CHAPTER 1

1.1 Introduction

As we enter the twenty-first century, few would dispute that the construction industry has a poor image. (ILO 2001) The construction industry is experiencing increasing competition, rising legal cost related to cost overruns and schedule delays, and decreasing profit margins. These symptoms are forcing many construction companies to realize that fundamental changes in the way they conduct business must be made if they are to remain competitive. Consequently, many construction companies are beginning to adopt the methods and ideas of Total Quality Management (TQM) used by many manufacturing companies to improve the state of their industry. (DAVID B. 1991)

Quality management is now a major management function within construction companies. Unless a construction company can guarantee its client a quality product it can now no longer compete effectively in the modern construction market. Crucial to the delivery of such quality products is the quality of processes that produce the product. (Frank H. & Ronald M. 2001)

The clients are now a moving target – their expectations and requirements are constantly changing. To keep up with their ever hanging goals, the contractors need to have in place a system of identifying, measuring and continuously improving their tangible and intangible products and services. (L.Suganth &Anand A. 2005)

The construction industry, particular the building industry in Sudan is considered as the largest industrial sector that has a direct effect on the national economy.(Awad Saad, 2002)

Sudanese companies are still focusing on the quantity of outputs and competitive for that considering just the profitability. (Ahmed Bakhit, 2006). The uncared of motivation, traditional methods and the lack of training program had been behind the deterioration of the productivity in Sudan. (Bakhit Elballa, 2010)

1.2 Problem Statement

Construction firms are faced with the problem of securing "sufficient" work to remain viable in an industry containing many companies capable or at least willing to undertake almost any type of work for clients. (Frank H. & Ronald M. 2001). For that they need to improve their performance to **increase productivity** and prevent work from defects and eventually achieve customer satisfaction which will return positively on the company reputation that will able the company to stay in the competitive construction market.

The construction companies need to comprehend the total quality management and define the critical factors to succeed in implementing TQM.

1.3 Aims of Study

This study aims to achieve the following:

1. Review the situation of performing the total quality management at the construction phase in the Sudanese construction companies, in the Khartoum state.
2. Use the Critical Success Factors to review the situation of the performance.
3. Study and analyze the result of total quality management at the construction phase.

1.4 OBJECTIVES OF STUDY

Review the adoption and implementation of TQM in the construction industry through efficiently utilize the critical success factors of TQM.

1.5 Research Hypotheses

The Sudanese construction companies failed in implementing TQM through the critical success factors.

1.6 Limitation of the Study

The study limited to the construction projects undertaken in Khartoum – Sudan. The researcher will take a random sample of contractors for this study.

1.7 Scope of the Study

This research proposes to review the adoption and implementation of TQM in the Sudanese construction companies through utilizing the CSFs. Literature and theoretical reviews have been taken from books, articles and papers to describe the main concept of implementing TQM in construction companies.

A questionnaire will be distributed to a number of construction contractors about their performance in some projects they had done in Khartoum. For the local construction contractors, this study has the potential of demonstrating tangible benefits of using TQM in their organizations. This will be done by showing that quality improvement efforts can be quantified, measured, and analyzed - thereby enabling the construction company to continuously improve its products and services to meet and even exceed customer requirements.

1.8 Methodology of Data Collection

The methodology of this study started from identifying the problem statement, literature review, collecting data, analysis of results, discussion of results, conclusions and recommendations.

The main method of collecting data for this research will be a questionnaire. The data for this research was collected through the use of one questionnaire targeting contractors in the Khartoum to review the adoption and implementation of TQM in the Sudanese construction companies; and defining to which degree the contractors consider the critical success factors.

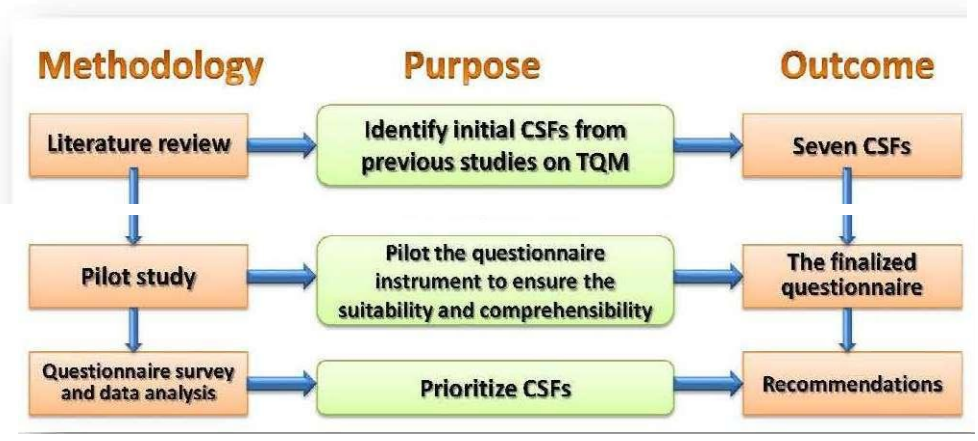

Fig. 1. Research framework of this study

CHAPTER 2
Literature Review

2. 1 Background

It is widely recognized that construction as a discipline is a combination of art and science. While understanding the technical aspects of construction is extremely important, it is also essential that construction professionals have knowledge of the business and management aspects of the profession. Close observation and participation in actual construction projects is very valuable in obtaining an understanding of the construction process as well. (S.W. Nunnally 2007)

The principles of TQM create the foundation for developing an organization's system for planning, controlling, and improving quality (Deming 1993).

A project is an endeavor that is undertaken to produce the results that are expected from the requesting party. A project consists of three components: scope, budget, and schedule. (Garold D.2000). The project management process begins with identification of the user requirement, project constraints, resource needs, and establishment of realistic objectives to meet the strategic goals. Many times this will be an iterative process as new information becomes available through efforts by various professionals on the project and input from third parties, communities, users, and agencies having jurisdiction. (FTA *et al.* 2006)

A general contractor assumes overall responsibility for construction of a building. The contractor engages subcontractors who take responsibility for the work of the various trades required for construction. Sometimes, in addition to a general contractor, the owner contracts separately with specialty contractors, such as electrical and mechanical contractors, who perform a substantial amount of the work required for a building. (Frederick S. & Jonathan T. 2001)

For all that implementing TQM in construction processes will help contractor to accomplish the construction project smoothly.

In the next pages it will be a comprehensive review of TQM fundamentals to understand how contractors can control and improve their construction processes through the critical success factors, but first it is suitable to define the construction industry and take a quick glance on its characteristics.

2. 2 Characteristics of the Construction Industry

2.2.1 Definition

- Construction is constructing, altering, erecting, repairing, and demolishing building, civil engineering, works, and other similar structure. It also contains assembly and installation on site of prefabricated component and building engineering services. Building a house, repairing a road, demolishing, dams, erecting bridge, etc. are an example of constructions.

- Industry is a group of related economic classified in accordance with the output or services supplied. Thus, **construction industry** is a sector of economic activities which erect, alter, repair, and demolish a building, civil engineering works, and other similar structures. (http://kumahauing.wordpress.com).

Construction industry has unique characteristics such as:

1. Involvement of many parties in delivering a product.
2. Traditionally Design, construction, and maintenance are undertaken by different parties.
3. The products are long lasting and require routine maintenance.
4. Difficult to deliver a product, involves huge amount of information processing, disputes, ambiguities, therefore requires thorough management.
5. Construction products are always initiated by clients, opposite to most of the industries. (http://wiki.answers.com)

Change in construction industry necessarily occurs at a measured pace because of the risks and responsibilities associated with construction.

2.2.2Construction industry in Sudan

The construction industry, particularly the building industry in Sudan is considered as the largest industrial sector that has direct effect on the national economy. (Awad Saad, 2002).Growing interest in both social

and commercial building projects over the past ten years has certainty improved the fortunes of the Sudan construction industry. (Bakhit, 2010). It is hard to downplay the pivotal role that the industry has in promoting economic development. Many analysts conclude that it is the lack of adequate infrastructure that has prevented Sudan from catching up with the first world standards. Contractors working in the construction sector are come from different social and educational backgrounds and experiences, some mechanical and electrical engineers even some accountants and lawyers are involved in this field. With the technical development and demanding market requirements, things are become more complicate for the contractors. (Bakhit, 2010). Sudanese companies are still focusing on the quantity of outputs and competitive for that considering just the profitability. (Ahmed Bakhit, 2006). The absence of motivation and training programs is leading to declining productivity of site workers. (Bakhit, 2010).

2.3 Concept of Quality

- **Quality**

An entity has characteristics. Some of these characteristics are derived from stated or implied needs. The set of these special need-oriented characteristics make up the quality of entity. In short, a quality is characteristic. For example, the need for dependability is met by designing a dependable product. Dependability then becomes a quality (characteristic) of the product (entity). An entity is a product, process, person, activity, institution or organization. (Frank H. & Ronald M.2001).

ISO 8402 defines quality as the degree of excellence in a competitive sense, such as reliability, serviceability, maintainability or even individual characteristics.

- **Quality Systems (QS)**

Quality system is a network of processes made up of elements. Elements include responsibilities, authorities, relationships, functions, plans, policies, procedures, practices, processes and resources. The purpose of a quality system is to satisfy quality management requirements and to assure that customers receive quality products and services. (Garold D.2000).

- **Quality Assurance (QA)**

Quality assurance is the planned and systematic activities implemented within quality system and demonstrated, as needed, to provide adequate confidence that an entity will fulfill requirements for quality. (Garold D.2000).

- **Quality Control (QC)**

Both ANSI and ISO define quality control as the operational technique and activity; for example, providing a means to control and measure the characteristics of a material, structure, component, or system that are used to fulfill requirements for quality. (Frank H. & Ronald M.2001).

- **Quality Management (QM)**

Quality management refers to all activities of overall management functions, especially top management leadership, that determine quality policy objectives and responsibilities for all members of the organization. (Frank H. & Ronald M.2001).

- **Total Quality Management (TQM)**

Total quality management is the management approach that tries to achieve and sustain long-term organizational success by encouraging employee feedback and participation, satisfying customer needs and expectations, respecting social values and beliefs, and obeying governmental statutes and regulations. (L.Suganth &Anand A.2005)

2.4 Previous Studies:

2.4.1 TQM fundamentals Concepts & Founders:

2.4.1.1 Edwards Deming

Edwards Deming is known as the father of the Japanese post-war industrial revival and was regarded by many as the leading quality guru in the United States. He passed on in 1993. Dr. Deming helped Japan construct the global economic jargon that has been emulated and copied around the world. In Japan today, there is no greater honour than to be awarded the The Deming Prize.

Deming's work in Japan following World War II that made him famous, at least in Japan. In 1949 the Union of Japanese Scientists and Engineers (JUSE) asked Deming to come to Japan to help increase productivity. He went in 1950 and gave eight lectures to 230 of Japan's leading industrialists. (Eighty percent of Japan's capital was controlled by the men in that room, Deming claims.) Ironically, it was the same course

he had taught Americans during the war. They asked Deming how long it would take to shift the perception of the world from the existing paradigm that Japan produced cheap, shoddy imitations to one of producing innovative quality products.

He trained as a statistician; his expertise was used during World War II to assist the United States in its effort to improve the quality of war materials. Dr. Deming told the group that if they would follow his directions, they could achieve the desired outcome in five years. Few of the leaders believed him. But they were ashamed to say so and would be embarrassed if they failed to follow his suggestions.

As Dr. Deming told it, "They surprised me and did it in four years." He was invited back to Japan time after time where he became a revered counselor. For his efforts he was awarded the Second Order of the Sacred Treasure by the former Emperor Hirohito. In 1950 the annual Deming Prize(s) were established by the Union of Japanese Scientists and Engineers (JUSE).

Deming Chain Reaction

1. Improve quality
2. Costs decrease
3. Productivity improves
4. Increase market share with better quality and lower prices
5. Stay in business
6. Provide jobs and more jobs

Key Idea

The Deming philosophy focuses on continual improvements in product and service quality by reducing uncertainty and variability in design, manufacturing, and service processes, driven by the leadership of top management.

- **Deming's Quality Circle**

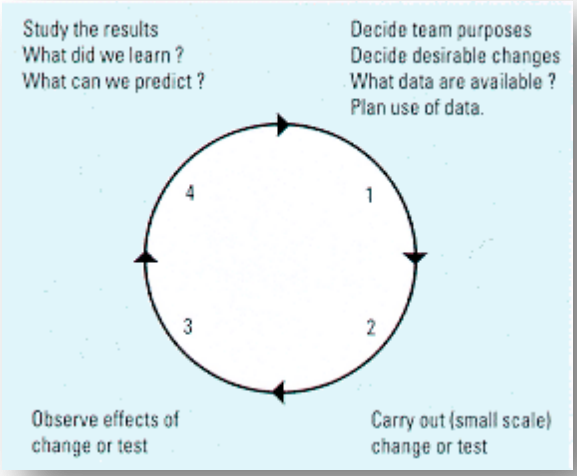

Fig. 2. Deming's Quality Circle
Source http://webarchive.nationalarchives.gov.uk/+/http://www.dti.gov.uk/mbp/bpgt/m9ja00001/m9ja000016.html

- **Plan**
  - Define the process: its start, end, and what it does.
  - Describe the process: list the key tasks performed and sequence of steps, people involved, equipment used, environmental conditions, work methods, and materials used.
  - Describe the players: external and internal customers and suppliers, and process operators.
  - Define customer expectations: what the customer wants, when, and where, for both external and internal customers.
  - Determine what historical data are available on process performance, or what data need to be collected to better understand the process.
  - Describe the perceived problems associated with the process; for instance, failure to meet customer expectations, excessive variation, long cycle times, and so on.
  - Identify the primary causes of the problems and their impacts on process performance.
  - Develop potential changes or solutions to the process, and evaluate how these changes or solutions will address the primary causes.
  - Select the most promising solution(s).

- **Do**
  - Conduct a pilot study or experiment to test the impact of the potential solution(s).
  - Identify measures to understand how any changes or solutions are successful in addressing the perceived problems.

- **Study**
  - Examine the results of the pilot study or experiment.
  - Determine whether process performance has improved.
  - Identify further experimentation that may be necessary.

- **Act**
  - Select the best change or solution.
  - Develop an implementation plan: what needs to be done, who should be involved, and when the plan should be accomplished.
  - Standardize the solution, for example, by writing new standard operating procedures.
  - Establish a process to monitor and control process performance.
- **Deming's 14 Points**
  1. Create and publish a company mission statement and commit to it.
  2. Learn the new philosophy of TQM.
  3. Use inspection to improve design & processes.
  4. End business practices driven by price alone.
  5. Constantly improve system of production and service.
  6. Institute training.
  7. Teach and institute quality leadership (guidance).
  8. Drive out fear and create trust.
  9. Optimize team and individual efforts.
  10. Eliminate exhortations for work force—Work to improve the system.
  11. Eliminate numerical quotas and Management by objective Focus on improvement.
  12. Remove barriers that rob people of pride of workmanship.
  13. Encourage education and self-improvement.
  14. Take action to accomplish the transformation

2.4.1.2 Joseph M. Juran

- **Juran's Quality Trilogy**
  1. Quality planning
  2. Quality control
  3. Quality improvement
- **Key Idea**

Juran proposed a simple definition of quality: "fitness for use." This definition of quality suggests that it should be viewed from both external and internal perspectives; that is, quality is related to "(1) product performance that results in customer satisfaction; (2) freedom from product deficiencies, which avoids customer dissatisfaction."

Joseph Juran follows W Edward Deming, at least in time, as one of the major Quality Gurus. Indeed, he followed Deming to Japan where his name is just as illustrious as that of Deming. Juran was awarded the Order of the Sacred Treasure by the Emperor for his work in the development of quality in Japan.

The difference between Juran and Deming is really no more than emphasis. While the core of Deming's work is his use of statistical tools to identify quality problems and their causes, Juran centers upon the role of employees in quality management – indeed their involvement and empowerment. Juran would not deny the utility of statistical techniques any more than Deming would deny the importance of employee empowerment.

- **Juran's 'Quality Planning Road Map' consists of the following steps:**
  1. Identify who are the customers.
  2. Determine the needs of those customers.
  3. Translate those needs into our language.
  4. Develop a product that can respond to those needs.
  5. Optimize the product features so as to meet our needs as well as customer needs.
  6. Develop a process which is able to produce the product.
  7. Optimize the process.
  8. Prove that the process can produce the product under operating conditions.
  9. Transfer the process to Operations.

2.4.1.3 Phillip B. Crosby

"Quality is free. It's not a gift, but it is free. What costs money are the unquality things -- all the actions that involve not doing jobs right the first time." Crosby…

Philip Crosby who is recognized as one of the top gurus of quality. Crosby is best known for concepts like 'Do It Right the First Time,' and 'Zero Defects.' Crosby is also recognized as a lecturer, an author, and a businessman whose had over forty years of hands on management experience. In his lecturers he describes how it is the manager role to make sure that the company, employees, and themselves are successful. He relates his lectures back to real life situation that has happened to him. As an author he has written and edited thirteen books, all that have been best sellers. His first book is the one he is probably most famous for as an author. The name of that book was Quality is Free. In 1996, he came out with a book that was named Quality is Still Free.

- **Absolutes of Quality Management:**
  1. Quality means conformance to requirements
  2. Problems are functional in nature
  3. Do the job right the first time
  4. Cost of quality is the only useful measurement
  5. Zero defects is the only performance standard

2.4.1.4 A.V. Feigenbaum

Feigenbaum's ideas are contained in his now famous book Total Quality Control, first published in 1951 under the title Quality Control: Principles, Practice, and Administration, and based on his earlier articles and program installations in the field. The book has been translated into more than a score of languages, including Japanese, Chinese, French, and Spanish. And he is recognized as an innovator in the area of quality cost management. His was the first text to characterize quality costs as the costs of prevention, appraisal, and internal and external failure.

- **A.V. Feigenbaum's Three Steps to Quality**
  1. Quality Leadership, with a strong focus on planning
  2. Modern Quality Technology, involving the entire work force
  3. Organizational Commitment, supported by continuous training and motivation

2.4.1.5 Kaoru Ishikawa

He has been awarded the Deming Prize and the Nihon Keizen Press Prize, the Industrial Standardization Prize for his writings on Quality Control, and the Grant Award in 1971 from the American Society for Quality Control for his education programmer on Quality Control. The early origins of the now famous Quality Circles can be traced to the United States in the 1950s, Professor Ishikawa is best known as a pioneer of the Quality Circle movement in Japan in the early 1960s, which has now been re-exported to the West. In a speech to mark the 1000th quality circle convention in Japan in 1981, he described how his work took him in this direction. Instrumental in developing Japanese quality strategy Influenced participative approaches involving all workers Advocated the use of simple visual tools and statistical techniques At the simplest technical level, his work has emphasized good data collection and presentation, the use of Cause-and-Effect (or Ishikawa or Fishbone) Diagrams, Ishikawa sees the cause-and-effect diagram, like other tools, as a device to assist groups or quality circles in quality improvement. As such, he emphasizes open group communication as critical to the construction of the diagrams. Ishikawa diagrams are useful as systematic tools for finding, sorting out and documenting the causes of variation of quality in production and organizing mutual relationships between them.

- **Cause and Effect Diagrams**

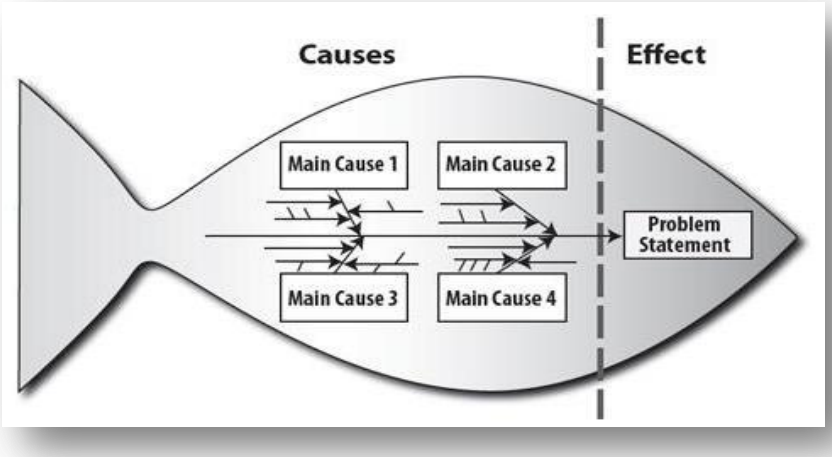

Fig. 3. Cause and Effect Diagram-
Source-http://www.hrsa.gov/quality/toolbox/methodology/developingandimplementingaqiplan/part2.html

Thus Ishikawa sees the Company-wide Quality Control movement as implying that quality does not only mean the quality of product, but also

of after sales service, quality of management, the company itself and the human being. This has the effect that:

1. Product quality is improved and becomes uniform. Defects are reduced.
2. Reliability of goods is improved.
3. Cost is reduced.
4. Quantity of production is increased, and it becomes possible to make rational production schedules.
5. Wasteful work and rework are reduced.
6. Technique is established and improved.
7. Expenses for inspection and testing are reduced.
8. Contracts between vendor and vendee are rationalised.
9. The sales market is enlarged.
10. Better relationships are established between departments.
11. False data and reports are reduced.
12. Discussions are carried out more freely and democratically.
13. Meetings are operated more smoothly.
14. Repairs and installation of equipment and facilities are done more rationally.
15. Human relations are improved.

- **Quality Circles**

The nature and role of quality circles varies between companies. In Japan a quality circle is a typically voluntary group of some 5-10 workers from the same workshop, who meet regularly and are led by a foreman, assistant foreman, work leader or one of the workers. The aims of the quality circle activities are:

1. To contribute to the improvement and development of the enterprise.
2. To respect human relations and build a happy workshop offering job satisfaction.
3. To deploy human capabilities fully and draw out infinite potential.

The members of the circle have mastered statistical quality control and related methods and all utilize them to achieve significant results in quality improvement, cost reduction, productivity and safety. The seven tools of quality control are taught to all employees:

1. Pareto charts
2. Cause and effects diagrams

3. Stratification
4. Check sheets
5. Histograms
6. Scatter diagrams
7. Shewhart's control charts and graphs.

2.4.2 Critical Success Factors:

With concern of critical success factors, there is no universal critical success factor research method. Scholars and researchers used various critical success factor methods such as a priori list of critical success factors based on literature sources, interviews, analysis of related organizational activities, mailed questionnaires, a combination of interviews and with subsequent questionnaires (Auruškeviciene, Šalciuviene, & Trifanovas, 2006).

1. **Meanwhile, Black and Porter** (1996) place emphasis on Baldrige Award criteria, revealing ten critical factors for TQM, these factors are: supplier partnership, People and customer management, customer satisfaction orientation, external interface management, communication of improvement information, strategic quality management, operational quality planning, quality improvement measurement systems, teamwork structure for improvement, and corporate quality culture.

2. **Saraph et al**.(1989) developed a reliable instrument to measure quality management practice this instrument based on 8 critical factors, these factors are: Role of divisional top management and quality policy, Role of quality department, Training, Product/service design, Supplier quality management, Process management operating Quality, data and reporting, Employee relations.

3. **Ahire et al**, (1996) expanded the practices even further and identified 12 factors that are critical for the implementation of TQM derived mainly from the literature, these factors are: Top management commitment, Customer focus, Supplier quality management, Design quality management, Benchmarking, use of statistical process control, internal quality information, Employee empowerment, Employee involvement, Employee training, Product quality, and Supplier performance.

4. **Fotopoulos et al**.(2009), surveyed 370 Greek companies, they find out that, leadership, process management, service design, human resource management, customer focus, Education and Training, and supplier quality management are critical success factors in TQM implementation.

Although there are many studies in TQM literature, many authors recommend that further concern should be made for the evaluation of critical success factor of TQM, the results of their adoption and the type and extent of their relationships.

Author	Purpose	Source of factors	Results/final instrument	Study on business size
Saraph *et al.* (1989)	To develop an instrument for studying critical factors of quality management	Mainly from concepts and prescriptions of quality gurus	Eight factors with 66 elements	Size arbitrarily set where small company defined to be 1000–5000 employees. Less than 1000 not considered
Black & Porter (1996)	To identify critical factors of TQM	Malcolm Baldridge Award model	10 factors with 32 elements	Not indicated
Ahire *et al.* (1996)	To develop implementation constructs of TQM	Mainly from the literature, including best practices in case studies (large businesses)	12 factors with 50 elements	Considered only plants with more than 100 employees
Tamimi & Gershon (1995)	To develop a tool for assessing TQM practices	Used Deming's 14 points	14 factors with 50 elements	Not indicated
Quazi & Padibjo (1998)	To assess training and consultancy support needs	Malcolm Baldridge/ Singapore Award model	Seven factors with 39 elements	For SMEs (mainly < 100 employees)

Fig. 4. Comparison of some previous CSFs studies

5. **Several specific studies**, such as (Al-Khalifa & Aspinwall, 2000; Alomaim, Tunca, & Zairi, 2003; Baidoun, 2004; Chapman & Al-Khawaldeh, 2002), carried out in The Arab countries, indicate that there are seven common critical success factors of TQM (top management commitment; education and training; supplier quality management; employee involvement; vision and plan statement; Recognition and Reward ;customer focus) and that these factors have been applied to studies in similar environments of developing countries in general, and in the Arab countries in particular.

The researcher toke the most likely study to his study conditions which is part of Fotopoulos et al. (2009) study and the Arab common CSFs. These factors were adopted for this study to evaluate TQM implementation in Sudanese Construction Companies, But the researcher make some modification on these factors which is combine the(education and training, employee involvement and Recognition & Reward) under the Human Resource Management, and add from the literature reviews (Process Control & Improvement and Communications Management)

2.5 Critical Success Factors In TQM

TQM has gained widespread global acceptance. However, some have achieved remarkable success while others have suffered dismal failures. Many of the failures can be attributed to a misunderstanding of TQM or the way the organization had implemented TQM.

Critical success factors are the behavioral aspects of management styles or the human factors which emphasized on organization's total quality management. Rahman et al. & Lewis et al., pointed out that success factors include Leadership, Customer focus, Quality culture, Teamwork, Training, Communication, Product design and etc. Moreover, the efficient utilize of critical success factors can increase quality improvement in each organization. (Rahman et al. 2005), (Lewis et al. 2005) . Kumar et al. referred to many articles and stated that although there are many definitions of TQM; generally TQM is a comprehensive procedure for improving quality, productivity and competitiveness in the international marketplace. (Kumar et al. 2009).

In the same manner, Yang gives more details by expressing that total quality management is a general section of management which emphasizes competitive advantage, quality improvement, and customers' requirements . (Yang, C. C. 2005). Total quality management is very effective in decision making, and problem solving. TQM also has a prominent role in the continuous improvement of organizations.

The critical success factors to implement TQM in construction industry that will study in this research are:

1. Leadership.
2. Vision and plan statement.
3. Customer focus.
4. Human Resource Management.
5. Supplier Quality Management.
6. Process Control & Improvement.
7. Communications Management.

Fig. 5. The Critical Success Factors – Source field study

2.5.1 Leadership

Even though there are many factors that attribute to the success of quality management practice, the main and most critical factor is top management commitment. Failures in many places are due to lack of top management commitment. Leadership is considered as doing right things while management is doing things right. Leadership is influencing the people so that all of them do the right things, the right way at the right time willingly, on their own. (L.Suganth &Anand A.2005)

Contemporary brutal facts confront construction industry leaders, such as resource depletion and availability, and ever-increasing competition for capital in an accelerating global economy. Challenging leaders in this capital-intensive industry, which traditionally focuses on short-term financial returns and risk mitigation, these brutal facts demand new thinking and practices. (John S, et.al. 2009)

Construction leaders are expected to set quality as a priority while allocating adequate resources to continuous quality improvement and evaluating employees based on their performances (Minjoon et al. 2006). When the top management is committed in TQM implementation it will enhanced employee empowerment, teamwork, training and employees job satisfaction. (Thaddeus et al 2008). Olorunniwo and Udo (2002) identified three main facets of top management support which are crucial in TQM practice and project realization.

1. Showing interest by participating in team meetings, willingness to spend time with people and listen to feedback as well as willing to help resolve problem
2. Providing necessary resources, including training and other crucial resources
3. Providing leadership by helping to translate plan into action, regular review of project programs and official commissioning of a project leaders and project team.

They also emphasizes the fact that top management are expected to set the overall directions of the project by formally forming an executive steering committee to tract, review and monitor the project progress.

2.5.2 Vision and Plan Statement

Construction industry leaders need to face the harsh realities of their own set of brutal facts, develop innovative strategies to deal with them, and in doing so, re-establish the role and leadership potential of engineers in society. (John S,2009) this can be a vision for overall construction industry. There are two main levels of planning associated with construction projects. There are strategic planning(Mission) and operational planning(Goals). (Frank H. & Ronald M.2001). Strategic planning deals with the high-level selection of overall projects objectives, including the scope, procurement routs, time-scale, and financing options. Strategic planning for a project results in broad outlines of what the project has to achieve and how it is to be undertaken. Operational planning on the other hand involves establishing a method statement for each activity (as objectives and targets), it is allows a more detailed look at the project's resources requirements that is not obvious at the strategic level.

When developing strategies, analysis of the organization and its environment as it is at the moment and how it may develop in the future, is important. The analysis has to be executed at an internal level as well as an external level to identify all opportunities and threats of the external environment as well as the strengths and weaknesses of the organizations. There are several factors to assess in the external situation analysis : Markets (customers), Competition, Technology, Supplier markets Labor markets, The economy , The regulatory environment (wikipedia.org)

2.5.3 Customer Focus

Identification of customers is a top priority the implementation of TQM. If the customer is known, the next step is to identify the needs, desires and expectations. There are two kinds of customer organizations, namely internal customers and external customers, both of which are the driving force of organizational activity. External customers to determine the quality of the products they receive, whereas the internal customers play a role in determining the quality of human resources, processes, and environment-related products. (Tri &Yuli 2011)

Customer relations in construction are non-recurrent and dynamic. Moreover, there are a small number of customers but the relationship is complex. (Sami Kärnä 2009)

The customer's expectations of construction are a function of several factors: the customer's past or direct experiences with the contractor and similar contractors, word-of-mouth information about the contractor, and the customer's personal needs. In addition, a customer's expectations are affected by a contractor's marketing activities and image, the customer's own investment in the project and the relationship between the two parties. (Sami Kärnä 2009)

Quality Function Deployment is a systematic approach to design based on a close awareness of customer desires, coupled with the integration of corporate functional groups. It consists in translating customer desires into design characteristics for each stage of the product development. (http://www.ciri.org.nz)

2.5.4 Human Resource Management

Human Resource Management has always been linked to human as the most important asset that drives the organization to success or failure (Pierce et. al., 2003; Torrington et. al., 2002). Managing project teams is a fundamental skill within the area of human resource management. The Project Management Institute defines human resource management as the art and science of directing coordinating human resource throughout the life of a project, by using administrative and behavioral knowledge to achieve predetermined project objectives of scope, cost, time, quality, and participant satisfaction. (Garold D. 2000).

Work in construction is not regarded as "decent work". Lack of opportunities for training and skill formation contribute to the unattractiveness of a career in construction. Attracting new entrants is a major problem in countries where workers have alternatives (mainly, but not entirely, the richer ones). In both developed and developing countries difficulties are experienced in recruiting young, educated workers.(I LO 2001)

Construction contractors employ labor that may or may not be unionized. Unionized craftspeople are members of unions that are organized by construction trades, such as carpenter, plumber, and

electrician unions. Union members will perform only the work assigned to their trade. On the job, groups of workers are supervised by crew supervisors, all of whom report to a superintendent. (Frederick S. & Jonathan T.2001)

The construction contractor is responsible for the performance of all work in accordance with the contract documents that have been prepared by the designer. This includes furnishing all labor, equipment, material, and know-how necessary to build the project. (Garold D. 2000).

- **Employee commitment**

Man is said to be the most complex compared to the other three M, namely money, machine and material. In organization employers' concern for employee commitment is on the rise due to the high turnover and job-hopping culture which has been a major set-back for organization. In this era of talent-war, employers thrive to compensate with motivational factors to gain competitive advantage in building employee commitment. In returns, employee commitment will have positive impact on job satisfaction as well as productivity and minimize turnover. (YASMIN B.M. NOR2011)

Gibson et. al. (2009) defined commitment as a sense of identification, loyalty and involvement expressed by an employee towards the organization or unit of organization. Allen and Meyer (1990) proposed that there are three components of organizational commitment, namely, affective, continuous and normative commitment. Affective commitment refers to the employee's emotional attachment to, identification with, and involvement in the organization. The continuous commitment refers to commitment based on the costs that the employee associates with leaving the organization. The normative commitment refers to the employee's feeling of obligation to remain with the organization.

- **Motivation (Recognition and Rewords)**

Behavioral theorists like Maslow, Herzberg, Skinner and others have helped to shape the modern industry we know as "rewards and recognition," which is also sometimes called "awards" or "incentives" among other names. While their theories have been helpful in discussing motivation and behavior change, in only a few instances have the results of reward and recognition efforts.

Management theorists argue that employees are capable of performing at high levels when motivated to do so (Pfeffer 1998).
One of the strategies to motivate and improve the employees' work-life balance is as (Helen Lingard *et al*. 2007) conclude the compressed work week which was very successful in improving
employees' work-life balance. Further, the project's time and cost performance suggest that the change to a 5-day week did not hinder the attainment of objectives in other key result areas of the project. Furthermore, the employees were very satisfied with the compressed work week and reported a number of benefits, including increased physical and psychological well-being, greater motivation, improved productivity, increased job commitment, and increased involvement in home/family activities.

Yukl (2002) defined recognition as giving praise and showing appreciation to others for excellent performance and significant contributions by an employee to an organization.
There is informal and formal recognition. Informal recognition can be in the form of simple gestures as a pad on the back to show gratitude, acknowledgement for a job well done and a short note conveying "thank you" meets the basic needs for recognition (Kouzes and Posner,2003).Formal recognition refers to performance-based awards, new employees' recognition and etc.(Gostick and Elton,2005).

For many organizations, providing employees with some choice and flexibility in how they are recognized is a key strength of their program. This allows organizations to tailor the recognition and rewards to the needs and wants of the individual employee. (Nicole Stewart2011)
There is some principles of a good incentive scheme such as:

- Bonus should be paid to workers in direct proportion to the effort applied.
- The earning of the workers should not be limited in any way.
- The set targets should be attainable and thereafter remain unaltered. In the construction industry this is not always possible due to the lack of reliable data on which to base the targets. (Frank H. & Ronald M.2001).

- **Training**

A clear program for employees' training will consider as a motivation mean that increase employee commitment toward the organization. Training must considered for all members of the organization, from the top management level to the workers.

The report of the Construction Task Force to the Deputy Prime Minister, John Prescott(1998) suggest that Modern building techniques require fewer specialist craftsmen but more workers able to undertake a range of functions based around processes rather than trade skills. Also they found that upgrading, retraining and continuous learning are not part of construction's current vocabulary. There is already frustration amongst component suppliers that their innovations are blocked because construction workers cannot cope with the new technologies that they are making available.

- **Teamwork**

It is time to recognize the key role of individuals within project networks, including the communication and trust that is the basis for achieving high performance results. (Paul Chinowsky et al.2008)

Teamwork is necessary to tap the vast resource potential of the labor force, and to develop cross functional cooperation that breaks barriers both horizontally and vertically within an organization. (DAVID B.1991)

The construction industry is based on network instability where project participants are regrouped on almost every project with little regard to past network connections. (Paul Chinowsky et al.2008)

Training and quality are inextricably interlinked. The experience of Task Force members is unequivocally that quality will not improve and costs will not reduce until the industry educates its workforce not only in the skills required but in the culture of teamwork. (John Prescott1998) Regardless of the size and number of teams, there must be a single head project manager to make final decisions and keep focus on the project. (Garold D. 2000).

The integration of social science concepts such as trust can affect the outcome of construction networks. In projects where trust and value sharing are not evident, the impact on information and knowledge sharing

can be significant. The reduction in this open sharing results in an equally significant impact on the final project outcome. (Paul Chinowsky et al.2008)

2.5.5 Supplier Quality Management

During the last decades empirical studies have shown that industrial markets can be characterized by the existence of long-term customer and supplier relationships , and that these relationships in turn are both complex and vary with regard to content and dynamic aspects (Gadde and Mattsson, 1987). CRiSPS researchers have suggested the following definition of supply networks: "Supply networks are nested within wider interorganization networks and consist of interconnected entities whose primary purpose is the procurement, use, and transformation of resources to provide packages of goods and services. Supply networks comprise chains through which goods and services flow from original supply sources to end customers" (Harland et al., 2001, p. 22).

Within the generic supply chain the first-tier construction firm plays the major 'integrating' role for all upstream supply chains. Each organization in a tier is able to manage its supply relationships in such a way that it can effectively act as a procurement gatekeeper. The first-tier organization typically acts as a gatekeeper to the subcontractors' tiers of suppliers and each trade subcontractor subsequently acts as a gatekeeper to the materials suppliers operating at the third-tier. Furthermore, the relatively unmanaged use of subcontracting within the industry increases the endemic problems associated with opportunism. (Andrew Cox et al., 2006).

The Supplier library is a technique contained 2 to 6 preferred suppliers within each category. For each supplier, the main contractor had information about the name and address of the supplier, the main contact person, the different areas within construction projects the contractor had experiences from working with the supplier, and the contractor's opinion of the supplier's willingness to co-operate with the contractor. The reason for developing this library was a desire to reduce the number of suppliers used by the business unit. (Elsebeth Holmen et al. 2003)

On the basis of the Supplier library the supplier will selecting. The selection process was carried out by a team including; the purchasing manager, project managers, site managers and foremen.

The final project-specific construction supply chain that arises is, however, a system of multiple supply chains delivering all raw materials, human resources and information required for the successful completion of a project to the place where the specific end product must arise. (Andrew Cox et al., 2006).

Every organization, department and individual involved in any process will play the roles of customer, processor, and supplier. Juran calls this phenomenon the triple role concept. The Owner is the ultimate project customer. However, when he communicates his requirements, decisions and feedback, and provides funding he becomes a supplier to both the A/E Firm and the Constructor. Upon receipt of the Owner's requirements (input) the A/E switches roles from a customer to a processor, and processes the plans and

specifications (output). The Constructor, can then transform the input (plans and specifications) into a complete facility (output) that meets the Owner's (customer) requirements. (DAVID B. 1991)

2.5.6 Process Control & Improvement

A process is a way of getting things done. A process consists of the tasks, procedures and policies necessary to carry out an internal or external customer need (Adrian 1995). According to the TQM philosophy if the process is correct, so will be the end result (product).

As the quality of the construction process (scoping, design, procurement, construction and start-up) improves, the cost associated with failures decreases (fewer change orders and delays, less rework and shorter schedule). The goal is to minimize the "cost of quality"(cost of failures), and maximize the return on investment. (cost of prevention and appraisal) (L.Suganth &Anand A.2005) When the process is under reasonable control, whether deterministic or probabilistic, the result should be a manufacturing process operating at a high level of efficiency. Good continuous improvement programs at this level should result in increased efficiency of manufacturing and production operations. Traditionally increases in efficiency would often directly translate into increases in the profitability of the operation. (Peter G.2010)

Continual improvement in the quality of on-site construction activity procedures and methods aimed at better satisfaction of the customer at the

next stage will result in less rework, fewer delays and mistakes, and better use of construction inputs. Consequently, constant improvement in the quality of the construction activity process leads to decreased cost of quality and increased productivity. (DAVID B. 1991)

Before improving the quality of any process, there must be a method of measuring current performance. The unit of measurement is a defined amount of some quality feature that both expresses the customers' needs, and permits evaluation of the process. (DAVID B. 1991)

Each on-site construction activity is a distinct process with defined procedures for the management of construction inputs (people, skills, materials, tools, equipment, information, place and energy), and with defined construction methods for transforming the inputs into an output that meets the project plans and specifications(requirements).

Quality in construction is associated not only with the materials and final product, but also with the way people work, the way tools and equipment are operated, and the way systems and procedures are dealt with.

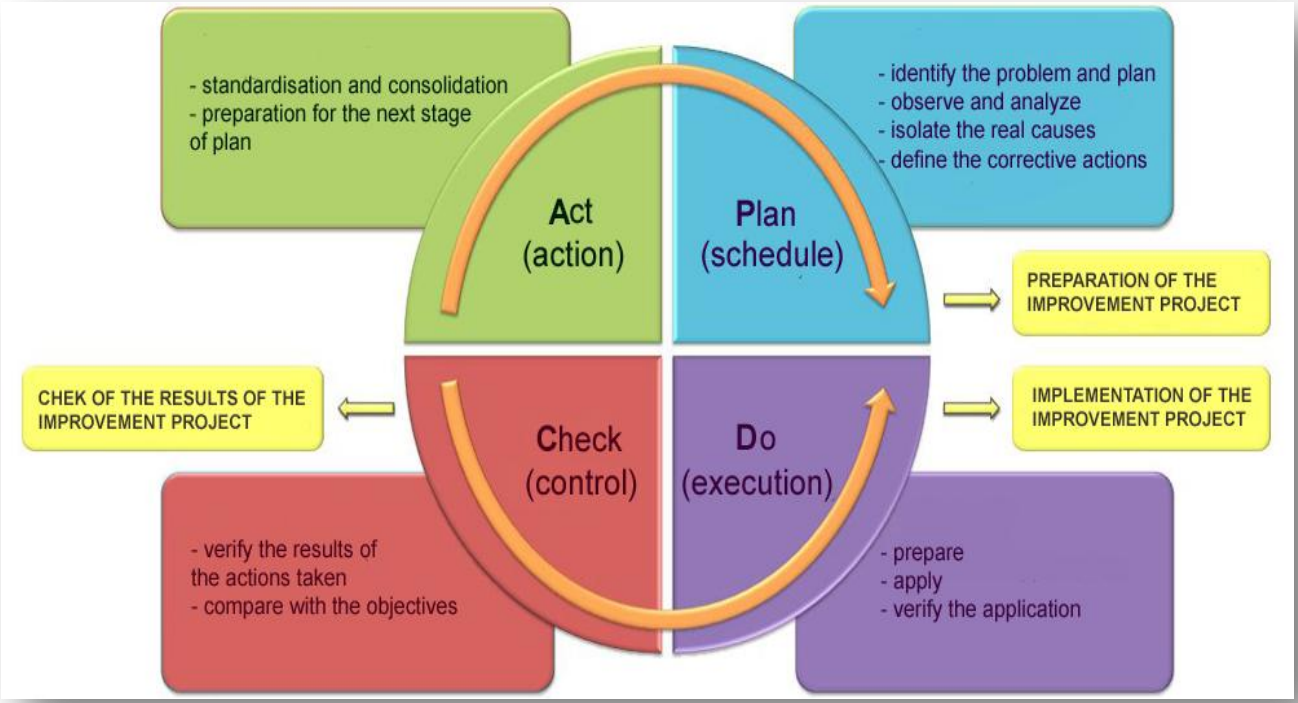

Fig. 6. Continuous improvement cycle - Source http://www.iwolm.com/en/the-pdca-method-or-deming-wheel-for-your-improvement/

The management of construction business can follow many rules, one of which is PDCA cycle law , it expounds four steps: plan, do, check and act, and explains that every step also includes a small PDCA, which makes up a large PDCA. According to the analysis of the management, following Deming wheel should make the preventive measures, reduce business risk, and make sure the implementation of the strategy, so processes continuously improve. (www.eng-paper.com)

Clients too must accept their responsibilities for effective design. Too often they are impatient to get their project on site the day after planning consent is obtained. The industry must help clients to understand the need for resources to be concentrated up-front on projects if greater efficiency and quality are to be delivered. (John Prescott,1998)

- **Quality improvement techniques**

Total Quality Management mainly demands a process of continued improvement aimed at reducing variability. An organization wishing to support and develop such a process needs to use quality management tools and techniques. It is prudent to start with the more simple tools and techniques: Check-sheet, Check list, Histogram, Pareto Diagram, Cause-and-Effect Diagram (Fishbone Diagram), Scatter Chart and Flowchart. (Frank H. & Ronald M.2001).

- **Check-sheet**

Check-sheet is used to record events, or non-events (non–conformances). They can also include information such as the position where the event occurred and any known causes. They are usually prepared in advance and are completed by those who are carrying out the operations or monitoring their progress. The value of check-sheet can be retrospective analysis, so they help with problem identification and problem solving. (Frank H. & Ronald M.2001).

- **Checklist**

Checklists (sometimes called inspection or validation checklists) are used as prompts and aids to personnel. They highlight the key features of a process, equipment, system and/or product/service to which attention needs to be given, and ensure that the procedures for an operation, housekeeping, inspection, maintenance, etc. have been followed. Checklists are also used in audits of both product and systems. They are

an invaluable aid for quality assurance and, as might be imagined, the variety and style and content of such lists is immense. (DALE 2003)

- **Histogram**

Histogram provides a graphical representation of the individual measured values in a data set according to the frequency of occurrence. It helps to visualize the distribution of data and there are several forms, which should be recognized, and in this way they reveal the amount of variation within a process. It should be well designed so that people who carry out the operation can easily use them. (L.Suganth &Anand A.2005)

- **Pareto Analysis**

It is a technique employed to prioritize the problems so that attention is initially focused on those, having the greatest effect. It was discovered by an Italian economist, named Vilfredo Pareto, who observed how the vast majority of wealth (80%) was owned by relatively few of the population (20%). As a generalized rule for considering solutions to problems, Pareto analysis aims to identify the critical 20% of causes and to solve them as a priority. (Frank H. & Ronald M.2001).

- **Cause and Effect Diagram (Fishbone Diagram)**

Cause and effect diagrams are graphic outlines of probable causes of problems. From the diagram, you then determine actual causes and seek their solutions. These diagrams are also called Ishikawa diagrams after the man who developed them. They are also called "fish-bone diagrams" because they look like a fish skeleton. The center line represents the problem and each main line off the center represents a cause category. (Bruce E.1999).

- **Scatter Diagram**

The relationship of two variables can be plotted in the scatter diagrams. They are easy to complete and obviously linear pattern reveals a strong correlation.

- **Flowcharts**

Flow chart is used to provide a diagrammatic picture using a set of symbols. They are used to show all the steps or stages in a process project or sequence of events. A flowchart assists in documenting and describing a process so that it can be examined and improved. Analyzing the data collected on a flowchart can help to uncover irregularities and potential problem points. (Frank H. & Ronald M.2001).

2.5.7 Communication Management:

Communication is a process through which information is exchanged between individuals/ groups. Communicate the organizational objectives, goals, priorities, values expectations of quality accomplishment, achievements to all the employees. (. Frank H. & Ronald M.2001).

Many researchers suggest that communication is critical to the success of construction project teams. Communication includes the transmission and understanding of meaning, there must be both a source and a receiver of the message. Between the source and receiver are a number of factors that affect the transmission and understanding of meaning, including the message, encoding, the channel, decoding, and feedback. (Robert S. 2004)

Effective communication is not simply talking clearly; it is, in many cases, and often more importantly, **listening effectively**. (Barry Benator2003) A functioning communication system is a significant precondition for the operations of a work site organization and in building customer satisfaction. The importance of communication is further stressed by the fact that business is based more and more on long-term customer relations. (Sami Kärnä 2009)

Construction communication that is contracted to public relations firms with experience in public works projects can improve customer satisfaction. (Tanzer, M. 1999) Contractors can engage in a variety of activities that communicate important ideas, needs, and information to the public. For example, contractors can organize pre-construction meetings where the project is explained and where the public can voice concerns about the project. During the project, the contractor can provide ongoing information to the public with newsletters that detail scheduled travel restrictions and utility disruptions. (Robert S. 2004)

When communicate it is important that clear, coherent, and efficient communication skills exist to ensure successful work by all participants in a project. The project manager must realize that all people do not interpret the same thing in the same way and that a communication is of no value unless it is both received and understood. (Garold D. 2000).

There are many channels to communicate, Computer-Based Technology such as e-mail and project web sites, etc. Audio Technologies like teleconferencing, voice-mail, or telephone calls, etc., Video Technologies such as videoconferencing, remote presentations, or video/snapshot phone, etc. Traditional Written Communications Media as reports, forms, etc. Traditional Verbal Communications Media like Ad Hoc Conversations, meetings, and press briefings. All tools, templates, and structures above designed to afford a level of clarity. No project manager should use all of these tools they should be chosen for their propriety to the project environment, the customer, and the team. (Carl Pritchard2004)

When evaluating co-operation between parties in the construction supply chain, it is essential to exploit mutual feedback. It is also well known that the poor performance of one party will affect the performance of the next party (Kanji and Wong 1998).

CHAPTER 3
Quality Management Systems

3.1 Introduction

A quality management system (QMS) is a collection of business processes focused on achieving your quality policy and quality objectives — i.e. what your customer wants and needs, It is expressed as the organizational structure, policies, procedures, processes and resources needed to implement quality management. Early systems emphasized predictable outcomes of an industrial product production line, using simple statistics and random sampling. By the 20th century, labour inputs were typically the most costly inputs in most industrialized societies, so focus shifted to team cooperation and dynamics, especially the early signalling of problems via a continuous improvement cycle. In the 21st century, QMS has tended to converge with sustainability and transparency initiatives, as both investor and customer satisfaction and perceived quality is increasingly tied to these factors. Of all QMS regimes, the ISO 9000 family of standards is probably the most widely implemented worldwide - the ISO 19011 audit regime applies to both, and deals with quality and sustainability and their integration**.** (http://en.wikipedia.org/wiki/Quality_management_system)

3.2 Quality Management System

A quality management system consists of various elements.
ISO 9001 groups them into these into 4 categories:

1. **Management** - planning, goals & objectives, reviewing progress(
2. **Resources** - people, tools, equipment etc.
3. **Services or Products** 'realization' - whatever is involved in creating or delivering them, and lastly the
4. **Monitor**, Measurement & Checking - the all-important feedback loop.

So you see that the scope of a quality management system extends beyond just what you do to make the service or product itself. It includes how you:

- Manage your organization: planning, setting goals, reviewing progress and results
- Make sure people are competent for their work and the right resources are available: plant, equipment, IT, tools, etc.
- Check and analyze results, to see what happened and why
- Identify failures or problems systematically and fix them
- Improve. (http://www.iso9001consultant.com.au/FAQs-quality-systems-management.html)

3.3 History

The organization today known as ISO began in 1926 as the International Federation of the National Standardizing Associations (ISA). It was suspended in 1942 during World War II, but after the war ISA was approached by the recently formed United Nations Standards Coordinating Committee (UNSCC) with a proposal to form a new global standards body. In October 1946, ISA and UNSCC delegates from 25 countries met in London and agreed to join forces to create the new International Organization for Standardization; the new organization officially began operations in February 1947.

3.4 Structure

ISO is a voluntary organization whose members are recognized authorities on standards, each one representing one country. Members meet annually at a General Assembly to discuss ISO's strategic objectives. The organization is coordinated by a Central Secretariat based in Geneva.

A Council with a rotating membership of 20 member bodies provides guidance and governance, including setting the Central Secretariat's annual budget.

The Technical Management Board is responsible for over 250 technical committees, who develop the ISO standards.

3.5 The right system characteristic

- Each employee knows how the system works because he was involved in writing or updating it.
- Everyone knows how their job works because they are familiar with the written procedures.
- The workforce uses the system to prevent and correct errors.
- Staff uses the quality manual as source of information, and to remind them how a product should be made.

3.6 ISO 9000 rule in TQM implementation

- So ISO 9000 need not be the enemy of TQM. It can be the reverse of the same coin.
- TQM looks at the corporate culture.

- And ISO 9000 looks at the corporate systems. Together they help the company.

The company have develop

- Setting objectives and targets. SMART
- Setting benchmarks.
- Setting responsibilities.
- Organization charts.
- Drawing up a timetable.
- Simple project management software is now widely available.

3.7 ISO 9001 principles

- Customer focus.
- Leadership.
- Empowerment.
- Process approach.
- Systemic approach.
- Continuous improvement.
- Decisions based on facts .
- Relationship with suppliers mutually beneficiary.

3.8 Five reasons why companies dislike ISO 9000

1. It is bureaucratic
2. It is internally focused.
3. It is imposed by a customer.
4. The company dislikes being assessed by an outsider.
5. The company doesn't want to pay for it.

3.9 Why ISO 9000 helps to make TQM work in the project

- ISO 9000 gets you to write down how your main processes work.
- Keep records.
- Do audits.
- Manage quality control.
- Allocate responsibility.

CHAPTER 4
Methodology and Analyses

4.1 Methodology of Research
4.1.1 Introduction

The study combines two qualitative and quantitative method. Two methods were used to collect the data; namely, a survey questionnaire and semi-structured interviews. The questionnaire aimed to identify critical success factors of TQM implementation in Construction Companies.

A total of125 copies of the questionnaire were distributed to the targeted employees working within these Companies. Five-point Likert scales (strongly disagree, disagree, neutral, agree, strongly agree) were used in the questionnaire. Collis et al.(2003) stated that this scale makes the respondents more comfortable with a wide a variety of choices. The questionnaire includes 77 statements to identify critical success factors for the implementation of TQM.

The questionnaire was validated through distribution to academics in the construction field who are specializing in TQM and quality management. They gave their feedback on the content of the questionnaire; their comments were taken into account, amendments were made and the document revalidated.

Out of 125 questionnaires sent to the targeted sample, a total of 75questionnaires were returned completed. Data collected were analyzed by using the SPSS program version 16.0. Semi-structured interviews with quality managers were the second step of the data collection. The interviews were used to get a clear understudying of the issues that had emerged from the questionnaire and collect more information about the implementation of TQM.

4.1.2 A brief description of the responding

According to the information that taken from the Sudanese Contractors union about the number of registered and unregistered contractors, the researcher set the number of target contractors for the questionnaire. The Sudanese Contractors Union define the registered contractors as 2000 contractors at the whole Sudan regions, and about 25% from that number are unregistered contractors since the nature of this carrier there is new firms arise and others get out of the game. So the approximate number of the contractual firms is about 2500.

The researcher toke a random sample of contractors to exceed the aim of this study from the contractors list that given from the Sudanese

Contractors Union (see appendix C), and since this study is limited to Khartoum so the contractors number will drop to the half , so when the researcher targeting approximate 10% of the Khartoum contractors the number of the random sample will be 125 contractors.

In this study a researcher take a questionnaire method to collect field data, this questionnaire was divided to eight sections to reach the research objectives, these seven sections were: Knowledge about TQM, Leadership, Vision and plan statement, Customer focus, Human resource management, Supplier Quality Management, Process control & improvement and Communications. These eight sections demonstrates the perception of quality that contractors have and the degree of implementing TQM fundamentals throw the seven critical factors to successful management.

The researcher distributed 125 copy of the questionnaire to the random sample of contractors companies, but only 75 questionnaire was return (60%) from the total. The reason of unreturned questionnaires is: first the most of contractors are busy so they do not have the time to fill the questionnaire at a particular time, second many contractors interest about the things that will returned on them by financially benefits, so they do not care about the educational issues, third some contractors just do not care about the hole subject and underestimate this study.

4.2 Analyses of adoption and Implementation TQM in the Construction Companies

In the flowing the researcher will demonstrate in details the results of his questionnaire , that will be by diagramming every question in each section individually then brief the entire section result to show the respondents tendency toward the subject of the section.

When the researcher take the questions individually she show the percentage of every answer, but when she comes to the section brief she show the mean of the section questions. The questions phrased positively so the answer categories will analyze as flowing: (Strongly disagree) category got 1degree, (Disagree) category got 2 degrees, (Neutral) category got 3 degrees, (Agree) category got 4 degrees and (Strongly agree) category got 5 degrees.

4.2.1 Knowledge about TQM

1. (76.40%) of contractors believe that quality implementation lead to performance improvement, and the rest of population(23.60%) agree on that.

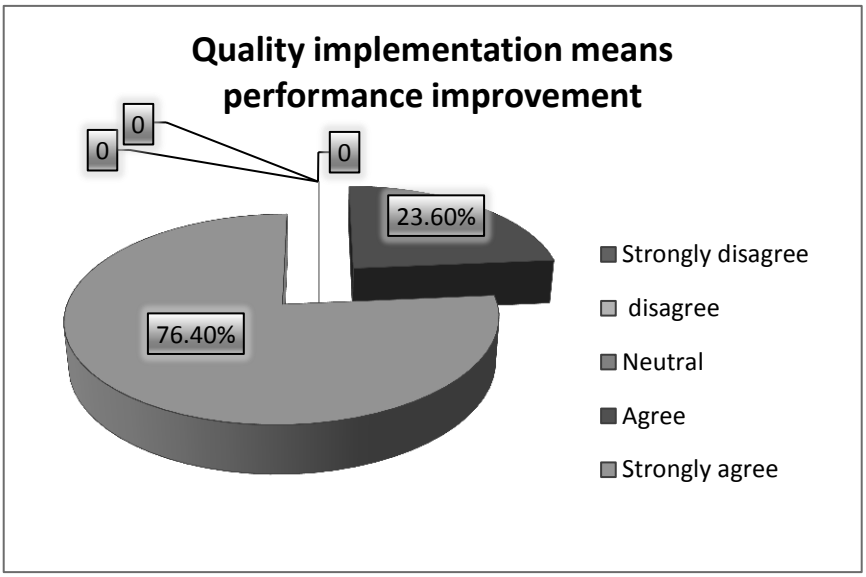

Fig. 7- Source field study

2. Only (12.50%) strongly agreed that the quality considerations will increase the cost, also (33.30%) know the quality will affect the cost but the rest of the population is not sure about the relationship between quality and cost.

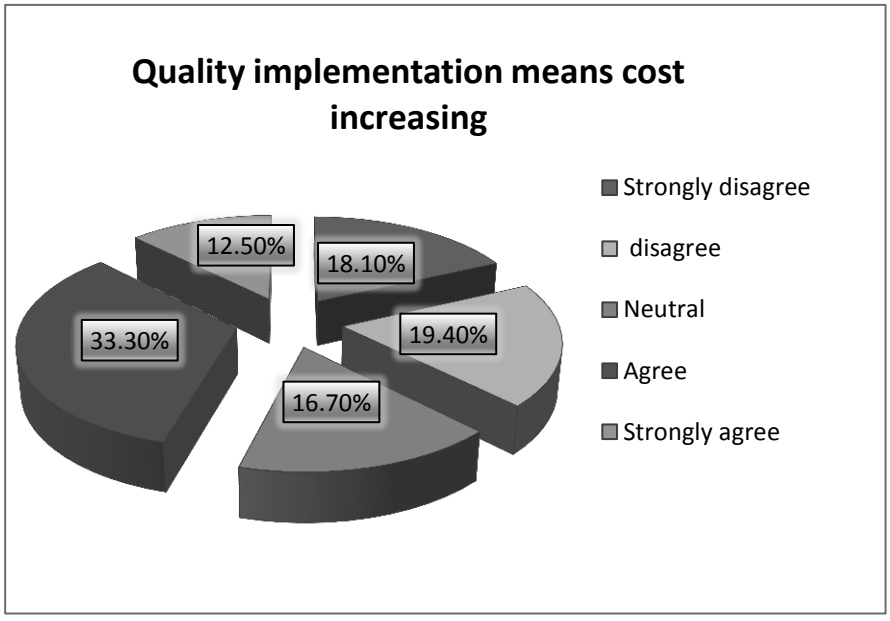

Fig. 8- Source field study

3. Only (12.50%) sure the quality will come to their organization with more profits and (16.70%) think positively about that, but the rest don't believe that.

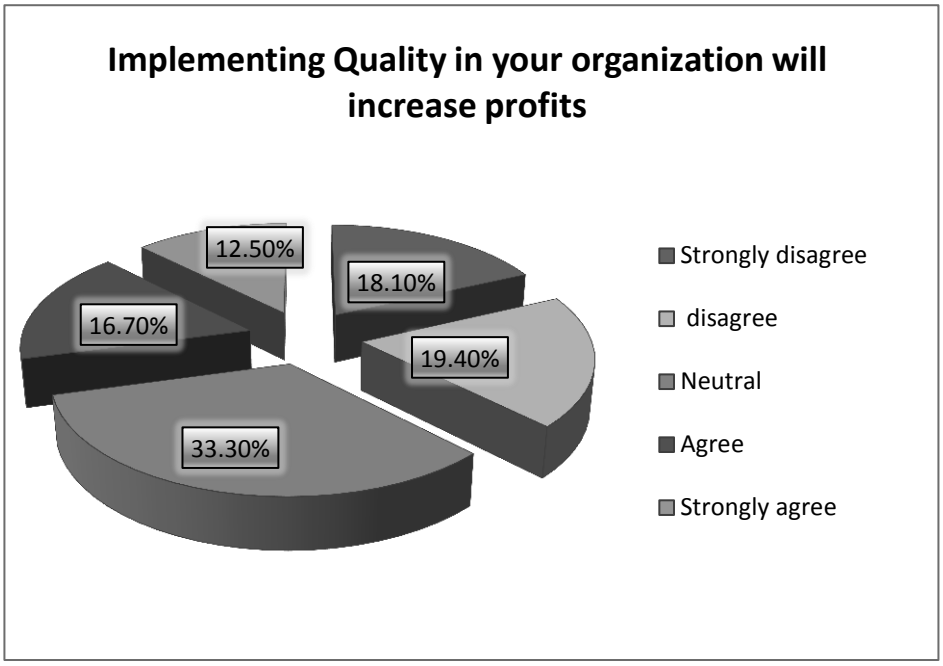

Fig. 9- Source field study

4. (58.30%) strongly agreed on the quality is a customer desier .

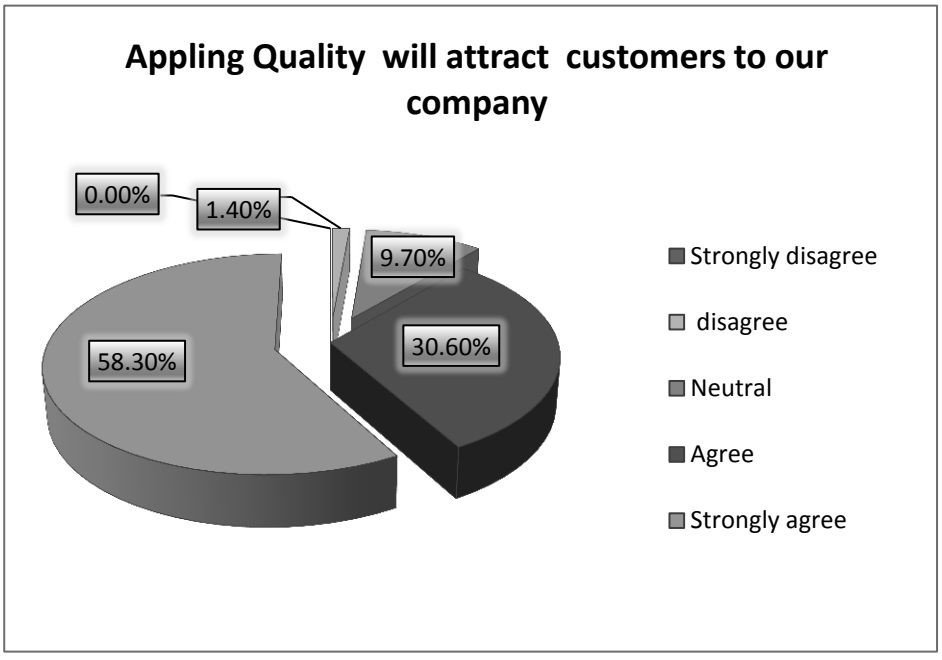

Fig. 10- Source field study

5. (62.540%) believes TQM can improve their abilities on planning projects, a few dispute that(2.80%)

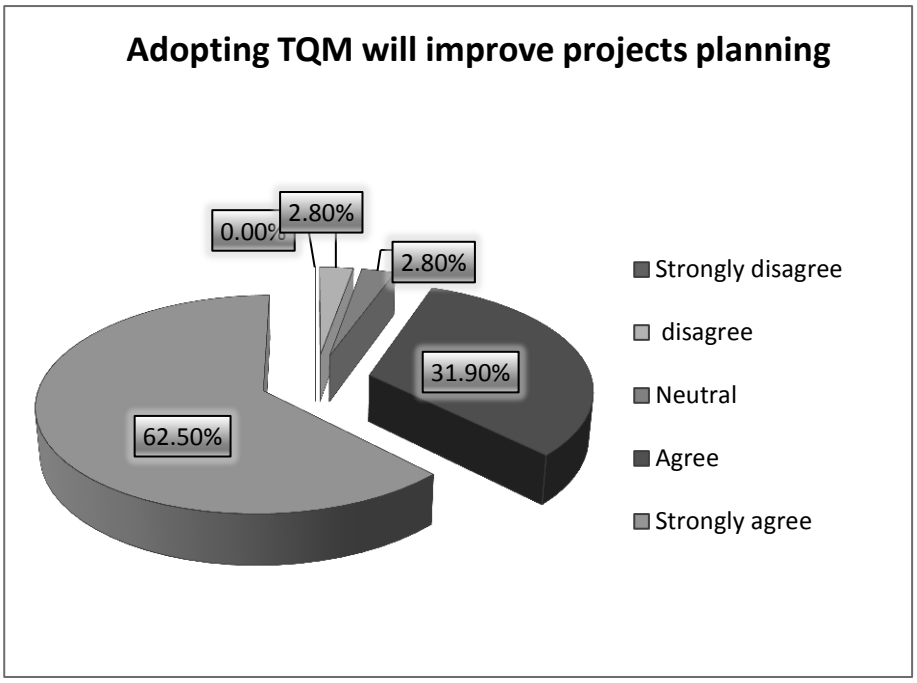

Fig. 11- Source field study

6. (50%) Believe that to increase profits they must satisfy and maintain the relationship between them and the customers, on the other hand a few percent (1.40%) deny the customer role in increasing the profits.

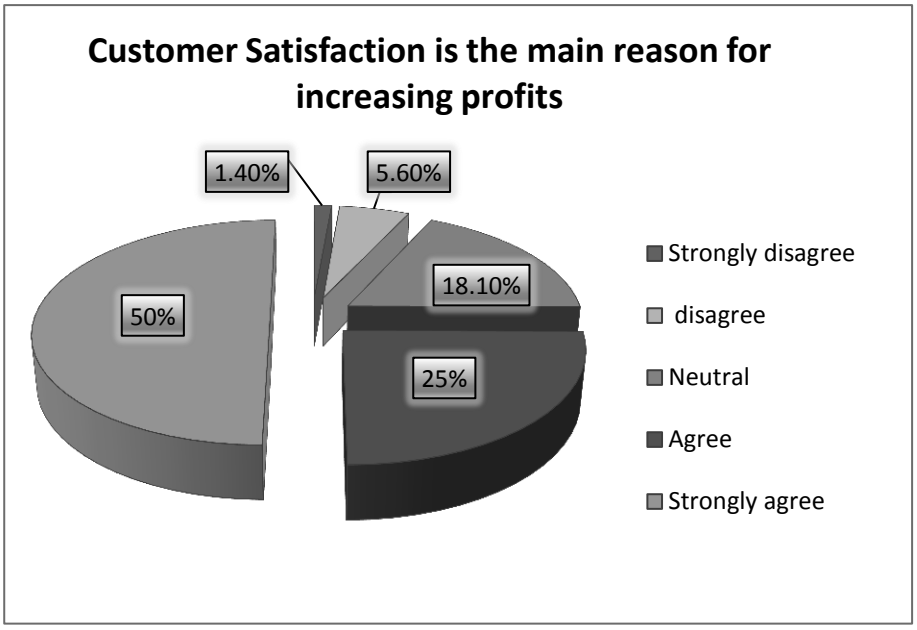

Fig. 12- Source field study

7. (31.90%) Have a good supervision on sites which help them to apply quality.

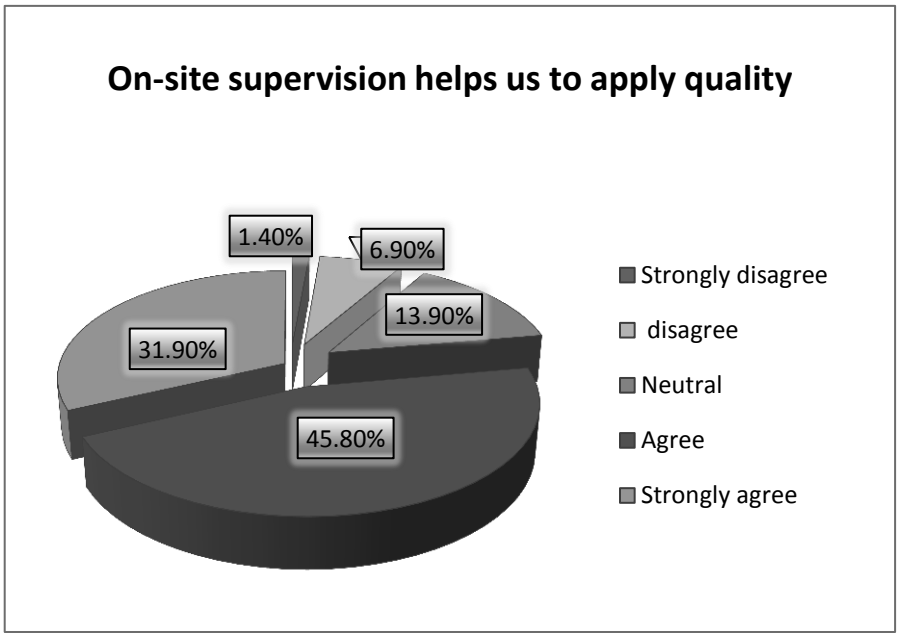

Fig. 13- Source field study

8. (45.80%) Believes that with auditing and best coordination the redesign will be decrease to the minimum.

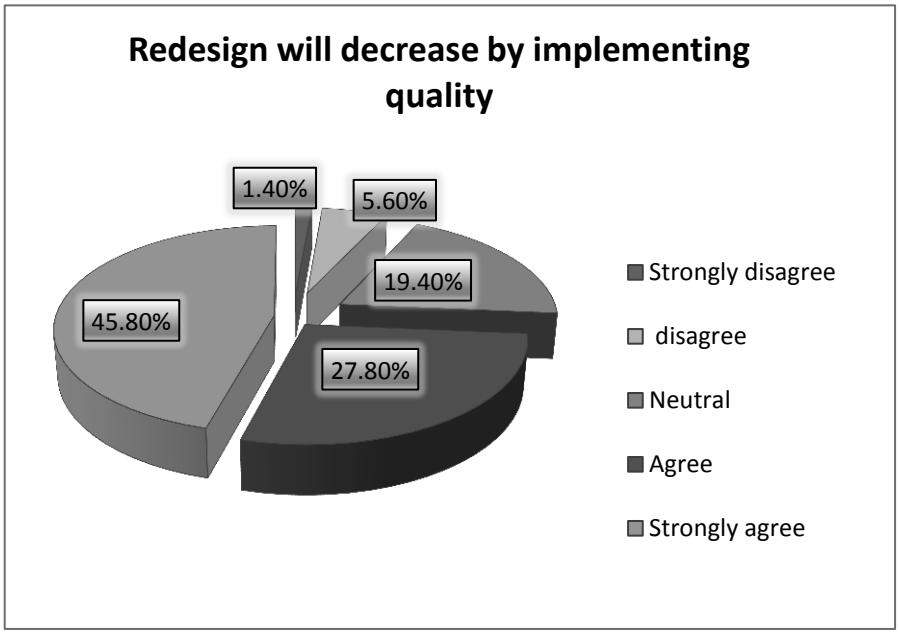

Fig. 14- Source field study

9. (50.00%) Believes that the dealing with materials (loading-storage-scrap) on sites will improve by implementing quality, (40.30%) also agreed on that and a few percentages (1.40%) disagree.

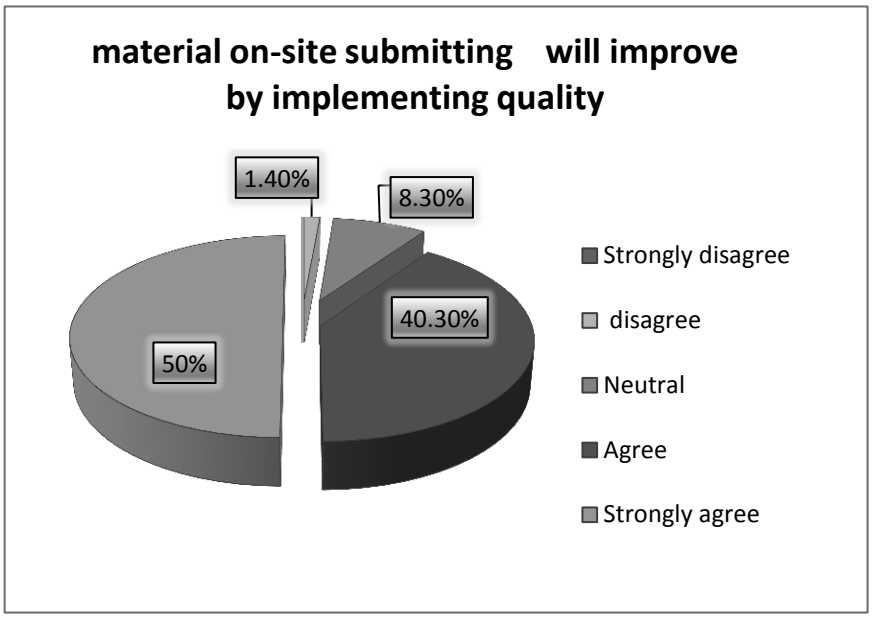

Fig. 15- Source field study

10. (51.40%) Think that quality affecting the final handover, whether (6.90%) don't think that.

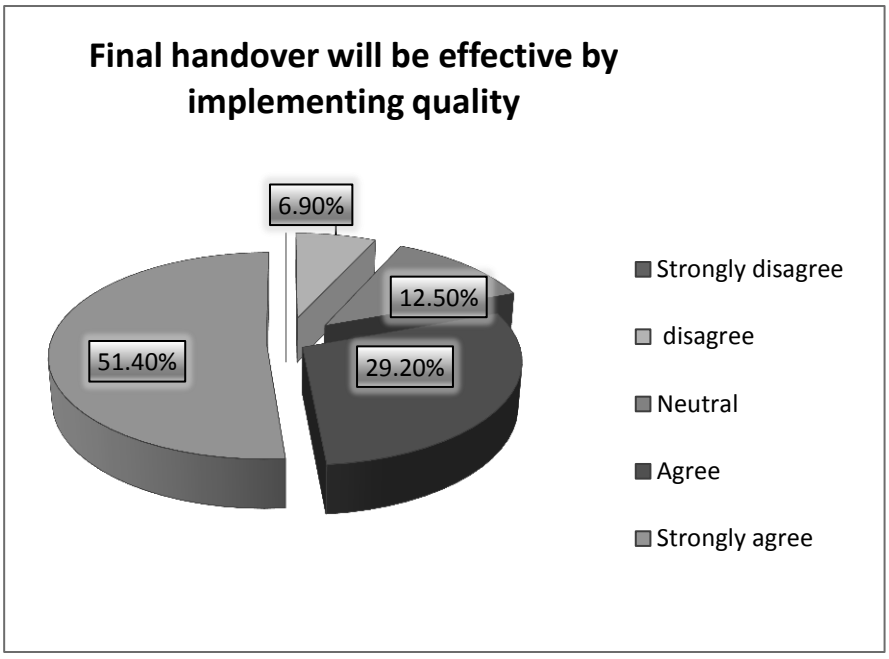

Fig. 16- Source field study

11.(65.30%) Strongly agreed on the relationship between quality and safety on sites, only (2.80%) disagreed.

Fig. 17- Source field study

12.(47.20%) Believe that quality helps employees to grow their management skills and personality and only (6.90%) strongly disagreed.

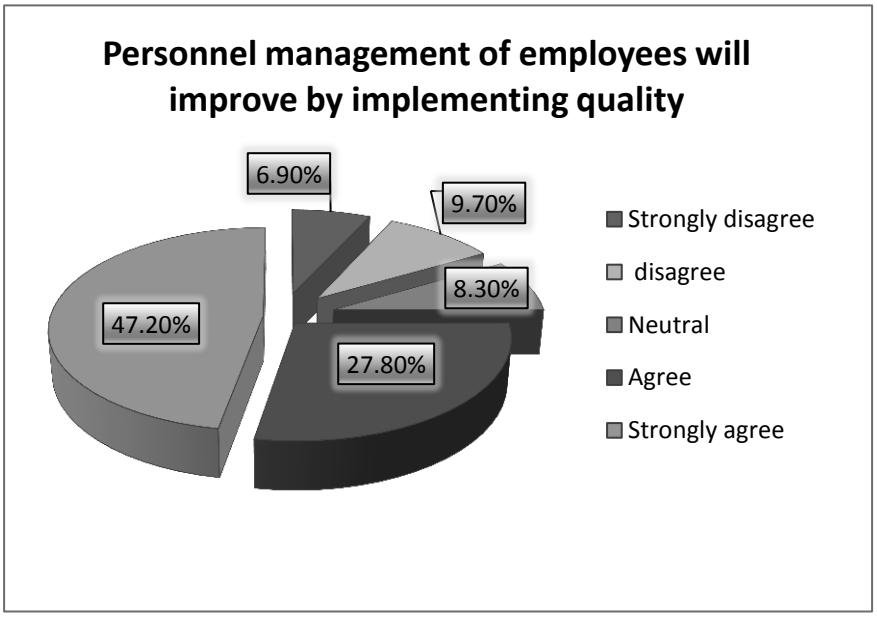

Fig. 18- Source field study

Brief of the section

As shown in the histogram below the respondents have a tendency toward applying total quality management to improve their performance,

attract more customers and increase profits, although they do not sure about how the quality affecting the cost.

4.2.2 Leadership

1. (30.60%) See the leadership of the company as a wise leader who has a clear vision and ability to role and balancing the priorities.

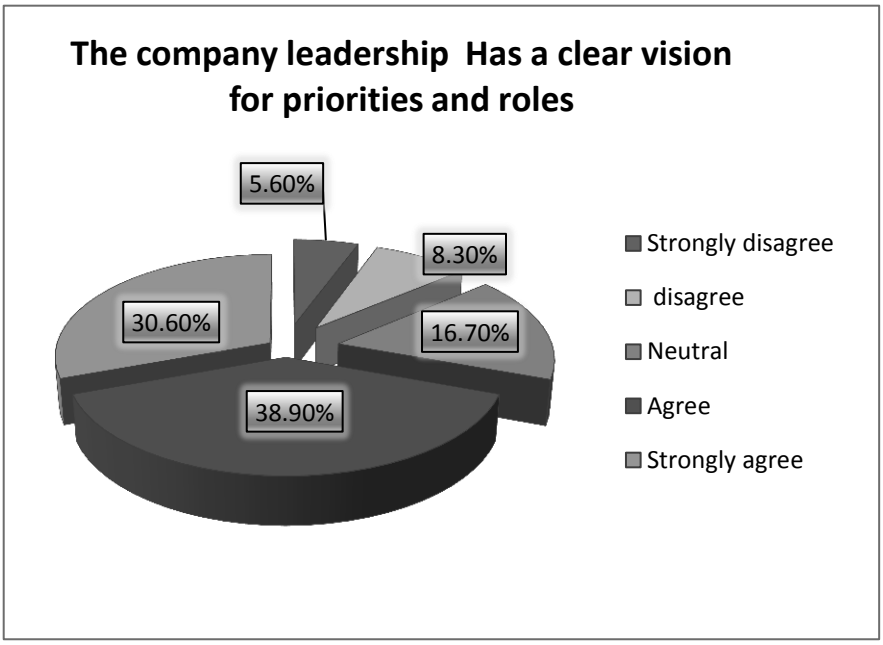

Fig. 19- Source field study

2. (41.70%) Believes that the leadership lead the company to successes by reduces and eliminate of barriers.

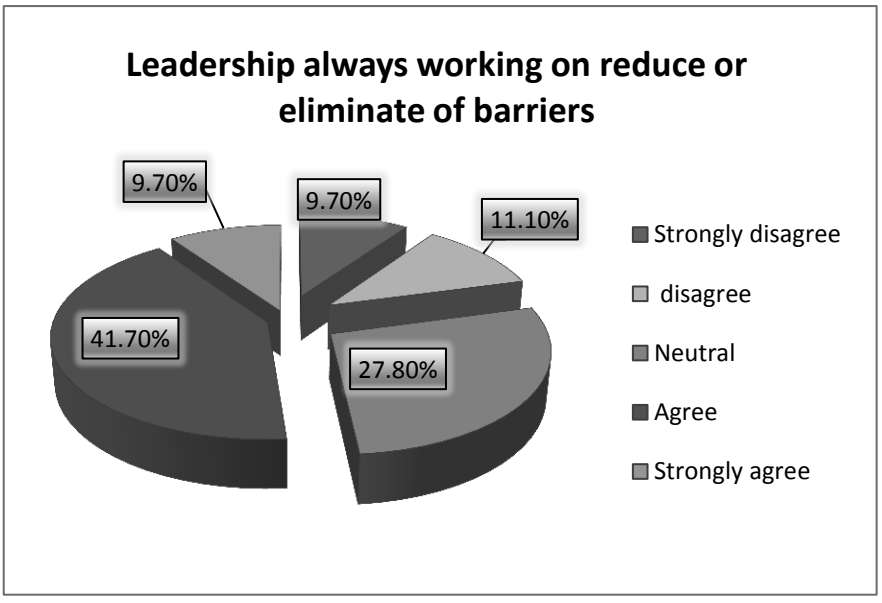

Fig. 20- Source field stud

3.(52.8%)Admitted that leadership energizing motivation in the organization.

Fig. 21- Source field study

4. (48.60%)Agreed on how leadership is care about resources provision and mobilization .

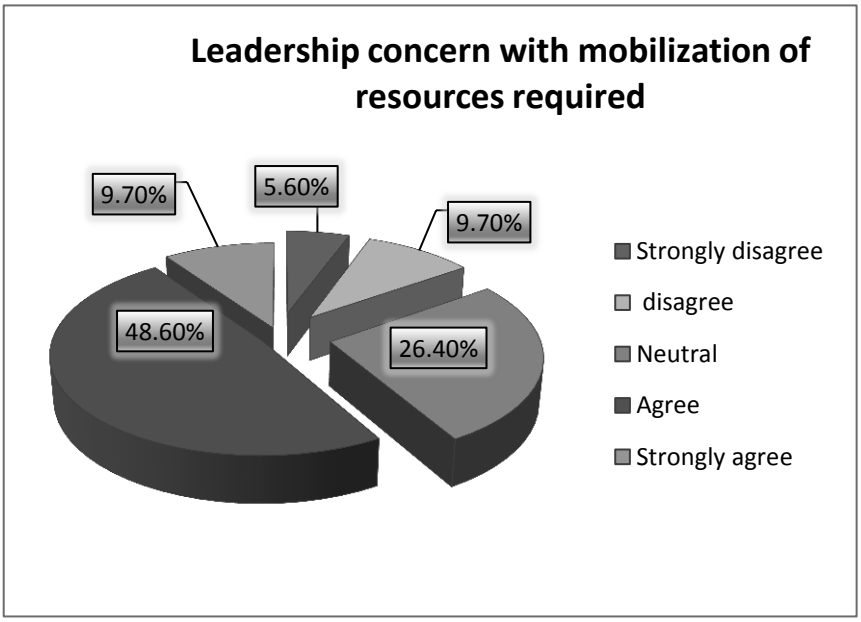

Fig. 22- Source field study

5.Only(11.10%)see leadership as open one who encouraging employees to think and give their opinions.

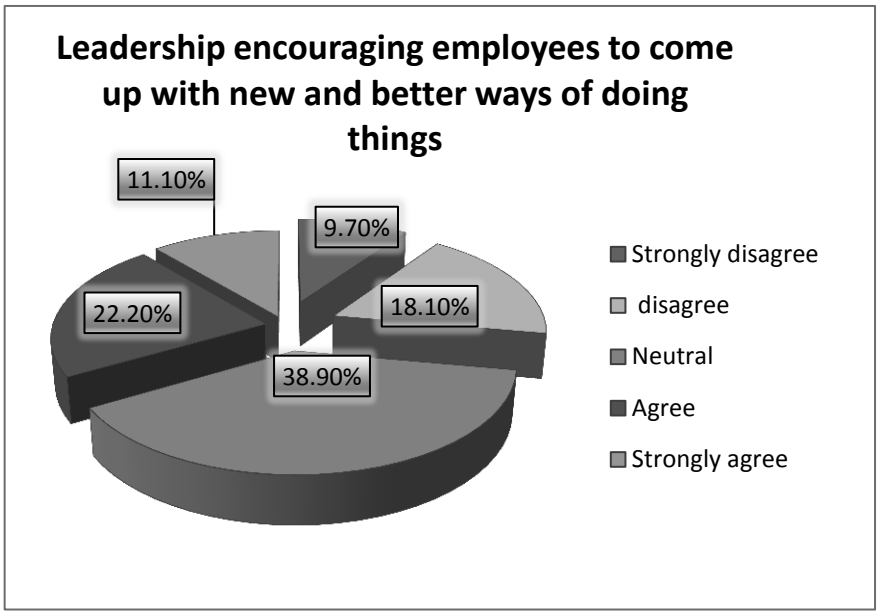

Fig. 23- Source field study

6.Just(4.20%) see leadership concern with taking a good look to the different teams' ideas and directions.

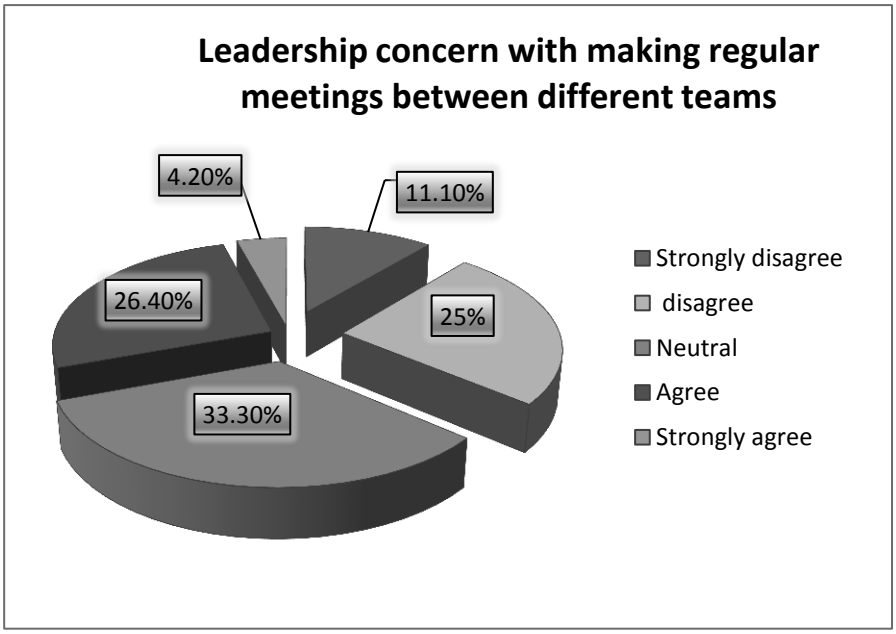

Fig. 24- Source field study

7.Only(12.50%)see the implementation of the open door policy.

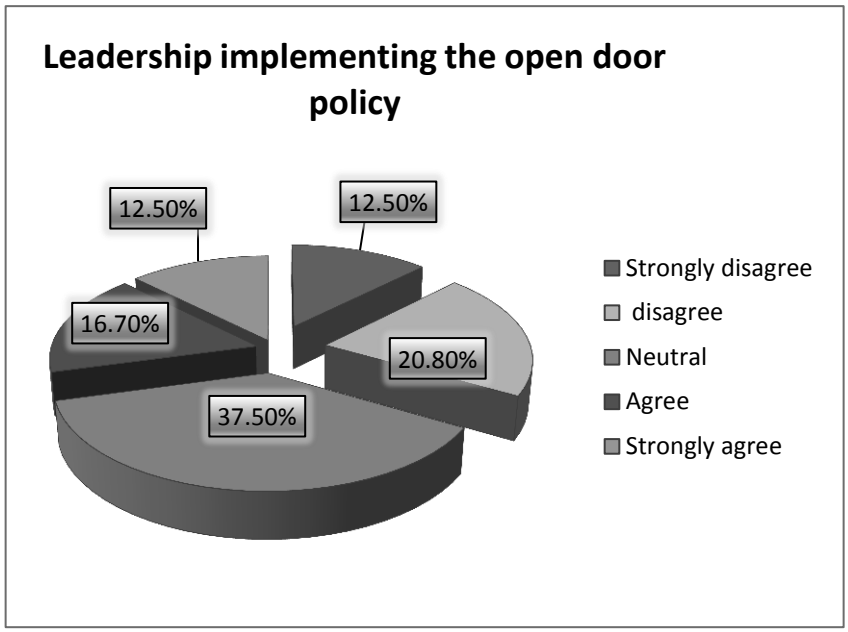

Fig. 25- Source field study

8.(6.90%)say that the leadership assess the employees' strengths and weaknesses.

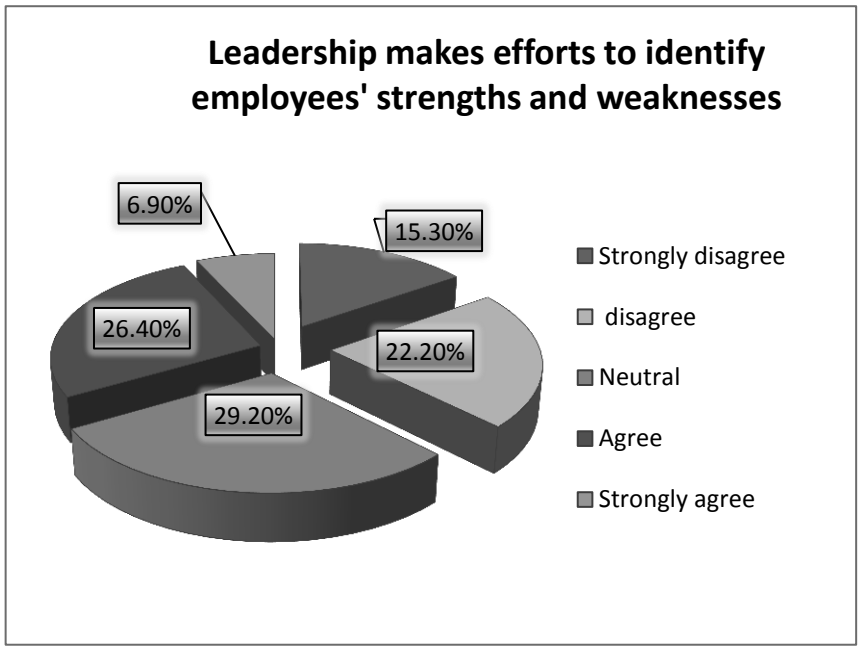

Fig. 26- Source field study

9.Only(6.90%)see the leadership concern about improve the employees facilities, whether (31.90%) doubt the leadership concerns, and (18.10%) strongly upset from their leaders.

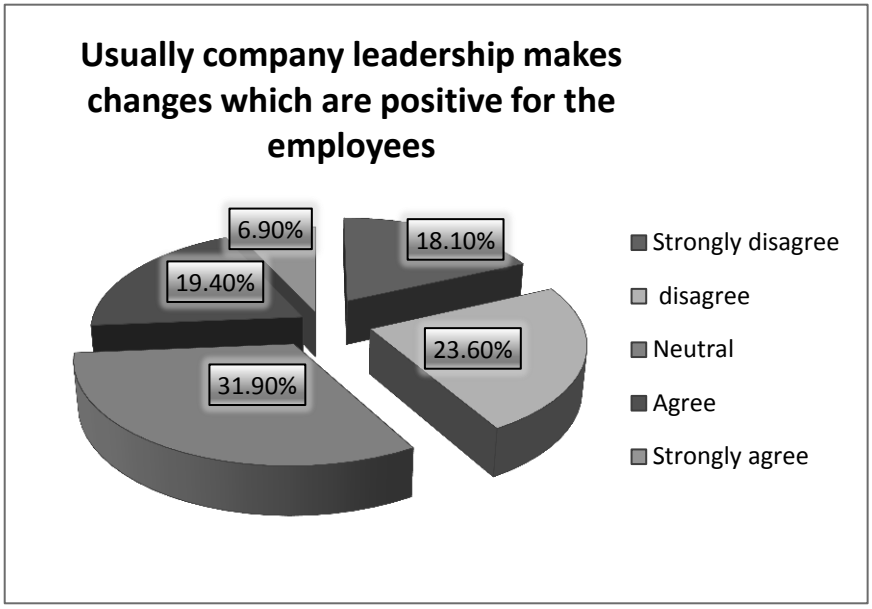

Fig. 27- Source field study

10. Just(4.20%) believes that the leadership concern about training, and the most of population (40.30%) disagreed.

Fig. 28- Source field study

Brief of the section

As shown in the histogram below the respondents do not sure about the company leadership abilities. They describes the leadership as a dictatorial leading style (X-theory) which never care about employees needs and do not consider the quality as everyone responsibility.

4.2.3 Vision and plan statement

1.(15.30%)side they have a clear vision for the next 10years, only (5.6%) strongly confessed that they never concern about the next 10 years.

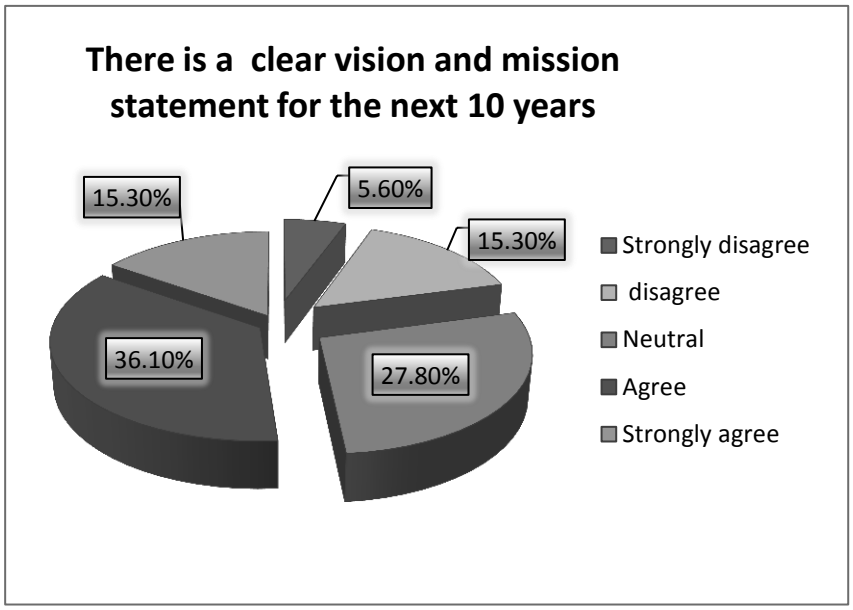

Fig. 29- Source field study

2.(30.60%)Satisfy with the nature of the projects they had, and (43.10%) agreed on that, only (1.40%) are dissatisfy .

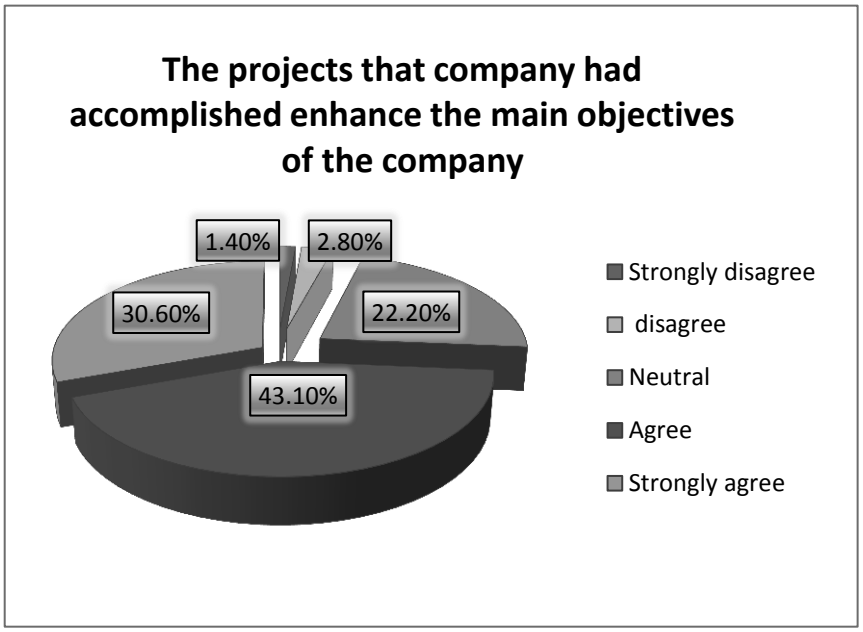

Fig. 30- Source field study

3.(36.10%)described their vision by quality in the performance, and only (1.40%) have no idea about their vision.

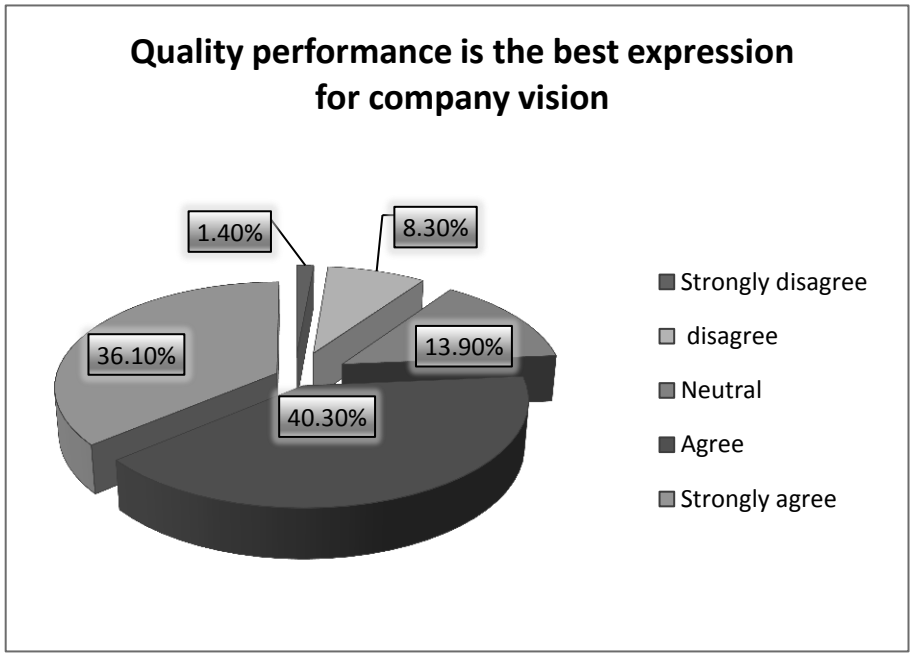

Fig. 31- Source field study

4. Only (8.30%) describes their company as a profitable one, but (40.30%) claim the profit is not the most important thing.

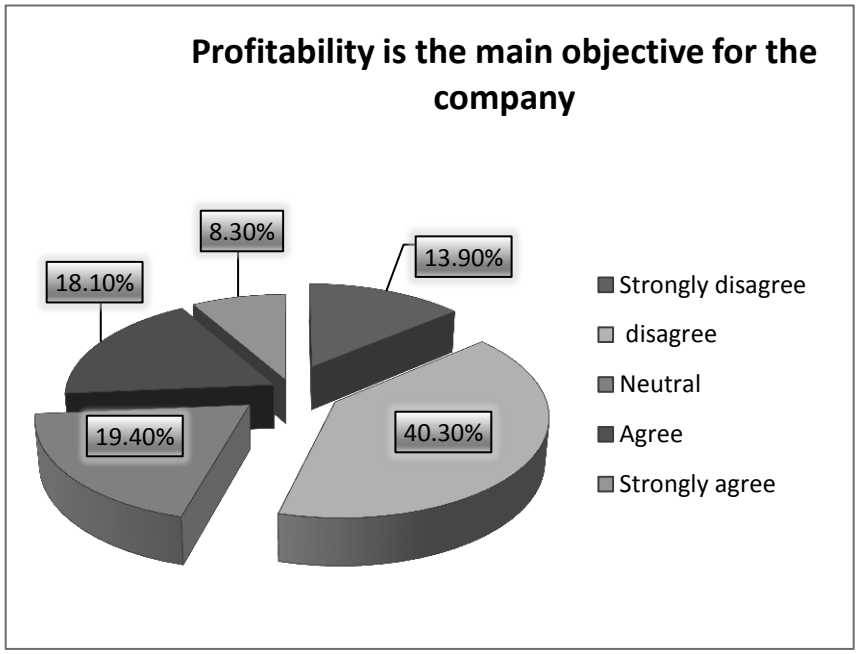

Fig. 32- Source field study

5.(62.50%)Strongly agreed on the important of good reputation for the company, but only (5.60%) strongly disagreed.

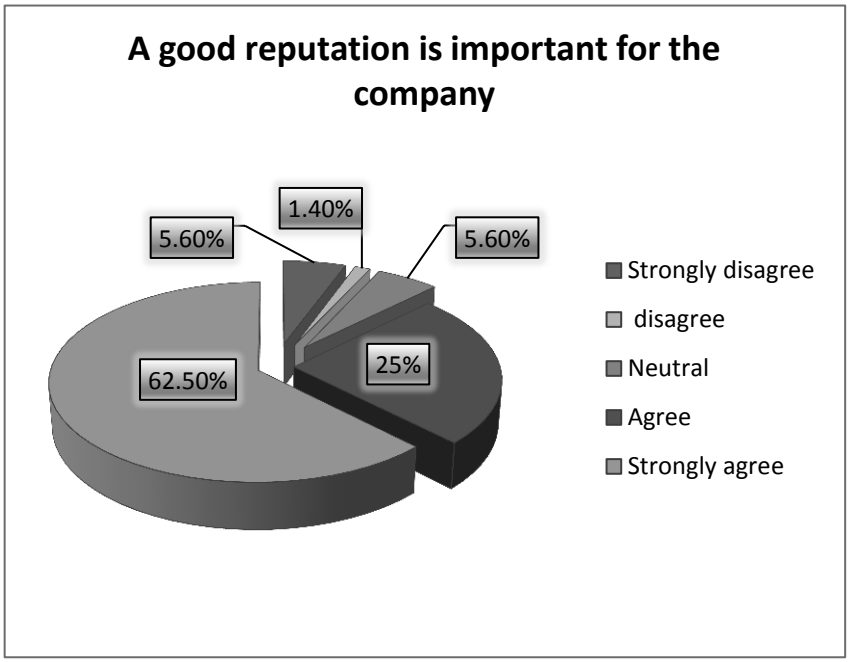

Fig. 33- Source field study

6.(36.10%) agreed on the importance of the customer satisfaction to reach company objectives, and only (2.80%)were disagreed

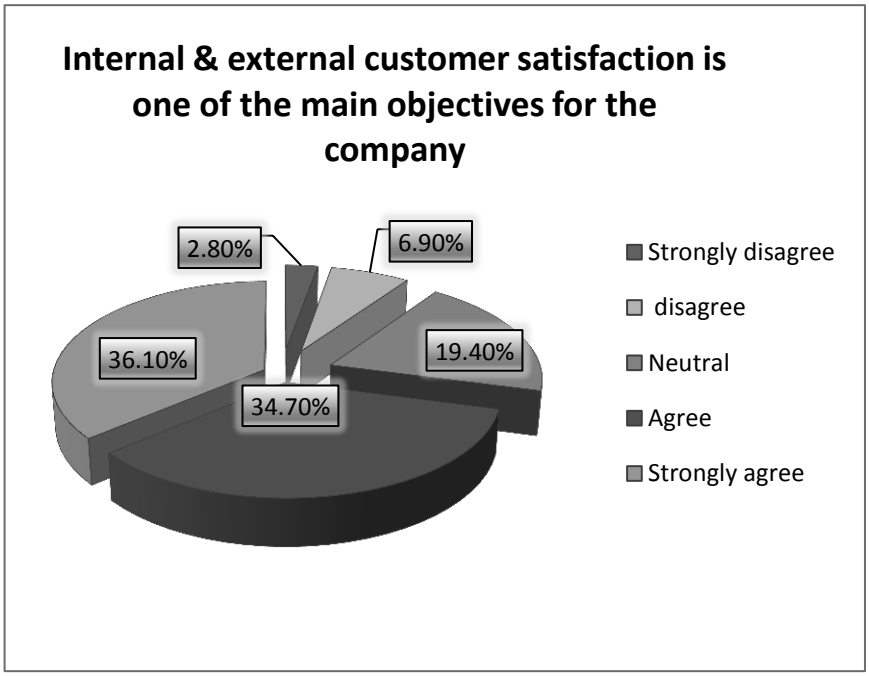

Fig. 34- Source field study

7. (20.80%) Claims that IT is one of their priorities, but (36.10%) didn't care about that. Only (2.80%) were disagreed with the IT.

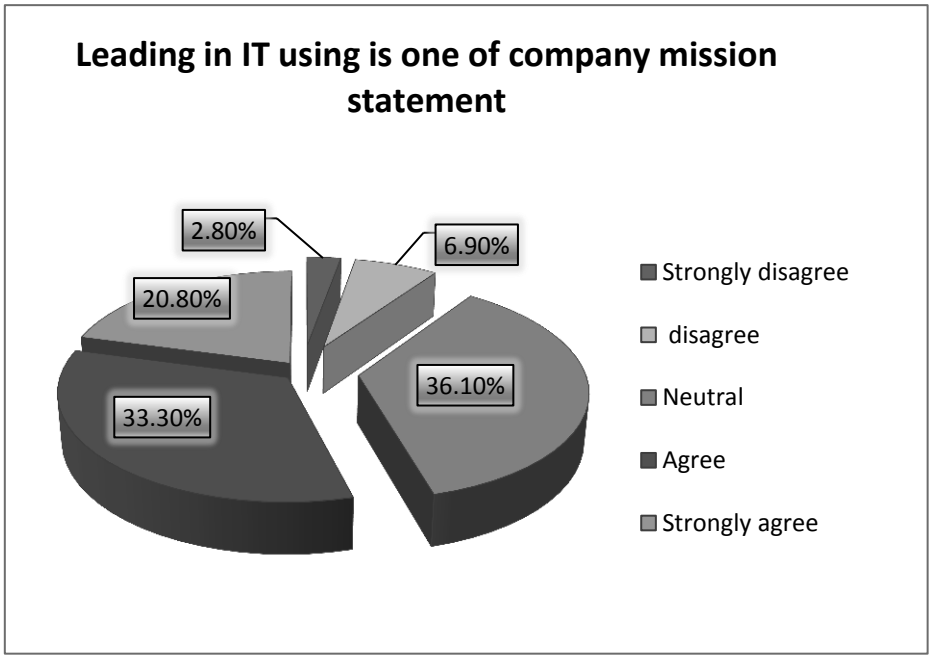

Fig. 35- Source field study

8.(9.70%)Claims that the company care about assessing its situation, and (19.40%) shows that they don't consider about self-assessment.

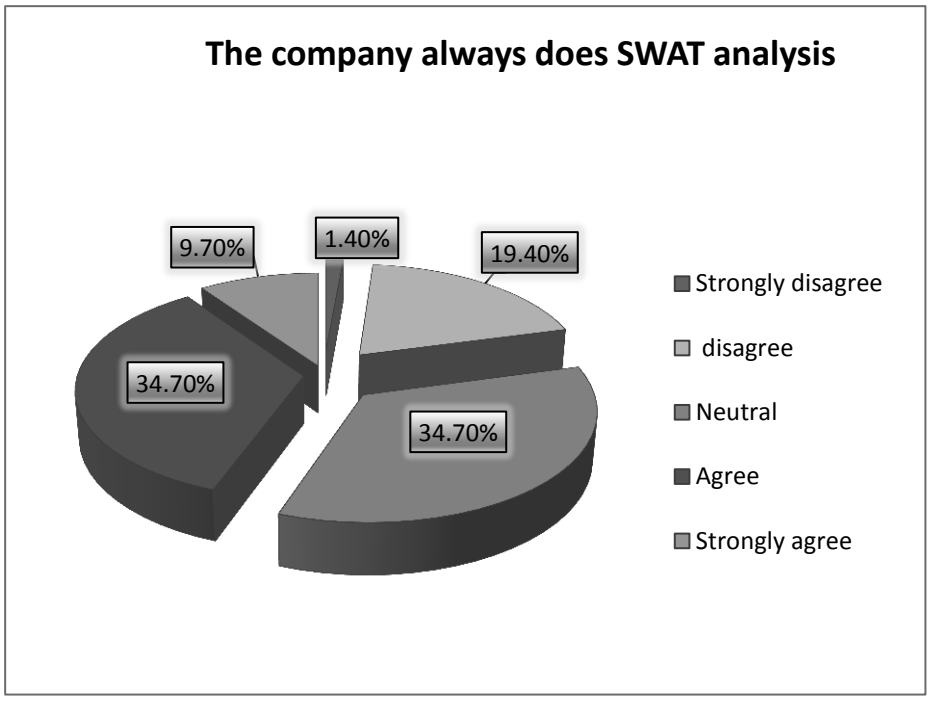

Fig. 36- Source field study

10.(20.80%) feel the importance of employees awareness of company vision and mission , the same percentage (13.90%) were disagreed and strongly disagreed on the employees involvement in the strategic planning.

Fig. 37- Source field study

Brief of the section

As shown in the histogram below the respondents know the important of strategic planning but they do not know how to execute the steps that will lead to strategic planning from identify clear vision, mission, objectives and goals to activation of this steps by spread the awareness of this planning between the employees.

4.2.4 Customer focus

1.(61.10%)care about making a good impression to the customer , only (2.80%) didn't care

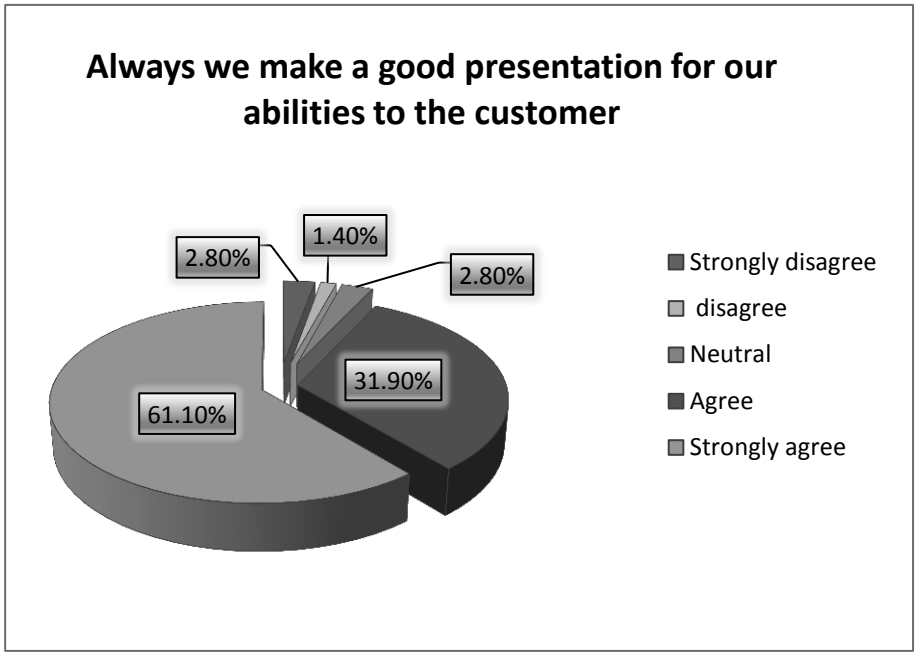

Fig. 38- Source field study

2.(26.40%)Claims that they keeping in contact with customers after handover to get feedback , (27.80%) not sure about that

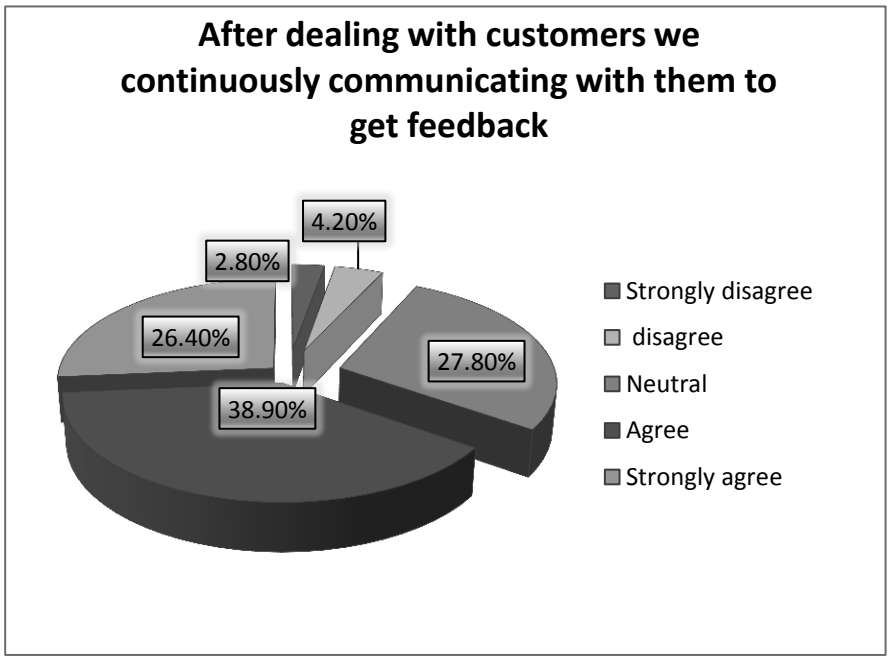

Fig. 39- Source field study

3.Only(4.20%)had a serious legislation issues with the customer , but (27.80%) working in maintain a good relations with the customers

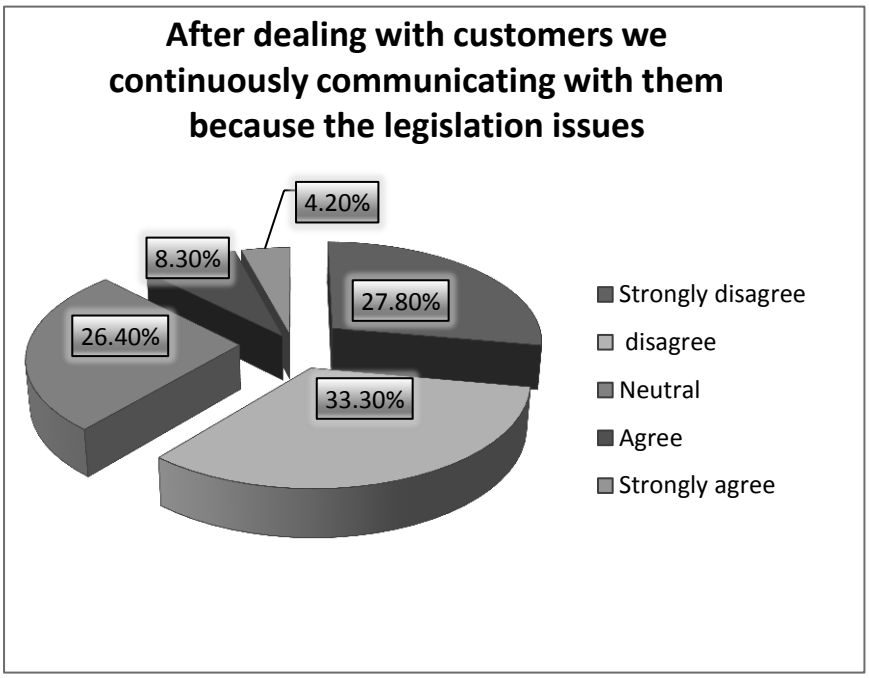

Fig. 40- Source field study

4.(34.70%)Claims that they always can understand customer needs, only (2.80%) can't get the customer thoughts.

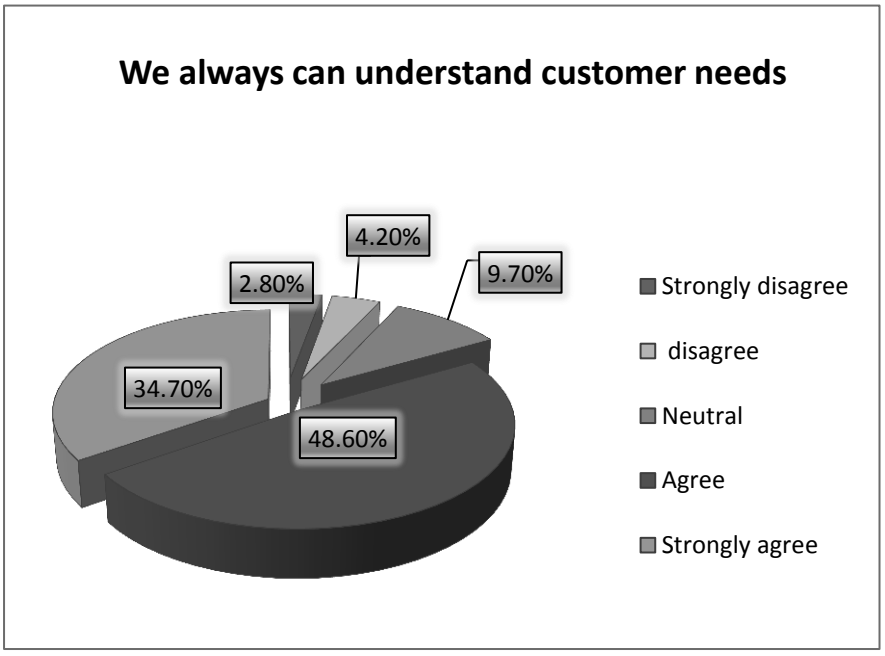

Fig. 41- Source field study

5.(47.20%)Believe they have the ability to solve problems, also (44.40%) agreed on that, a small percent don't sure and don't care.

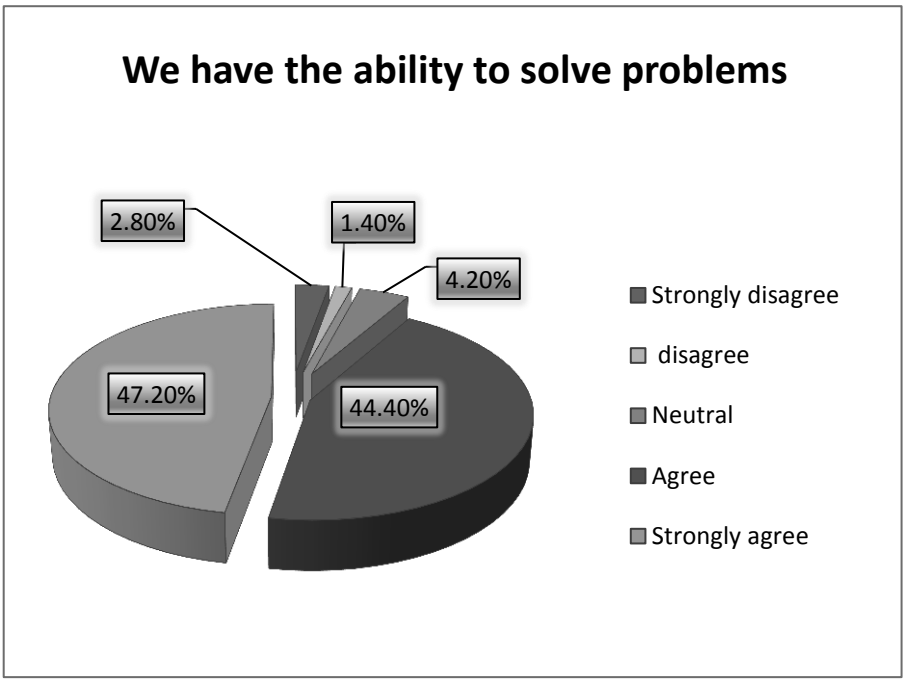

Fig. 42- Source field study

6.(40.30%)claims that their responsiveness is so high and the same percent also agreed

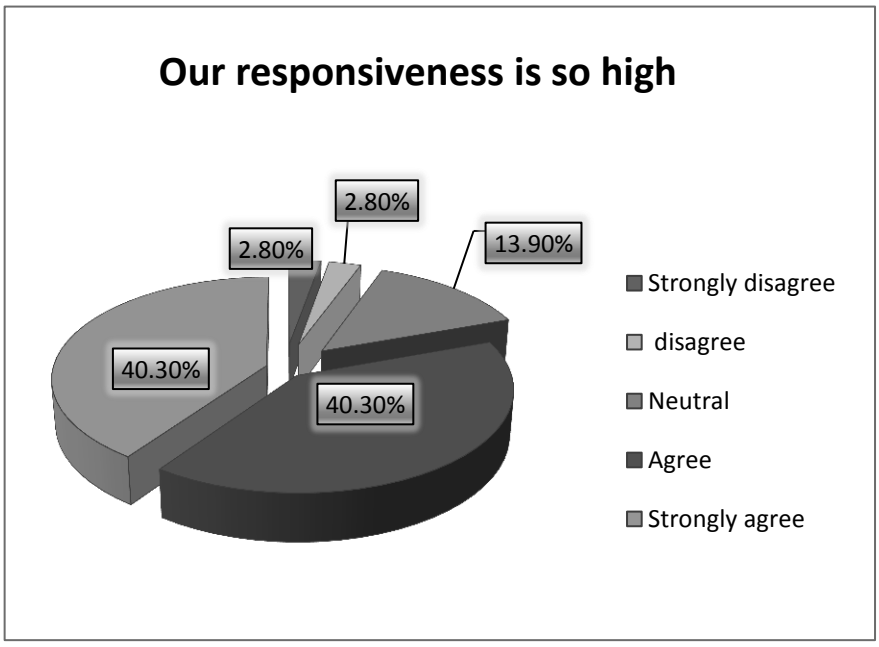

Fig. 43- Source field study

7.(19.40%)agreed on the important role of customer during the execution phase, but (38.90%) don’t sure about that.

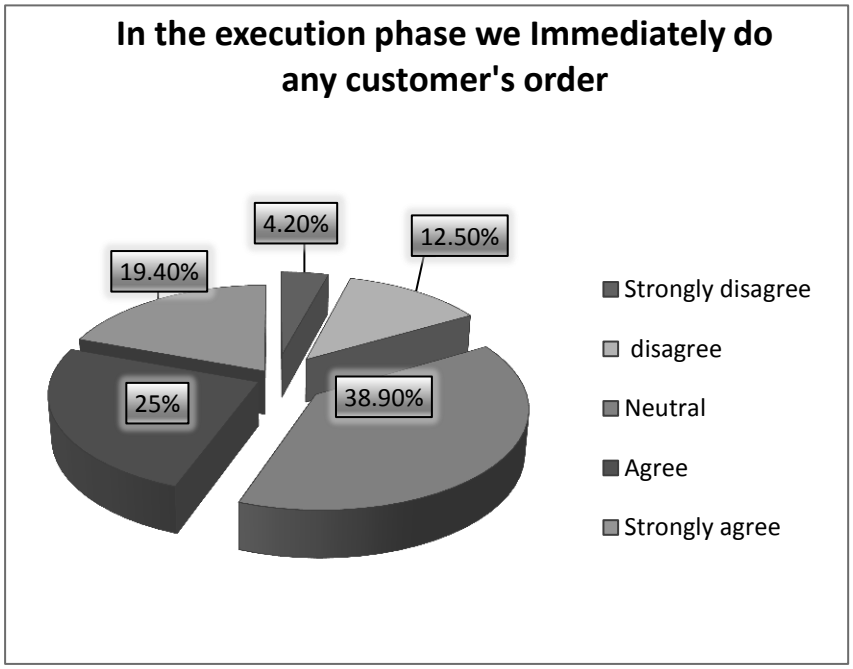

Fig. 44- Source field study

8.(30.50%)considered keeping customer aware with everything is very important , and only (12.50%) disagreed

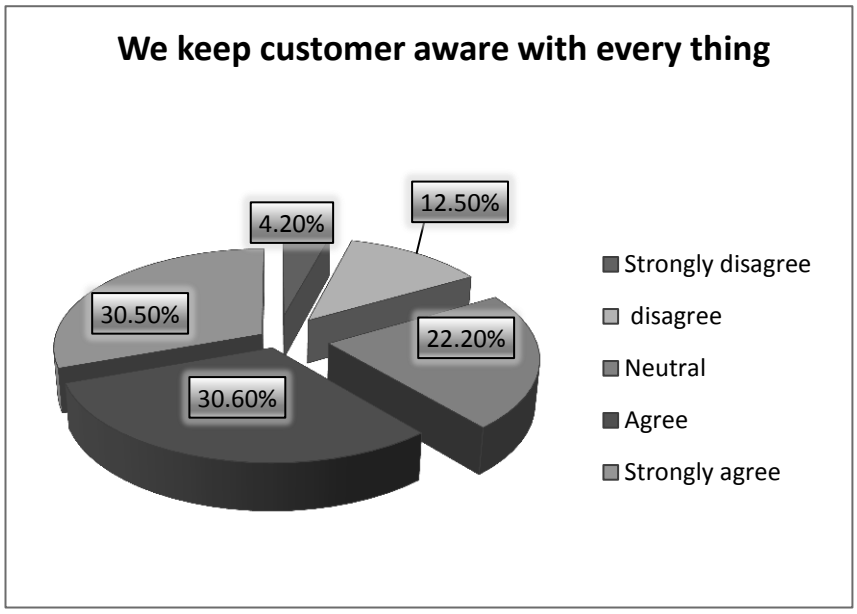

Fig. 45- Source field study

9.(20.80%)take the customer advises to solve problems, but (12.50%) never do that.

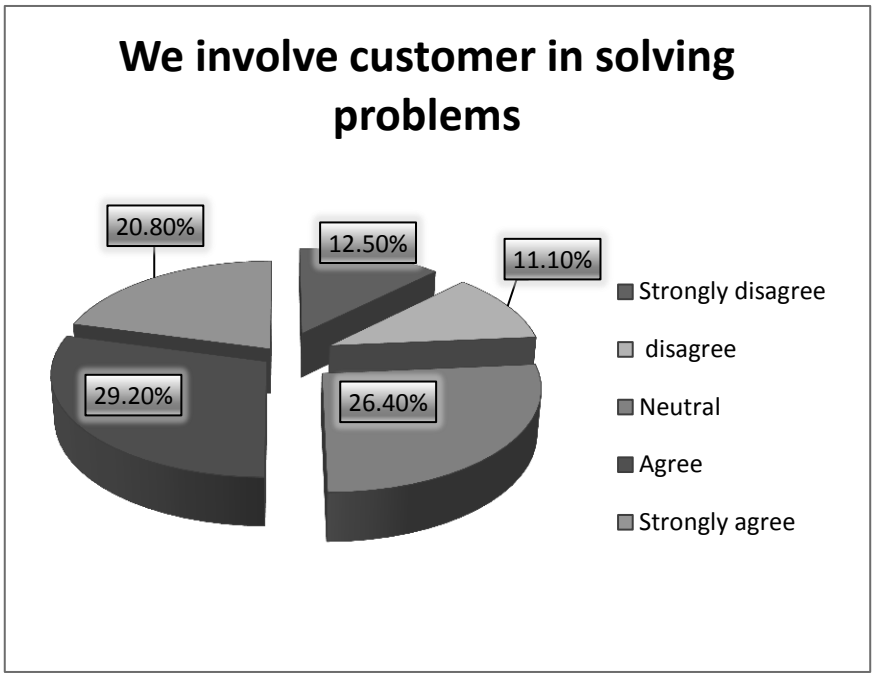

Fig. 46- Source field study

Brief of the section

As shown in the histogram below the respondents know the important of take care about customers and in general they deal with customer very well but they do not let the customer take enough involvement in the project execution phases.

4.2.5 Human Resource Management

1.(15.30%)claim that they have an excellent employment system.

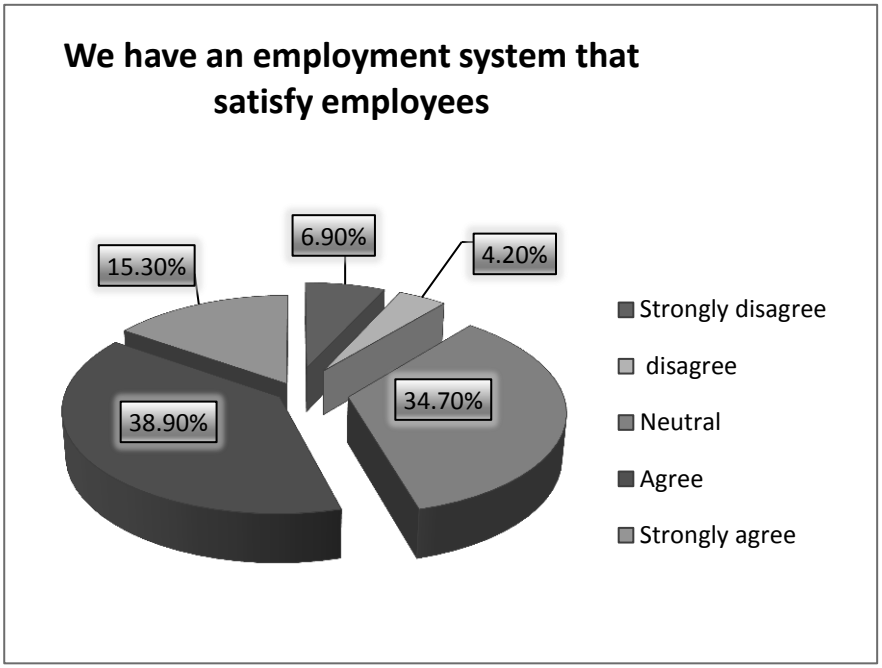

Fig. 47- Source field study

2.(19.40%)Believes that the employees have all facilities that helps them to do their work perfectly.

Fig. 48- Source field study

3. (23.60%) think that the employees have a good idea about quality .

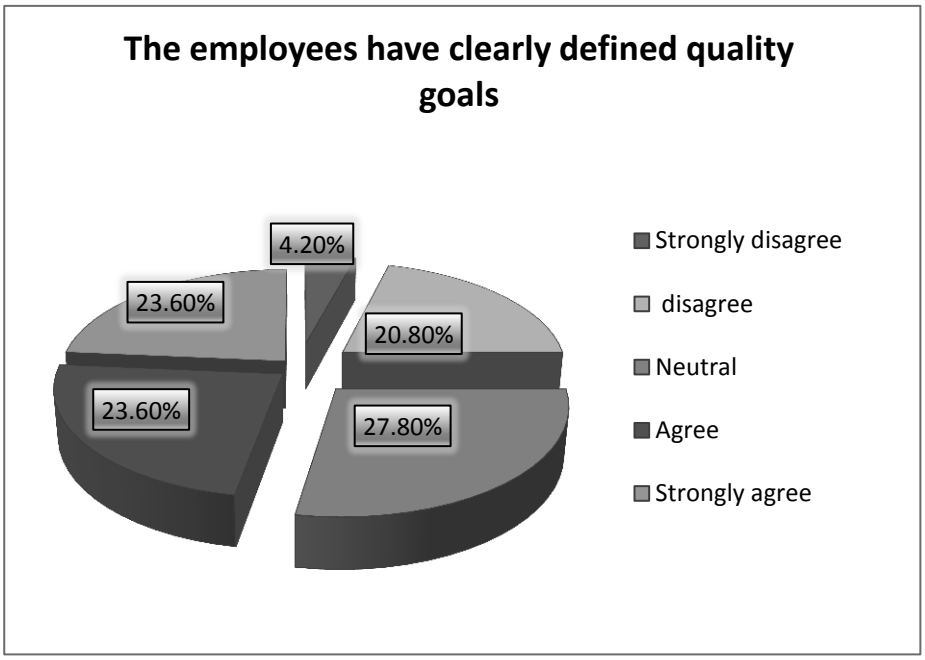

Fig. 49- Source field study

4.(34.70%)know about the importance of employees involvement.

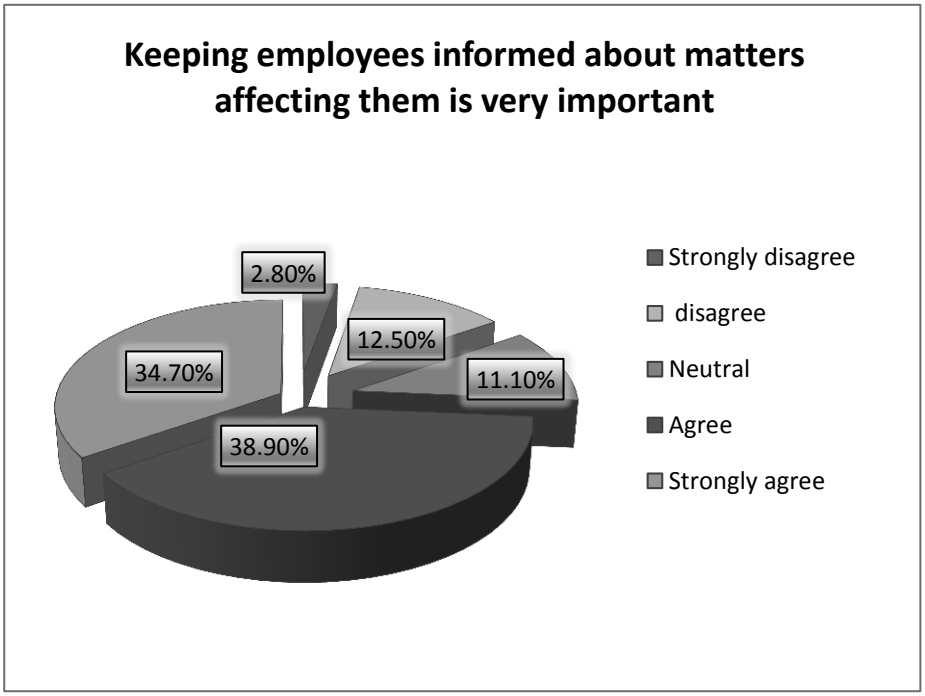

Fig. 50- Source field study

5.Only(16.70%)caring about employees training.

Fig. 51- Source field study

6.(27.80%)claim that there is a clear system of rewards.

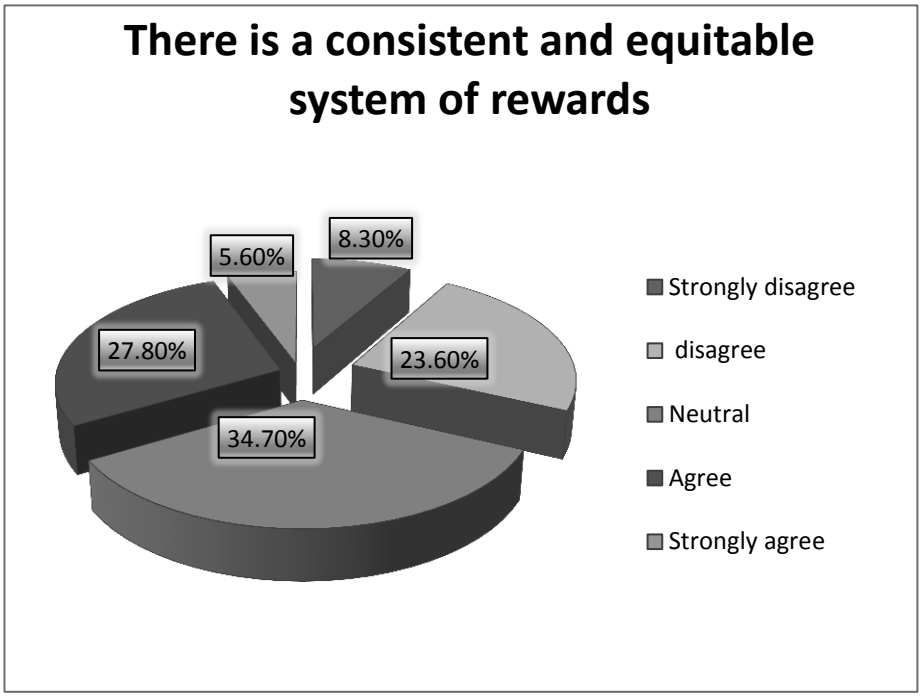

Fig. 52- Source field study

7.(18.10%)claim that their recruitment system is straight and fair.

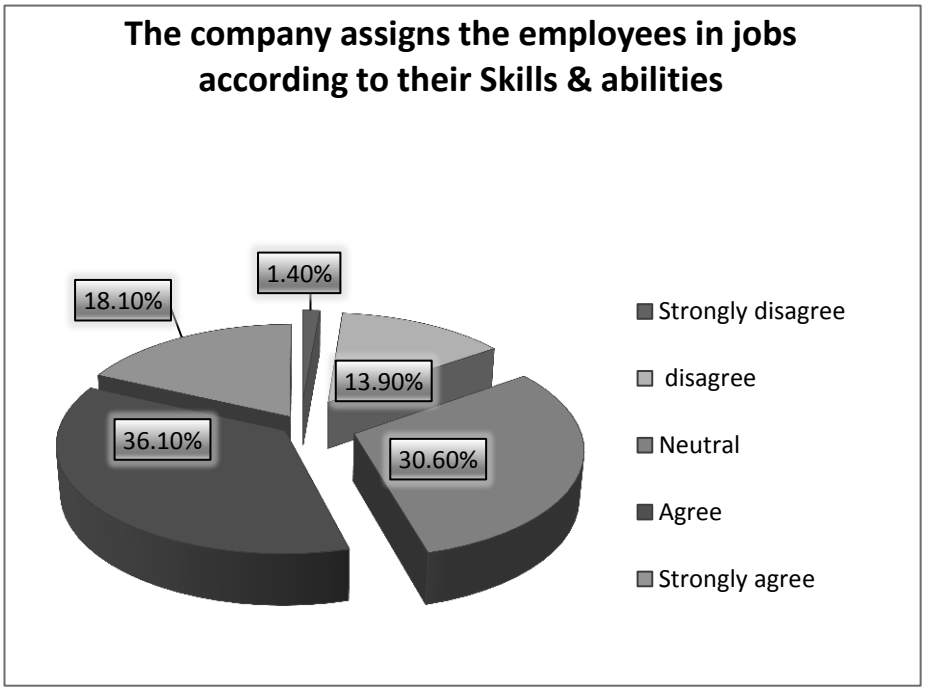

Fig. 53- Source field study

8.(38.90%)admitted that there is employees turnover.

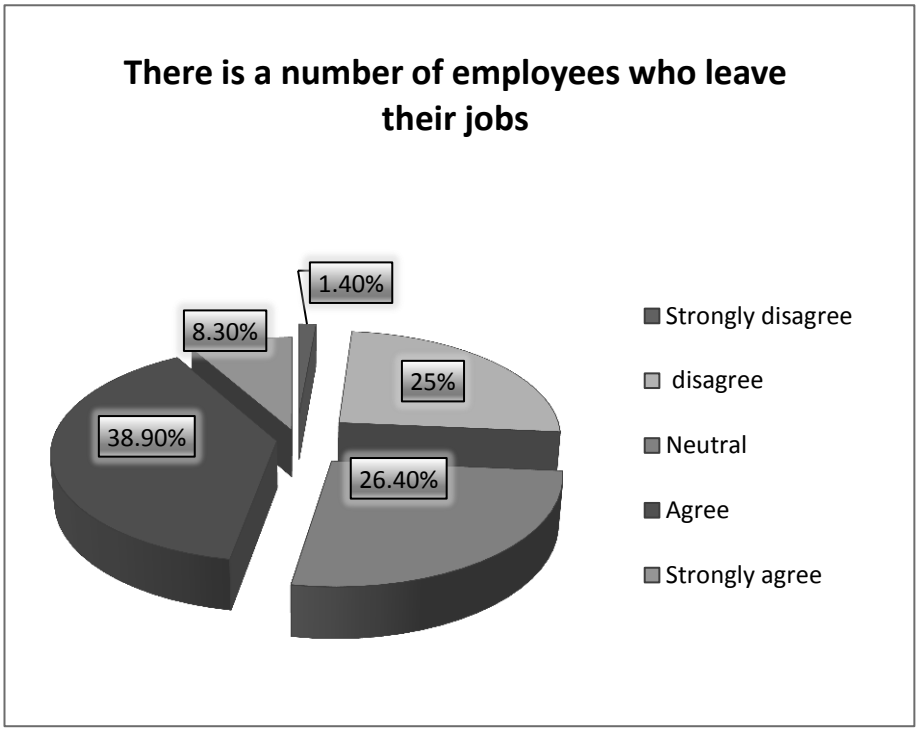

Fig. 54- Source field study

9.(38.90%)think there is a good relationships bonding teams together.

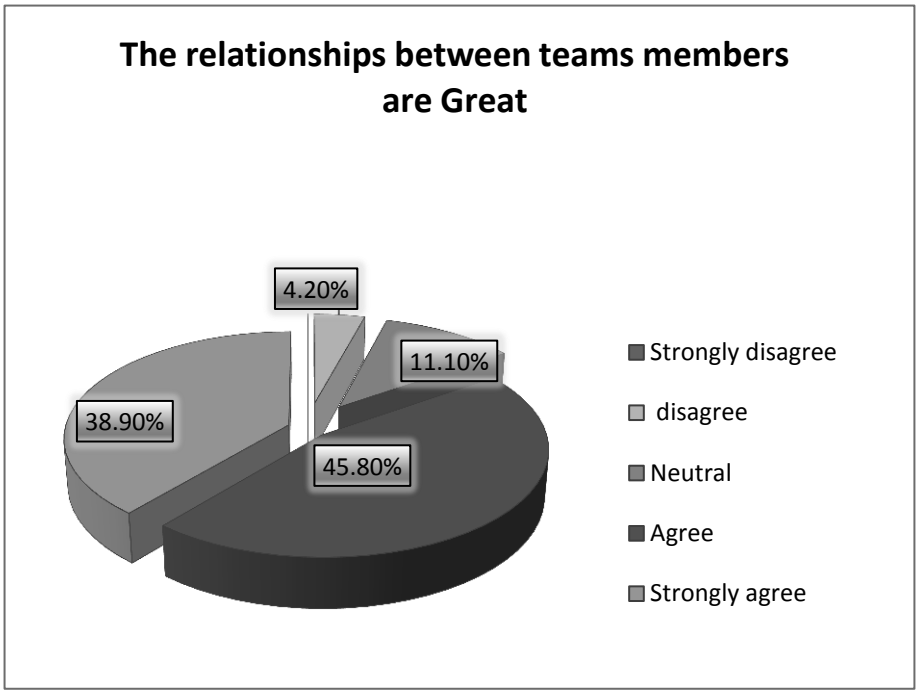

Fig. 55- Source field study

10.(22.20%)admitted that the employees do not take what they deserve from recognition.

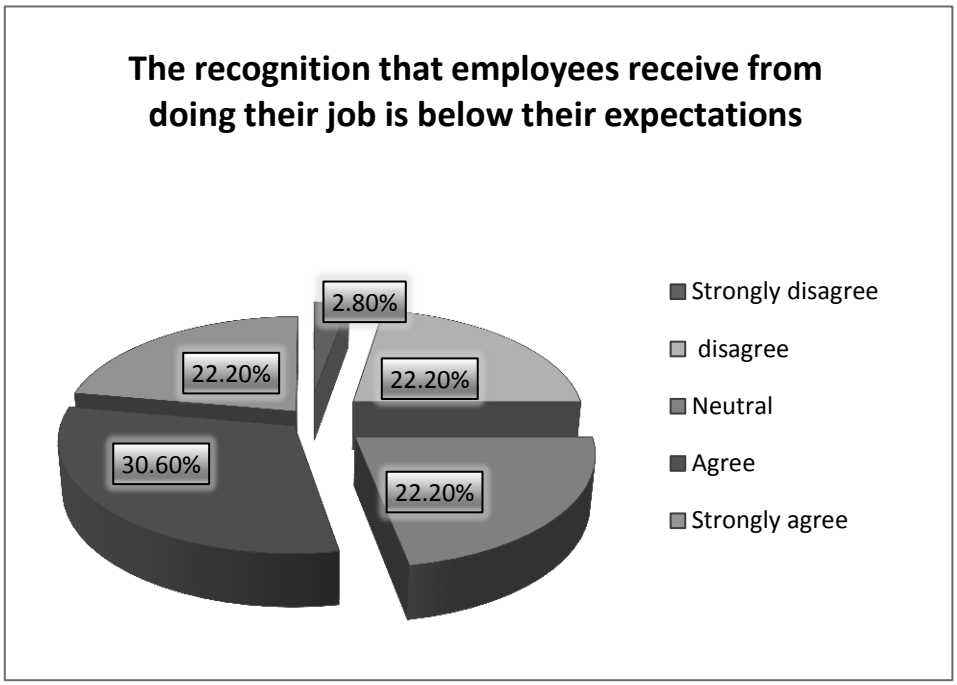

Fig. 56- Source field study

11.(76.00%)strongly agree on the employees voice can reach the upper management.

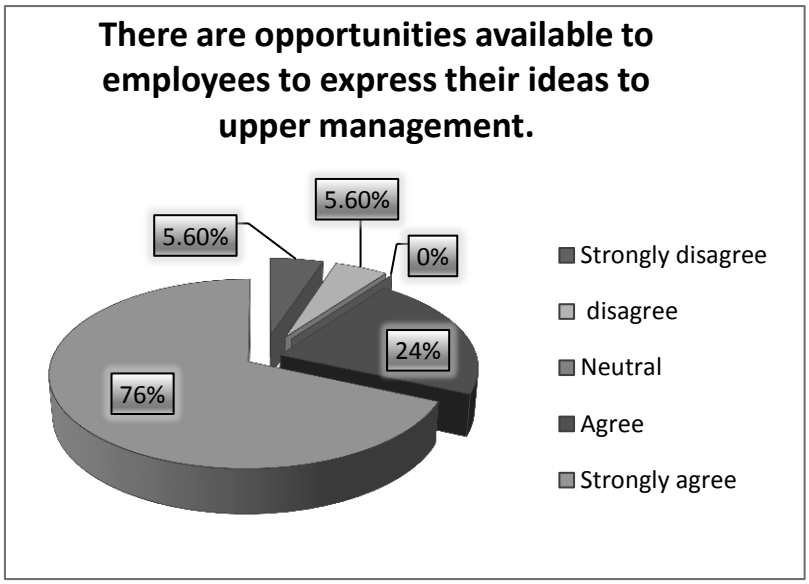

Fig. 57- Source field study

Brief of the section

As shown in the histogram below the respondents know the important of take care about their employees and in general they give the minimum employees requirements and needs, but they do not care about training , motivation, empowerment , and job enhancement & innovation.

4.2.6 Supplier Quality Management

1.Only(9.70%)are use on-line computer order system

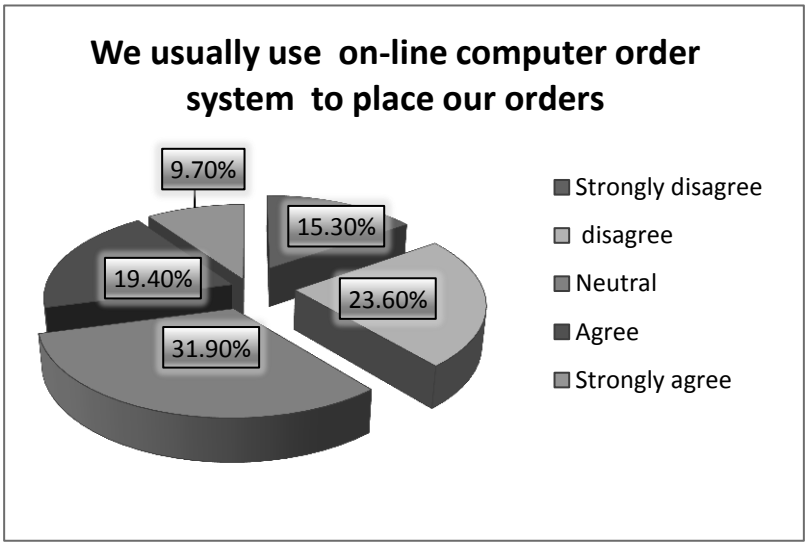

Fig. 58- Source field study

2.Just(2.80%) had training arrangements with the suppliers.

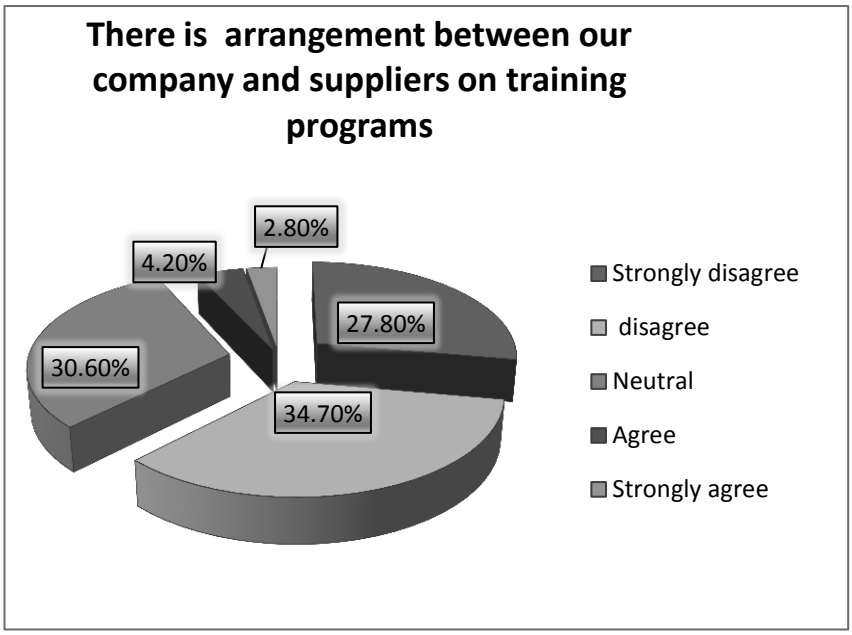

Fig. 59- Source field study

3.(19.40%)agreed on indeed they deal with many suppliers.

Fig. 60- Source field study

4.Just(24.00%)choose their supplier according to his reputation.

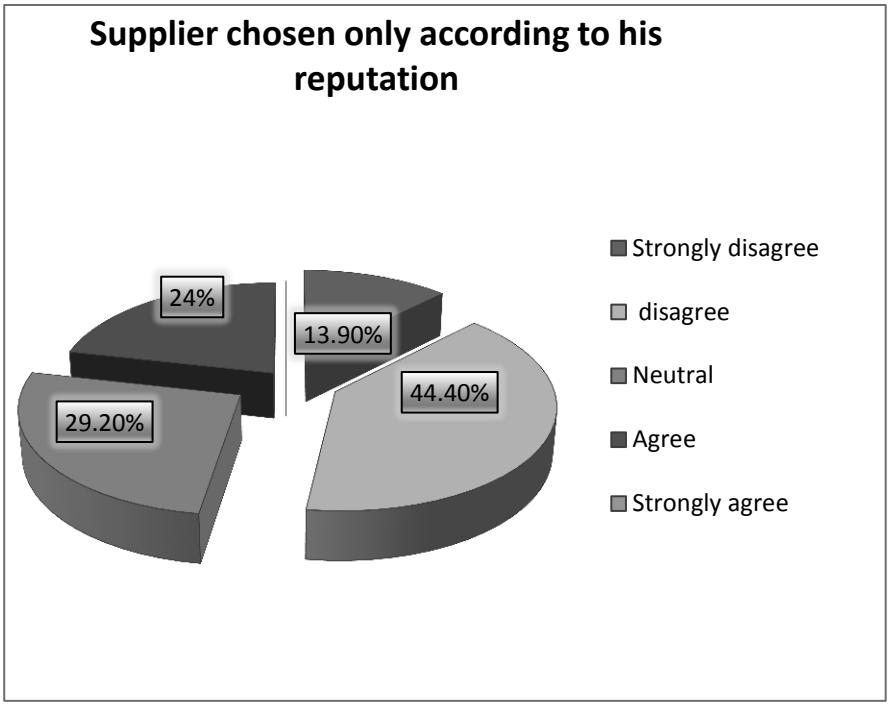

Fig. 61- Source field study

5.(36.10%)prefers to deal with the supplier who give more facilities.

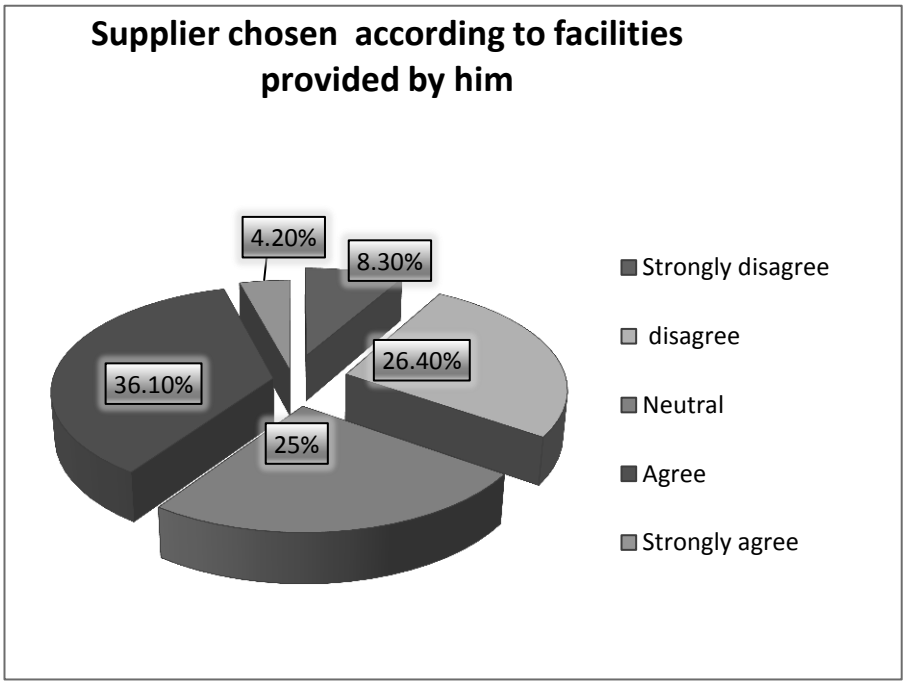

Fig.62- Source field study

6.(37.50%) prefers to deal with the supplier who provide a quality product.

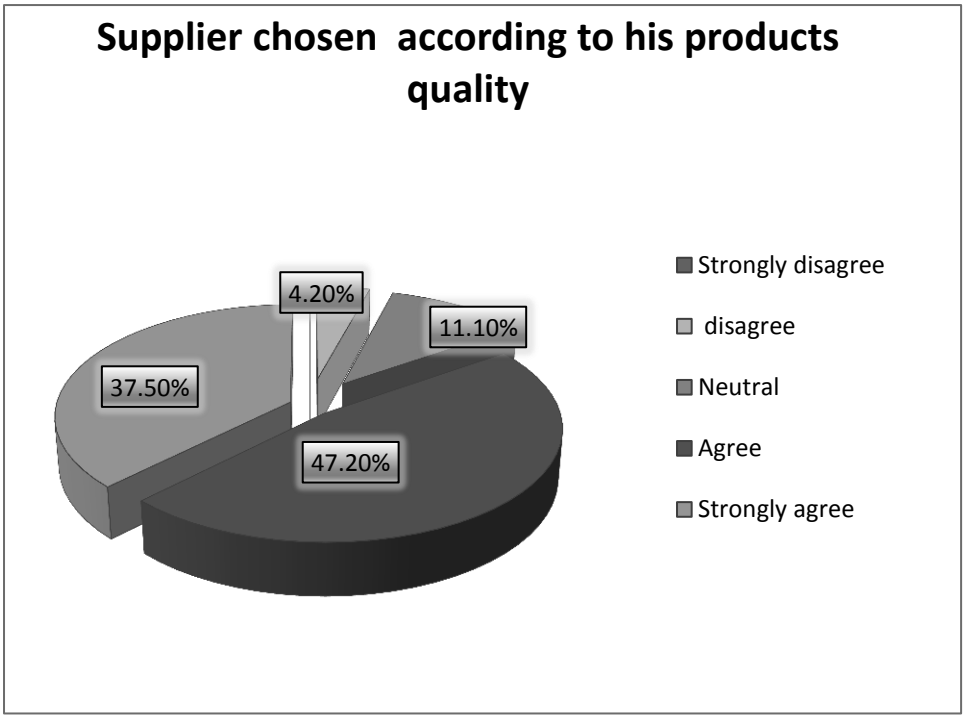

Fig. 63- Source field study

7.(18.10%)happy with the delivery time of their supplier.

Fig. 64- Source field study

8.(16.70%)agree that their supplier delivers the products without breakage.

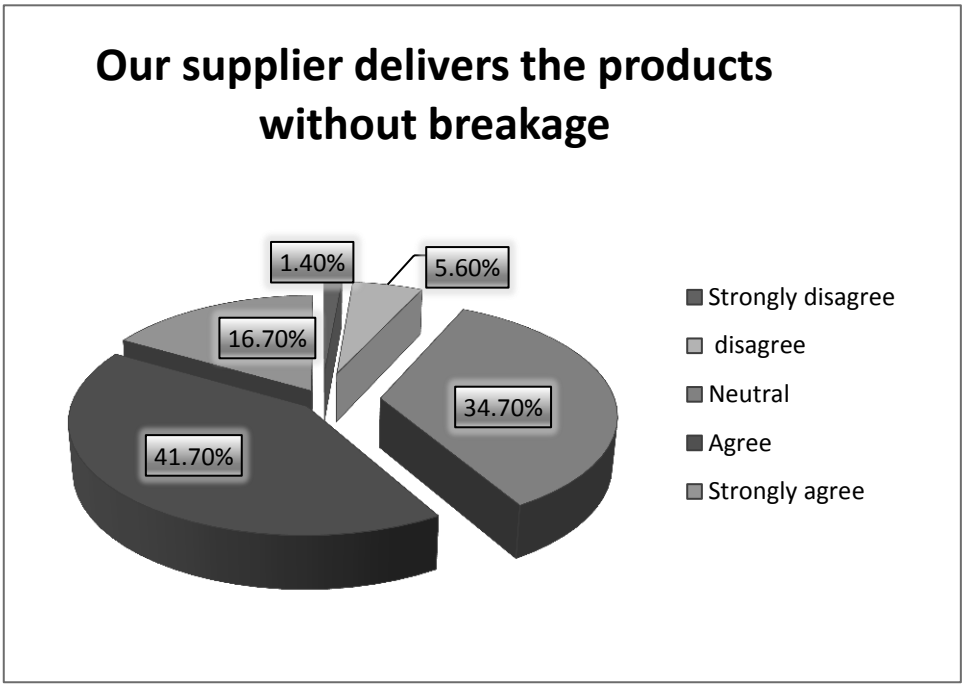

Fig. 65- Source field study

9.(69.50%)agreed on their suppliers have available lines.

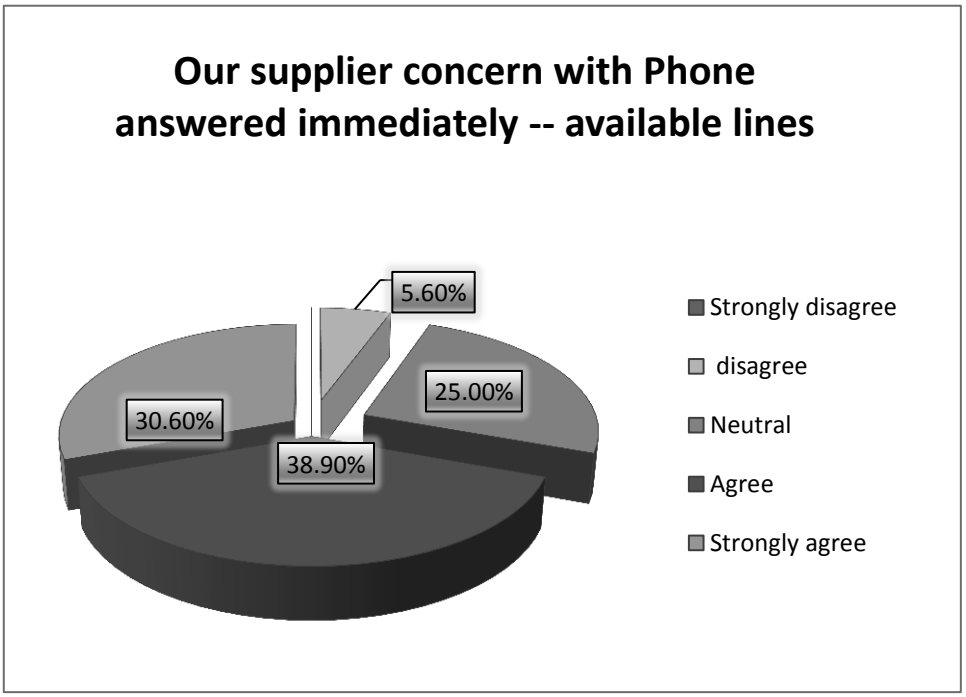

Fig. 66- Source field study

10.Only(13.90%)have a supplier with discounting policies.

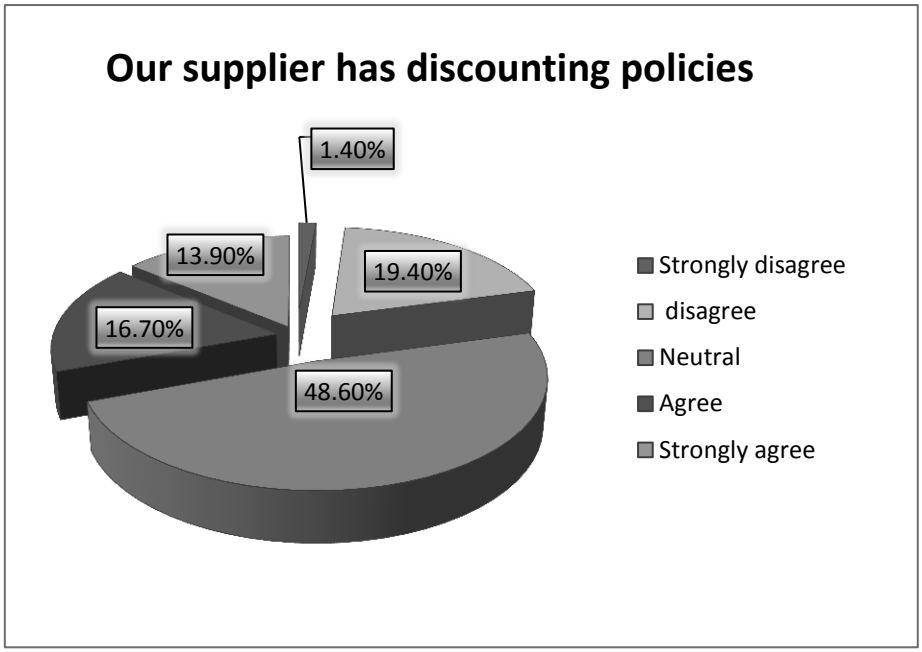

Fig. 67- Source field study

Brief of the section

As shown in the histogram below the respondents do not deal with suppliers by modern methods and the relationship between them is too short so there is many suppliers. there is no standard criteria's to choose the best supplier, they depend on try and error.

4.2.7 Process Control & Improvement

1.(51.40%)Claims that they perform their job as processes

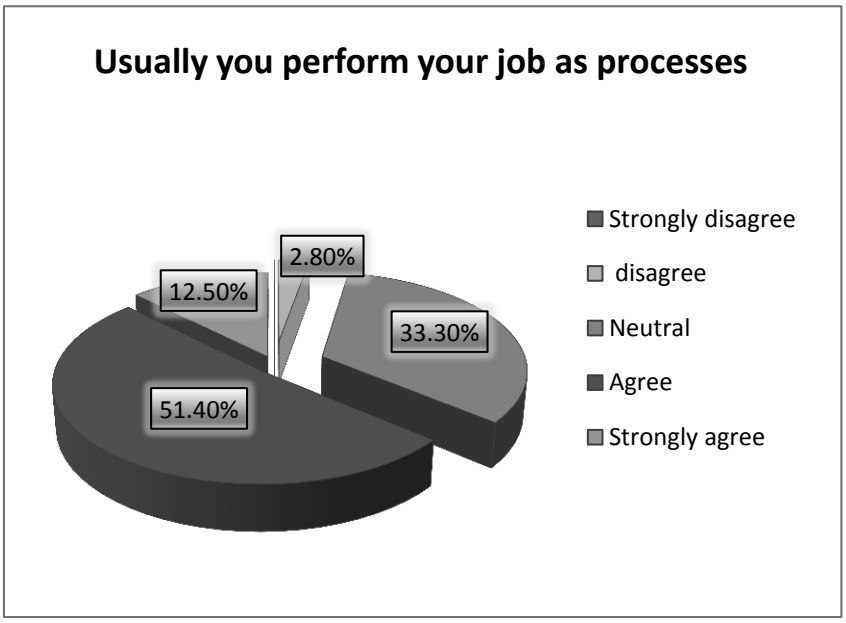

Fig. 68- Source field study

2.(15.30%)Identify their job processes and prepare for every single one.

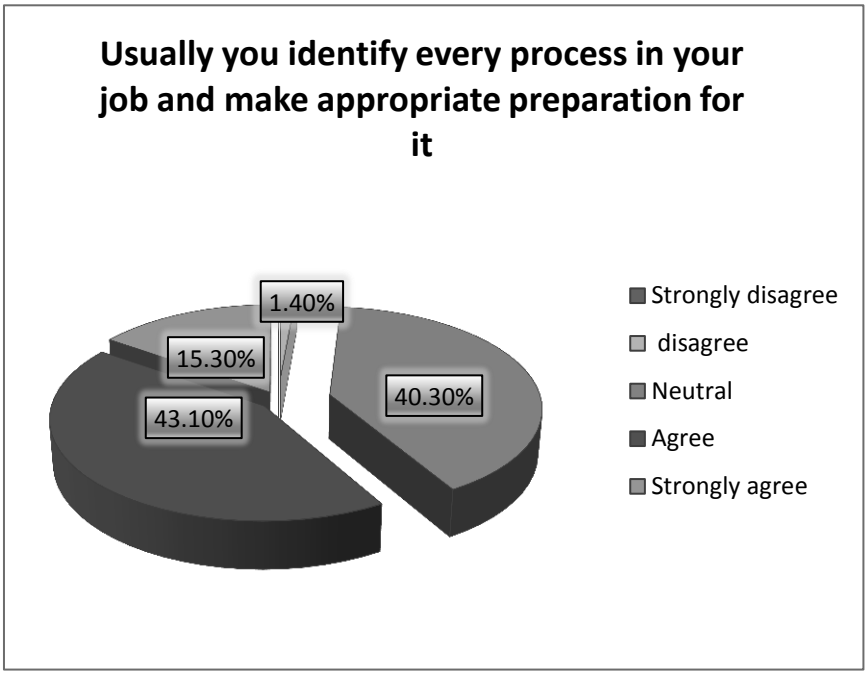

Fig. 69- Source field study

3.(38.90%)Strongly agree on bond between the process planning and profits increasing.

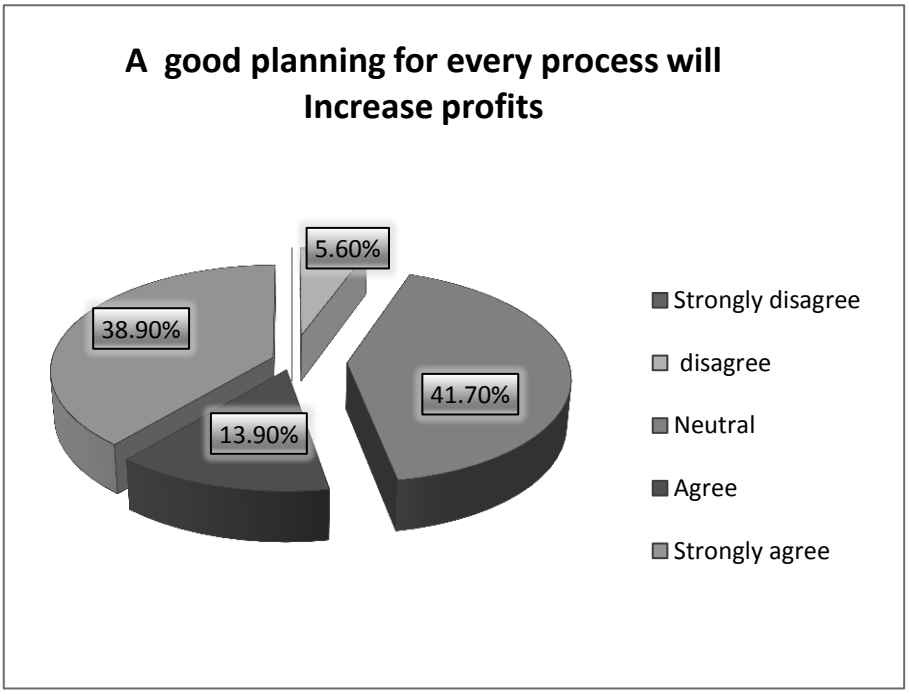

Fig. 70- Source field study

4.(31.90%)Strongly agree on the relationship between process planning and decreasing of errors & rework.

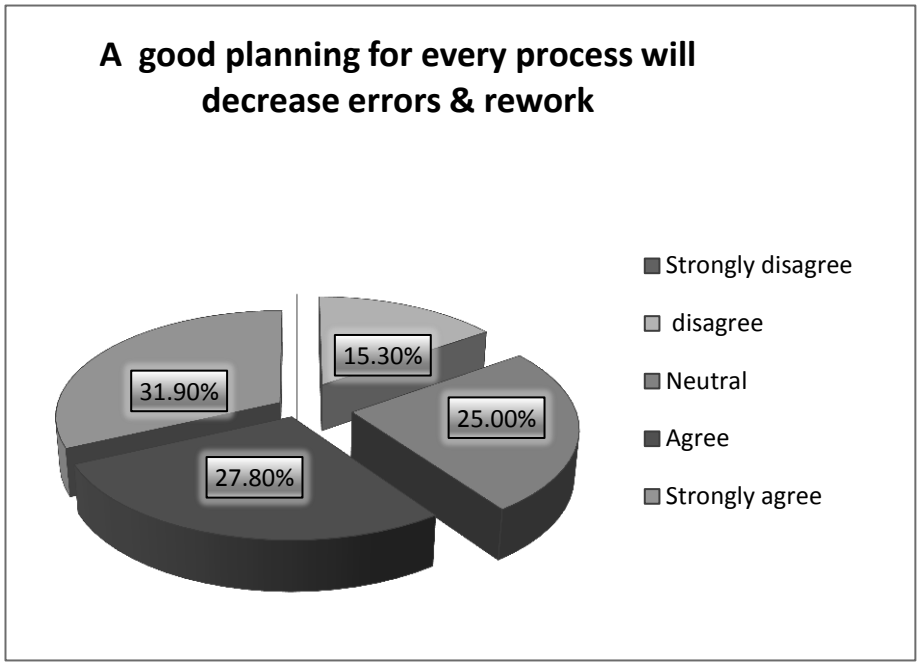

Fig. 71- Source field study

5.(22.20%) Agreed on the relationship between process planning and customer satisfaction.

Fig. 72- Source field study

6.(30.60%)Agreed on the relationship between process planning and reduction of quality costs although the same percentage disagree on that.

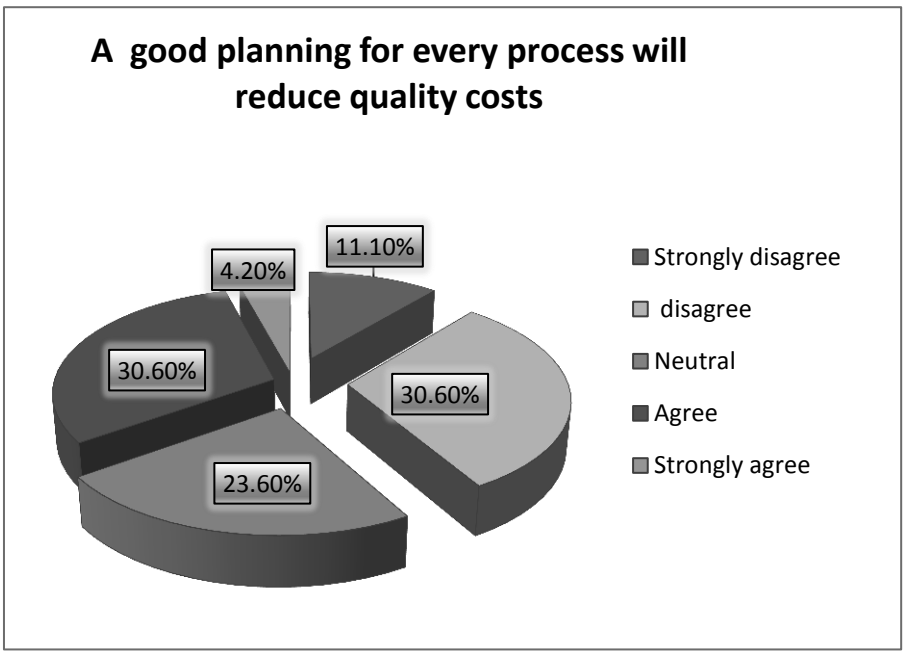

Fig. 73- Source field study

7.Only(2.80%)are aware about the TQM seven process measures.

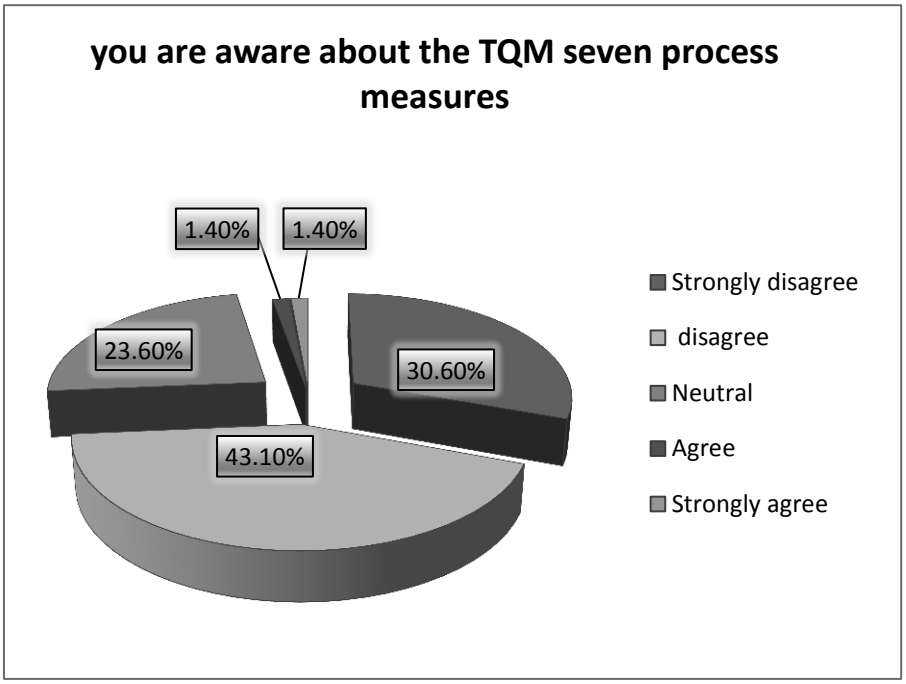

Fig. 74- Source field study

Brief of the section

As shown in the histogram below the respondents have a kind of idea about the important of doing jobs as processes and how that will affect profits, customer satisfaction and decrease errors, rework and quality costs , but they do not know how to apply that in their actual life because they have no idea about the TQM process measurement tools.

4.2.8 Communications Management

1.(50.00%)satisfy with the amount of communication inside the company.

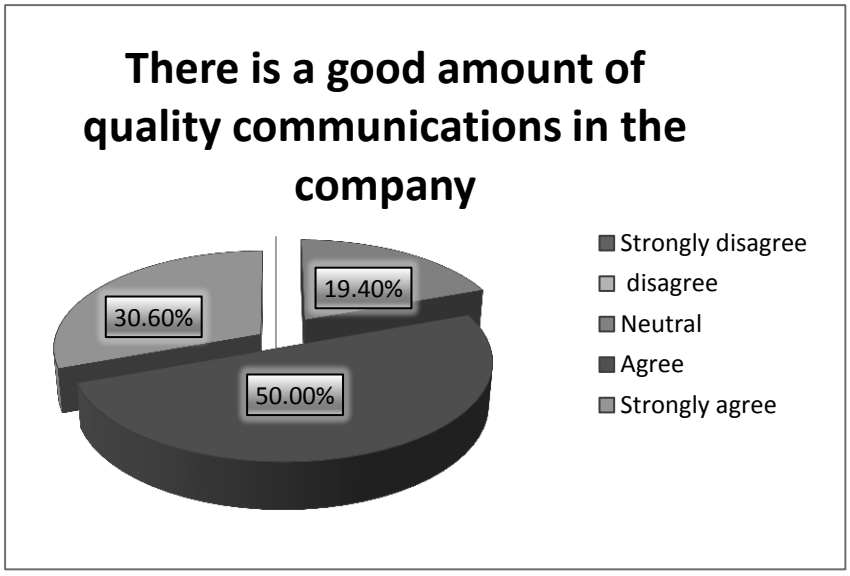

Fig. 75- Source field study

2.(20.80%)Claims that they doing well when it comes to meet the consultant and customer.

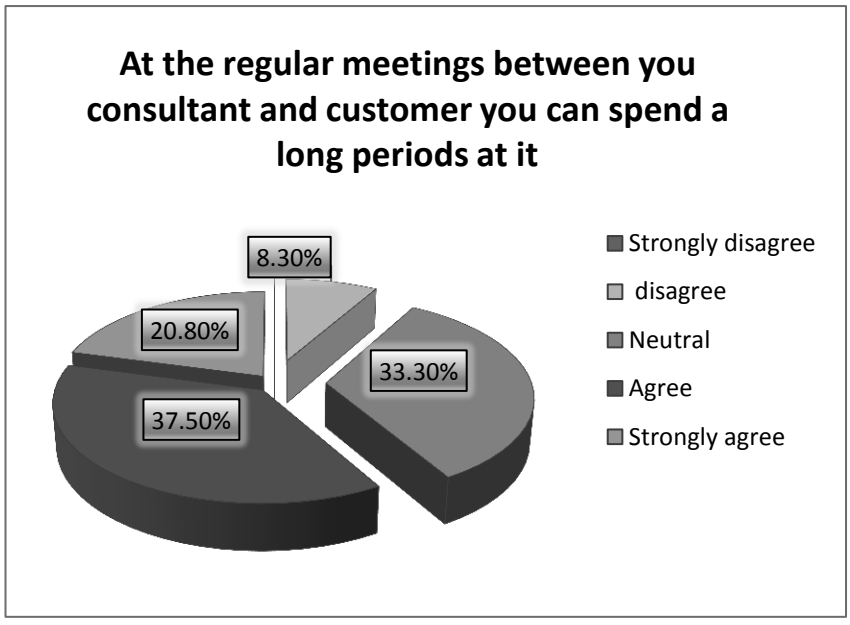

Fig. 76- Source field study

3.(15.30%)Claim that they have an effective documentation system.

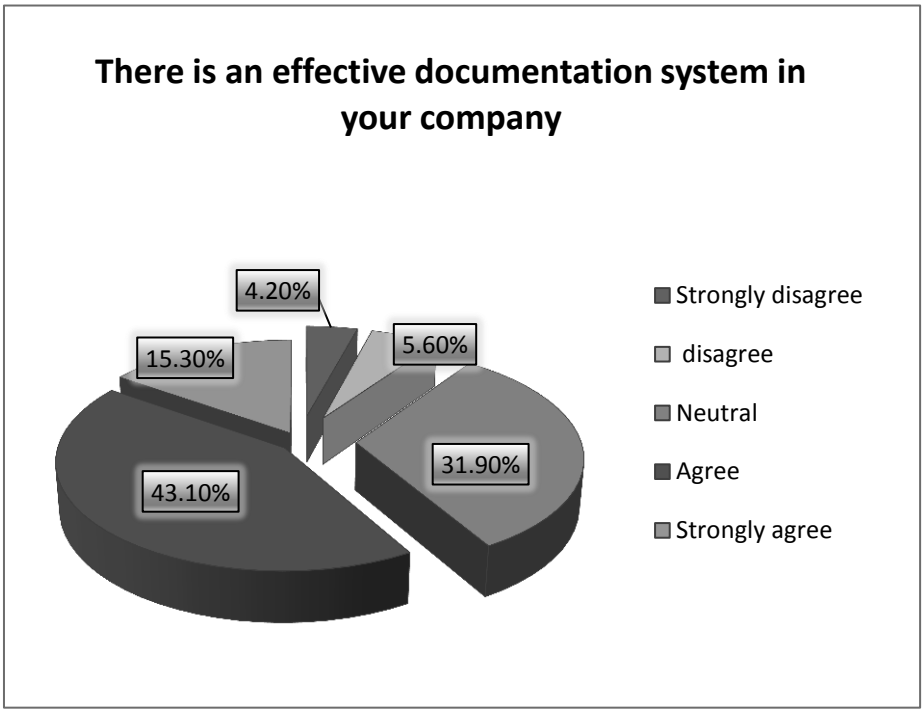

Fig. 77- Source field study

4.(16.70%)feel that the documentation system is suitable to their needs.

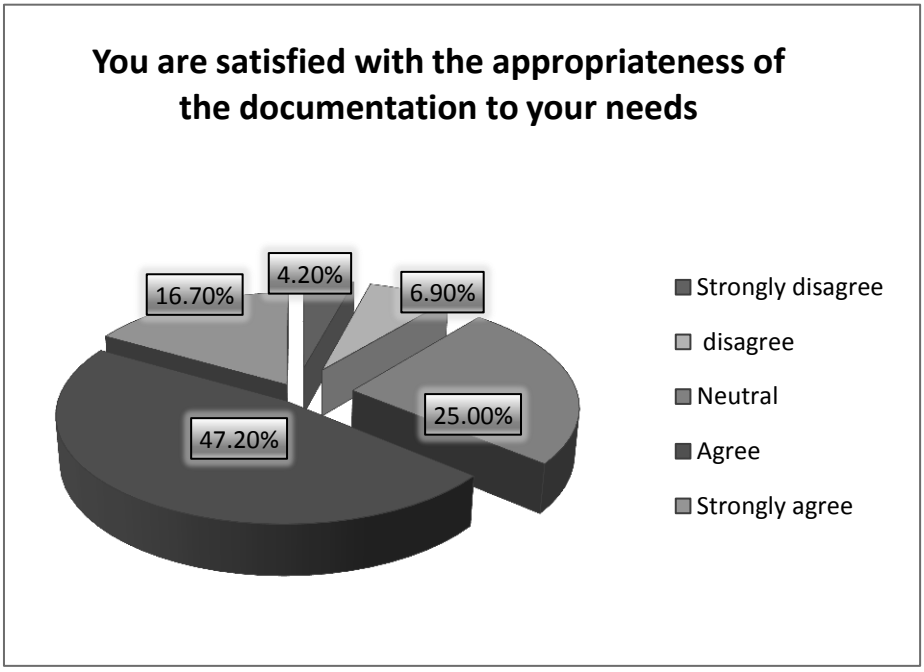

Fig.78- Source field study

5.(30.60%)Can reach document easily.

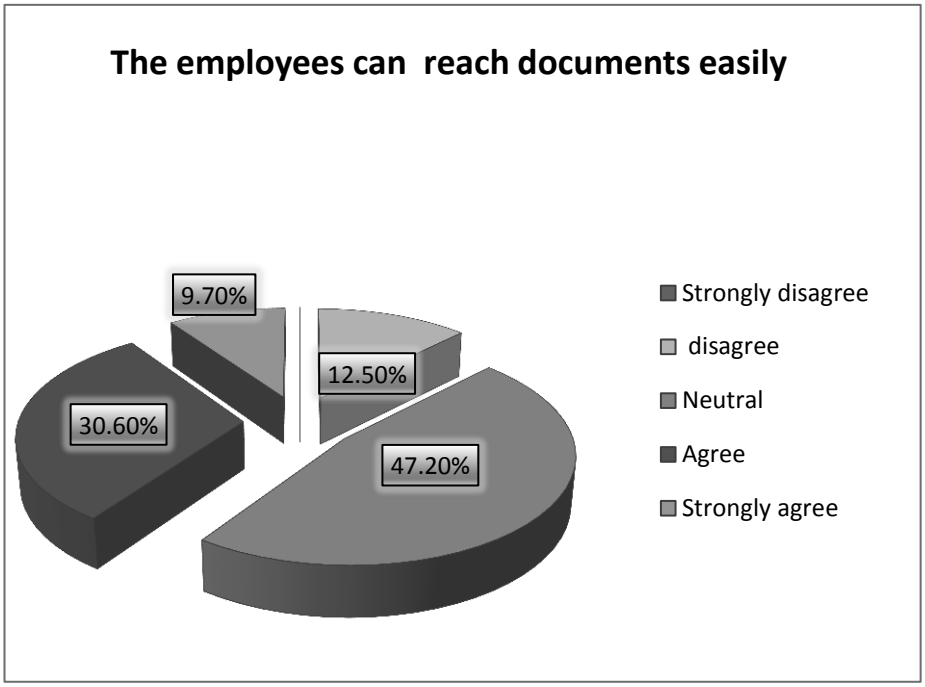

Fig. 79- Source field study

6.(9.70%)think that there is appropriate number of internal meetings.

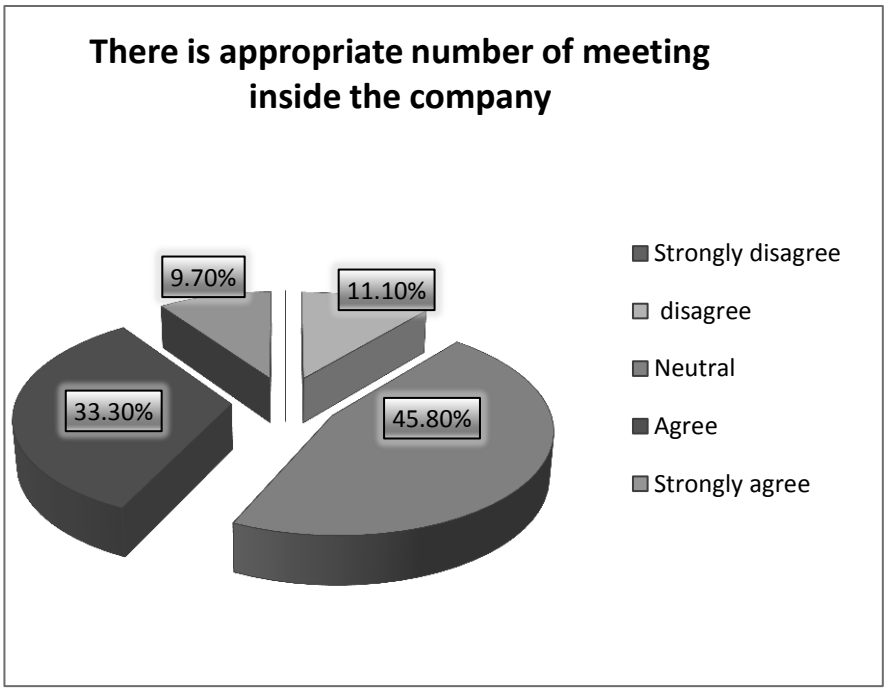

Fig. 80- Source field study

7.(33.30%)Think that there is actual results after meetings.

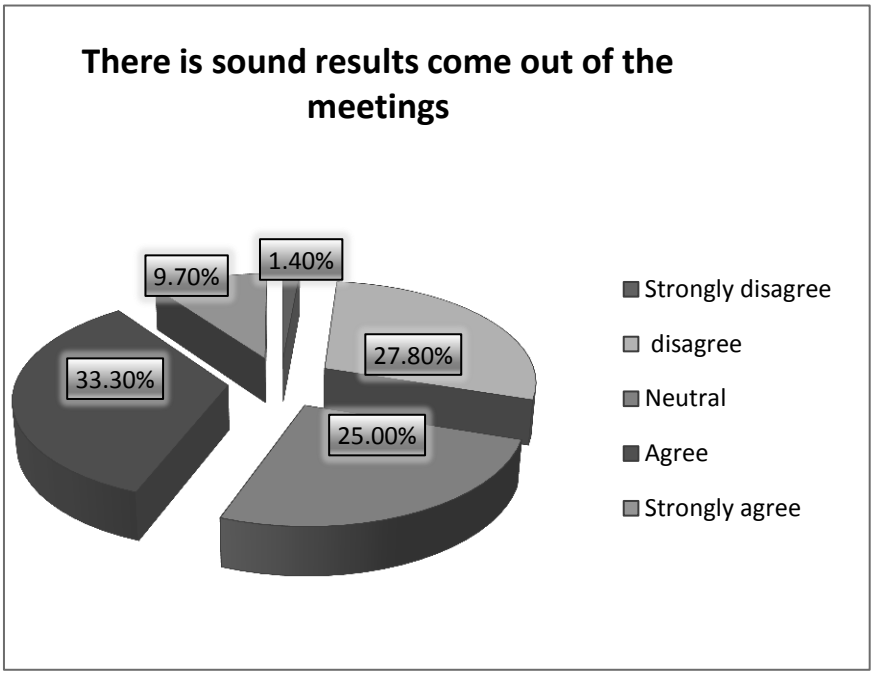

Fig. 81- Source field study

8.(16.70%)Claim that there is a reporting system between sites-company-customer .

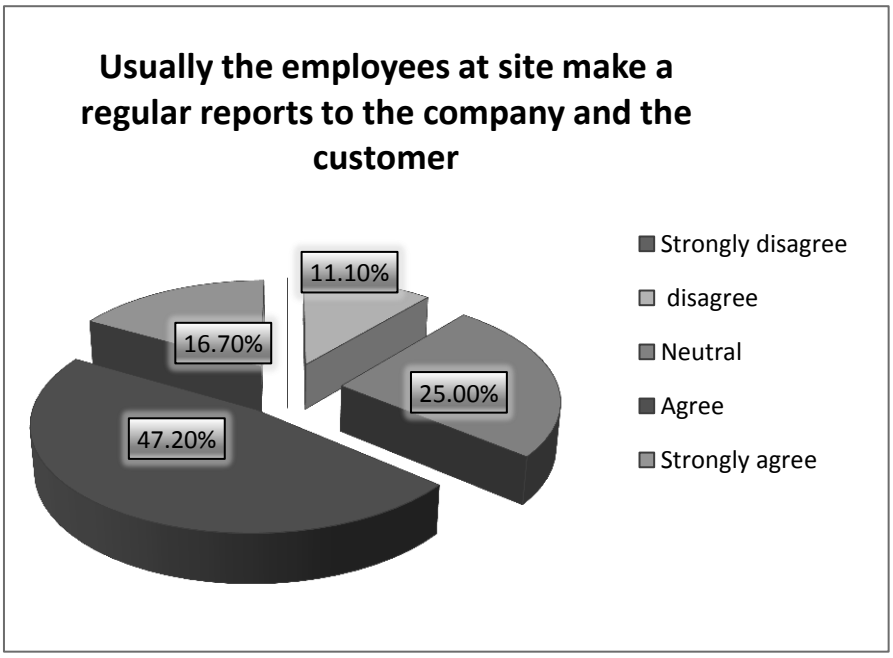

Fig. 82- Source field study

Brief of the section

As shown in the histogram below the respondents know about the importance of communications and to some limit they have an oral and documentary channels to activate it, but these channels and system not tight enough.

4.3. The numerical data:

Table 4.1. The numerical data (Source Field study)

		Strongly disagree= **1**	Disagree = **2**	Neutral = **3**	Agree = **4**	Strongly agree=**5**	Mean
Knowledge about TQM							
Quality implementation means performance improvement	F %	0 %0	0 %0	0 %0	17 %23.6	55 %76.4	4.76
Quality implementation means cost increasing	F %	13 %18.1	14 %19.4	12 %16.7	24 %33.3	9 %12.5	4.22
Implementing Quality in your organization will increase profits	F %	13 %18.1	14 %19.4	24 %33.3	12 %16.7	9 %12.5	3.33
Appling Quality will attract customers to our company	F %	0 %0	1 %1.4	7 %9.7	22 %30.6	42 %58.3	4.46
Adopting TQM will improve projects planning	F %	0 %0	2 %2.8	2 %2.8	23 %31.9	45 %62.5	4.54
Customer Satisfaction is the main reason for increasing profits	F %	1 %1.4	4 %5.6	13 %18.1	18 %25	36 %50	4.17
On-site supervision helps us to apply quality	F %	1 %1.4	5 %6.9	10 %13.9	33 %45.8	23 %31.9	4.00
Redesign will decrease by implementing quality	F %	1 %1.4	4 %5.6	14 %19.4	20 %27.8	33 %45.8	4.11
material on-site submitting will improve by implementing quality	F %	0 %0	1 %1.4	6 %8.3	29 %40.3	36 %50	4.39
Final handover will be effective by implementing quality	F %	0 %0	5 %6.9	9 %12.5	21 %29.2	37 %51.4	4.25
On-site safety will improve by implementing quality	F %	0 %0	2 %2.8	8 %11.1	15 %20.8	47 %65.3	4.49
Personnel management of employees will improve by implementing quality	F %	5 %6.9	7 %9.7	6 %8.3	20 %27.8	34 %47.2	3.99
Leadership							
The company leadership Has a clear vision for priorities and roles	F %	4 %5.6	6 %8.3	12 %16.7	28 %38.9	22 %30.6	3.81
Leadership energizing motivation in your organization	F %	6 %8.3	7 %9.7	12 %16.7	38 %52.8	9 %12.5	3.51
Leadership concern with	F	4	7	19	35	7	3.47

mobilization of resources required	%	%5.6	%9.7	%26.4	%48.6	%9.7	
Leadership always working on reduce or eliminate of barriers	F %	7 %9.7	8 %11.1	20 %27.8	30 %41.7	7 %9.7	3.31
Leadership encouraging employees to come up with new and better ways of doing things	F %	7 %9.7	13 %18.1	28 %38.9	16 %22.2	8 %11.1	3.07
Leadership concern with making regular meetings between different teams	F %	8 %11.1	18 %25	24 %33.3	19 %26.4	3 %4.2	2.88
Leadership implementing the open door policy	F %	9 %12.5	15 %20.8	27 %37.5	12 %16.7	9 %12.5	2.96
Leadership makes efforts to identify employees' strengths and weaknesses	F %	11 %15.3	16 %22.2	21 %29.2	19 %26.4	5 %6.9	2.88
Usually company leadership makes changes which are positive for the employees	F %	13 %18.1	17 %23.6	23 %31.9	14 %19.4	5 %6.9	2.74
Always the leadership make sure there is a budget for training	F %	14 %19.4	29 %40.3	18 %25	8 %11.1	3 %4.2	2.40
Vision and plan statement							
There is a clear vision and mission statement for the next 10 years	F %	4 %5.6	11 %15.3	20 %27.8	26 %36.1	11 %15.3	3.40
The projects that company had accomplished enhance the main objectives of the company	F %	1 %1.4	2 %2.8	16 %22.2	31 %43.1	22 %30.6	3.99
Quality performance is the best expression for company vision	F %	1 %1.4	6 %8.3	10 %13.9	29 %40.3	26 %36.1	4.01
Profitability is the main objective for the company	F %	10 %13.9	29 %40.3	14 %19.4	13 %18.1	6 %8.3	2.67
A good reputation is important for the company	F %	4 %5.6	1 %1.4	4 %5.6	18 %25	45 %62.5	4.38
Internal & external customer satisfaction is one of the main objectives for the company	F %	2 %2.8	5 %6.9	14 %19.4	25 %34.7	26 %36.1	3.94
Leading in IT using is one of company mission statement	F %	2 %2.8	5 %6.9	26 %36.1	24 %33.3	15 %20.8	3.62
The company always does SWAT analysis	F %	1 %1.4	14 %19.4	25 %34.7	25 %34.7	7 %9.7	3.32
It is very important to keep all employees aware of the company vision , mission and objectives	F %	10 %13.9	10 %13.9	19 %26.4	17 %23.6	15 %20.8	3.24
Customer focus							
Always we make a good	F	2	1	2	23	44	4.47

presentation for our abilities to the customer	%	%2.8	%1.4	%2.8	%31.9	%61.1	
After dealing with customers we continuously communicating with them to get feedback	F %	2 %2.8	3 %4.2	20 %27.8	28 %38.9	19 %26.4	3.82
After dealing with customers we continuously communicating with them because the legislation issues	F %	20 %27.8	24 %33.3	19 %26.4	6 %8.3	3 %4.2	2.28
We always can understand customer needs	F %	2 %2.8	3 %4.2	7 %9.7	35 %48.6	25 %34.7	4.08
We have the ability to solve problems	F %	2 %2.8	1 %1.4	3 %4.2	32 %44.4	34 %47.2	4.32
Our responsiveness is so high	F %	2 %2.8	2 %2.8	10 %13.9	29 %40.3	29 %40.3	4.12
Always we deal with customer with Courtesy & Friendliness	F %	2 %2.8	0 %0	9 %12.5	33 %45.8	28 %38.9	4.18
In the execution phase we Immediately do any customer's order	F %	3 %4.2	9 %12.5	28 %38.9	18 %25	14 %19.4	3.43
We keep customer aware with every thing	F %	3 %4.2	9 %12.5	16 %22.2	22 %30.6	22 %30.5	3.71
We involve customer in solving problems	F %	9 %12.5	8 %11.1	19 %26.4	21 %29.2	15 %20.8	3.38
Human Resource Management							
We have an employment system that satisfy employees	F %	5 %6.9	3 %4.2	25 %34.7	28 %38.9	11 %15.3	3.51
The employees have the tools and resources to do their job well	F %	1 %1.4	2 %2.8	19 %26.4	36 %50	14 %19.4	3.83
The employees have clearly defined quality goals	F %	3 %4.2	15 %20.8	20 %27.8	17 %23.6	17 %23.6	3.42
Keeping employees informed about matters affecting them is very important	F %	2 %2.8	9 %12.5	8 %11.1	28 %38.9	25 %34.7	3.90
Our employees were trained to satisfy the customers	F %	8 %11.1	16 %22.2	22 %30.6	14 %19.4	12 %16.7	3.08
There is a consistent and equitable system of rewards	F %	6 %8.3	17 %23.6	25 %34.7	20 %27.8	4 %5.6	2.99
The company assigns the employees in jobs according to their Skills & abilities	F %	1 %1.4	10 %13.9	22 %30.6	26 %36.1	13 %18.1	3.56
There is a number of employees who leave their jobs	F %	1 %1.4	18 %25	19 %26.4	28 %38.9	6 %8.3	3.28
The relationships between teams members are Great	F %	0 %0	3 %4.2	8 %11.1	33 %45.8	28 %38.9	4.19
The recognition that	F	2	16	16	22	16	3.47

employees receive from doing their job is below their expectations	%	%2.8	%22.2	%22.2	%30.6	%22.2	
There are opportunities available to employees to express their ideas to upper management.	F %	4 %5.6	4 %5.6	0 %0	17 %24	55 %76	3.72
Supplier Quality Management							
We usually use on-line computer order system to place our orders	F %	11 %15.3	17 %23.6	23 %31.9	14 %19.4	7 %9.7	2.85
There is arrangement between our company and suppliers on training programs	F %	20 %27.8	25 %34.7	22 %30.6	3 %4.2	2 %2.8	2.19
The company deals with many suppliers	F %	0 %0	8 %11.1	18 %25	32 %44.4	14 %19.4	3.72
Supplier chosen only according to his reputation	F %	10 %13.9	32 %44.4	21 %29.2	17 %24	0 %0	2.40
Supplier chosen according to facilities provided by him	F %	6 %8.3	19 %26.4	18 %25	26 %36.1	3 %4.2	3.01
Supplier chosen according to his products quality	F %	0 %0	3 %4.2	8 %11.1	34 %47.2	27 %37.5	4.18
Our supplier has a good timeliness of deliveries	F %	0 %0	2 %2.8	23 %31.9	34 %47.2	13 %18.1	3.81
Our supplier delivers the products without breakage	F %	1 %1.4	4 %5.6	25 %34.7	30 %41.7	12 %16.7	3.67
Our supplier concern with Phone answered immediately -- available lines	F %	0 %0	4 %5.6	18 %25	28 %38.9	22 %30.6	3.94
Our supplier has discounting policies	F %	1 %1.4	14 %19.4	35 %48.6	12 %16.7	10 %13.9	3.20
Process Control & Improvement							
Usually you perform your job as processes	F %	0 %0	2 %2.8	24 %33.3	37 %51.4	9 %12.5	3.74
Usually you identify every process in your job and make appropriate preparation for it	F %	0 %0	1 %1.4	29 %40.3	31 %43.1	11 %15.3	3.72
A good planning for every process will Increase profits	F %	0 %0	4 %5.6	30 %41.7	10 %13.9	28 %38.9	3.86
A good planning for every process will decrease errors & rework	F %	0 %0	11 %15.3	18 %25	20 %27.8	23 %31.9	3.76
A good planning for every process will lead to customer satisfaction	F %	1 %1.4	14 %19.4	17 %23.6	24 %33.3	16 %22.2	3.56
A good planning for every process will reduce quality costs	F %	8 %11.1	22 %30.6	17 %23.6	22 %30.6	3 %4.2	2.86

you are aware about the TQM seven process measures	F %	22 %30.6	31 %43.1	17 %23.6	1 %1.4	1 %1.4	2.00
Communications							
There is a good amount of quality communications in the company	F %	0 %0	0 %0	14 %19.4	36 %50	22 %30.6	4.11
At the regular meetings between you consultant and customer you can spend a long periods at it	F %	0 %0	6 %8.3	24 %33.3	27 %37.5	15 %20.8	3.71
There is an effective documentation system in your company	F %	3 %4.2	4 %5.6	23 %31.9	31 %43.1	11 %15.3	3.60
You are satisfied with the appropriateness of the documentation to your needs	F %	3 %4.2	5 %6.9	18 %25	34 %47.2	12 %16.7	3.65
The employees can reach documents easily	F %	0 %0	9 %12.5	34 %47.2	22 %30.6	7 %9.7	3.38
There is appropriate number of meeting inside the company	F %	0 %0	8 %11.1	33 %45.8	24 %33.3	7 %9.7	3.42
There is sound results come out of the meetings	F %	1 %1.4	20 %27.8	18 %25	24 %33.3	9 %12.5	3.28
Usually the employees at site make a regular reports to the company and the customer	F %	0 %0	8 %11.1	18 %25	34 %47.2	12 %16.7	3.69

4.4 summary of main findings :

4.4.1 Critical Success Factors

The value of each TQM factor has been rated by a group of questions using a five -points Likert scale method. Participants were asked to score their answer from 1-5 with agree or disagree with the given statements. Using this scale, the average of the measure is 3 ((1+2+3+4+5)/5), therefore, the means greater than 3 indicate an agreement with the statements while the means less than 3 indicate overall disagreement with the statement. Table (2) below shows the mean of each factor investigated within the current study. These factors are: Leadership, Vision and plan statement, Customer focus Human Resource Management, Supplier Quality Management , Process Control & Improvement and Communications

Critical Success Factors	Mean	St. Dev.
Leadership	3.10	0.74
Vision and plan statement	3.60	0.52
Customer focus	3.80	0.65
Human Resource Management	3.50	0.48
Supplier Quality Management	3.20	0.41
Process Control & Improvement	3.30	0.60
Communications	3.60	0.59

Table 4.2. TQM Factors Mean (Source Field study)

CHAPTER 5
Conclusion and Recommendations

5.1 Interdiction:

The aim of this research is to carry out an empirical study on the determinants of TQM in the Sudanese Construction Companies. The main contribution of this thesis is to persuade managers to take a serious attention on the importance of the effective utilization of CSFs to implement TQM in their construction companies.

5.2 Conclusion

This thesis has presented the results of a questionnaire on critical success factors of TQM carried out in Sudanese Construction Companies. 125 questionnaires were distributed. The main findings from the research are as follows:

1. The research hypothesis was verified , The Sudanese construction companies failed in implementing TQM through the critical success factors
2. There is a tendency toward applying total quality management to improve the contractors performance, attract more customers and increase profits.
3. The contractors do not sure about how the quality affecting the cost.
4. The contractors have no leading abilities, and there is a huge lack of top management commitment.
5. There is poor vision and plan statement.
6. The contractors know the important of take care about customers and in general they deal with customer very well.
7. The contractors do not let the customer take enough involvement in the project execution phases.
8. The contractors know the important of take care about their employees and in general they give the minimum employees requirements and needs, but they do not care about training , motivation, empowerment , and job enhancement & innovation.
9. The contractors do not deal with suppliers by modern methods and the relationship between them is too short so there is many suppliers.
10. There is no standard criteria's to choose the best supplier, contractors depend on try and error.

11. The contractors have a kind of idea about the important of doing jobs as processes and how that will affect profits, customer satisfaction and decrease errors, rework and quality costs .
12. The contractors do not know how to processing their jobs because they have no idea about the TQM process measurement tools.
13. The contractors know about the importance of communications and to some limit they have an oral and documentary channels to activate it, but these channels and system not tight enough.

5.3 Recommendations:

Some characteristics that are common to companies that wont to successfully implement TQM in their daily operations are listed here:

- Recognize the need for measurement and fact-based decision making.
- Place a strong emphasis on the right kind of leadership, and provide supervisors with a significant amount of leadership training.
- Realize that total quality management is a strategic choice made by top management, and must be *consistently translated* into guidelines provided to the whole organization.
- Contractors must envision what you desire to be as an organization, but *start working from where you actually are.*
- Use the principle of *get it right, the first time, every time*.
- Strive for owner/customer satisfaction and employee satisfaction
- Strive for accident-free jobsites
- Recognize that the owner/customer provides the revenue while the employees are responsible for the profit
- Arrange for employees to become involved in helping the company improve
- Train extensively
- Believe that people will produce quality goods and services when the meaning of quality is expressed daily in their relations with their work, colleagues, and organization.
- Use teams of employees to improve processes.
- Comprehend that each system with a certain degree of complexity has a *probability of variation*, which can be understood by scientific methods.

- Involve subcontractors and suppliers, requiring them to adopt TQM
- Strive for **continuous** improvement and understand that quality is a journey, not a destination. It consists of steps that form a process that is continuous.
- Work hard at improving communication inside and outside the company.

5.4 Farther Studiers:

This research proposes to investigate the adoption and implementation of TQM in the Sudanese construction industry through utilizing the CSFs, and it clarify the weakness of utilization CSFs . The researcher suggest to go farther from here by investigate the customer dissatisfactions and find the rote cause to define the customer satisfaction index so the contractor will energize to measure their performance to meet that index.

5.5 Research benefits:

Many facilities and foundations will take advantages from this thesis such as:

1. All Sudanese universities.
2. The Sudanese Contractors Union.
3. The Sudanese Engineering Council
4. Myslon Engineering Company LTD

References:

- Ahmed Bakhit Elballa, 2006, **Contractors & Buildings Management**, 123/2006 G.town Khartoum.
- Allen, N., & Meyer, J. (1990). **The measurement of antecedents of affective, continuance and normative commitment to the organization**. Journal of Occupational Psychology. 63, 1-18.
- Alberta's 10-year 2007 **A workforce strategy for Alberta's Construction Industry Building and Educating Tomorrow's Workforce (BETW)**

- Adrian, J.J. 1995, **Total quality management**, The Illinois Department of Transportation

- **Application of PDCA in the Construction Industry Enterprise Management** http://www.eng-paper.com/application-of-pdca-in-the-construction-industry-enterprise-management/ 19-1-2013
- Auruškeviciene, V., Šalciuviene, L., & Trifanovas, A. (2006). **A comparison between recent and prospective critical success factors in Lithuanian printing industry.** International Research Journal, 4(4), 327-346.

- Awad Saad Hassan, Symposium on an architecture education in Sudan, published paper, 2002.

- Bakhit Elballa Ahmed Salim, 2010, **Effective of Motivation in the Sudanese Construction Industry**, a thesis of the degree of doctor of philosophy in civil Engineering.

- Barry Benator, P.E., C.E.M. Albert Thumann, P.E., C.E.M. (2003) **Project Management and Leadership Skills for Engineering and Construction Projects**. the fairmont press, inc. Lilburn, Georgia marcel dekker, inc. New York and Basel
- Barrie G. Dale,2003, **Managing Quality**, Blackwell Publishers Ltd

- Bertelsen, S. (2004) **Lean Construction**: Where are we how to proceed? Lean Construction Journal. Vol.1, pp. 46-69.

- Black, S.A. and Porter, L.J. (1996), **Identification of the critical factors of TQM,** Blackwell Publishers Ltd
- Building Design and Construction handbook 2001 **Introducing the Tools for Continuous Improvement**

- Cronin, J.J. and Taylor, S.A. (1992) **SERVPERF versus SERVQUAL: reconciling performance-based and perceptions-minus-expectations measurement of service quality**. Journal of Marketing. Vol.58 (January), pp. 125-131.

- David B. Cortinas 1991, **On-Site Construction Productivity Improvement Through Total Quality Management**, report presented to the faculty of the

graduate school of the university of Texas at Austin in partial fulfillment of the requirements for the degree of master of science in civil-engineering

- Deming, W. E. **1993**. **The New Economics For Industry, Government & Educati**on. Cambridge: Massachusetts Institute of Technology Center ...

- Elsebeth Holmen, Håkan Håkansson, Ann-Charlott Pedersen (2003), Paper for **the 19th Annual IMP Conference** 4-6 September 2003, Lugano, Switzerland

- Enclosure E1 (Formerly referred as Attachment E1) **Construction Quality Control And Construction Quality Assurance (Cqc/Cqa) Of Clay Liner/Final Cover** Quality achieved by people who take pride in their work and have the necessary skills and experience to do the work.

- Federal Transit Administration FTA Program Management Officer; and Kam Shadan, P.E., Author, and Project Manager ,**Construction Project Management Handbook- The project managers consisted of Henry Nejako**, Gannett Fleming, Inc.

- Frank, H and Ronald, M (2001) **Modern. Construction Management**, USA: Blackwell.

- Frederick S. & Jonathan T. 2001, **Building Design and Construction Handbook,** 6th Edition**,** Hill Higher Education

- Feigenbaum, A.V.(1983), **Total Quality Control**, McGraw-Hill, New York,NY.

- Fotopoulos, C. B., & Psomas, E. L. (2009). **The impact of "soft" and "hard" TQM elements on quality management results**. International Journal of Quality & Reliability Management.

- Garold D.2000, **Project Management for Engineering and Construction**, McGraw -Hill Higher Education

- Gibson, J.L., Ivancevich, J.M., Donnelly, J.H. Jr & Konopaske, R. (2009). **Organizations: Behavior, Structure, Processes,** Thirteenth Edition. New York: McGraw Hill.

- Gostick, A. & Elton, C. (2005). **Managing With Carrots: Using Recognition To Attract and Retain the Best People**. Singapore : John Wiley & Sons (Asia) Pte Ltd.

- Harland, C., Lamming, R.C., Zheng, J., Johnsen, T., 2001. **A Taxonomy of Supply Networks.** The Journal of Supply Chain Management, Fall, 21-27.

- Håkansson, H. (Ed.), 1982. **International Marketing and Purchasing of Industrial Goods**. An Interaction Approach. Wiley, London.

- Håkansson, H. and Snehota, I., 1995**. Developing Business Relationships in Industrial Networks**. Routledge, London.

- Helen Lingard, Ph.D.1; Kerry Brown, Ph.D.2; Lisa Bradley, Ph.D.3; Caroline Bailey, Ph.D.4; and Keith Townsend, Ph.D.(2007) **Improving Employees' Work-Life Balance in the Construction Industry**: Project Alliance Case Study

- International Labour Office Geneva(ILO) , 2001- **The construction industry in the twenty first century:** *Its image, employment prospects and skill requirements Tripartite Meeting on the Construction Industry in the Twenty-first Century* Geneva

- John S, Nelson, PE1, Awad S. Hanna, PhD, PE2, Jeffrey S. Russell, PhD, PE3, and Mark L. Hendrickson, JBA, MA4(2009) **Leadership In The Global Construction Industry: The Challenge Of The Brutal Facts**

- John Prescott, Egan, J. (1998), **Rethinking Construction** The report of the Construction Task Force to the Deputy Prime Minister, on the scope for improving the quality and efficiency of UK construction All enquiries relating to the copyright in the work should be addressed to, HMSO, The Licencing Division, St Clements House, 2-16 Colegate, Norwich NR3 1BQ © Crown Copyright 1998 URN 03/951
- Jones T.O. and Sasser, W.E. (1995) **Why Satisfied Customers Defect**. Harvard Business Review. Nov-Dec, pp. 88-99.
- Juran, J.M. (1988), **Quality Control Handbook**, McGraw-Hill, New York,NY

- Kanji, G.K. and Wong, A. (1998) **Quality culture in the construction industry**. Total Quality Management. Vol. 9 Issue4/5, pp. 133-140.

- Kouzes, G.M., & Posner, B.Z. (2003). **Encouraging the heart**. San Francisco: Jossey Bass.
- Lamming, R.C., 1993. **Beyond Partnership**. Prentice Hall, London

- Liu, A.M.M. and Walker, A. (1998) **Evaluation of project outcomes**. Construction Management and Economics. Vol. 16, pp. 209-216.

- Love, P.E.D., Smith, J., Treloar, G.J. and Li, H. (2000) **Some empirical observations of service quality in construction**. Engineering Construction and Architectural Management. Vol.7 No.2, pp. 191-201.

- Lionapriyathershini **suganth,** Sashi **Anand (2005), The Economics,** Black wall

- Mbachu, J. and Nkado, R (2006) **Conceptual framework for assessment of client needs and satisfaction in the building development process**. Construction Management and Economics. 24, pp. 31-44.

- Molinari, L.K., Abratt, R. and Dion. P. (2008) **Satisfaction, quality and effects on repurchase and positive word-of-mouth behavioural intentions in a B2B services context**. Journal of Services Marketing. 22/5, pp. 363-373.

- **Paper for the 19th Annual IMP Conference** 4-6 September 2003, Lugano, Switzerland Designing and Monitoring a Supply Network Elsebeth Holmen , Håkan Håkansson, Ann-Charlott Pedersen

- Peter G. Martin PhD(2006), Vice President and Invensys Fellow Managing in Construction Supply Chains and Markets Reactive and Proactive Options for Improving Performance and Relationship Management Andrew Cox, Paul Ireland and Mike Townsend, **Profit-Based Continuous Improvement**, Published by Thomas Telford Publishing, Thomas Telford Ltd, 1 Heron Quay, London E14 4JD.

- Pfeffer, J. _1998_. "**The real keys to high performance**." Leader to Leader, 8, 23–29.

- Paul Chinowsky1; James Diekmann2; and Victor Galotti3(2008) **Social Network Model of Construction**

- Robert S. Done, Ph.D. Data Methods Corporation 805 N, **Improving Construction Communication** ,. Camino Miramonte Tucson, AZ 85716 JUNE 2004 Tanzer, M. 1999. Increasing profitability and goodwill. Roads and Bridges 37:44-48.

- Rahman , & Bullock, P. (2005). **Soft TQM, hard TQM, and organizational performance relationships: An empirical investigation.** The International Journal of Management Science, 33, 73-83

- Sami Kärnä 2009, **Concepts and attributes of customer satisfaction in construction,** Helsinki University of Technology Faculty of Engineering and Architecture, Department Structural Engineering and Building Technology, TKK-R-DISS-2, Espoo 2009
- Santos, A. dos and Hinks, J. (1997). **In the Search for Excellence: the principle of transparency.** Internal report, Department of Surveying, Univ. of Salford, September.

- Saraph, J. V.; Benson, P. G.; Schroeder, R. G. 1989. **An instrument for measuring the critical factors of quality management** Decision Sciences

- S.W. Nunnally 2007, **Construction Methods and Management,** 7th Edition, Prentice-Hall Career & Technology, 1993. Original from, the University of Michigan. Digitized, Dec 5, **2007**

- V. Kumar., F. Choisne., D. Grosbois., and U. Kumar. Impact of TQM on company's performance. International journal of quality & reliability management. 2009, 26(1): 23-37

- W.G. Lewis., and T.R.M. Lalla. Exploring soft versus hard factors for total quality management implementation in SMEs. International Journal of Productivity and Performance Management. 2006, 55(7):539- 554.

- Yang, C. C. (2005). **An integrated model of TQM and GE-Six Sigma. International Journal of Six Sigma and Competitive Advantage**, 1(1), 97-105.

- Yasmin Binti Mohamad Nor (2011) the impact of motivational factors on employee commitment in the oil and gas industry in malaysia

- Yulk, G. (2002). Leadership in Organizations (5th Edition). Upper Saddle River, NJ: Prentice Hall.

- (http://wiki.answers.com/Q/What_are_the_characteristics_of_the_construction_industry 17-1-2013)

- (http://kumahauing.wordpress.com/2010/11/13/construction-industry-and-its-characteristics/ 9-1-2013)
- http://sielearning.tafensw.edu.au/MBA/9791K/BusinessServices/9791/9791K/Continuous_Improvement_Tools_wi.pdf 25-1-2013

- http://www.orau.gov/pbm/handbook/ 20march Copyright 2005 Oak Ridge Associated Universities