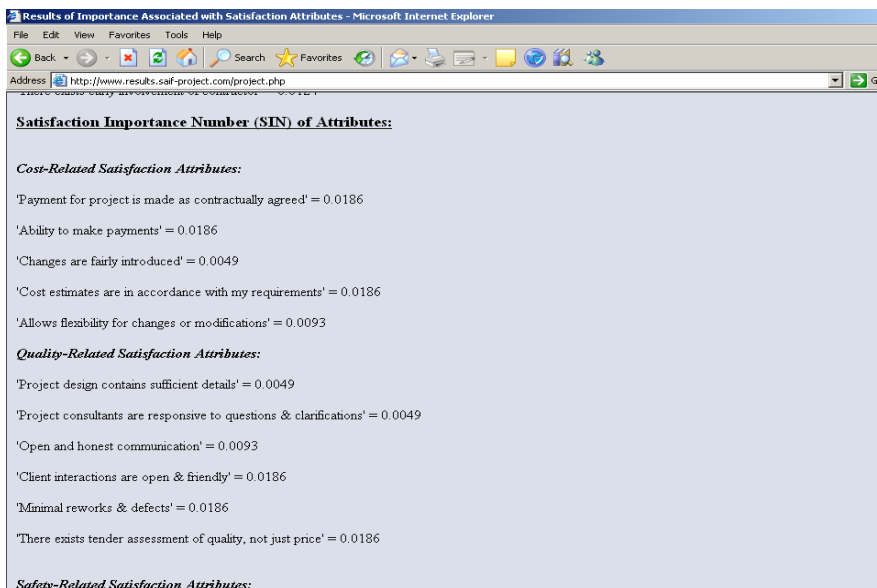
The client group results page displays the significance of the satisfaction attributes of the participants belonging to the client group, in terms of the Satisfaction Importance Number of the attributes. The page also highlights the category of satisfaction attributes that have the highest impact on the satisfaction of a given participant. Figure 8.14 presents an illustration of the results of the main client based on the client's recordings for the attributes.



8.14: Client Group Results Page

8.1.6.2 Project Management Group Results

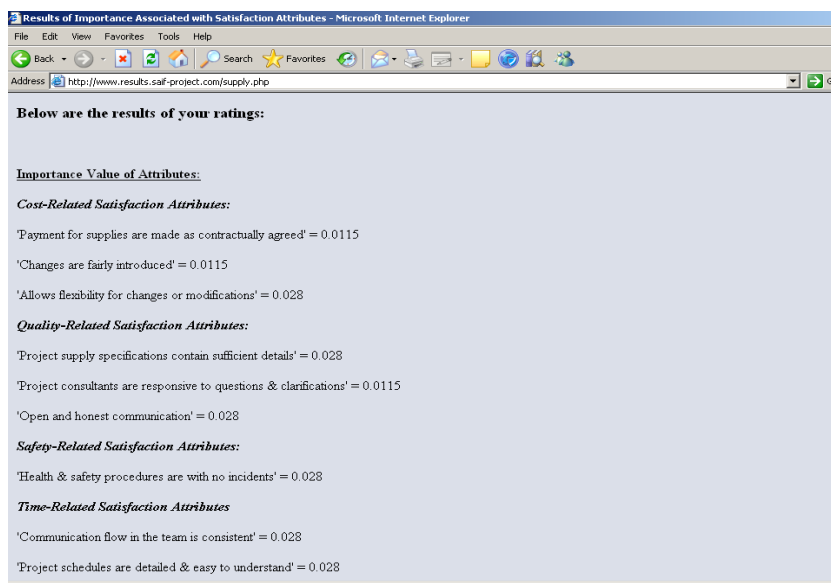
The project management group results page displays the significance of the satisfaction attributes of the participants belonging to the project management group, in terms of the Satisfaction Importance Number of the attributes. Like the client group results page, the page also highlights the category of satisfaction attributes that have the highest impact on the satisfaction of a given participant. Figure 8.15 presents an illustration of the results of the main contractor based on the contractor’s recordings for the attributes.



8.15: Project Management Group Results Page

8.1.6.3 Supply Group Results

The supply group results page displays the significance of the satisfaction attributes of the participants belonging to the supply group, in terms of the Satisfaction Importance Number of the attributes. The page also highlights the category of satisfaction attributes that have the highest impact on the satisfaction of a given supplier, distributor or manufacturer. Figure 8.16 presents an illustration of the results of the supplier based on the supplier's recordings for the attributes.



8.16: Supply Group Results Page

8.1.6.4 Client Group Assessment Results

The client group assessment results page displays the assessment results of a given participant based on assessment by the participants belonging to the client group, in terms of the Satisfaction Assessment Number of the attributes. Figure 8.17 presents an illustration of the assessment results of the architect based on the assessment of the project consultant.

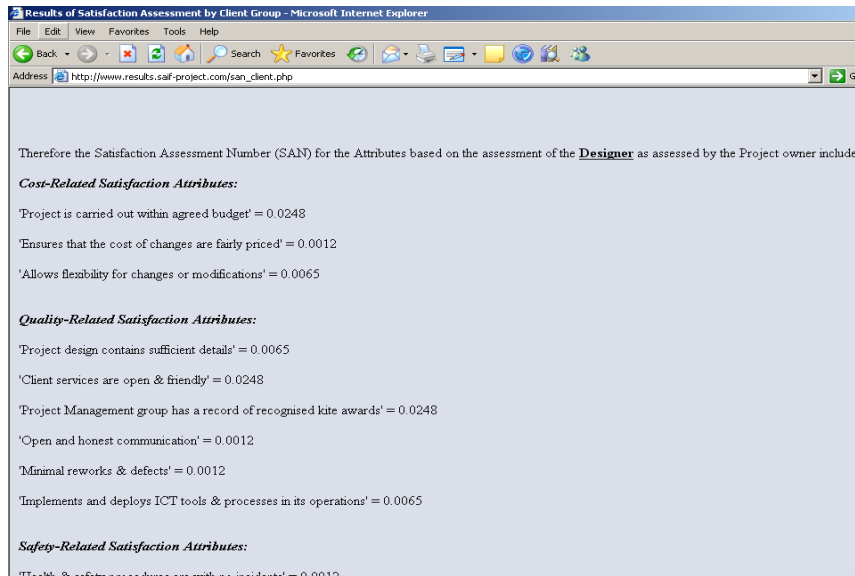


Figure 8.17: Client Group Assessment Results Page

8.1.6.5 Project Management Group Assessment Results

The project management group assessment results page displays the assessment results of a given participant based on assessment by the participants belonging to the project management group, in terms of the Satisfaction Assessment Number of the attributes. Figure 8.18 presents an illustration of the assessment results of the project owner based on the assessment of the project manager.

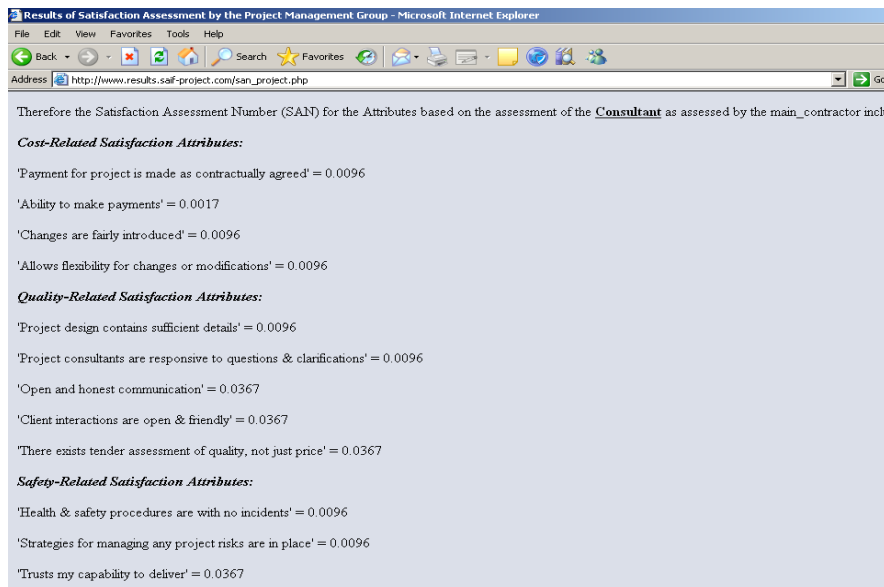


Figure 8.18: Project Management Group Assessment Results Page

8.1.6.6 Supply Group Assessment Results

The supply group assessment results page displays the assessment results of a given participant based on assessment by the participants belonging to the supply group, in terms of the Satisfaction Assessment Number of the attributes. Figure 8.19 presents an illustration of the assessment results of the main contractor based on the assessment of the supplier.

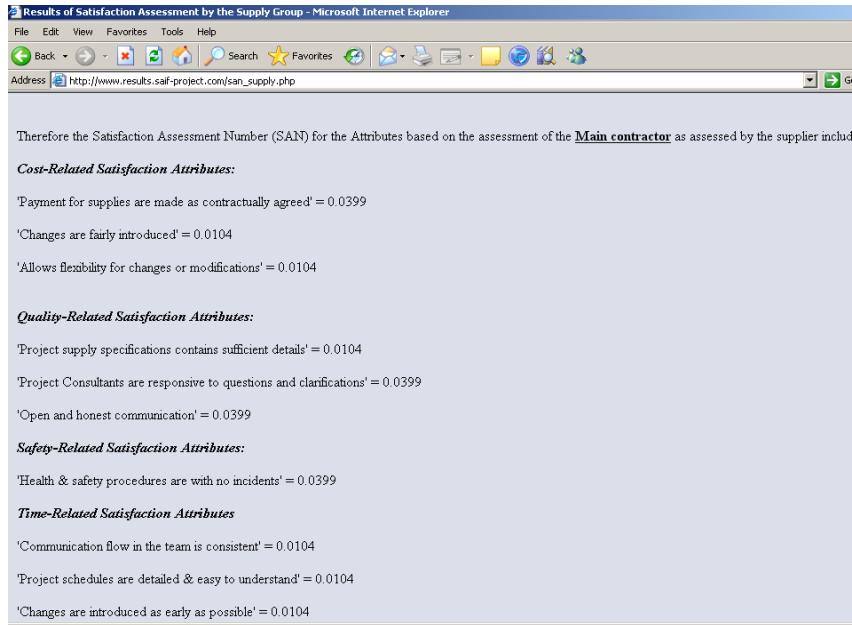


Figure 8.19: Supply Group Assessment Results Page

8.1.6.7 Impact of Integrated Project Team

This page displays the percentage impact of the integrated project team on the four category of satisfaction attributes. Figure 8.20 is an illustration of the impact of the integrated project team on satisfaction based on the perception of the designer.

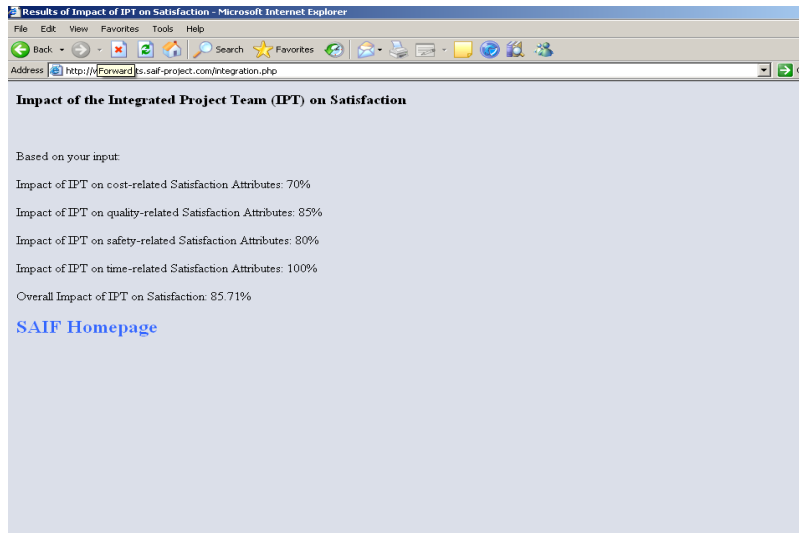


Figure 8.20: Integrated Project Team Results Page

8.2 TEST AND VALIDATION OF THE SATISFACTION ASSESSMENT INTEGRATED FRAMEWORK

The validity of any research demonstrates its strength and robustness. Validation is primarily concerned with testing a system, model or framework for accuracy. This section of the thesis explains the approach that was adopted to justify the rationale and assess the validity of the overall web-based structure of the framework. Operational validity was used to test if the framework incorporates fundamental satisfaction elements as well as examine if it integrates the project team in its design, capability and functionality. This is to say that the framework was tested to verify its ability to capture satisfaction criteria, and verify its ability to highlight areas that require focus, in its output behaviour.

This was carried out using **10** experts and professionals in the construction sector, indicating that the validity of this research (with particular emphasis on SAIF) is for the interests of the construction project team. A structured and open-style questionnaire was used to obtain the viewpoints of the participants on the framework based on a number of

defined questions, discussed in the following section. The responses, which were obtained individually from the participants, were largely positive. Table 8.1 shows the summary of profile of the experts used in testing the framework. The table shows that the experts occupy recognised roles and an overall average of 15 years experience each in the construction sector.

Table 8.1: Profile of Validation Experts

Expert	Designation	Years of Experience
1 (V)	Project Manager	15
2 (G)	Main Contractor	37
3 (N)	Architect	10
4 (W)	Structural Engineer	8
5 (I)	Mechanical Engineer	15
6 (E)	Civil Engineer	14
7 (U)	Civil Engineer	13
8 (T)	Project Manager	9
9 (C)	Project Consultant	9
10 (E)	Project Manager	13

8.2.1 Benchmark Used for the Testing Process

Four specific target points, focussed on the objective of the research, were used to test the web-based SAIF, which include the following:

To measure the usability and accessibility of the framework

- Responses and results (table 8.2) from the participants show that all the participants consider the framework as being user-friendly and easy to navigate. 80% of the participants understood the aim of the framework as well as the results

(analyses) presented by the framework. However, 20% of the participants highlighted the need for more clarification on the results.

To measure its ability to capture requirements of clients and participants in the construction sector:

- The results show that the participants consider that the framework captures the requirements of not just the main client or project owner in its design. In addition, it was highlighted that the framework reflects the satisfaction requirements in the construction sector.

The incorporation of the integrated project team concept in the design and analyses of the framework:

- The participants agreed that the framework promoted the integrated project team concept in its make-up and captures requirements of the team

The usefulness of the results and analyses produced in using the framework:

- Overall, the participants state that stakeholders (construction clients and project participants) could gain clear indications of significant factors and attributes for satisfaction.

Table 8.2: Summary of Response from Experts Used for Framework Testing

Testing Criteria	Experts' Responses									
	1 (V)	2 (G)	3 (N)	4 (W)	5 (I)	6 (E)	7 (U)	8 (T)	9 (C)	10 (E)
Measure usability and accessibility of framework	Yes, easy to navigate and user-friendly	Yes, very user-friendly. Better explanation of the significance of analysis	Yes, quite easy to navigate	Yes, comfortable to navigate and use	Yes, very user-friendly	Yes, user-friendly and navigable	Yes, very usable and accessible	Yes, user-friendly and accessible; however, would prefer more clarification of results/analysis	Yes, the framework is user-friendly	Yes, I had no navigation problems and it is very usable
Measure value and validity of framework in the construction sector	Yes	Yes, the framework captures requirements of most project participants	Yes; however would consider the 'project consultant' as belonging to the project management group	Yes,	Yes, the framework, considers the satisfaction requirements of not just the main client	Yes	Yes, the framework is valuable for the project team	Yes, however not sure about the 'project consultant' being considered in the client group	Yes, the tool, highlights areas for improvement in the project team	Yes
Incorporation of IPT concept in the design and analyses of the framework	Yes	Yes	Yes	Yes, the requirements of project team members are considered	Yes	Yes, I quite like the idea of assessment	Yes	Yes	Yes	Yes, it's good to know that the client is also being assessed
The usefulness of the results and analyses produced in using the framework	Yes	Yes; but more clarity of results	Yes	Yes, provides clear indications of significant attributes for satisfaction	Yes	Yes	Yes	Yes; Suggest better clarification of results	Yes	Yes

8.2.2 Validation of Techniques used in the Framework

The validation of the techniques in the context of this research (satisfaction assessment) is based on the following:

- As stated in chapter 4, the research ensured an ethical approval from the University as well as a pre-test of the questionnaire in order to ensure its validity.
- The satisfaction attributes of participants defined as the basic elements in the project tree were first obtained
- The smallest order satisfaction attributes (success paths), defined as the critical paths in the project tree in the context of this research, were then identified. The attributes were afterwards verified to ensure that they are indeed valid success paths to determining the satisfaction of the project participants by using the FMEA methodology to define their Satisfaction Importance Number (SIN).
- The different rectangle and oval symbols used on the project tree, which specify the project participants and satisfaction attributes respectively, were examined so as to confirm and validate the accuracy of the relationship of the construction project team. This is to say that every participant represented in the project tree was confirmed if a valid participant as well as ensure that no satisfaction attribute of the participants was omitted.
- The probability values for the attributes were derived and checked to determine their significance to the satisfaction of the project team. The analyses shown in chapter 7 in the implementation of the fault tree methodology show that the lowest order attributes, which are defined as the attributes of the participants at the lowest level of the project tree (supplier in our case), have the highest probability values for their attributes

- In verifying and validating the probability values for the participants, the analyses further show that the probability values for lower level participants are higher than that of the higher-level participants
- The probability value of the participant under consideration (top element) was also verified for its rationality. Very low probabilities are considered to be unreasonable and indicate the unlikeliness of the occurrence of the top element. For example, Vesely *et al.* (*ibid.*) suggests that probabilities such as 1×10^{-9} or lower are untrue.
- An FMEA worksheet was afterwards generated specifying the key information regarding the satisfaction assessment of the project team. An example of the worksheet has been discussed in the preceding chapter

8.2.3 Validation of the Overall Framework

To further ensure the validity of the Satisfaction Assessment Integrated Framework and its components, a number of publications were written and put subject to expert reviews and interrogations. A total of seven conference publications have been approved and published, with one journal publication accepted and currently in press. The first two publications outlined this research interests and the aim of the research. The next two publications described and discussed the system development methodology adopted in developing the framework. Subsequently, the fifth publication discussed the five different techniques adopted and used in the framework development. The sixth publication was then devoted to a discussion on the findings of the pilot study and the importance associated with the satisfaction attributes as perceived by construction clients and project participants. The seventh publication discussed the use of the fault tree analysis technique in the satisfaction assessment process. Finally, the eight publication (journal) discussed the developed framework (SAIF) and the different concepts/ techniques adopted in

developing the framework. Table 8.3 shows the number of references cited in each publication and the total references cited in the eight publications.

Table 8.3: Research Publications and Number of References Cited

Publication Title	Date	Number of References
ICT Deployment to construction SMEs	2 nd -4 th Oct 2006	53
Review on the Role of ICT in the Development of a Sustainable Environment	17 th -19 th Jan.2007	19
Achieving High Client Satisfaction in the Built Environment	17 th -19 th June 2007	49
Improved Client Satisfaction: A Strategic Approach for in the Construction Sector	20 th -22 nd Nov 2007	27
An Integrated Framework for Satisfaction Assessment in the Construction Sector	April 16-19, 2008	13
An Approach for Evaluating the Satisfaction of a Construction Project Team	1 st -3 rd Sept 2008	19
Using Fault Tree Analysis Strategy to Evaluate Satisfaction in relation to Time	26 th -30 th Jan 2009	21
Integrated Framework for Satisfaction Assessment in the Construction Sector	Journal of Engineering Design and Technology	28
Total Number of References cited		201

8.3 SUMMARY

This chapter discussed the approaches adopted to verify the validity of the different components of the framework as well as the overall framework. In addition, the web-based version of the framework was discussed as a step towards evaluating, testing and validating the framework. The framework testing highlighted sections of the framework that required modifications and clarifications. The results of the testing process were then

incorporated in the final design of SAIF so as to ensure a robust and reliable tool. The succeeding chapter concludes the research and goes over the aim and objectives of the research to ensure that each objective has been carefully dealt with and justified.

CHAPTER 9: CONCLUSIONS AND RECOMMENDATIONS

9.0 INTRODUCTION

This chapter presents conclusions on the research and wraps up all that have been discussed in previous chapters of the thesis. It starts by reviewing and discussing the achievement of the research aim and objectives. It then presents the benefits and contributions of the research to academia and the industry. The recommendations for further research are also presented.

9.1 RESEARCH OBJECTIVES AND REFLECTIONS

The research, as stated in chapter 2, aimed to develop an integrated framework that can be used for assessing satisfaction levels of members of a construction project team in different stages of the project life-cycle. An assessment of the discussions, findings and results presented in the eight preceding chapters of this thesis indicates that the aim of the research has been realised based on its objectives, which are:

- To explore the structure of construction project teams, and identify satisfaction attributes that may affect their performance during the delivery of a construction project
- To identify and analyse relevant satisfaction models, and formal systems engineering techniques most suited for representing the satisfaction relationships of members of a construction project team
- To design a mechanism/ conceptual framework for capturing and prioritising the importance of each satisfaction attribute for different members of a construction project team.

- To devise a method that enables the rating of the assessment of different members of the project team in relation to satisfaction
- To implement the framework in the form of a ready-to-use web-based toolkit by integrating the system engineering techniques

9.1.1 To Explore the Structure of Construction Project Teams, and Identify Their Satisfaction Attributes

The research commenced with an in-depth literature review on satisfaction in the construction industry (chapter 2). In addition, satisfaction theory was also explored from the marketing and psychological sectors, considering that there exist limited studies on satisfaction in the construction sector. Findings from the review revealed the need to identify the satisfaction attributes of members of the project team, as well as the project owner. However, in order to adequately understand the participants and members of the construction project team, an investigation of the structure of the project team was carried out in chapter 4. The investigation and analysis carried out in this chapter revealed that satisfaction is an issue that is required by the project owner or main client as well as other members of the project team. Subsequently, primary data relating to satisfaction and assessment attributes were collected from construction clients and project participants through a pilot study and field investigations as presented in chapter 4. The pilot study provided clearer view and understanding of satisfaction, satisfaction assessment and satisfaction attributes. Additional attributes were generated (secondary data) from relevant existing statistics, reports and survey results.

From the pilot study carried out on satisfaction attributes, it was also observed that some of the attributes required by the main client were also required by other project participants, indicating the need for members of the team to understand and focus on one another's

requirements so as to ensure an enhancement in the satisfaction levels of the team, and an improvement in the project delivery.

This objective and its accomplishment provided the basis upon which the first component, the Attribute/ Intelligence Initiator, of the SAIF was developed. Hence, the Attribute/ Intelligence Initiator is used for understanding and identifying the construction clients and project participants' satisfaction attributes.

9.1.2 To Analyse Satisfaction Models, and Systems Engineering Techniques

The research further explored different satisfaction models, identified their benefits and highlighted their limitations. Need for the framework development was highlighted from the limitations of these existing models. The research then investigated and drew knowledge from pertinent engineering techniques, which are fault tree analysis and the failure modes and effects analysis, in order to develop the robust satisfaction assessment integrated framework. Knowledge generated from these techniques was used to incorporate the ability for the framework to define critical sections (or path) in the construction project team, in terms of identifying the exact satisfaction attributes that have the most impact on the satisfaction of the entire project team. However, prior to defining the critical attributes in the project team, the fault tree analysis strategy, discussed in chapters 6 and 7, was used to structurally show the satisfaction relationship of the project team. Mathematical symbols, set theory operations, Boolean algebraic reductions, and probability concepts were adopted in the application of the FTA strategy. In summary, FTA was used to:

- Provide valuable information on the actual participants required to ensure the satisfaction of the client
- Identify the satisfaction relationship between different members of the construction

project team

- Provide information on the requirements of the project participants so as to ensure satisfaction of the client, as well as emphasise the importance associated with the requirements of the participants
- Place emphasis on not just the main client but also on the significance of other project participants and their satisfaction attributes.
- Identify the probability of satisfying the client or meeting the satisfaction attribute(s) of the client based on the probability of satisfying other members of the project team
- Identify impact of the integrated project team in determining the probability of meeting the satisfaction attribute (s) of the project owner.

This objective and its accomplishment provided the basis upon which the fourth component, the Attribute/ Criticality Connector, of the SAIF was developed. Hence, the Attribute / Criticality Connector, FTA, is used for defining the impact of each participant has on determining the satisfaction or ability to meet the satisfaction attributes of another participant

9.1.3 To Design a Mechanism/ Conceptual Framework for Capturing and Prioritising the Importance of each Satisfaction Attribute

In order to capture and present the different concepts of the research, a conceptual framework was developed to do this, as discussed in chapter 5. The five key concepts expressed in the conceptual framework were:

- Define Project Team and Identify Satisfaction Attributes of the Participants
- Categorise Satisfaction Attributes under CQST Module

- Allocate weights to Satisfaction Attributes
- Establish a Link in the Project Team
- Assess Participants

Based on vast number of satisfaction attributes of the team identified from the review, the research defined a module, CQST, for grouping the attributes into the four most recognised satisfaction attributes (cost, quality, safety and time). Hence, the CQST module was basically used to:

- Capture whatever type of satisfaction attribute is required by the project team
- Ensure better management and classification of the flexible satisfaction attributes required by the project team

As a means of distinguishing and prioritising the satisfaction attributes of the project team, the research employed the multi-attribute analysis, as means of allocating weights to the attributes. Three fundamental terms were defined using the multi-attribute analysis, which are Importance Index, Relative Importance Index, and Satisfaction Score. Hence, the multi-attribute analysis:

- Provides a means for providing a significance for the satisfaction attributes of the project team by defining weights for the attributes
- Explains the implications of the satisfaction attributes by identifying a hierarchy for the attributes

This objective and its accomplishment provided the basis upon which the second and third components, the Attribute/ Module Classifier, and the Attribute/ Importance Quantifier, of the SAIF were developed. Hence, the Attribute/ Module Classifier is used for grouping and classifying the attributes into the Cost, Quality, Safety and Time Categories; while the

Attribute/ Importance Quantifier is used for allocating weights and ranking importance to the satisfaction attributes.

9.1.4 To Devise a Method that Enables the Rating of the Assessment of different Members of the Project Team in relation to Satisfaction

The research adopted the methodical approach in the FMEA strategy as a means for assessing the members of the project team. As discussed and illustrated in chapters 6 and 7, FMEA was used to:

- Identify the effect of each category of satisfaction attribute and the relative impact (criticality) of each attribute in determining the satisfaction of the project team
- Identify which satisfaction attributes resulted in a low Satisfaction Assessment Number (SAN) in comparison to the Satisfaction Importance Number (SIN)
- Define a method for assessing the members of the construction project team
- Identify the effect of each category of satisfaction attributes on the SAN value, in terms of the impact of the four categories in determining the SAN

This objective and its accomplishment provided the basis upon which the fifth component, the Assessment Scoring System, of the SAIF was developed. Hence, the Assessment Scoring System is used for evaluating how much each participant meets the attributes of other project participants.

9.1.5 To implement the Framework in the form of a Ready-to-Use Web-Based Toolkit

As a means to enable full access and utilisation of the Satisfaction Assessment Integrated Framework, a web-based version of the framework was designed using hypertext mark-up

language, pre-processor hypertext and server query language. In doing this, databases for storing the perceptions of respondents and project participants were carefully created and enabled. Details of how this objective was established have been discussed in the preceding chapter.

9.2 MAJOR ACHIEVEMENTS AND CONTRIBUTION TO KNOWLEDGE

Currently, satisfaction has been primarily looked at as an issue required by just construction clients or project owners. Furthermore, the practise of the integrated project team has not been fully embraced in the industry. In an attempt to redress and to improve upon the issue of satisfaction being addressed as a factor required by every participant in the construction project team by encouraging a better integration of the project team and their requirements, this research was aimed at developing a satisfaction assessment integrated framework using questionnaire analysis, multi-attribute approach, fault tree analysis strategy, and failure mode and effects analysis methodical approach. The outcome of the research resulted in several potential benefits and contributions to relevant studies and the industry, which are summarised below:

9.2.1 Main Original Contributions

- This research makes an original contribution of identifying possible links between the project participants and their satisfaction attributes using a process and paradigm that underpins team integration, known as fault tree analysis. Hence,

through this research, more emphasis has been placed on the need to integrate the participants in a construction project by drawing attention to how project team integration positively impacts on the participants' satisfaction attributes, and their satisfaction levels in general (Nzekwe-Excel 2009; Nzekwe-excel *et al.*, 2009). Therefore, satisfaction depends on what (satisfaction attributes, in the context of this research) the client receives and is determined by how well the industry integrates the project participants.

- The research further helps to enhance the way satisfaction is addressed in construction by providing a tool or framework (SAIF) that gives a datum point to indicate areas that require focus in order to improve the satisfaction of clients and project participants (Nzekwe-Excel *et al.*, 2008a; Nzekwe-Excel *et al.*, 2009). The framework offers a new methodology, that starts from the project inception and measures satisfaction continuously (based on satisfaction attributes) throughout the different stages of the project process. It does not just show high and low importance values for the attributes, but also indicates which group of participants needs to adjust, as well as what category of satisfaction attributes that needs to be improved upon (Nzekwe-Excel *et al.*, 2008b). More so, the framework clearly explains what satisfaction attributes each participant requires in a prioritised format.
- Furthermore, with the Satisfaction Assessment Integrated Framework, the participants and satisfaction attributes that need more focus are highlighted to ensure that the project is completed to target and to requirement, using a novel application of two reliability techniques, which are the fault tree analysis and the failure mode and effects analysis. The outcome of the analyses of this research help to improve understanding of the satisfaction requirements of every client and participant represented in a given construction project team (Nzekwe-Excel 2009).

9.2.2 Other Original Contributions

- The research adds to the studies on satisfaction in the construction sector by interpreting satisfaction based on its functions, characteristics, or parameters (called satisfaction attributes in the context of this research). The review conducted offers up-to-date information on satisfaction in the industry.
- In the identification of the satisfaction attributes, an attempt was made to identify not just attributes relating to the three most highlighted issues (cost, quality, and time) in construction studies, but also with an inclusion of a vital factor (safety and environment), which helps to present a more detailed picture about the satisfaction requirements of construction clients and the project participants.
- Identifying the impacts of cost, quality, safety and environment, and time-related issues on satisfaction helps to understand how cost, quality, safety and time may influence satisfaction of the project team, thereby providing more information on what factors to improve and for what participants.
- This research addresses the problem of the lack of a common approach for satisfaction measurement in construction, in the developed novel framework (SAIF), where a process in the framework entails a definition of the project participants at the onset of a project using the questionnaire analysis. This would help understand the nature of the project and the participants involved as well as define a common approach in identifying their satisfaction requirements. The questionnaire analysis component of the framework helps to identify not just

exactly what the main client requires, in terms of satisfaction but also what other project participants require at an early stage of the project.

- Finally, the findings and results of this research have been disseminated to conferences and industries for expert and academic peer reviews. Seven peer-reviewed papers have been published and presented in conferences (Nzekwe-Excel *et al.*, 2006; Nzekwe-Excel 2007; Nzekwe-Excel *et al.*, 2007a and 2007b; Nzekwe-Excel *et al.*, 2008a and 2008b; Nzekwe-Excel 2009). One paper has also been peer reviewed and accepted for publications, and is in press with Emerald's Journal of Engineering Design and Technology. In addition, a paper is currently under review with the International Journal of Project Management.

9.3 RECOMMENDATIONS FOR FURTHER RESEARCH

While this research contributes to the academic field and to the construction industry as detailed above, there are still areas for improvement. This is to say that the research findings discussed in previous chapters indicate the need for recommendations and further research on satisfaction in the construction sector. Directions for further studies are presented under the following areas:

- The findings presented create the need to further explore systems or models that would focus on communication and interactions in the project team; and hence facilitate understanding of the participants' requirements and improve the satisfaction assessment process
- Furthermore, this research can be developed by implementing the framework (SAIF) in life-projects (both short-term and long-term) in the built environment

cluster so as to explore its value to project team satisfaction and to the industry at large

- An additional potential area for further studies for this research is to explore the application of other systems engineering techniques in the satisfaction assessment process of project teams. For example, the use of probability tree method in place of fault tree analysis to investigate the implications of satisfying a given participant (meeting the participant's satisfaction attributes) against dissatisfying the participant; root cause analysis in the place of failure mode and effects analysis for assessing the reasons for low assessment scores.

9.4 SUMMARY

The Satisfaction Assessment Integrated Framework is developed to enable structured and carefully planned observation and measurement of the concept of satisfaction, satisfaction attributes and assessment of meeting the attributes. It evaluates the dynamics of satisfaction and quality in the construction industry by providing a platform for determining the extent of the practice of team integration in the project team and its impact on their satisfaction.

The SAIF (ready-to-use web-based toolkit) provides an integrated framework for assessing the satisfaction levels of the clients and project participants. The framework allows users or the participants to assess their satisfaction levels by an assessment scoring system, to check precisely which of their satisfaction attributes have been met, and to analyse exactly how their satisfaction can be improved. It scales the expectations and satisfaction attributes of the clients and project participants at each project phase. It applies the idea behind tree structure analyses in analysing the integrated team. The mathematical

algorithm/ model behind the framework design is such that the participants' needs and requirements are scaled at each project phase. The framework allows dynamism and flexibility such that satisfaction can be measured and improved upon based on the clients' and project participants' satisfaction and assessment attributes.

In summary, the SAIF:

- Is designed and developed to capture flexible and unlimited number of satisfaction attributes
- Is aimed at improving the satisfaction levels of construction clients and the project participants
- Considers and integrates the members of the project team and their satisfaction attributes
- Could be applied at the initial stage of the project definition, and at different phases of the project life cycle. It is applied before the actual start of the project, in order to define the satisfaction attributes of the clients and project participants and the link between them. It is applied during the project process, at different project phases, so as to ensure that focus is placed on the defined satisfaction attributes. It could also be applied after the project to ensure that total satisfaction has been achieved, and if not, identify reasons for this so as to avoid any flaws or correct any mistakes.

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APPENDIX A: ACHIEVEMENTS AND DETAILS OF PUBLICATIONS

Nzekwe-Excel, C., Nwagboso, C., Georgakis, P., Proverbs, D., An Integrated Framework for Satisfaction Assessment in the Construction Sector, *Journal of Engineering, Design and Technology*, In Press.

Nzekwe-Excel, C., Using Fault Tree Analysis Strategy to Evaluate Satisfaction in relation to Time. *International Built Environment & Human Environment Research Week 2009*, University of Salford, Manchester, UK, 26th-30th Jan 2009

Nzekwe-Excel, C., Nwagboso, C., Georgakis, P., Proverbs, D., An Approach for Evaluating the Satisfaction of a Construction Project Team, *ARCOM Conference, The 24th Annual Association of Researchers in Construction Management*, University of Glamorgan Wales UK, 1st -3rd Sept 2008

Nzekwe-Excel, C., Nwagboso, C., Georgakis, P., Proverbs, D., An Integrated Framework for Satisfaction Assessment in the Construction Sector, *American Real Estate Society (ARES) Conference, The 24th Annual Meeting*, April 16-19, 2008, Captiva Island, Florida; A Joint Meeting with the International Real Estate Society (IRES)

Nzekwe-Excel, C. A Satisfaction, & Team Integration Assessment Framework, *Built Environment and Engineering Researchers Seminar*, University of Wolverhampton, 16th January 2008

Nzekwe-Excel, C. Improved Client Satisfaction: A Strategic Approach for in the Construction Sector *PROBE Conference, The Third Scottish Conference for Postgraduate Researchers of the Built and Natural Environment*; Edited by Prof Charles Egbu & Michael K.L. Tong; ISBN-13 978-1-905 866-17-5; ISBN-10 1-905 866-17-8, Glasgow Caledonian University, Glasgow UK, 20th-22nd Nov 2007

Nzekwe-Excel, C., Nwagboso, C., Georgakis, P., Proverbs, D., Achieving High Client Satisfaction in the Built Environment, *Second Built Environment Conference*, Port Elizabeth, South Africa, 17th-19th June 2007

Nzekwe-Excel, C., Nwagboso, C., Georgakis, P., Nawar, G., Review on the Role of ICT in the Development of a Sustainable Environment *Obafemi Awolowo University Annual International Conference, Nigeria, Edited by Prof S. Fadera, 17th-19th Jan.2007*

Nzekwe-Excel, C., Nwagboso, C., Georgakis, P., Proverbs, D., ICT Deployment to construction SMEs, *WCAEBE 2006 International Conference, Millennium Point Birmingham, 2nd-4th Oct 2006*

APPENDIX B: CORRESPONDENCE LETTER FOR QUESTIONNAIRE

INVITATION TO PARTICIPATE IN A STUDY ON CLIENT SATISFACTION, AND TEAM INTEGRATION ASSESSMENT OF CONSTRUCTION PARTICIPANTS

This research questionnaire on client and stakeholder satisfaction, and team integration assessment in the Construction sector forms part of the West Midlands Centre for Constructing Excellence (WMCCE) research activities. Purposefully, the research aims to develop a framework that will enable client/ customer satisfaction assessment by SMEs as the basis for monitoring and analysing project delivery and evaluation. Through this survey exercise, the research aims to analyse the data collected, to study the key attributes influencing satisfaction in the construction industry, and the level of importance assigned to each attribute or factor. Further more, the relationship and impact of the construction team integration on satisfaction will be explored.

Your participation in this project is completely voluntary. The questionnaire should take you about 10 minutes to complete. We do appreciate that the questionnaire will take some of your time; however it will provide a valuable contribution to the current study on measures to improve the satisfaction level and team integration in the construction industry. Please note that any information you provide will be treated with the **strictest confidence**.

On behalf of WMCCE and the University of Wolverhampton, I, Chinny Nzekwe-Excel, thank you for your time and contribution to this research. Any further information and the final outcome of the research will be available upon your request. Please feel free to contact me if you require further information.

SECTION 1: BASIC DETAILS

Name of respondent (Optional)

Years of experience in the construction sector

Name of organisation (Optional)

Business Address

.....

Tel. Fax E-mail

Please indicate the number of employees in your organisation

< 100	100 - 1000	1000 - 5000	5000 - 10000	> 10000
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please indicate the size of your organisation in terms of annual turnover

< £5m	£6m – £10m	£11m – £25m	£26m - £100m	> £100m
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 2:
CLIENT GROUP QUESTIONNAIRE

Please indicate the client (s) that best describes you:

Project Owner Client Advisor Intermediary

Please rate and tick the following sections considering that:

[5 is 'strongly agree', 4 is 'agree', 3 is 'somewhat agree', 2 is 'disagree', 1 is 'strongly disagree']

<u>2I – GENERAL SATISFACTION</u>					
As a client I would be satisfied if:					
	5	4	3	2	1
Project design contains sufficient details	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project is carried out within agreed budget	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project is completed on time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project schedules are detailed & easy to understand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Health & safety procedures are with no incidents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Communication flow is honest, consistent & friendly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Response to complaints, changes, or clarifications is quick & productive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Client services are open & friendly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project Management body has a record of recognised kite awards (eg ISO, Investor-in-people, Construction Line, Business Improvement, Best Practice awards)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<u>2II – SPECIFIC SATISFACTION</u>					
[5 is 'strongly agree', 4 is 'agree', 3 is 'somewhat agree', 2 is 'disagree', 1 is 'strongly disagree']					
As a client, I believe that my satisfaction would improve if the Project management group (contractor, designer, architect, engineer, sub-contractor):					
	5	4	3	2	1
Ensures that the cost of changes are fairly priced	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ensures that the cost of changes are introduced as early as possible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exhibits the ability to meet my deadlines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exhibits open and honest communication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ensures that there is minimal reworks & defects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ensures that strategies for managing any project risks are in place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allows flexibility for changes or modifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Implements and deploys ICT tools and processes in its operations (eg CRM, ERP, Database Management, Web-based tools, etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2III – TEAM INTEGRATION

As a client, I consider myself to be part of an integrated project team if:

	5	4	3	2	1
There is mutual support and trust amongst all members of the team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Focus is placed on my goals and objectives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information is shared freely without restrictions to any profession/ unit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My relationship and contribution to the team is equitable and respected	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There is equal opportunity throughout the design/ construction process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Every member of the team operates with a 'no blame' culture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Achievements are shared throughout the team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There is true commitment & understanding of each other's needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2IV – BENEFITS OF TEAM INTEGRATION

As a client, I believe that an integrated team could result in:

	5	4	3	2	1
Environment where individuals can work together	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mutual benefits for the entire project team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Focus on shared goals and ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better alignment of the client & contracting bodies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better management of a complaint & response system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consistency in techniques and procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improved image of the contracting body	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fewer defects in delivery & future processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improved transition into the different project stages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better decision-making strategies due to open & vast ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunity to offer alternatives and innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Continuous improvement of processes and results	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunity to learn from own and other's mistakes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A greater value in project delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Less generation of wastes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safer working conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On time delivery of projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2V – LACK OF TEAM INTEGRATION

As a client, I believe that lack of an integrated team could result in:

	5	4	3	2	1
Increased fragmentation of the project team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cost overruns in projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delay in project delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increased defects and poor quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Information flow deficiencies

More conflicts amongst the project team

Thank you for completing the questionnaire.

SECTION 2:
PROJECT MANAGEMENT GROUP QUESTIONNAIRE

Please indicate the project team member (s) that best describes your role (s):

- Main Contractor
 Specialist Contractor
 Sub-Contractor
 Architect
 Designer
 Engineer

Please rate and tick the following sections considering that:
[5 is ‘strongly agree’, 4 is ‘agree’, 3 is ‘somewhat agree’, 2 is ‘disagree’, 1 is ‘strongly disagree’]

2I – GENERAL SATISFACTION

As a contractor, designer, architect, engineer, sub-contractor, I would be satisfied if:

	5	4	3	2	1
Project design contains sufficient details	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Payment for project is made as contractually agreed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There exists early involvement of contractor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Each phase of the project process is completed on time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There exists tender assessment of quality, not just price	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sufficient time is allowed for tender	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project schedules are detailed & easy to understand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Health & safety procedures are with no incidents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Strategies for managing and assessing any project risks are in place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project consultants are responsive to questions & clarifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Communication flow is honest, consistent & friendly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Response to complaints is quick & productive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Client interactions are open & friendly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2II – SPECIFIC SATISFACTION

As a contractor, designer, architect, engineer, sub-contractor, I believe that my satisfaction would improve if the client group (main client, client advisor, client intermediary):

	5	4	3	2	1
Ensures and maintains the ability to make payments	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ensures that changes are fairly introduced	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ensures that changes are introduced as early as possible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exhibits open and honest communication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Trusts my capability to deliver	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allows flexibility for changes or modifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

As a contractor, designer, architect, engineer, sub-contractor, I believe that my satisfaction would improve if the supply chain (suppliers, manufacturers, distributors):	5	4	3	2	1
Ensures that cost estimates are in accordance with my requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ensures that there is minimal defects in supply	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exhibits the ability to meet my deadlines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exhibits open and honest communication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allows flexibility for changes or modifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<u>2III – TEAM INTEGRATION</u>					
[5 is ‘strongly agree’, 4 is ‘agree’, 3 is ‘somewhat agree’, 2 is ‘disagree’, 1 is ‘strongly disagree’]					
As a contractor, designer, architect, engineer, sub-contractor, I consider myself to be part of an integrated project team if:	5	4	3	2	1
There is mutual support and trust amongst all members of the team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Focus is placed on my goals and objectives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There is consistent communication between the project team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information is shared freely without restrictions to any profession /unit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My relationship and contribution to the team is equitable and respected	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There is equal opportunity throughout the design & construction process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Every member of the team operates with a ‘no blame’ culture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There is true commitment & understanding of each other’s needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Achievements are shared throughout the team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<u>2IV – BENEFITS OF TEAM INTEGRATION</u>					
[5 is ‘strongly agree’, 4 is ‘agree’, 3 is ‘somewhat agree’, 2 is ‘disagree’, 1 is ‘strongly disagree’]					
As a contractor, designer, architect, engineer, sub-contractor, I believe that an integrated team could result in:	5	4	3	2	1
Environment where individuals can work together efficiently & effectively	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mutual benefits for the entire project team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Focus on shared goals and ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better alignment of the client & contracting bodies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better management of a complaint & response system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consistency in techniques and procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improved image of the contracting body	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fewer defects in delivery & future processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Improved transition into the different project stages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better decision-making strategies due to open & vast ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunity to offer alternatives and innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Continuous improvement of processes and results	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Opportunity to learn from own and other's mistakes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A greater value in project delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Less generation of wastes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safer working conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On time delivery of projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2V – LACK OF TEAM INTEGRATION

[5 is 'strongly agree', 4 is 'agree', 3 is 'somewhat agree', 2 is 'disagree', 1 is 'strongly disagree']

As a contractor, designer, architect, engineer, sub-contractor, I believe that lack of an integrated team could result in:

	5	4	3	2	1
Increased fragmentation of the project team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cost overruns in projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delay in project delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increased defects and poor quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information flow deficiencies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More conflicts amongst the project team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thank you for completing the questionnaire.

SECTION 2:
SUPPLY CHAIN GROUP QUESTIONNAIRE

Please indicate the supply chain member (s) that best describes your role (s):

Supplier (Material, Machine, Labour) Distributor Manufacturer

Please rate and tick the following sections considering that:

[5 is 'strongly agree', 4 is 'agree', 3 is 'somewhat agree', 2 is 'disagree', 1 is 'strongly disagree']

2I – GENERAL SATISFACTION

As a supplier, distributor, manufacturer, I would be satisfied if:

	5	4	3	2	1
Project supply specifications contains sufficient details	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project schedules are detailed & easy to understand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Health & safety procedures are with no incidents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project consultants are responsive to questions & clarifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Communication flow is honest, consistent & friendly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2II – SPECIFIC SATISFACTION

As a supplier, distributor, manufacturer, I believe that my satisfaction would improve if the project management group (contractor, designer, architect, engineer, sub-contractor):

	5	4	3	2	1
Ensures that changes are fairly introduced	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ensures that changes are introduced as early as possible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exhibits open and honest communication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allows flexibility for changes or modifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2III – TEAM INTEGRATION

[5 is 'strongly agree', 4 is 'agree', 3 is 'somewhat agree', 2 is 'disagree', 1 is 'strongly disagree']

As a supplier, distributor, manufacturer, I consider myself to be part of an integrated project team if:

	5	4	3	2	1
There is mutual support and trust amongst all members of the team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Focus is placed on my goals and objectives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There is consistent communication between the project team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information is shared freely without restrictions to any profession /unit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My relationship and contribution to the team is equitable and respected	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There is equal opportunity throughout the design & construction process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Every member of the team operates with a 'no blame' culture	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There is true commitment & understanding of each other's needs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Achievements are shared throughout the team

2IV – BENEFITS OF TEAM INTEGRATION

[5 is ‘strongly agree’, 4 is ‘agree’, 3 is ‘somewhat agree’, 2 is ‘disagree’, 1 is ‘strongly disagree’]

As a supplier, distributor, manufacturer, I believe that an integrated team could result in:	5	4	3	2	1
Environment where individuals can work together efficiently & effectively	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mutual benefits for the entire project team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Focus on shared goals and ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better alignment of the client & contracting bodies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better management of a complaint & response system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Consistency in techniques and procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improved image of the contracting body	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fewer defects in delivery & future processes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improved transition into the different project stages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Better decision-making strategies due to open & vast ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunity to offer alternatives and innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Continuous improvement of processes and results	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunity to learn from own and other’s mistakes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A greater value in project delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Less generation of wastes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safer working conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On time delivery of projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2V – LACK OF TEAM INTEGRATION

[5 is ‘strongly agree’, 4 is ‘agree’, 3 is ‘somewhat agree’, 2 is ‘disagree’, 1 is ‘strongly disagree’]

As a supplier, distributor, manufacturer, I believe that lack of an integrated team could result in:	5	4	3	2	1
Increased fragmentation of the project team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cost overruns in projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Delay in project delivery	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increased defects and poor quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information flow deficiencies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
More conflicts amongst the project team	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thank you for completing the questionnaire.

**APPENDIX D: ORGANISATIONS CONTACTED/ USED FOR PILOT
STUDY**

AMEC Group Ltd

Edmund Nuttall Limited

Ecolec

Costain Limited

WSP Buildings Ltd

Loughborough University

GCA (UK) Ltd

Stoke on Trent College

University of Central England

Oxford Brookes University

West Midlands Centre for Constructing Excellence

Birmingham City Council Stepnell Limited

Ciria

The Wilkes Partnership

APPENDIX E: DETAILED RESULTS OF COMPUTATIONAL ANALYSIS

DETAILED RESULTS FOR DESIGNERS

	Designer 1					Designer 2					Designer 3					Designer 4					Designer 5					Designer 6					
	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS	
tsa1	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	5	4.5455	0.2273	0.0676	0.01536	5	4.5455	0.2273	0.0484	0.01101	
tsa2	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	3	2.7273	0.0818	0.0367	0.003	3	2.7273	0.0818	0.01685	0.00138	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
tsa3	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
tsa4	5	4.5455	0.2273	0.0689	0.0157	4	3.6364	0.1455	0.0563	0.0082	2	1.8182	0.0364	0.0163	0.0006	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
tsa5	4	3.6364	0.1455	0.0441	0.0064	4	3.6364	0.1455	0.0563	0.0082	3	2.7273	0.0818	0.0367	0.003	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
tsa6	4	3.6364	0.1455	0.0441	0.0064	4	3.6364	0.1455	0.0563	0.0082	2	1.8182	0.0364	0.0163	0.0006	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
tsa7	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	4	3.6364	0.1455	0.031	0.00451	
tsa8	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	4	3.6364	0.1455	0.031	0.00451	
ssa1	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	3	2.7273	0.0818	0.0367	0.003	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
ssa2	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
ssa3	4	3.6364	0.1455	0.0441	0.0064	4	3.6364	0.1455	0.0563	0.0082	2	1.8182	0.0364	0.0163	0.0006	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
qsa1	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
qsa2	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
qsa3	5	4.5455	0.2273	0.0689	0.0157	5	4.5455	0.2273	0.088	0.02	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
qsa3*	4	3.6364	0.1455	0.0441	0.0064	4	3.6364	0.1455	0.0563	0.0082	2	1.8182	0.0364	0.0163	0.0006	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
qsa4	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	2	1.8182	0.0364	0.0163	0.0006	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
qsa5	4	3.6364	0.1455	0.0441	0.0064	4	3.6364	0.1455	0.0563	0.0082	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
qsa6	4	3.6364	0.1455	0.0441	0.0064	3	2.7273	0.0818	0.0317	0.0026	2	1.8182	0.0364	0.0163	0.0006	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
csa1	4	3.6364	0.1455	0.0441	0.0064	4	3.6364	0.1455	0.0563	0.0082	3	2.7273	0.0818	0.0367	0.003	5	4.5455	0.2273	0.04682	0.01064	5	4.5455	0.2273	0.0676	0.01536	5	4.5455	0.2273	0.0484	0.01101	
csa2	5	4.5455	0.2273	0.0689	0.0157	4	3.6364	0.1455	0.0563	0.0082	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	3	2.7273	0.0818	0.0174	0.00143	
csa3	4	3.6364	0.1455	0.0441	0.0064	4	3.6364	0.1455	0.0563	0.0082	3	2.7273	0.0818	0.0367	0.003	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
csa4*	0	0	0	0	0	4	3.6364	0.1455	0.0563	0.0082	4	3.6364	0.1455	0.0653	0.0095	5	4.5455	0.2273	0.04682	0.01064	4	3.6364	0.1455	0.0432	0.00629	5	4.5455	0.2273	0.0484	0.01101	
Σ			3.3					2.5818					2.2273					4.8545										3.3636		4.6909	

DETAILED RESULTS FOR ENGINEERS

	Engineer 1					Engineer 2					Engineer 3					Engineer 4					Engineer 5					Engineer 6					
	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS	
tsa1	4	3.6364	0.1455	0.0426	0.0062	5	4.5455	0.2273	0.0529	0.012	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	3	2.7273	0.0818	0.0257	0.0021	
tsa2	5	4.5455	0.2273	0.0665	0.0151	5	4.5455	0.2273	0.0529	0.012	5	4.5455	0.2273	0.0575	0.0131	5	4.5455	0.2273	0.0455	0.0103	5	4.5455	0.2273	0.0644	0.0146	3	2.7273	0.0818	0.0257	0.0021	
tsa3	3	2.7273	0.0818	0.0239	0.002	5	4.5455	0.2273	0.0529	0.012	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	4	3.6364	0.1455	0.0457	0.00665	
tsa4	3	2.7273	0.0818	0.0239	0.002	5	4.5455	0.2273	0.0529	0.012	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	5	4.5455	0.2273	0.0714	0.01623	
tsa5	4	3.6364	0.1455	0.0426	0.0062	4	3.6364	0.1455	0.0338	0.0049	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	4	3.6364	0.1455	0.0457	0.00665	
tsa6	4	3.6364	0.1455	0.0426	0.0062	5	4.5455	0.2273	0.0529	0.012	5	4.5455	0.2273	0.0575	0.0131	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	4	3.6364	0.1455	0.0457	0.00665	
tsa7	4	3.6364	0.1455	0.0426	0.0062	3	2.7273	0.0818	0.019	0.0016	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	4	3.6364	0.1455	0.0457	0.00665	
tsa8	4	3.6364	0.1455	0.0426	0.0062	3	2.7273	0.0818	0.019	0.0016	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	4	3.6364	0.1455	0.0457	0.00665	
ssa1	4	3.6364	0.1455	0.0426	0.0062	5	4.5455	0.2273	0.0529	0.012	5	4.5455	0.2273	0.0575	0.0131	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	2	1.8182	0.0364	0.0114	0.00042	
ssa2	4	3.6364	0.1455	0.0426	0.0062	5	4.5455	0.2273	0.0529	0.012	5	4.5455	0.2273	0.0575	0.0131	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	3	2.7273	0.0818	0.0257	0.0021	
ssa3	3	2.7273	0.0818	0.0239	0.002	5	4.5455	0.2273	0.0529	0.012	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	5	4.5455	0.2273	0.0714	0.01623	
qsa1	4	3.6364	0.1455	0.0426	0.0062	5	4.5455	0.2273	0.0529	0.012	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	4	3.6364	0.1455	0.0457	0.00665	
qsa2	4	3.6364	0.1455	0.0426	0.0062	5	4.5455	0.2273	0.0529	0.012	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	4	3.6364	0.1455	0.0457	0.00665	
qsa3	5	4.5455	0.2273	0.0665	0.0151	5	4.5455	0.2273	0.0529	0.012	5	4.5455	0.2273	0.0575	0.0131	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	5	4.5455	0.2273	0.0714	0.01623	
qsa3*	5	4.5455	0.2273	0.0665	0.0151	4	3.6364	0.1455	0.0338	0.0049	5	4.5455	0.2273	0.0575	0.0131	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	4	3.6364	0.1455	0.0457	0.00665	
qsa4	5	4.5455	0.2273	0.0665	0.0151	5	4.5455	0.2273	0.0529	0.012	5	4.5455	0.2273	0.0575	0.0131	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	4	3.6364	0.1455	0.0457	0.00665	
qsa5	4	3.6364	0.1455	0.0426	0.0062	4	3.6364	0.1455	0.0338	0.0049	5	4.5455	0.2273	0.0575	0.0131	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	4	3.6364	0.1455	0.0457	0.00665	
qsa6	4	3.6364	0.1455	0.0426	0.0062	5	4.5455	0.2273	0.0529	0.012	3	2.7273	0.0818	0.0207	0.0017	5	4.5455	0.2273	0.0455	0.0103	5	4.5455	0.2273	0.0644	0.0146	3	2.7273	0.0818	0.0257	0.0021	
csa1	4	3.6364	0.1455	0.0426	0.0062	5	4.5455	0.2273	0.0529	0.012	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	3	2.7273	0.0818	0.0257	0.0021	
csa2	5	4.5455	0.2273	0.0665	0.0151	5	4.5455	0.2273	0.0529	0.012	5	4.5455	0.2273	0.0575	0.0131	5	4.5455	0.2273	0.0455	0.0103	5	4.5455	0.2273	0.0644	0.0146	5	4.5455	0.2273	0.0714	0.01623	
csa3	4	3.6364	0.1455	0.0426	0.0062	4	3.6364	0.1455	0.0338	0.0049	5	4.5455	0.2273	0.0575	0.0131	5	4.5455	0.2273	0.0455	0.0103	5	4.5455	0.2273	0.0644	0.0146	4	3.6364	0.1455	0.0457	0.00665	
csa4*	4	3.6364	0.1455	0.0426	0.0062	4	3.6364	0.1455	0.0338	0.0049	4	3.6364	0.1455	0.0368	0.0054	5	4.5455	0.2273	0.0455	0.0103	4	3.6364	0.1455	0.0412	0.006	5	4.5455	0.2273	0.0714	0.01623	
Σ			3.4182					4.3					3.9545					5						3.5273				3.1818			

DETAILED RESULTS FOR PROJECT MANAGERS

	Project Manager 1					Project Manager 2				
	Ra	PRa	II	RII	SS	Ra	PRa	II	RII	SS
tsa1	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
tsa2	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
tsa3	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
tsa4	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
tsa5	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
tsa6	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
tsa7	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
tsa8	5	4.5455	0.22727273	0.04545455	0.01033	5	4.5455	0.2272727	0.0637755	0.01449
ssa1	5	4.5455	0.22727273	0.04545455	0.01033	5	4.5455	0.2272727	0.0637755	0.01449
ssa2	5	4.5455	0.22727273	0.04545455	0.01033	5	4.5455	0.2272727	0.0637755	0.01449
ssa3	5	4.5455	0.22727273	0.04545455	0.01033	3	2.7273	0.0818182	0.0229592	0.00188
qsa1	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
qsa2	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
qsa3	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
qsa3*	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
qsa4	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
qsa5	5	4.5455	0.22727273	0.04545455	0.01033	5	4.5455	0.2272727	0.0637755	0.01449
qsa6	5	4.5455	0.22727273	0.04545455	0.01033	5	4.5455	0.2272727	0.0637755	0.01449
csa1	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
csa2	5	4.5455	0.22727273	0.04545455	0.01033	5	4.5455	0.2272727	0.0637755	0.01449
csa3	5	4.5455	0.22727273	0.04545455	0.01033	4	3.6364	0.1454545	0.0408163	0.00594
csa4*	5	4.5455	0.22727273	0.04545455	0.01033	3	2.7273	0.0818182	0.0229592	0.00188
Σ			5					3.5636364		

DETAILED RESULTS FOR ARCHITECT**Architect 1**

	Ra	PRa	II	RII	SS
tsa1	5	4.5455	0.22727273	0.05	0.01136
tsa2	5	4.5455	0.22727273	0.05	0.01136
tsa3	5	4.5455	0.22727273	0.05	0.01136
tsa4	5	4.5455	0.22727273	0.05	0.01136
tsa5	5	4.5455	0.22727273	0.05	0.01136
tsa6	5	4.5455	0.22727273	0.05	0.01136
tsa7	5	4.5455	0.22727273	0.05	0.01136
tsa8	5	4.5455	0.22727273	0.05	0.01136
ssa1	5	4.5455	0.22727273	0.05	0.01136
ssa2	5	4.5455	0.22727273	0.05	0.01136
ssa3	4	3.6364	0.14545455	0.032	0.00465
qsa1	5	4.5455	0.22727273	0.05	0.01136
qsa2	5	4.5455	0.22727273	0.05	0.01136
qsa3	3	2.7273	0.08181818	0.018	0.00147
qsa3*	5	4.5455	0.22727273	0.05	0.01136
qsa4	5	4.5455	0.22727273	0.05	0.01136
qsa5	5	4.5455	0.22727273	0.05	0.01136
qsa6	5	4.5455	0.22727273	0.05	0.01136
csa1	5	4.5455	0.22727273	0.05	0.01136
csa2	3	2.7273	0.08181818	0.018	0.00147
csa3	4	3.6364	0.14545455	0.032	0.00465
csa4*	5	4.5455	0.22727273	0.05	0.01136
Σ			4.54545455		

DETAILED RESULTS FOR SUB CONTRACTOR

Sub Contractor					
	Ra	PRa	II	RII	SS
Tsa1	4	3.6364	0.14545455	0.03773585	0.00549
Tsa2	4	3.6364	0.14545455	0.03773585	0.00549
Tsa3	5	4.5455	0.22727273	0.05896226	0.0134
tSa4	5	4.5455	0.22727273	0.05896226	0.0134
tSa5	5	4.5455	0.22727273	0.05896226	0.0134
tSa6	4	3.6364	0.14545455	0.03773585	0.00549
tSa7	5	4.5455	0.22727273	0.05896226	0.0134
tSa8	5	4.5455	0.22727273	0.05896226	0.0134
ssa1	5	4.5455	0.22727273	0.05896226	0.0134
ssa2	5	4.5455	0.22727273	0.05896226	0.0134
ssa3	4	3.6364	0.14545455	0.03773585	0.00549
qsa1	4	3.6364	0.14545455	0.03773585	0.00549
qsa2	4	3.6364	0.14545455	0.03773585	0.00549
qsa3	4	3.6364	0.14545455	0.03773585	0.00549
qsa3*	4	3.6364	0.14545455	0.03773585	0.00549
qsa4	4	3.6364	0.14545455	0.03773585	0.00549
qsa5	4	3.6364	0.14545455	0.03773585	0.00549
qsa6	4	3.6364	0.14545455	0.03773585	0.00549
csa1	5	4.5455	0.22727273	0.05896226	0.0134
csa2	4	3.6364	0.14545455	0.03773585	0.00549
csa3	4	3.6364	0.14545455	0.03773585	0.00549
csa4*	4	3.6364	0.14545455	0.03773585	0.00549
Σ			3.85454545		

DETAILED RESULTS FOR SUPPLIER

Supplier 1

	Ra	PRa	II	RII	SS
Csa1 _{sg}	5	4.5455	0.22727273	0.1	0.02273
Csa2 _{sg}	5	4.5455	0.22727273	0.1	0.02273
Csa3 _{sg}	5	4.5455	0.22727273	0.1	0.02273
Qsa1 _{sg}	5	4.5455	0.22727273	0.1	0.02273
Qsa2 _{sg}	5	4.5455	0.22727273	0.1	0.02273
Qsa3 _{sg}	5	4.5455	0.22727273	0.1	0.02273
Ssa1 _{sg}	5	4.5455	0.22727273	0.1	0.02273
Tsa1 _{sg}	5	4.5455	0.22727273	0.1	0.02273
Tsa2 _{sg}	5	4.5455	0.22727273	0.1	0.02273
Tsa3 _{sg}	5	4.5455	0.22727273	0.1	0.02273
Σ			2.27272727		

APPENDIX F: HTML CODES FOR SAIF HOMEPAGE: MAIN MENU

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-
transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
  <title>SAIF-Project</title>
  <meta name="generator" content="Starfield Technologies; WebSite Tonight 4.6.0"/>
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
  <script type="text/javascript" src="scripts/imageSwap.js"></script>
  <script type="text/javascript">
    MM_preloadImages('images/building3.jpg');
  </script>
  <script type="text/javascript" src="scripts/scrollingMarquee.js"></script>
  <script type="text/javascript" src="scripts/siteUtil.js"></script>
  <link rel="stylesheet" type="text/css" id="layout8.css" href="layout8.css" />
  <link rel="stylesheet" type="text/css" id="theme.css" href="theme.css" />
  <link rel="stylesheet" type="text/css" id="color_4.css" href="color_4.css" />
  <link rel="stylesheet" type="text/css" id="custom.css" href="custom.css" />
  <link rel="stylesheet" type="text/css" id="wstuseradvancedstyles.css" href="WstUserAdvancedStyles.css?a883db73-2684-48f1-9039-
99b347b473bf" />
</head>
<body>
<div class="sf_outer_wrapper">
  <!-- 1 --><div class="sf_extra1"><span></span></div>
  <div class="sf_wrapper">
    <div class="sf_navigation_top">
      <!-- Nav:Begin -->
      <!-- Nav:End -->
    </div><!-- /sf_navigation_top -->
    <!-- 10 --><div class="sf_extra10"><span></span></div>
    <div class="sf_header_wrapper">
      <!-- 2 --><div class="sf_extra2"><span></span></div>
      <div class="sf_main_header">
        <!-- MainHead:Begin -->
        <div style="display:block" ><span style="font-family: Verdana; "><span style="color:
rgb(17, 91, 141); ">SAIF-PROJECT</span></span></div><span style="font-size: 16px; "><br /></span></div></div>
        <!-- MainHead:End -->
      </div>
      <!-- 3 --><div class="sf_extra3"><span></span></div>
      <div class="sf_sub_header">
        <!-- SubHead:Begin -->
        <div style="display:block" >Your Subtitle text</div>
        <!-- SubHead:End -->
      </div>
    </div><!-- /sf_header_wrapper -->
    <!-- 4 --><div class="sf_extra4"><span></span></div>
    <div class="sf_navigation">
      <!-- Nav:Begin -->
      <div style="display:block" ><ul id="Nav1"><li class="sf_first_nav_item"><a
href="Home_Page.html" target="_self">SAIF-Project</a></li><li><a href="Attribute_Initiator.html" target="_self">Attribute
Initiator</a></li><li><a href="Attribute_Quantifier.html" target="_self">Attribute Quantifier</a></li><li><a
href="Assessment_ScoringSystem.html" target="_self">Assessment ScoringSystem</a></li><li class="sf_last_nav_item"><a
href="integrated_project_team.html" target="_self">integrated project team</a></li></ul></div>
      <!-- Nav:End -->
    </div><!-- /sf_navigation -->
    <!-- 5 --><div class="sf_extra5"><span></span></div>
    <div class="sf_pagetitle">
      <!-- PageTitle:Begin -->
      <div style="display:block" ><span style="font-family: verdana; "><span style="color: rgb(0, 0, 102);
">The Satisfaction Assessment Integrated Framework (SAIF)</span></span></div>
      <!-- PageTitle:End -->
    </div>
    <!-- 6 --><div class="sf_extra6"><span></span></div>
    <div class="sf_subnavigation">
      <!-- Nav:Begin -->
      <!-- Nav:End -->
    </div><!-- /sf_subnavigation -->
    <!-- 11 --><div class="sf_extra11"><span></span></div>
    <div class="sf_content">
      <!-- Content:Begin -->
      <div style="display:block" ><div id="content1"><div style="display:block" ><div
style="display:block" ><span><span><span style="font-family: verdana; "><span style="color: rgb(0, 0, 153); "><div
class="marqueecenter1"><div class="marqueecenter2" style="width:216px;">
<SCRIPT language="JavaScript">

```

```

<!--
    //set the marquee parameters
    function init1239052673() { marquee1239052673.start(); }
    var gds_Text1239052673 = 'Satisfaction is an issue required by both construction clients and other participants of the
construction project team';
    var gds_Direction1239052673 = 'up';
    var gds_marquee_contents1239052673='<center><span style="font-family:Verdana;font-size:8pt;white-space:normal;">' +
gds_Text1239052673 + '</span><center>';
    marquee1239052673 = new xbMarquee('marquee_1239052673', '72px', '216px', 1, 100, 'up', 'scroll',
gds_marquee_contents1239052673);
    window.setTimeout( init1239052673, 200);
-->
</SCRIPT>
</div></div></span></span></span></span><br /></div></div></div><div id="content2"><div style="display:block" ><div
style="display:block" ><span></span></div></div></div><div id="content3"><div
style="display:block" ><div style="display:block" ><!--StartFragment--><span style="font-size: 12pt; "><span style="font-family:
'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); ">The Satisfaction Assessment </span></span></span></span><span
lang="EN-US" style="font-size: 12pt; "><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153);
">Integrated</span></span></span></span><span style="font-size: 12pt; "><span style="font-family: 'comic sans ms'; "><span><span
style="color: rgb(0, 0, 153); "> Framework (SAIF) is an integrated system or framework that collects data, analyses the data, enables
collaboration of construction clients and professionals, and provides valuable information for the professionals in terms of satisfying
them and improving the project delivery process.</span></span></span><span style="font-family: 'comic sans ms';
"><span><span style="color: rgb(0, 0, 153); "> </span></span></span></span></span><!--EndFragment--><span style="color: rgb(0,
0, 153); ">
</span>
</div><span style="font-size: 16px; "><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); "><br />
</span>
</span></span></span></div>
<div><span style="font-size: 16px; "><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153);
"><Components of SAIF-Project:</span></span></span></span></div>
<div>
<ul>
<li><span style="font-size: 16px; "><a href="Attribute_Initiator.html"><span style="font-family: 'comic sans ms'; "><span><span
style="color: rgb(0, 0, 153); ">Attribute Initiator</span></span></span></a></span></li>
</ul>
<ul>
<li><span style="font-size: 16px; "><a href="Attribute_Quantifier.html"><span style="font-family: 'comic sans ms'; "><span><span
style="color: rgb(0, 0, 153); ">Attribute Quantifier</span></span></span></a></span></li>
</ul>
<ul>
<li><span style="font-size: 16px; "><a href="Assessment_ScoringSystem.html"><span style="font-family: 'comic sans ms';
"><span><span style="color: rgb(0, 0, 153); ">Assessment Scoring System</span></span></span></a></span></li>
</ul>
<ul>
<li><span style="font-size: 16px; "><a href="integrated_project_team.html"><span style="font-family: 'comic sans ms';
"><span><span style="color: rgb(0, 0, 153); ">Integrated Project Team</span></span></span></a></span></li>
</ul>
</div></div></div></div></div>
    <!-- Content:End -->
</div><!-- /sf_content -->
<!-- 12 --><div class="sf_extra12"><span></span></div>
<div class="sf_subnavigation2">
    <!-- Nav:Begin -->
    <!-- Nav:End -->
</div><!-- /sf_subnavigation2 -->
    <!-- 7 --><div class="sf_extra7"><span></span></div>
    <div class="sf_footer">
        <!-- Footer:Begin -->
        <div style="display:block" ><span style="color: rgb(101, 101, 101); ">Copyright 2008; SAIF-Project
All rights reserved.</span></div>
        <!-- Footer:Begin -->
    </div><!-- /sf_footer -->
    <!-- 8 --><div class="sf_extra8"><span></span></div>
</div><!-- /sf_wrapper -->
    <!-- 9 --><div class="sf_extra9"><span></span></div>
</div><!-- /sf_outer_wrapper -->
<div class="sf_banner">
    <div style="display:block" >
</div>
</body>
</html>

```

APPENDIX G: HTML CODES FOR ATTRIBUTE INITIATOR WEB PAGE

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-
transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
    <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
    <title>Attribute Initiator</title>
    <meta name="generator" content="Starfield Technologies; WebSite Tonight 4.6.0"/>
    <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
    <script type="text/javascript" src="scripts/imageSwap.js"></script>
    <script type="text/javascript">
        MM_preloadImages('images/quest.jpg');
        MM_preloadImages('images/tfile_pic9.jpg');
    </script>
    <script type="text/javascript" src="scripts/siteUtil.js"></script>
    <link rel="stylesheet" type="text/css" id="layout4.css" href="layout4.css" />
    <link rel="stylesheet" type="text/css" id="theme.css" href="theme.css" />
    <link rel="stylesheet" type="text/css" id="color_4.css" href="color_4.css" />
    <link rel="stylesheet" type="text/css" id="custom.css" href="custom.css" />
    <link rel="stylesheet" type="text/css" id="wstuseradvancedstyles.css" href="WstUserAdvancedStyles.css?1ac0fd3a-a097-4e91-be61-
70b183ec8410" />
</head>
<body>
<div class="sf_outer_wrapper">
    <!-- 1 --><div class="sf_extra1"><span></span></div>
    <div class="sf_wrapper">
        <div class="sf_navigation_top">
            <!-- Nav:Begin -->
            <!-- Nav:End -->
        </div><!-- /sf_navigation_top -->
        <!-- 10 --><div class="sf_extra10"><span></span></div>
        <div class="sf_header_wrapper">
            <!-- 2 --><div class="sf_extra2"><span></span></div>
            <div class="sf_main_header">
                <!-- MainHead:Begin -->
                <div style="display:block" ><span style="font-family: Verdana; "><span style="color:
rgb(17, 91, 141); ">SAIF-PROJECT</span></span></div><span style="font-size: 16px; "><br /></span></div></div>
                <!-- MainHead:End -->
            </div>
            <!-- 3 --><div class="sf_extra3"><span></span></div>
            <div class="sf_sub_header">
                <!-- SubHead:Begin -->
                <div style="display:block" >Your Subtitle text</div>
                <!-- SubHead:End -->
            </div>
        </div><!-- /sf_header_wrapper -->
        <!-- 4 --><div class="sf_extra4"><span></span></div>
        <div class="sf_navigation">
            <!-- Nav:Begin -->
            <div style="display:block" ><ul id="Nav1"><li class="sf_first_nav_item"><a
href="Home_Page.html" target="_self">SAIF-Project</a></li><li><a href="Attribute_Initiator.html" target="_self">Attribute
Initiator</a></li><li><a href="Attribute_Quantifier.html" target="_self">Attribute Quantifier</a></li><li><a
href="Assessment_ScoringSystem.html" target="_self">Assessment ScoringSystem</a></li><li class="sf_last_nav_item"><a
href="integrated_project_team.html" target="_self">integrated project team</a></li></ul></div>
            <!-- Nav:End -->
        </div><!-- /sf_navigation -->
        <!-- 5 --><div class="sf_extra5"><span></span></div>
        <div class="sf_pagetitle">
            <!-- PageTitle:Begin -->
            <div style="display:block" ><span style="font-family: verdana; "><span><span style="color: rgb(0, 0,
102); ">Attribute Initiator</span></span></span></div>
            <!-- PageTitle:End -->
        </div>
        <!-- 6 --><div class="sf_extra6"><span></span></div>
        <div class="sf_subnavigation">
            <!-- Nav:Begin -->
            <!-- Nav:End -->
        </div><!-- /sf_subnavigation -->
        <!-- 11 --><div class="sf_extra11"><span></span></div>

        <div class="sf_content">
            <!-- Content:Begin -->
            <div style="display:block" ><div id="content1"><div style="display:block" ><div
style="display:block" ><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); ">Attribute Initiator is

```

```

the platform for identifying and understanding the satisfaction attributes of construction clients and project
participants.</span></span></span><span style="color: rgb(0, 0, 153); ">
</span>
<div><span style="font-family: 'comic sans ms'; "><span style="color: rgb(0, 0, 153); "><br />
</span>
</span></div>
<div><span><span style="color: rgb(0, 0, 153); "><span></span></span></span><span style="font-family: 'comic sans ms'; "><span
style="color: rgb(0, 0, 153); ">
</span><!--StartFragment-->
<p class="MsoNormal" style="text-align: justify; "><span style="color: rgb(0, 0, 153); ">Satisfaction attributes are
defined as the needs and parameters required and specified by construction
clients and the project participants to ensure their satisfaction.</span><span><span style="color: rgb(0, 0, 153); ">
</span></span><span style="color: rgb(0, 0, 153); "><o:p></o:p></span></p>
<!--EndFragment-->
</span><span style="color: rgb(0, 0, 153); ">
</span>
<div><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); "><br />
</span>
</span></span></div>
<div><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); ">Please select the one (s) that apply to
you:</span></span></span></div>
<div><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); "><br />
</span>
</span></span></div>
<div><!--StartFragment-->
<ul style="margin-top: 0cm; " type="disc">
  <li class="MsoNormal" style="text-align: justify; "><span style="font-weight: bold; "><span><span><a
href="http://www.results.saif-project.com/"><span><span style="color: rgb(0, 0, 153);
">ClientGroup</span></span></a></span></span></span><span style="font-family: 'comic sans ms'; "><span><span style="color:
rgb(0, 0, 153); ">: relates to project owners,    project consultants, client advisors, etc.</span></span></span></li>
</ul>
<ul style="margin-top: 0cm; " type="disc">
  <li class="MsoNormal" style="text-align: justify; "><span style="font-weight: bold; "><span><span><a
href="http://www.results.saif-project.com/project.html"><span><span style="color: rgb(0, 0, 153);
">ProjectMgtGroup</span></span></a></span></span></span><span style="font-family: 'comic sans ms'; "><span><span
style="color: rgb(0, 0, 153); ">: relates to project managers,    architects, engineers, designers, main and sub contractors,
etc.</span></span></span></li>
</ul>
<ul style="margin-top: 0cm; " type="disc">
  <li class="MsoNormal" style="text-align: justify; "><span style="font-weight: bold; "><span><span><a
href="http://www.results.saif-project.com/supply.html"><span><span style="color: rgb(0, 0, 153);
">SupplyGroup</span></span></a></span></span></span><span style="font-family: 'comic sans ms'; "><span><span style="color:
rgb(0, 0, 153); ">: relates to suppliers,    distributors, manufacturers, etc.</span></span></span></li>
</ul>
<!--EndFragment--></div>
</span></div></div></div></div><div id="content2"><div style="display:block" ><div style="display:block" ><span></span></div></div></div><div id="content3"><div style="display:block" ><div style="display:block"
><span></span></div></div></div>
  <!-- Content:End -->
</div><!-- /sf_content -->
<!-- 12 --><div class="sf_extra12"><span></span></div>
<div class="sf_subnavigation2">
  <!-- Nav:Begin -->
  <!-- Nav:End -->
</div><!-- /sf_subnavigation2 -->
  <!-- 7 --><div class="sf_extra7"><span></span></div>
  <div class="sf_footer">
    <!-- Footer:Begin -->
    <div style="display:block" ><span style="color: rgb(101, 101, 101); ">Copyright 2008; SAIF-Project
All rights reserved.</span></div>
    <!-- Footer:Begin -->
  </div><!-- /sf_footer -->
  <!-- 8 --><div class="sf_extra8"><span></span></div>
</div><!-- /sf_wrapper -->
  <!-- 9 --><div class="sf_extra9"><span></span></div>
</div><!-- /sf_outer_wrapper -->
<div class="sf_banner">
  <div style="display:block" >
</div>
</body>
</html>

```

APPENDIX H: HTML CODES FOR ATTRIBUTE QUANTIFIER WEB PAGE

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-
transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
    <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
    <title>Attribute Quantifier</title>
    <meta name="generator" content="Starfield Technologies; WebSite Tonight 4.6.0"/>
    <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
    <script type="text/javascript" src="scripts/imageSwap.js"></script>
    <script type="text/javascript">
        MM_preloadImages('images/pix3.jpg');
    </script>
    <script type="text/javascript" src="scripts/siteUtil.js"></script>
    <link rel="stylesheet" type="text/css" id="layout10.css" href="layout10.css" />
    <link rel="stylesheet" type="text/css" id="theme.css" href="theme.css" />
    <link rel="stylesheet" type="text/css" id="color_4.css" href="color_4.css" />
    <link rel="stylesheet" type="text/css" id="custom.css" href="custom.css" />
    <link rel="stylesheet" type="text/css" id="wstuseradvancedstyles.css" href="WstUserAdvancedStyles.css?5c4d25de-2be2-45c5-9965-
2c05832bb2f1" />
</head>
<body>
<div class="sf_outer_wrapper">
    <!-- 1 --><div class="sf_extra1"><span></span></div>
    <div class="sf_wrapper">
        <div class="sf_navigation_top">
            <!-- Nav:Begin -->
            <!-- Nav:End -->
        </div><!-- /sf_navigation_top -->
        <!-- 10 --><div class="sf_extra10"><span></span></div>
        <div class="sf_header_wrapper">
            <!-- 2 --><div class="sf_extra2"><span></span></div>
            <div class="sf_main_header">
                <!-- MainHead:Begin -->
                <div style="display:block" ><span style="font-family: Verdana; "><span style="color:
rgb(17, 91, 141); ">SAIF-PROJECT</span></span></div><div><span style="font-size: 16px; "><br /></span></div></div>
                <!-- MainHead:End -->
            </div>
            <!-- 3 --><div class="sf_extra3"><span></span></div>
            <div class="sf_sub_header">
                <!-- SubHead:Begin -->
                <div style="display:block" >Your Subtitle text</div>
                <!-- SubHead:End -->
            </div>
        </div><!-- /sf_header_wrapper -->
        <!-- 4 --><div class="sf_extra4"><span></span></div>
        <div class="sf_navigation">
            <!-- Nav:Begin -->
            <div style="display:block" ><ul id="Nav1"><li class="sf_first_nav_item"><a
href="Home_Page.html" target="_self">SAIF-Project</a></li><li><a href="Attribute_Initiator.html" target="_self">Attribute
Initiator</a></li><li><a href="Attribute_Quantifier.html" target="_self">Attribute Quantifier</a></li><li><a
href="Assessment_ScoringSystem.html" target="_self">Assessment ScoringSystem</a></li><li class="sf_last_nav_item"><a
href="integrated_project_team.html" target="_self">integrated project team</a></li></ul></div>
            <!-- Nav:End -->
        </div><!-- /sf_navigation -->
        <!-- 5 --><div class="sf_extra5"><span></span></div>
        <div class="sf_pagetitle">
            <!-- PageTitle:Begin -->
            <div style="display:block" ><span><span style="font-family: 'trebuchet ms'; "><span style="color:
rgb(0, 0, 102); ">Attribute Quantifier</span></span></div>
            <!-- PageTitle:End -->
        </div>
        <!-- 6 --><div class="sf_extra6"><span></span></div>
        <div class="sf_subnavigation">
            <!-- Nav:Begin -->
            <!-- Nav:End -->
        </div><!-- /sf_subnavigation -->
        <!-- 11 --><div class="sf_extra11"><span></span></div>
        <div class="sf_content">
            <!-- Content:Begin -->
            <div style="display:block" ><div id="content1"><div style="display:block" ><div
style="display:block" ><span style="font-family: 'comic sans ms'; "><span></span><br />
</span>

```

```

<div><!--EndFragment--></div></div></div></div><div id="content2"><div style="display:block" ><div style="display:block"
><span><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); ">Attribute Quantifier helps to define
the significance of your required satisfaction attributes by allocating weights to the attributes. </span></span></span></span><span
style="color: rgb(0, 0, 153); ">
</span>
<div><span style="font-family: 'comic sans ms'; "><span style="color: rgb(0, 0, 153); "><br />
</span>
</span></div>
<div><span><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); ">Hence, this helps to define the
Satisfaction Importance Number (SIN) for each member of the project team based their satisfaction attributes.<br />
</span>
</span>
</span></span></span><span style="color: rgb(0, 0, 153); ">
</span>
<div><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); "><br />
</span>
</span></span></div>
<div><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); ">Please select the one (s) that apply to
you:</span></span></span></div>
<div><span style="font-family: 'comic sans ms'; "><span><span style="color: rgb(0, 0, 153); "><br />
</span>
</span></span></div>
<div><!--StartFragment-->
<ul style="margin-top: 0cm; " type="disc">
<li class="MsoNormal" style="text-align: justify; "><span style="font-weight: bold; "><span><span><a
href="http://www.results.saif-project.com/"><span><span style="color: rgb(0, 0, 153);
">ClientGroup</span></span></a></span></span></span><span style="font-family: 'comic sans ms'; "><span><span style="color:
rgb(0, 0, 153); ">: relates to project owners, project consultants, client advisors, etc.</span></span></span></li>
</ul>
<ul style="margin-top: 0cm; " type="disc">
<li class="MsoNormal" style="text-align: justify; "><span style="font-weight: bold; "><span><span><a
href="http://www.results.saif-project.com/project.html"><span><span style="color: rgb(0, 0, 153);
">ProjectMgtGroup</span></span></a></span></span></span><span style="font-family: 'comic sans ms'; "><span><span
style="color: rgb(0, 0, 153); ">: relates to project managers, architects, engineers, designers, main and sub contractors,
etc.</span></span></span></li>
</ul>
<ul style="margin-top: 0cm; " type="disc">
<li class="MsoNormal" style="text-align: justify; "><span style="font-weight: bold; "><span><span><a
href="http://www.results.saif-project.com/supply.html"><span><span style="color: rgb(0, 0, 153);
">SupplyGroup</span></span></a></span></span></span><span style="font-family: 'comic sans ms'; "><span><span style="color:
rgb(0, 0, 153); ">: relates to suppliers, distributors, manufacturers, etc.</span></span></span></li>
</ul>
<!--EndFragment--></div>
</div></div></div></div></div>
<!-- Content:End -->
</div><!-- /sf_content -->
<!-- 12 --><div class="sf_extra12"><span></span></div>
<div class="sf_subnavigation2">
<!-- Nav:Begin -->
<!-- Nav:End -->
</div><!-- /sf_subnavigation2 -->
<!-- 7 --><div class="sf_extra7"><span></span></div>
<div class="sf_footer">
<!-- Footer:Begin -->
<div style="display:block" ><span style="color: rgb(101, 101, 101); ">Copyright 2008; SAIF-Project
All rights reserved.</span></div>
<!-- Footer:Begin -->
</div><!-- /sf_footer -->
<!-- 8 --><div class="sf_extra8"><span></span></div>
</div><!-- /sf_wrapper -->
<!-- 9 --><div class="sf_extra9"><span></span></div>
</div><!-- /sf_outer_wrapper -->
<div class="sf_banner">
<div style="display:block" >
</div>
</body>
</html>

```

APPENDIX I: HTML CODES FOR ASSESSMENT SCORING SYSTEM WEB PAGE

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-
transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
  <title>Assessment ScoringSystem</title>
  <meta name="generator" content="Starfield Technologies; WebSite Tonight 4.6.0"/>
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
  <script type="text/javascript" src="scripts/imageSwap.js"></script>
  <script type="text/javascript">
    MM_preloadImages('images/tfile_pic5.jpg');
  </script>
  <script type="text/javascript" src="scripts/siteUtil.js"></script>
  <link rel="stylesheet" type="text/css" id="layout10.css" href="layout10.css" />
  <link rel="stylesheet" type="text/css" id="theme.css" href="theme.css" />
  <link rel="stylesheet" type="text/css" id="color_4.css" href="color_4.css" />
  <link rel="stylesheet" type="text/css" id="custom.css" href="custom.css" />
  <link rel="stylesheet" type="text/css" id="wstuseradvancedstyles.css" href="WstUserAdvancedStyles.css?c4cbd88d-41e3-41e3-956f-
44c040788acd" />
</head>
<body>
<div class="sf_outer_wrapper">
  <!-- 1 --><div class="sf_extra1"><span></span></div>
  <div class="sf_wrapper">
    <div class="sf_navigation_top">
      <!-- Nav:Begin -->
      <!-- Nav:End -->
    </div><!-- /sf_navigation_top -->
    <!-- 10 --><div class="sf_extra10"><span></span></div>
    <div class="sf_header_wrapper">
      <!-- 2 --><div class="sf_extra2"><span></span></div>
      <div class="sf_main_header">
        <!-- MainHead:Begin -->
        <div style="display:block" ><span style="font-family: Verdana; " ><span style="color:
rgb(17, 91, 141); " >SAIF-PROJECT</span></span></div><span style="font-size: 16px; " ><br /></span></div></div>
        <!-- MainHead:End -->
      </div>
      <!-- 3 --><div class="sf_extra3"><span></span></div>
      <div class="sf_sub_header">
        <!-- SubHead:Begin -->
        <div style="display:block" >Your Subtitle text</div>
        <!-- SubHead:End -->
      </div>
    </div><!-- /sf_header_wrapper -->
    <!-- 4 --><div class="sf_extra4"><span></span></div>
    <div class="sf_navigation">
      <!-- Nav:Begin -->
      <div style="display:block" ><ul id="Nav1"><li class="sf_first_nav_item"><a
href="Home_Page.html" target="_self">SAIF-Project</a></li><li><a href="Attribute_Initiator.html" target="_self">Attribute
Initiator</a></li><li><a href="Attribute_Quantifier.html" target="_self">Attribute Quantifier</a></li><li><a
href="Assessment_ScoringSystem.html" target="_self">Assessment ScoringSystem</a></li><li class="sf_last_nav_item"><a
href="integrated_project_team.html" target="_self">integrated project team</a></li></ul></div>
      <!-- Nav:End -->
    </div><!-- /sf_navigation -->
    <!-- 5 --><div class="sf_extra5"><span></span></div>
    <div class="sf_pagetitle">
      <!-- PageTitle:Begin -->
      <div style="display:block" ><span><span style="font-family: 'trebuchet ms'; " ><span style="color:
rgb(0, 0, 102); " >Assessment Scoring System</span></span></div>
      <!-- PageTitle:End -->
    </div>
    <!-- 6 --><div class="sf_extra6"><span></span></div>
    <div class="sf_subnavigation">
      <!-- Nav:Begin -->
      <!-- Nav:End -->
    </div><!-- /sf_subnavigation -->
    <!-- 11 --><div class="sf_extra11"><span></span></div>
    <div class="sf_content">
      <!-- Content:Begin -->
      <div style="display:block" ><div id="content1"><div style="display:block" ><div
style="display:block" ><span style="color: rgb(0, 0, 153); font-family: 'comic sans ms'; " ><span></span><br />
</span>

```

```

<div>
<div>
<ul style="margin-top: 0cm; " type="disc">
</ul>
<!--EndFragment--></div>
</div></div></div></div><div id="content2"><div style="display:block" ><div style="display:block" ><span style="font-family:
'comic sans ms'"><span><span style="color: rgb(0,0,153)">Assessment Scoring System is used to assess to what extent other members
of the construction project team meet the satisfaction attributes of the participant under consideration (assessor) before, during and after
the project life cycle.</span></span></span>
<div>
<div><span style="font-family: 'comic sans ms'"><span><span style="color: rgb(0,0,153)"><br />
</span></span></span></div>
<div><span style="font-family: 'comic sans ms'"><span style="color: rgb(0,0,153)">With the Assessment Scoring System, the
Satisfaction Assessment Number (SAN) is defined in comparison to the Satisfaction Importance Number (SIN) defined from the
importance associated with the satisfaction attributes.</span></span></div>
<div><span style="font-family: 'comic sans ms'"><span style="color: rgb(0,0,153)"><br />
</span></span></div>
<div><span><span style="font-family: 'comic sans ms'"><span><span style="color: rgb(0,0,153)">There are three groups of
assessment targeting members of the project:</span></span></span></span></div>
<div><span><span style="font-family: 'comic sans ms'"><span><span style="color: rgb(0,0,153)"><br />
</span></span></span></span></div>
<ul style="margin-top: 0cm" type="disc">
<li class="MsoNormal" style="text-align: justify"><span style="font-weight: bold"><span><span><a href="http://www.results.saif-
project.com/client_assessment.html" style="color: red"><span style="font-family: 'comic sans ms'"><span><span style="color:
rgb(0,0,153)">Client Group Assessment</span></span></span></a></span></span></span> </li>
</ul>
<ul style="margin-top: 0cm" type="disc">
<li class="MsoNormal" style="text-align: justify"><span style="font-weight: bold"><span><span><a href="http://www.results.saif-
project.com/project_assessment.html" style="color: red"><span style="font-family: 'comic sans ms'"><span><span style="color:
rgb(0,0,153)">Project Management Group Assessment</span></span></span></a></span></span></span> </li>
</ul>
<ul style="margin-top: 0cm" type="disc">
<li class="MsoNormal" style="text-align: justify"><span style="font-weight: bold"><span><span><a href="http://www.results.saif-
project.com/supply_assessment.html" style="color: red"><span style="font-family: 'comic sans ms'"><span><span style="color:
rgb(0,0,153)">Supply Group Assessment</span></span></span></a></span></span></span> </li>
</ul>
<p style="text-align: justify"><font style="background-color: #faffbc" color="#000099" size="3"><strong>However, to assess any
project participant and to benefit from the full functionality of the SAIF-Project tool, it is recommended that you rate your satisfaction
attributes first from the </strong></font><a href="Attribute_Initiator.html"><font style="background-color: #faffbc" color="#000099"
size="3"><strong>attribute initiator </strong></font></a><font style="background-color: #faffbc" color="#000099"
size="3"><strong>page.</strong></font></p>
</div></div></div></div></div>
<!-- Content:End -->
</div><!-- /sf_content -->
<!-- 12 --><div class="sf_extra12"><span></span></div>
<div class="sf_subnavigation2">
<!-- Nav:Begin -->
<!-- Nav:End -->
</div><!-- /sf_subnavigation2 -->
<!-- 7 --><div class="sf_extra7"><span></span></div>
<div class="sf_footer">
<!-- Footer:Begin -->
<div style="display:block" ><span style="color: rgb(101, 101, 101); ">Copyright 2008; SAIF-Project
All rights reserved.</span></div>
<!-- Footer:Begin -->
</div><!-- /sf_footer -->
<!-- 8 --><div class="sf_extra8"><span></span></div>
</div><!-- /sf_wrapper -->
<!-- 9 --><div class="sf_extra9"><span></span></div>
</div><!-- /sf_outer_wrapper -->
<div class="sf_banner">
<div style="display:block" >
</div>
</body>
</html>

```


APPENDIX J: HTML CODES FOR INTEGRATED PROJECT TEAM WEB PAGE

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-
transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
  <title>integrated project team</title>
  <meta name="generator" content="Starfield Technologies; WebSite Tonight 4.6.0"/>
  <meta http-equiv="Content-Type" content="text/html; charset=utf-8" />
  <script type="text/javascript" src="scripts/imageSwap.js"></script>
  <script type="text/javascript">
    MM_preloadImages('images/teamwork_1.jpg');
    MM_preloadImages('images/people.jpg');
  </script>
  <script type="text/javascript" src="scripts/wstxForm.js"></script>
  <script type="text/javascript" src="scripts/siteUtil.js"></script>
  <link rel="stylesheet" type="text/css" id="layout4.css" href="layout4.css" />
  <link rel="stylesheet" type="text/css" id="theme.css" href="theme.css" />
  <link rel="stylesheet" type="text/css" id="color_4.css" href="color_4.css" />
  <link rel="stylesheet" type="text/css" id="custom.css" href="custom.css" />
  <link rel="stylesheet" type="text/css" id="wstuseradvancedstyles.css" href="WstUserAdvancedStyles.css?efea74b3-f452-43dc-932b-
50ae091c6df6" />
</head>
<body>
<div class="sf_outer_wrapper">
  <!-- 1 --><div class="sf_extra1"><span></span></div>
  <div class="sf_wrapper">
    <div class="sf_navigation_top">
      <!-- Nav:Begin -->
      <!-- Nav:End -->
    </div><!-- /sf_navigation_top -->
    <!-- 10 --><div class="sf_extra10"><span></span></div>
    <div class="sf_header_wrapper">
      <!-- 2 --><div class="sf_extra2"><span></span></div>
      <div class="sf_main_header">
        <!-- MainHead:Begin -->
        <div style="display:block" ><span style="font-family: Verdana; "><span style="color:
rgb(17, 91, 141); ">SAIF-PROJECT</span></span><div><span style="font-size: 16px; "><br /></span></div></div>
        <!-- MainHead:End -->
      </div>
      <!-- 3 --><div class="sf_extra3"><span></span></div>
      <div class="sf_sub_header">
        <!-- SubHead:Begin -->
        <div style="display:block" >Your Subtitle text</div>
        <!-- SubHead:End -->
      </div>
    </div><!-- /sf_header_wrapper -->
    <!-- 4 --><div class="sf_extra4"><span></span></div>
    <div class="sf_navigation">
      <!-- Nav:Begin -->
      <div style="display:block" ><ul id="Nav1"><li class="sf_first_nav_item"><a
href="Home_Page.html" target="_self">SAIF-Project</a></li><li><a href="Attribute_Initiator.html" target="_self">Attribute
Initiator</a></li><li><a href="Attribute_Quantifier.html" target="_self">Attribute Quantifier</a></li><li><a
href="Assessment_ScoringSystem.html" target="_self">Assessment ScoringSystem</a></li><li class="sf_last_nav_item"><a
href="integrated_project_team.html" target="_self">integrated project team</a></li></ul></div>
      <!-- Nav:End -->
    </div><!-- /sf_navigation -->
    <!-- 5 --><div class="sf_extra5"><span></span></div>
    <div class="sf_pagetitle">
      <!-- PageTitle:Begin -->
      <div style="display:block" ><span style="font-family: 'trebuchet ms; "><span style="color: rgb(0, 0,
102); ">Impact of Integrated Project Team (IPT) on Satisfaction</span></span></div>
      <!-- PageTitle:End -->
    </div>
    <!-- 6 --><div class="sf_extra6"><span></span></div>
    <div class="sf_subnavigation">
      <!-- Nav:Begin -->
      <!-- Nav:End -->
    </div><!-- /sf_subnavigation -->
    <!-- 11 --><div class="sf_extra11"><span></span></div>
    <div class="sf_content">
      <!-- Content:Begin -->
      <div style="display:block" ><div id="content1"><div style="display:block" ><div
style="display:block" ><form id="integration_form" name="integration_form" method="post" action="integration.php">

```


APPENDIX K: HTML CODES FOR CLIENT GROUP WEB PAGE

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-
transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1" />
<title>Satisfaction Attributes for the Client Group</title>
<link href="saif.css" rel="stylesheet" type="text/css" />
<script type="text/javascript">
function validate(form){
var errors = [];
if ( !checkRadioArray(client_form.client) ) {
errors[errors.length] = "You must indicate your role.";
}
if ( !checkRadioArray(client_form.csa1) ) {
errors[errors.length] = "Please rate attribute 1.";
}
if ( !checkRadioArray(client_form.qsa1) ) {
errors[errors.length] = "Please rate attribute 2.";
}
if ( !checkRadioArray(client_form.qsa2) ) {
errors[errors.length] = "Please rate attribute 3.";
}
if ( !checkRadioArray(client_form.qsa3) ) {
errors[errors.length] = "Please rate attribute 4.";
}
if ( !checkRadioArray(client_form.ssa1) ) {
errors[errors.length] = "Please rate attribute 5.";
}
if ( !checkRadioArray(client_form.tsa1) ) {
errors[errors.length] = "Please rate attribute 6.";
}
if ( !checkRadioArray(client_form.tsa2) ) {
errors[errors.length] = "Please rate attribute 7.";
}
if ( !checkRadioArray(client_form.tsa3) ) {
errors[errors.length] = "Please rate attribute 8.";
}
if ( !checkRadioArray(client_form.tsa4) ) {
errors[errors.length] = "Please rate attribute 9.";
}
if ( !checkRadioArray(client_form.csa2) ) {
errors[errors.length] = "Please rate attribute 10.";
}
if ( !checkRadioArray(client_form.csa3) ) {
errors[errors.length] = "Please rate attribute 11.";
}
if ( !checkRadioArray(client_form.qsa4) ) {
errors[errors.length] = "Please rate attribute 12.";
}
if ( !checkRadioArray(client_form.qsa5) ) {
errors[errors.length] = "Please rate attribute 13.";
}
if ( !checkRadioArray(client_form.qsa6) ) {
errors[errors.length] = "Please rate attribute 14.";
}
if ( !checkRadioArray(client_form.ssa2) ) {
errors[errors.length] = "Please rate attribute 15.";
}
if ( !checkRadioArray(client_form.tsa5) ) {
errors[errors.length] = "Please rate attribute 16.";
}
if ( !checkRadioArray(client_form.tsa6) ) {
errors[errors.length] = "Please rate attribute 17.";
}
if ( !checkRadioArray(client_form.project_team1) ) {
errors[errors.length] = "Please indicate how many project team members that report to you.";
}
if ( !checkRadioArray(client_form.project_team2) ) {
errors[errors.length] = "Please indicate how many project team members you report to.";
}
if (errors.length > 0) {
reportErrors(errors);
return false;
}
}

```

```

return true;
}
function checkRadioArray(radioButtons){
for (var i=0; i < radioButtons.length; i++) {
if (radioButtons[i].checked) {
return true;
}
}
return false;
}
function reportErrors(errors){
var msg = "Oops! there were some problems...\n";
var numError;
for (var i = 0; i<errors.length; i++) {
numError = i + 1;
msg += "\n" + numError + ". " + errors[i];
}
alert(msg);
}
</script>
<style type="text/css">
<!--
.style3 { color: #000066; font-weight: bold; }
.style4 { color: #000066}
.style5 { color: #000099}
.style6 { color: #3366FF}
-->
</style>
</head>
<body>
<form name="client_form" id="client_form" method="post" action="client.php" onsubmit="return validate(this);">
<table width="1111" border="0">
<tbody>
<tr>
<td width="80" rowspan="4" bgcolor="#003366">&nbsp;&nbsp;&nbsp;</td>
<td width="951" colspan="5"></td>
<td width="80" rowspan="4" bgcolor="#003366">&nbsp;&nbsp;&nbsp;</td>
</tr>
<tr>
<td bgcolor="#DBDFE9">
<div align="center"><span class="style6"><a href="http://saif-project.com/Home_Page.html">saif-project</a></span></div>
</td>
<td bgcolor="#DBDFE9">
<div align="center"><span class="style6"><a href="http://saif-project.com/Attribute_Initiator.html">attribute initiator
</a></span></div>
</td>
<td bgcolor="#DBDFE9">
<div align="center"><span class="style6"><a href="http://saif-project.com/Attribute_Quantifier.html">attribute quantifier
</a></span></div>
</td>
<td bgcolor="#DBDFE9">
<div align="center"><span class="style6"><a href="http://saif-project.com/Assessment_ScoringSystem.html">assessment scoring
system </a></span></div>
</td>
<td bgcolor="#DBDFE9">
<div align="center"><span class="style6"><a href="http://saif-project.com/integrated_project_team.html">integrated project team</a>
</span></div>
</td>
</tr>
<tr>
<td colspan="5" bgcolor="#DBDFE9">
<p class="style5">Please indicate the client (s) that best describes you:</p>
<p><span class="style5"> <label> <input type="radio" name="client" value="Project owner" /> Project Owner </label> <br /> <label>
<input type="radio" name="client" value="Client adviser" /> Client Adviser </label> <br /> <label> <input type="radio" name="client"
value="Project consultant" /> Project Consultant</label> </span> <label></label></p>
<p class="style5">Please rate and tick the following sections considering that:</p>
<p class="style4">[<strong>5 is &lsquo;strongly agree&rsquo;; 4 is &lsquo;agree&rsquo;; 3 is &lsquo;somewhat agree&rsquo;; 2 is
&lsquo;disagree&rsquo;; 1 is &lsquo;strongly disagree&rsquo;]</strong></p>
<p class="style4">&nbsp;&nbsp;&nbsp;</p>
<p class="style4"><strong><em><span style="text-decoration: underline;">I &ndash; GENERAL
SATISFACTION</span></em></strong></p>
<table width="750" border="0">
<tbody>
<tr>
<td colspan="7"><span class="style5">As a project owner, client advisor, project consultant, I would be satisfied if:</span></td>
</tr>
<tr>
<td width="26">&nbsp;&nbsp;&nbsp;</td>
<td width="479">&nbsp;&nbsp;&nbsp;</td>
<td align="center" width="49"><span class="style3">strongly agree</span></td>

```

```

<td align="center" width="49"><span class="style3">agree</span></td>
<td align="center" width="49"><span class="style3">somewhat agree</span></td>
<td align="center" width="49"><span class="style3">disagree</span></td>
<td align="center" width="49"><span class="style3">strongly disagree</span></td>
</tr>
<tr>
<td>1</td>
<td><span class="style5">Project is carried out within agreed budget</span></td>
<td align="center"><label> <input name="csa1" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="csa1" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="csa1" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="csa1" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="csa1" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>2</td>
<td><span class="style5">Project design contains sufficient details</span></td>
<td align="center"><label> <input name="qsa1" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="qsa1" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="qsa1" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="qsa1" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="qsa1" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>3</td>
<td><span class="style5">Client services are open & friendly</span></td>
<td align="center"><label> <input name="qsa2" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="qsa2" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="qsa2" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="qsa2" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="qsa2" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>4</td>
<td><span class="style5">Project Management body has a record of recognised kite awards (eg.
ISO, Investor-in-people, Construction Line, Business Improvement, Best Practice awards)</span></td>
<td align="center"><label> <input name="qsa3" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>5</td>
<td><span class="style5">Health & safety procedures are with no incidents</span></td>
<td align="center"><label> <input name="ssa1" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="ssa1" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="ssa1" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="ssa1" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="ssa1" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>6</td>
<td><span class="style5">Project is completed on time</span></td>
<td align="center"><label> <input name="tsa1" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa1" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa1" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="tsa1" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="tsa1" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>7</td>
<td><span class="style5">Project schedules are detailed & easy to understand</span></td>
<td align="center"><label> <input name="tsa2" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa2" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa2" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="tsa2" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="tsa2" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>8</td>
<td><span class="style5">Communication flow in the team is consistent </span></td>
<td align="center"><label> <input name="tsa3" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa3" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa3" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="tsa3" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="tsa3" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>9</td>

```



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</tr>
</tbody>
</table>
<p>&nbsp;</p>
<p class="style4"><strong><em><span style="text-decoration: underline;">II &ndash; SPECIFIC
SATISFACTION</span></em></strong></p>
<table width="750" border="0">
<tbody>
<tr>
<td colspan="6"><span class="style5">As a project owner, client advisor, project consultant, I would be satisfied if:</span></td>
</tr>
<tr>
<td width="479">&nbsp;</td>
<td align="center" width="49"><span class="style4"><strong>strongly agree</strong></span></td>
<td align="center" width="49"><span class="style4"><strong>agree</strong></span></td>
<td align="center" width="49"><span class="style4"><strong>somewhat agree</strong></span></td>
<td align="center" width="49"><span class="style4"><strong>disagree</strong></span></td>
<td align="center" width="49"><span class="style4"><strong>strongly disagree</strong></span></td>
</tr>
<tr>
<td><span class="style5">Ensures that the cost of changes are fairly priced</span></td>
<td align="center"><input name="csa2" type="radio" value="5" /> </td>
<td align="center"><input name="csa2" type="radio" value="4" /> </td>
<td align="center"><input name="csa2" type="radio" value="3" /> </td>
<td align="center"><input name="csa2" type="radio" value="2" /> </td>
<td align="center"><input name="csa2" type="radio" value="1" /> </td>
</tr>
<tr>
<td><span class="style5">Allows flexibility for changes or modifications</span></td>
<td align="center"><input name="csa3" type="radio" value="5" /> </td>
<td align="center"><input name="csa3" type="radio" value="4" /> </td>
<td align="center"><input name="csa3" type="radio" value="3" /> </td>
<td align="center"><input name="csa3" type="radio" value="2" /> </td>
<td align="center"><input name="csa3" type="radio" value="1" /> </td>
</tr>
<tr>
<td><span class="style5">Exhibits open and honest communication</span></td>
<td align="center"><input name="qsa4" type="radio" value="5" /> </td>
<td align="center"><input name="qsa4" type="radio" value="4" /> </td>
<td align="center"><input name="qsa4" type="radio" value="3" /> </td>
<td align="center"><input name="qsa4" type="radio" value="2" /> </td>
<td align="center"><input name="qsa4" type="radio" value="1" /> </td>
</tr>
<tr>
<td><span class="style5">Ensures that there is minimal reworks & defects</span></td>
<td align="center"><input name="qsa5" type="radio" value="5" /> </td>
<td align="center"><input name="qsa5" type="radio" value="4" /> </td>
<td align="center"><input name="qsa5" type="radio" value="3" /> </td>
<td align="center"><input name="qsa5" type="radio" value="2" /> </td>
<td align="center"><input name="qsa5" type="radio" value="1" /> </td>
</tr>
<tr>
<td><span class="style5">Implements and deploys ICT tools and processes in its operations (eg. CRM, ERP, Database Management,
Web-based tools, etc)</span></td>
<td align="center"><input name="qsa6" type="radio" value="5" /> </td>
<td align="center"><input name="qsa6" type="radio" value="4" /> </td>
<td align="center"><input name="qsa6" type="radio" value="3" /> </td>
<td align="center"><input name="qsa6" type="radio" value="2" /> </td>
<td align="center"><input name="qsa6" type="radio" value="1" /> </td>
</tr>
<tr>
<td><span class="style5">Ensures that strategies for managing any project risks are in place</span></td>
<td align="center"><input name="ssa2" type="radio" value="5" /> </td>
<td align="center"><input name="ssa2" type="radio" value="4" /> </td>
<td align="center"><input name="ssa2" type="radio" value="3" /> </td>
<td align="center"><input name="ssa2" type="radio" value="2" /> </td>
<td align="center"><input name="ssa2" type="radio" value="1" /> </td>
</tr>
<tr>
<td><span class="style5">Ensures that the cost of changes are introduced as early as possible</span></td>
<td align="center"><input name="tsa5" type="radio" value="5" /> </td>
<td align="center"><input name="tsa5" type="radio" value="4" /> </td>
<td align="center"><input name="tsa5" type="radio" value="3" /> </td>
<td align="center"><input name="tsa5" type="radio" value="2" /> </td>
<td align="center"><input name="tsa5" type="radio" value="1" /> </td>
</tr>
<tr>
<td><span class="style5">Exhibits the ability to meet my deadlines</span></td>
<td align="center"><input name="tsa6" type="radio" value="5" /> </td>
<td align="center"><input name="tsa6" type="radio" value="4" /> </td>

```

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<td align="center"><label> <input name="tsa6" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="tsa6" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="tsa6" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td><span class="style5"></span></td>
<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
</tr>
</tbody>
</table>
<h3 class="style4">Find out the importance of your Satisfaction Attributes.</h3>
<span class="style5"> How many project team members report to you? <br /> 0 <input name="project_team1" type="radio" value="0" /> 1 <input name="project_team1" type="radio" value="1" /> 2 <input name="project_team1" type="radio" value="2" /> 3 <input name="project_team1" type="radio" value="3" /> 4 <input name="project_team1" type="radio" value="4" /> 5 <input name="project_team1" type="radio" value="5" /> 6-10 <input name="project_team1" type="radio" value="15.5" /> 11-20 <input name="project_team1" type="radio" value="35.5" /> <br /> <br /> How many project team members do you report to? <br /> 0 <input name="project_team2" type="radio" value="0" /> 1 <input name="project_team2" type="radio" value="1" /> 2 <input name="project_team2" type="radio" value="2" /> 3 <input name="project_team2" type="radio" value="3" /> 4 <input name="project_team2" type="radio" value="4" /> 5 <input name="project_team2" type="radio" value="5" /> 6-10 <input name="project_team2" type="radio" value="15.5" /> 11-20 <input name="project_team2" type="radio" value="35.5" /> <br /> <br /> <input type="submit" name="btnSubmit" id="btnSubmit" value="Importance Value" /> </span></td>
</tr>
</tbody>
</table>
</form>
</body>
</html>

```

APPENDIX L: HTML CODES FOR PROJECT MANAGEMENT GROUP WEB PAGE

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1" />
<title>Satisfaction Attributes for the Project Management Group</title>
<link href="saif.css" rel="stylesheet" type="text/css" />
<script type="text/javascript">
function validate(form){
var errors = [];
if ( !checkRadioArray(project_form.project_grp) ) {
errors[errors.length] = "You must indicate your role.";
}
if ( !checkRadioArray(project_form.csa1) ) {
errors[errors.length] = "Please rate attribute 1.";
}
if ( !checkRadioArray(project_form.qsa1) ) {
errors[errors.length] = "Please rate attribute 2.";
}
if ( !checkRadioArray(project_form.qsa2) ) {
errors[errors.length] = "Please rate attribute 3.";
}
if ( !checkRadioArray(project_form.qsa4) ) {
errors[errors.length] = "Please rate attribute 4.";
}
if ( !checkRadioArray(project_form.qsa6) ) {
errors[errors.length] = "Please rate attribute 5.";
}
if ( !checkRadioArray(project_form.ssa1) ) {
errors[errors.length] = "Please rate attribute 6.";
}
if ( !checkRadioArray(project_form.ssa2) ) {
errors[errors.length] = "Please rate attribute 7.";
}
if ( !checkRadioArray(project_form.tsa1) ) {
errors[errors.length] = "Please rate attribute 8.";
}
if ( !checkRadioArray(project_form.tsa2) ) {
errors[errors.length] = "Please rate attribute 9.";
}
if ( !checkRadioArray(project_form.tsa3) ) {
errors[errors.length] = "Please rate attribute 10.";
}
if ( !checkRadioArray(project_form.tsa6) ) {
errors[errors.length] = "Please rate attribute 11.";
}
if ( !checkRadioArray(project_form.tsa7) ) {
errors[errors.length] = "Please rate attribute 12.";
}
if ( !checkRadioArray(project_form.tsa8) ) {
errors[errors.length] = "Please rate attribute 13.";
}
if ( !checkRadioArray(project_form.csa11) ) {
errors[errors.length] = "Please rate attribute 14.";
}
if ( !checkRadioArray(project_form.csa2) ) {
errors[errors.length] = "Please rate attribute 15.";
}
if ( !checkRadioArray(project_form.csa4) ) {
errors[errors.length] = "Please rate attribute 16.";
}
if ( !checkRadioArray(project_form.qsa3) ) {
errors[errors.length] = "Please rate attribute 17.";
}
if ( !checkRadioArray(project_form.ssa3) ) {
errors[errors.length] = "Please rate attribute 18.";
}
if ( !checkRadioArray(project_form.tsa4) ) {
errors[errors.length] = "Please rate attribute 19.";
}
if ( !checkRadioArray(project_form.csa3) ) {
errors[errors.length] = "Please rate attribute 20.";
}
}

```



```

<tr>
<td colspan="5" bgcolor="#DBDFE9">
<p class="style5">Please indicate the project team member (s) that best describes your role (s):</p>
<p class="style5"><input type="radio" name="project_grp" value="project_manager" /> Project Manager <br /> <input type="radio"
name="project_grp" value="main_contractor" /> Main Contractor <br /> <input type="radio" name="project_grp"
value="specialist_contractor" /> Specialist Contractor <br /> <input type="radio" name="project_grp" value="sub_contractor" /> Sub-
Contractor <br /> <input type="radio" name="project_grp" value="designer" /> Designer <br /> <input type="radio"
name="project_grp" value="architect" /> Architect <br /> <input type="radio" name="project_grp" value="engineer" /> Engineer <br />
<br /> Other
<input type="text" name="project_grp2" id="other" /></p>
<p class="style5">&nbsp;</p>
<p class="style5">Please rate and tick the following sections considering that:</p>
[<span class="style4"><strong>5 is &lsquo;strongly agree&rsquo;; 4 is &lsquo;agree&rsquo;; 3 is &lsquo;somewhat agree&rsquo;; 2 is
&lsquo;disagree&rsquo;; 1 is &lsquo;strongly disagree&rsquo;;]</span> </strong> </span>
<p class="style4">&nbsp;</p>
<p class="style4"><strong><em><span style="text-decoration: underline;">I &ndash; GENERAL
SATISFACTION</span></em></strong></p>
&gt;
<table width="794" border="0">
<tbody>
<tr>
<td colspan="7"><span class="style5">As a contractor, designer, architect, engineer, sub-contractor, I would be satisfied
if:</span></td>
</tr>
<tr>
<td width="23">&nbsp;</td>
<td width="426">&nbsp;</td>
<td align="center" width="66"><span class="style4"><strong>strongly agree</strong></span></td>
<td align="center" width="44"><span class="style4"><strong>agree</strong></span></td>
<td align="center" width="78"><span class="style4"><strong>somewhat agree</strong></span></td>
<td align="center" width="60"><span class="style4"><strong>disagree</strong></span></td>
<td align="center" width="67"><span class="style4"><strong>strongly disagree</strong></span></td>
</tr>
<tr>
<td>1</td>
<td><span class="style5">Payment for project is made as contractually agreed </span></td>
<td align="center"><input name="csa1" type="radio" value="5" /> </td>
<td align="center"><input name="csa1" type="radio" value="4" /> </td>
<td align="center"><input name="csa1" type="radio" value="3" /> </td>
<td align="center"><input name="csa1" type="radio" value="2" /> </td>
<td align="center"><input name="csa1" type="radio" value="1" /> </td>
</tr>
<tr>
<td>2</td>
<td><span class="style5">Project design contains sufficient details</span></td>
<td align="center"><input name="qsa1" type="radio" value="5" /> </td>
<td align="center"><input name="qsa1" type="radio" value="4" /> </td>
<td align="center"><input name="qsa1" type="radio" value="3" /> </td>
<td align="center"><input name="qsa1" type="radio" value="2" /> </td>
<td align="center"><input name="qsa1" type="radio" value="1" /> </td>
</tr>
<tr>
<td>3</td>
<td><span class="style5">Project consultants are responsive to questions & clarifications</span></td>
<td align="center"><input name="qsa2" type="radio" value="5" /> </td>
<td align="center"><input name="qsa2" type="radio" value="4" /> </td>
<td align="center"><input name="qsa2" type="radio" value="3" /> </td>
<td align="center"><input name="qsa2" type="radio" value="2" /> </td>
<td align="center"><input name="qsa2" type="radio" value="1" /> </td>
</tr>
<tr>
<td>4</td>
<td><span class="style5">Client interactions are open & friendly</span></td>
<td align="center"><input name="qsa4" type="radio" value="5" /> </td>
<td align="center"><input name="qsa4" type="radio" value="4" /> </td>
<td align="center"><input name="qsa4" type="radio" value="3" /> </td>
<td align="center"><input name="qsa4" type="radio" value="2" /> </td>
<td align="center"><input name="qsa4" type="radio" value="1" /> </td>
</tr>
<tr>
<td>5</td>
<td><span class="style5">There exists tender assessment of quality, not just price</span></td>
<td align="center"><input name="qsa6" type="radio" value="5" /> </td>
<td align="center"><input name="qsa6" type="radio" value="4" /> </td>
<td align="center"><input name="qsa6" type="radio" value="3" /> </td>
<td align="center"><input name="qsa6" type="radio" value="2" /> </td>
<td align="center"><input name="qsa6" type="radio" value="1" /> </td>
</tr>
<tr>
<td>6</td>

```

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<td><span class="style5">Health &amp; Safety procedures are with no incidents </span></td>
<td align="center"><label> <input name="ssa1" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="ssa1" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="ssa1" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="ssa1" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="ssa1" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>7</td>
<td><span class="style5">Strategies for managing and assessing any project risks are in place</span></td>
<td align="center"><label> <input name="ssa2" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="ssa2" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="ssa2" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="ssa2" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="ssa2" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>8</td>
<td><span class="style5">Each phase of the project is completed on time </span></td>
<td align="center"><label> <input name="tsa1" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa1" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa1" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="tsa1" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="tsa1" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>9</td>
<td><span class="style5">Communication flow in the team is consistent </span></td>
<td align="center"><label> <input name="tsa2" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa2" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa2" type="radio" value="3" /> </label></td>
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<td align="center"><label> <input name="tsa2" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>10</td>
<td><span class="style5">Response to complaints is quick &amp; productive</span></td>
<td align="center"><label> <input name="tsa3" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa3" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa3" type="radio" value="3" /> </label></td>
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<td align="center"><label> <input name="tsa3" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>11</td>
<td><span class="style5">Project schedules are detailed &amp; easy to understand</span></td>
<td align="center"><label> <input name="tsa6" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa6" type="radio" value="4" /> </label></td>
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<td align="center"><label> <input name="tsa6" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>12</td>
<td><span class="style5">Sufficient time is allowed for tender</span></td>
<td align="center"><label> <input name="tsa7" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa7" type="radio" value="4" /> </label></td>
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<td align="center"><label> <input name="tsa7" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>13</td>
<td><span class="style5">There exists early involvement of contractor</span></td>
<td align="center"><label> <input name="tsa8" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa8" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa8" type="radio" value="3" /> </label></td>
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<tr>
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<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
</tr>
</table>

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</tr>
<tr>
<td>&nbsp;&nbsp;&nbsp;</td>
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<td align="center"><label> <input name="ssa8" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="ssa8" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="ssa8" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="ssa8" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="ssa8" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>&nbsp;&nbsp;&nbsp;</td>
<td><span class="style4">Other (Time-related Satisfaction Attributes)</span></td>
<td align="center">&nbsp;&nbsp;&nbsp;</td>
<td align="center">&nbsp;&nbsp;&nbsp;</td>
<td align="center">&nbsp;&nbsp;&nbsp;</td>
<td align="center">&nbsp;&nbsp;&nbsp;</td>
<td align="center">&nbsp;&nbsp;&nbsp;</td>
</tr>
<tr>
<td>&nbsp;&nbsp;&nbsp;</td>
<td><span class="style5"> <input type="text" name="Tsa9" id="Tsa9" /> </span></td>
<td align="center"><label> <input name="tsa9" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa9" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa9" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="tsa9" type="radio" value="2" /> </label></td>
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</tr>
<tr>
<td>&nbsp;&nbsp;&nbsp;</td>
<td><span class="style5"> <input type="text" name="Tsa10" id="Tsa10" /> </span></td>
<td align="center"><label> <input name="tsa10" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa10" type="radio" value="4" /> </label></td>
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</tr>
<tr>
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<td align="center"><label> <input name="tsa13" type="radio" value="1" /> </label></td>
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<p>&nbsp;&nbsp;&nbsp;</p>
<p class="style4"><strong><em><span style="text-decoration: underline;">II &ndash; SPECIFIC SATISFACTION</span></em></strong></p>
<table width="794" border="0">
<tbody>
<tr>
<td colspan="7"><span class="style5">As a contractor, designer, architect, engineer, sub-contractor, I believe that my satisfaction would improve if the client group:</span></td>
</tr>
<tr>
<td width="25">&nbsp;&nbsp;&nbsp;</td>
<td width="423">&nbsp;&nbsp;&nbsp;</td>
<td align="center" width="68"><span class="style4"><strong>strongly agree</strong></span></td>
<td align="center" width="47"><span class="style4"><strong>agree</strong></span></td>

```

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<td align="center" width="76"><span class="style4"><strong>somewhat agree</strong></span></td>
<td align="center" width="60"><span class="style4"><strong>disagree</strong></span></td>
<td align="center" width="65"><span class="style4"><strong>strongly disagree</strong></span></td>
</tr>
<tr>
<td>14</td>
<td><span class="style5">Ensures and maintains the ability to make payments</span></td>
<td align="center"><label> <input name="csa11" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="csa11" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="csa11" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="csa11" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="csa11" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>15</td>
<td><span class="style5">Ensures that changes are fairly introduced</span></td>
<td align="center"><label> <input name="csa2" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="csa2" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="csa2" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="csa2" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="csa2" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>16</td>
<td><span class="style5">Allows flexibility for changes or modifications</span></td>
<td align="center"><label> <input name="csa4" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="csa4" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="csa4" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="csa4" type="radio" value="2" /> </label></td>
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</tr>
<tr>
<td>17</td>
<td><span class="style5">Exhibits open and honest communication</span></td>
<td align="center"><label> <input name="qsa3" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>18</td>
<td><span class="style5">Trusts my capability to deliver</span></td>
<td align="center"><label> <input name="ssa3" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="ssa3" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="ssa3" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="ssa3" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="ssa3" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>19</td>
<td><span class="style5">Ensures that changes are introduced as early as possible</span></td>
<td align="center"><label> <input name="tsa4" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa4" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa4" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="tsa4" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="tsa4" type="radio" value="1" /> </label></td>
</tr>
<td colspan="7">
<p class="style5">&nbsp;</p>
<p class="style5">As a contractor, designer, architect, engineer, sub-contractor, I believe that my satisfaction would improve if the supply group:</p>
</td>
</tr>
<tr>
<td align="center" width="25">&nbsp;</td>
<td align="center" width="423">&nbsp;</td>
<td align="center" width="68"><span class="style4"><strong>strongly agree</strong></span></td>
<td align="center" width="47"><span class="style4"><strong>agree</strong></span></td>
<td align="center" width="76"><span class="style4"><strong>somewhat agree</strong></span></td>
<td align="center" width="60"><span class="style4"><strong>disagree</strong></span></td>
<td align="center" width="65"><span class="style4"><strong>strongly disagree</strong></span></td>
</tr>
<tr>
<td>20</td>
<td><span class="style5">Ensures that the cost estimates are in accordance with my requirements </span></td>
<td align="center"><label> <input name="csa3" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="csa3" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="csa3" type="radio" value="3" /> </label></td>

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<td align="center"><label> <input name="csa3" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="csa3" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>21</td>
<td><span class="style5">Allows flexibility for changes or modifications</span></td>
<td align="center"><label> <input name="csa41" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="csa41" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="csa41" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="csa41" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="csa41" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>22</td>
<td><span class="style5">Exhibits open and honest communication</span></td>
<td align="center"><label> <input name="qsa31" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="qsa31" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="qsa31" type="radio" value="3" /> </label></td>
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<td align="center"><label> <input name="qsa31" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>23</td>
<td><span class="style5">Ensures that there is minimal defects in supply</span></td>
<td align="center"><label> <input name="qsa5" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="qsa5" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="qsa5" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="qsa5" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="qsa5" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>24</td>
<td><span class="style5">Exhibits the ability to meet my deadlines</span></td>
<td align="center"><label> <input name="tsa5" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa5" type="radio" value="4" /> </label></td>
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<td align="center"><label> <input name="tsa5" type="radio" value="1" /> </label></td>
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<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
</tr>
</tbody>
</table>
<h3 class="style4">Find out the importance of your Satisfaction Attributes.</h3>
<span class="style5"> How many project team members report to you? <br /> 0
<input name="project_team1" type="radio" value="0" /> 1
<input name="project_team1" type="radio" value="1" /> 2
<input name="project_team1" type="radio" value="2" /> 3
<input name="project_team1" type="radio" value="3" /> 4
<input name="project_team1" type="radio" value="4" /> 5
<input name="project_team1" type="radio" value="5" /> 6-10
<input name="project_team1" type="radio" value="15.5" /> 11-20
<input name="project_team1" type="radio" value="35.5" /> <br /> <br /> How many project team members do you report to? <br /> 0
<input name="project_team2" type="radio" value="0" /> 1
<input name="project_team2" type="radio" value="1" /> 2
<input name="project_team2" type="radio" value="2" /> 3
<input name="project_team2" type="radio" value="3" /> 4
<input name="project_team2" type="radio" value="4" /> 5
<input name="project_team2" type="radio" value="5" /> 6-10
<input name="project_team2" type="radio" value="15.5" /> 11-20
<input name="project_team2" type="radio" value="35.5" /> <br /> </span>
<h3 class="style4"><span class="style5"><br /> <input type="submit" name="btnSubmit" id="btnSubmit" value="Importance Value"
/> </span></h3>
</td>
</tr>
</tbody>
</table>
</form>
</body>
</html>

```

APPENDIX M : HTML CODES FOR SUPPLY GROUP WEBPAGE

```

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-
transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1" />
<title>Satisfaction Attributes for the Supply Group</title>
<link href="saif.css" rel="stylesheet" type="text/css" />
<script type="text/javascript">
function validate(form){
var errors = [];
if ( !checkRadioArray(supply_form.supply_group) ) {
errors[errors.length] = "You must indicate your role.";
}
if ( !checkRadioArray(supply_form.qsa1) ) {
errors[errors.length] = "Please rate attribute 1.";
}
if ( !checkRadioArray(supply_form.qsa2) ) {
errors[errors.length] = "Please rate attribute 2.";
}
if ( !checkRadioArray(supply_form.ssa1) ) {
errors[errors.length] = "Please rate attribute 3.";
}
if ( !checkRadioArray(supply_form.tsa1) ) {
errors[errors.length] = "Please rate attribute 4.";
}
if ( !checkRadioArray(supply_form.tsa2) ) {
errors[errors.length] = "Please rate attribute 5.";
}
if ( !checkRadioArray(supply_form.csa1) ) {
errors[errors.length] = "Please rate attribute 6.";
}
if ( !checkRadioArray(supply_form.csa2) ) {
errors[errors.length] = "Please rate attribute 7.";
}
if ( !checkRadioArray(supply_form.csa3) ) {
errors[errors.length] = "Please rate attribute 8.";
}
if ( !checkRadioArray(supply_form.qsa3) ) {
errors[errors.length] = "Please rate attribute 9.";
}
if ( !checkRadioArray(supply_form.tsa3) ) {
errors[errors.length] = "Please rate attribute 10.";
}
if ( !checkRadioArray(supply_form.project_team1) ) {
errors[errors.length] = "Please indicate how many project team members that report to you.";
}
if ( !checkRadioArray(supply_form.project_team2) ) {
errors[errors.length] = "Please indicate how many project team members you report to.";
}
if (errors.length > 0) {
reportErrors(errors);
return false;
}
return true;
}
function checkRadioArray(radioButtons){
for (var i=0; i < radioButtons.length; i++) {
if (radioButtons[i].checked) {
return true;
}
}
return false;
}
function reportErrors(errors){
var msg = "Oops! there were some problems...\n";
var numError;
for (var i = 0; i<errors.length; i++) {
numError = i + 1;
msg += "\n" + numError + ". " + errors[i];
}
alert(msg);
}
</script>

```



```

<td align="center"><label> <input name="tsa6" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa6" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="tsa6" type="radio" value="2" /> </label></td>
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<td>&nbsp;</td>
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<td align="center"><label> <input name="tsa7" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa7" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa7" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="tsa7" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="tsa7" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>&nbsp;</td>
<td><span class="style5"> <input type="text" name="Tsa8" id="Tsa8" /> </span></td>
<td align="center"><label> <input name="tsa8" type="radio" value="5" /> </label></td>
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<td align="center"><label> <input name="tsa8" type="radio" value="3" /> </label></td>
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<td align="center"><label> <input name="tsa8" type="radio" value="1" /> </label></td>
</tr></tbody>
</table>
<p>&nbsp;</p>
<p class="style4"><strong><em><span style="text-decoration: underline;">II &ndash; SPECIFIC SATISFACTION</span></em></strong></p>
<table width="792" border="0">
<tbody>
<tr>
<td colspan="7"><span class="style5">As a supplier, distributor, manufacturer, I would be satisfied if the project management team:</span></td>
</tr>
<tr>
<td width="26">&nbsp;</td>
<td width="423">&nbsp;</td>
<td align="center" width="59"><span class="style4"><strong>strongly agree</strong></span></td>
<td align="center" width="47"><span class="style4"><strong>agree</strong></span></td>
<td align="center" width="75"><span class="style4"><strong>somewhat agree</strong></span></td>
<td align="center" width="60"><span class="style4"><strong>disagree</strong></span></td>
<td align="center" width="72"><span class="style4"><strong>strongly disagree</strong></span></td>
</tr>
<tr>
<td>6</td>
<td><span class="style5">Ensures that payment for supplies are made as contractually agreed</span></td>
<td align="center"><label> <input name="csa1" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="csa1" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="csa1" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="csa1" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="csa1" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>7</td>
<td><span class="style5">Ensures that changes are fairly introduced</span></td>
<td align="center"><label> <input name="csa2" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="csa2" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="csa2" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="csa2" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="csa2" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>8</td>
<td><span class="style5">Allows flexibility for changes or modifications</span></td>
<td align="center"><label> <input name="csa3" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="csa3" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="csa3" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="csa3" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="csa3" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>9</td>
<td><span class="style5">Exhibits open and honest communication</span></td>
<td align="center"><label> <input name="qsa3" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="qsa3" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>10</td>

```

```

<td><span class="style5">Ensures that changes are introduced as early as possible</span></td>
<td align="center"><label> <input name="tsa3" type="radio" value="5" /> </label></td>
<td align="center"><label> <input name="tsa3" type="radio" value="4" /> </label></td>
<td align="center"><label> <input name="tsa3" type="radio" value="3" /> </label></td>
<td align="center"><label> <input name="tsa3" type="radio" value="2" /> </label></td>
<td align="center"><label> <input name="tsa3" type="radio" value="1" /> </label></td>
</tr>
<tr>
<td>&nbsp;</td>
<td><span class="style5"></span></td>
<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
<td align="center">&nbsp;</td>
</tr></tbody>
</table>
<h3 class="style4">Find out the importance of your Satisfaction Attributes.</h3>
<span class="style5"> How many project team members report to you? <br /> 0
<input name="project_team1" type="radio" value="0" /> 1
<input name="project_team1" type="radio" value="1" /> 2
<input name="project_team1" type="radio" value="2" /> 3
<input name="project_team1" type="radio" value="3" /> 4
<input name="project_team1" type="radio" value="4" /> 5
<input name="project_team1" type="radio" value="5" /> 6-10
<input name="project_team1" type="radio" value="15.5" /> 11-20
<input name="project_team1" type="radio" value="35.5" /> <br /> <br /> How many project team members do you report to? <br /> 0
<input name="project_team2" type="radio" value="0" /> 1
<input name="project_team2" type="radio" value="1" /> 2
<input name="project_team2" type="radio" value="2" /> 3
<input name="project_team2" type="radio" value="3" /> 4
<input name="project_team2" type="radio" value="4" /> 5
<input name="project_team2" type="radio" value="5" /> 6-10
<input name="project_team2" type="radio" value="15.5" /> 11-20
<input name="project_team2" type="radio" value="35.5" /> </span>
<h3 class="style4"><span class="style5"><br /> <input type="submit" name="btnSubmit" id="btnSubmit" value="Importance Value"
/> </span></h3>
</td></tr>
</tbody></table>
</form>
</body>
</html>

```