CHAPTER 2

THEORETICAL CONSIDERATION

2.1 Risk Management

Risk management is starting important for all size of many projects due to the limitation of resource. Effective utilization of resource is very important to the one who manage the project (project manager), which need to investigate the risk in many aspects to achieve desired objective.

The appropriate framework of risk management may start from planning, identification, analysis, response and control, which depends on each organization. The successful of risk management is also the achievement of the objective for each project, or the ability to finish the project within the limitation of resources, which generally are budget, time and technical. Utilization of systematic risk management helps the organization to (Mills, 2001):

- Identify, assess, and rank risks, making the risks explicit.
- Focus on the major risks of the project.
- Make informed decision on the provision for adversity, e.g. mitigation measures.
- Minimize potential damage should the worst happen.
- Control the uncertain aspects of construction projects.
- Clarify and formalize the company's role and the roles of others in the risk management process.
- Identify the opportunities to enhance project performance.

Risk management for any project is now important thing, and sometime it is unavoidable even the project is already studied for feasibility, which ensures the successful of the project. Without the appropriate management on limited resource, it can bring the project to the risk, which is the source of project failure. Risk is now a part of any project, because the project is a set of activities, which needs to be finished in the future by using the limited resource. Risk can happen anytime due to an uncertainty and limited resource. It needs to be efficiently and effectively managed to reduce the problem in order to achieve the objective.

In general, risk management is a system or process to manage the risk, which is the source of the failure or the situation that diverge the desired objective. It is difficult to specify all risk factors that even affect to specified business. The simple way to classify risk is the source, which can be classified into:

- Internal risk factors
- External risk factors

2.1.1 Standard of Risk Management

Risk management is widely recognized as a process or system to minimize obstacle or barrier in order to meet the business objective, which is now recognized as an important part of business.

There are a number of risk management standards and guidelines, which are currently used in various fields (Kloman, 2003):

1. ***Australia/New Zealand Risk Management Standard 4360:2000:*** This standard has been established since 1995. The important of this standard is to combine opportunity and harm into risk. All employees and stakeholders are encouraged to participate in risk management, which has to be notified for the responsibility. Steps of risk management are clearly identified, and analysis should be done on both qualitative and quantitative techniques.

2. ***Canadian Risk Management Guideline CAN/CSA-Q850-97:*** This guideline focuses on affecting of risk on stakeholders, which follows Australia/New Zealand Risk Management Standard as a guideline. Recommendation on this guideline is to establish a risk management team, which constitutes of multidisciplinary group of internal and external experts including representative from all levels of stakeholders.

3. ***British Standard BS-6079-3:2000:*** This standard was setup as a guide to the management of business related project risk in the field of economic and general welfare of society, which includes setting the context, identifying risk, risk analysis, risk evaluation and risk treatment. The British standard, which is a conventional framework, confirms the following three levels of risk decision making:

    1. Strategic (long-term goals)
    2. Tactical (medium-term goals)
    3. Operational (short-term goals)

2.1.2 Various Process of Risk Management

Examples of risk management process are shown below:

Risk management is defined in various ways. According to Flanagan et al. (1993), *"risk management is a discipline for living with the possibility that future events may cause adverse effects"*. Risk management involves six tasks as follow. (Caltrans, 2003):

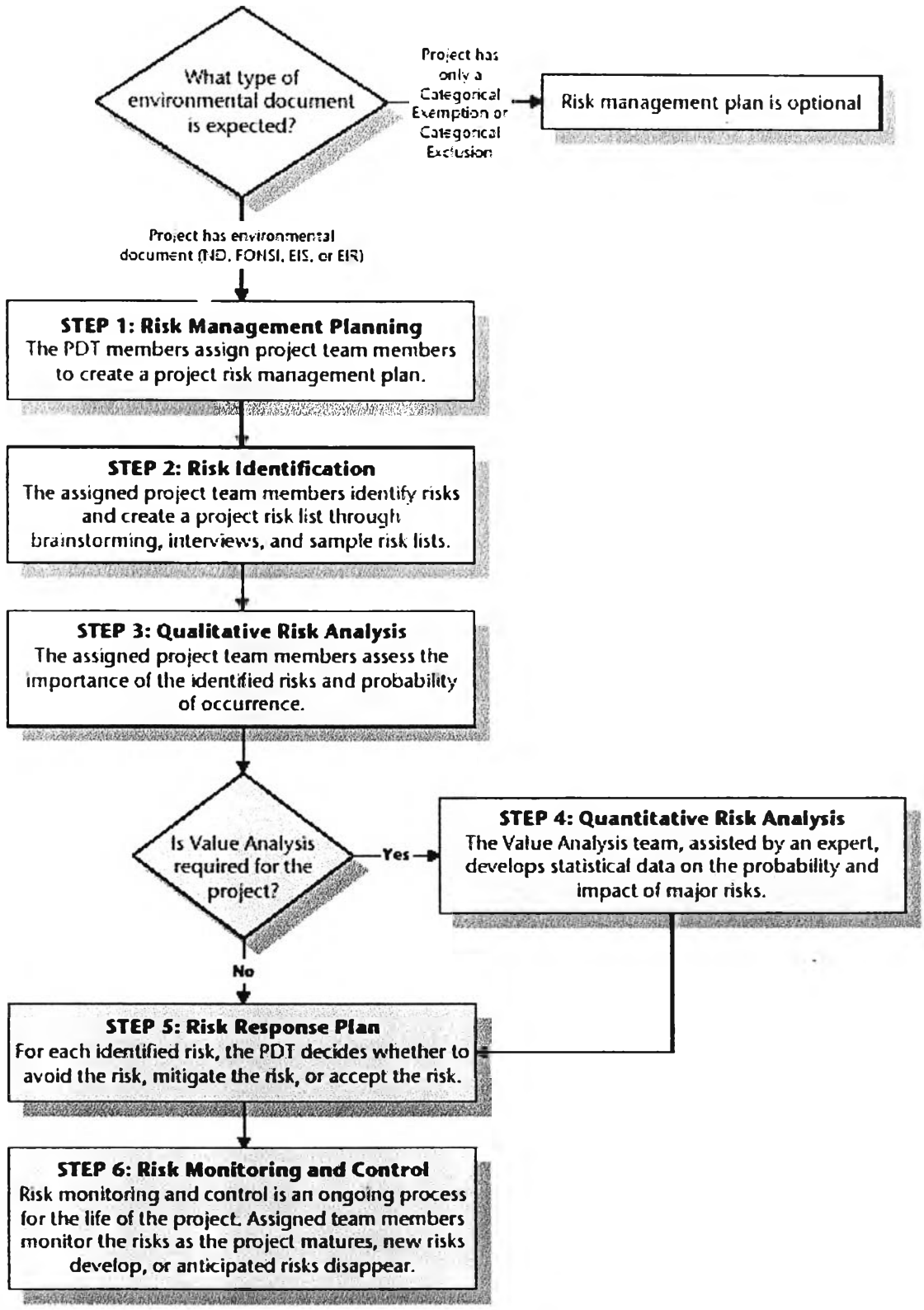

Figure 2.1 Risk Management Process Flowchart

Source: Caltrans (2003)

Risk Management Planning:

When starting risk management for any project, team has to be established to create the plan in order to deal with associated risk. Activity planning for risk management is established for the project.

Risk Identification:

It involves an identifying the source, type, its potential and characteristic. To identify risk, there are many sources to find out the risk in the project:

- Experience from the precedent or previous project.
- Brainstorming from the expert and involved people.
- Existing of recorded data.
- Gathering during project operation.

Risk Analysis:

The objective of risk analysis is to find its probability and effect, which will occur during manage the project. To measure the degree of risk for its probability and effect, it can be measured in the form of level e.g. low, medium, and high, or in the form of score for each objective.

Analysis on the risk can be classified into two categories. Qualitative risk analysis evaluate how importance of the risk to the objective, and prioritize for further analysis, while quantitative risk analysis is numerically estimation of probably to meet cost and schedule objective.

Risk Response Planning:

Response to the risk is the creation of appropriate strategy to manage each risk, and decide the action plan to manage the strategy. Strategy and action plan for each risk generally compose of:

- ***Avoidance:*** Elimination of the risk or to protect the objective from its impact.
- ***Transference:*** Relocation of the risk to another party, which is more capable to deal with associated risk.
- ***Mitigation:*** Reduction of probability or the effect from risk to an satisfactory point
- ***Acceptance:*** Accept the occurrence of unavoidable risk, as well as prepare to deal with the risk.

Risk Monitoring and Control:

Monitoring and control for the risk are expected to keep track of the risk in the project, and make sure that the response plan is still effective. Periodic review of the risk in the project is to deal with reoccurrence of unexpected risk.

Flanagan et al. (1993) clarifies risk management as "*a discipline for living with the possibility that future events may cause adverse effects*".

According to Flanagan et al. (1993), explanation and process of risk management, which constitutes of several stages, are clarified as follow:

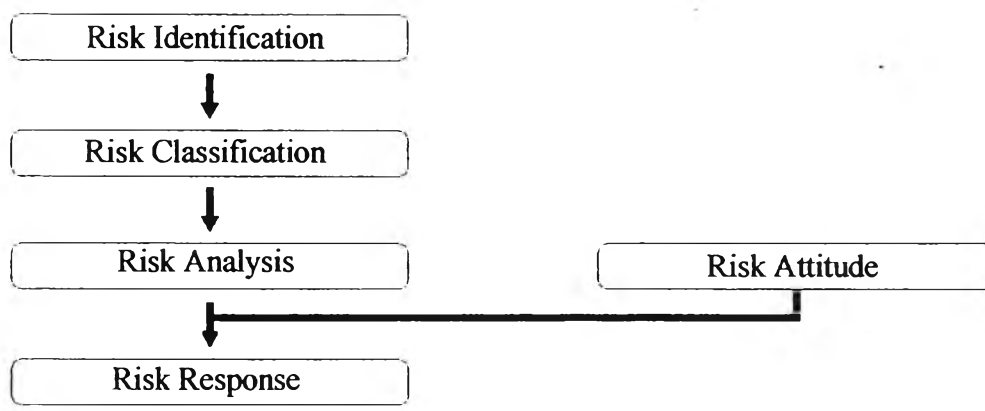

Figure 2.2 The Risk Management Framework

Source: Flanagan G. and Norman George (1993)

Risk Identification:

Identify the source and type of risk.

Risk Classification:

Consider the type of risk and its effect on the person and organization

Risk Analysis:

Evaluate the consequence associated with the type of risk, or combination of risk, by using analytical techniques.

Risk Attitude:

Any decision about risk will be affected by the attitude of the person or organization making the decision.

Risk Response:

Consider how the risk should be managed by either transferring it to another party or retaining it.

One of the most well-known risk management processes, which was first established in 1995 by Australia and New Zealand. Australia and New Zealand Standard for Risk Management defines risk management as *"the possibility of something happening that impacts on your objectives. It is the chance to either make a gain or a loss. It is measured in terms of likelihood and consequence*". Risk management standard from the Australian and New Zealand standard on risk management (AS/NZS 4360:2004) is illustrated as follow:

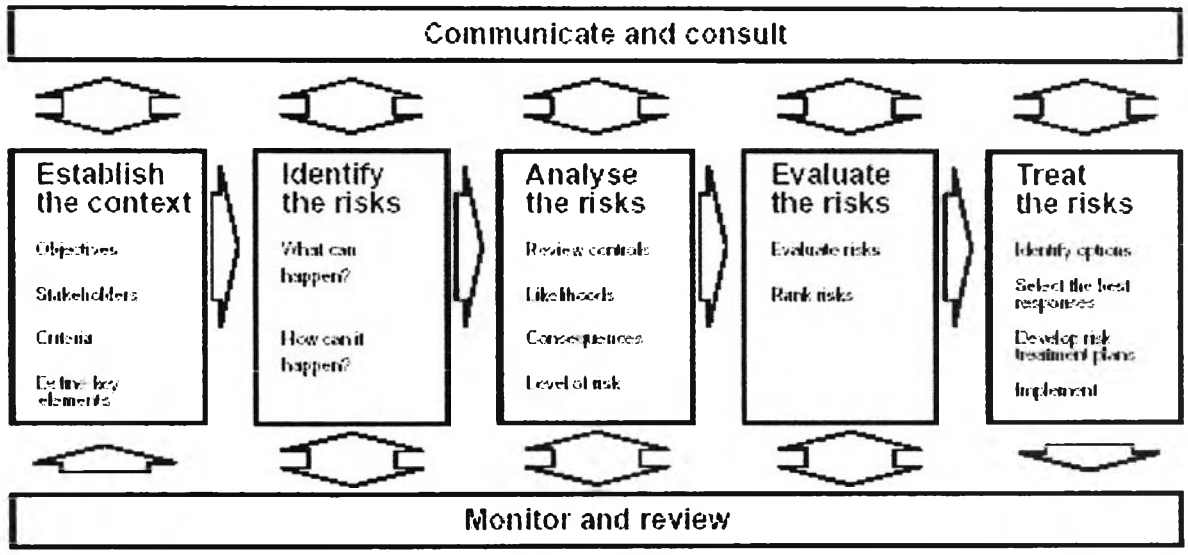

Figure 2.3 Risk Management Process Diagram

Source: Boardleaf Capital International (2004)

Establish the context:

The strategic and organizational context preparation is required for risk management. Business characteristics and objectives have to be clarified in order to indicate intrinsic risk in the business. From AS/NZS 4360:2004 standard, the context for risk management falls into two parts:

1. Descriptive
2. Creative

Identify the risks:

Potential risks are identified what would be the source of risk and how they occurred, which affect the business. Identification of potential risks, which might affect the business by brainstorming is preferable for further analysis.

Analyze the risks:

Potential risks are prioritized by rating in order to assign a significant of each factor. Significant of each risk is described in more detail to clarify the characteristic. Likelihood and its consequence are measured to analyze the level of risk.

Evaluate the risks:

Evaluation of the significant risks is ranked with its priority. Commonly, risks with high priority are to be firstly considered. Risk evaluation classifies the risk what plan is suitable to each risk.

Treat the risks:

Risk treatment is to determine what should be done in order to deal with risk. Risk treatment is expected to find the most appropriate plan to avoid the risk or at least to reduce their effect. Alternative response plans to the risk need to consider the characteristic of each risk.

Monitor and review:

Monitor and review of the outputs from previous stage need to be verified to ensure that the change of risk might not affect the business, and the situation must be brought up to date.

Communicate and consult:

Involving of related parties to risk management is an important thing to achieve successful outcome. Communicate and consult of related parties to each stage of risk management need to be concerned.

2.2 Project Management for Construction Industry

Project management for construction is a unique process. Construction project has a specified set of objective and constraint, which requires understanding and utilization on limited resource. According to Wideman (1986), *"Project management is the art of directing and coordinating human and material resources throughout the life of a project by using modern management techniques to achieve predetermined objectives of scope, cost, time, quality and participation satisfaction"*.

Hendrickson has stated the functions of project management for construction, which generally include the following (Hendrickson, 1989):

1. Specification of project objectives and plans including delineation of scope, budgeting, scheduling, setting performance requirements, and selecting project participants.
2. Maximization of efficient resource utilization through procurement of labor, materials and equipment according to the prescribed schedule and plan.
3. Implementation of various operations through proper coordination and control of planning, design, estimating, contracting and construction in the entire process.
4. Development of effective communications and mechanisms for resolving conflicts among the various participants.

Project management philosophy composes of important knowledge domains, which are necessary to achieve desired objective.

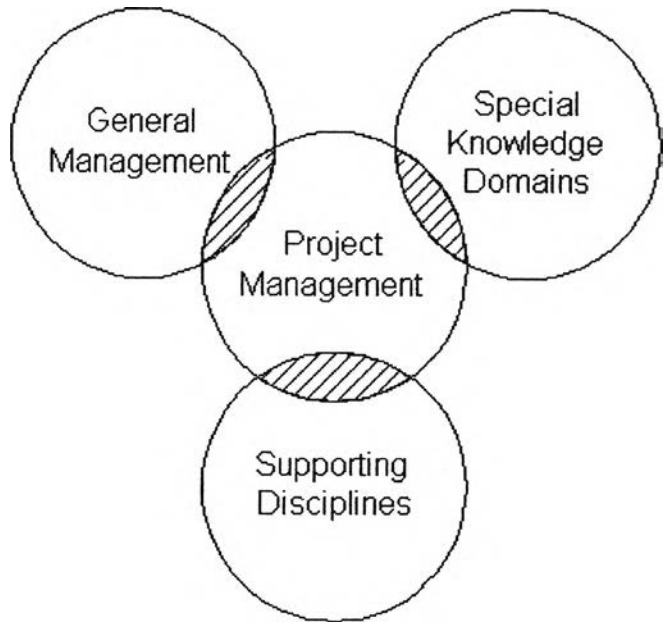

Figure 2.4 Basic Ingredients in Project Management

Source: Hendrickson, Chris (1998)

Successful or failure of any project depends on how to manage the project. It is necessary to understand the important aspects, which relates to the project.

2.2.1 Client Objectives

The clients expect to receive the completed plant at the shortest period with lowest cost and in a safe way (in case of plant). The plant is needed to be well balanced and rationalized establishment with reliability of the selected process. Objectives of each client for the project are different, but they can be normally grouped into (Flanagan et al., 1993):

- ***Quality:*** Requirement on technical standard, including safety and fitness to purpose.
- ***Cost:*** Obtaining value for money and completing the project within budget.
- ***Time:*** The needs for rapid construction and completion on specified date.

2.2.2 Engineering Company Role

Engineering company is established to offer the service for the client, which start from feasibility study towards the completion of plant construction, and also includes pre-commissioning and maintenance. Parts of project are managed, which depend on the contract between engineering company and client. The project would be executed by the engineering company, while the client team monitors the engineering company as well.

Generally, project management of engineering company is mainly constituted from engineering, procurement, and construction.

2.2.3 Relationship in Project

In every project, there are various involved parties to fulfill the project to achieve the desired goal. The relationship between various parties involved in a project is shown as below:

- Managing Contractor
- Consultant
- Owner
- Licensor
- Vendors
- Subcontractors

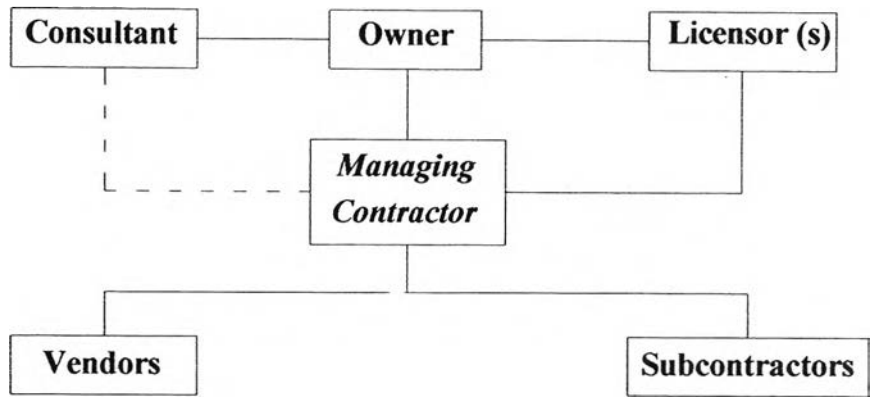

Figure 2.5 Basic Relationship between Various Parties in a Project

2.2.4 Project Management Target

For general objectives of project management in engineering company, targets can be classified into three main groups.

1. Quality

Plant construction is an integration of engineering, procurement and construction techniques. The quality level requirement shall be decided from the overall point of view of quality demand for the whole plant instead of from different individual technical level.

In general, quality is normally a requirement for any product or service. Clients' requirements for their projects basically are performance, completion, technical level, price and defective. Improper quality on product or service leads to the lose of clients' reliability, and requires many aspects of resource to recover the reputation for the clients. Every processes of project management such as design, purchasing and construction have to satisfy the clients, which close to the concept of Total Quality Management (Kerzner, 1998).

- ***Engineering***

Participation and close coordination of representatives from relevant sections for the decision are important to system design. Understanding of system diagram for engineering designer is required prior to start the project. Quality check list for inter-department squad check can be used as a tool to insure the required quality.

- ***Procurement***

Proper allocated budget is the important factor to procurement operation. There are many important control key points for desired quality level to be considered:

- Selection of reliable vendors
- Thorough bid evaluation, commercial and technical
- Expedition and inspection
- Contents of purchasing order (quality requirement, specifications insurance, terms of delivery and payment, etc.)

- ***Construction***

Appropriate organization requires good commanding, reporting system and coordination, which is the basis of good team work to react with unexpected situation. Labor training is also an important factor for construction. All of mentioned is not only the key factors to the success of construction, but also is closely related to quality control.

2. Cost

Cost can be controlled in any stages as follow:

- ***Engineering Stage***

The objectives of cost control at engineering stage are to control engineering man hour (M.H.) utilization and its contents in order to minimize associated cost: equipment, bulk material, volume of construction work.

In engineering design stage, cost can be minimized in various ways. Utilization of standard drawing in order to avoid an additional M.H., except the distinctive requirement of customer, is the basic approach. Computerization with CAD is now widely used, which is easy to modify and check to avoid the error. Applying of new technology or easier fabrication and machining can be used if they lead to cost down For the purpose of interchangeability, use materials of the same specification as much as possible or suggestion of alternative materials for client if it is better than original.

- ***Procurement Stage***

It is very important to control cost of required material, which is ordered from vendor at this stage. In the case of vendor's price exceeds the allocated budget, price negotiation is a basic approach to deal with cost. Sometime vendor's design in over specification is the source of cost problem. In case of out of control the cost due to vendor, selection of alternative vendors could be the way to manage cost.

In the case of vendor's price is well below the budget, thorough checking vendor's quality in various aspects: delivery time of equipment, financial status, previous task, is very important, which would affect to the allocated budget.

- ***Construction Stage***

Cost in construction stage can be controlled in the duration of preparing requisition. There are many items, which have to be considered if subcontracting is required:

- Scope of work
- Insurance
- Construction equipment and tool
- Term of payment
- Material
- Work duration

- etc.

Price negotiation is also a basic approach to control cost with subcontractor. Construction method of subcontractor should be properly reviewed, as well as the review of subcontractor's ability to manage its content of construction. Subcontractor's price could be lower than the allocated budget, if there is some missing item or unreasonable low unit price, which leads to the problem in cost management.

3. Schedule

For schedule control, collect progress related information for review, analyze cause of delay, and set up remedy measures, conduct progress meeting periodically for coordination and follow up purpose.

Schedule for the project is basically assigned a starting and ending point. Work Breakdown Structure (WBS) method is utilized to allocate tasks for schedule, which must be considered to limitation on resource and condition. Project composes of several hundred tasks. Gantt chart is normally used to facilitate project manager to manage task on schedule by indicating task in row and duration in column. The purpose of schedule control is to measure the project delay. Additional resources such as time, manpower and power would be considered when the schedule is managed (Kerzner, 1998).

- ***Engineering Progress***

Follow up drawing list and compare the status of actual progress to the planned schedule.

- ***Procurement Progress***

Follow up control sheet. Distribute procurement status periodically to relevant parties as required.

- ***Construction Progress***

Follow up progress schedule, which is normally scrutinized by supervisors.

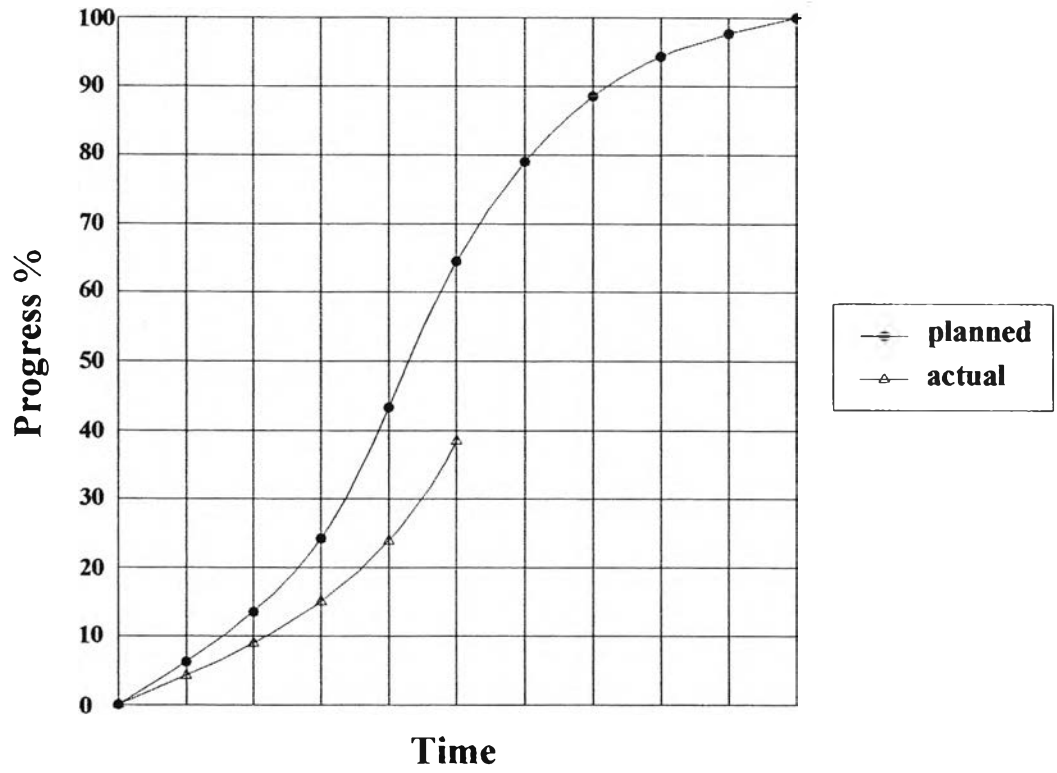

Figure 2.6 S-Curve Progress

2.3 Analytical Tools

In risk management, there are the requirements of the tool to deal with risk. Requirements of the tool are to find out what and how the risk can occur, and also why it occurs. Analytical tools help identify the potential risks, and also prioritize the problem areas. The tools that relate to risk management generally compose of (Kloman, 2003):

- Assumptions analysis
- Brainstorming, checklists
- Criticality analysis
- Cumulative frequency plots (S curves)
- Decision analysis
- Delphi technique
- Expert interviews
- Event tree analysis
- Fault tree analysis
- HAZOP study
- Influence diagrams
- Monte Carlo simulation
- Prompt lists
- Risk registers
- Databases
- Sensitivity analysis

Important alternative tools for risk management are described as follow:

2.3.1 Root Cause Analysis (RCA)

In general, Root Cause Analysis is a process to find the source of problem and how to make action to deal with the problem. According to Andersen et al. (2000), "*Root Cause Analysis is a structured investigation that aims to identify the true cause of problem, and the actions necessary to eliminate it*". Four major steps are involved with RCA as following (Rooney et al., 2004):

1. ***Data Collection:*** The first step of analytical tool is mostly data collection, which spends a lot of time to gather the data. Without the information and consideration of situation, the potential factors cannot be identified.

2. ***Causal Factor Charting:*** This step provides the structure in order to organize and analyze the collected data and information from the first step. Charting is simply a sequence diagram with logic test, which should be created as soon as the data and information are collected. It describes the event, which leads to the occurrence with the condition surrounding the event.

3. ***Root Cause Identification:*** Requirement of decision diagram called Root Cause Map is needed in this step. Root Cause Map helps identify the underlying reasons for each factor why they exist, and also facilitates to determine the cause.

4. ***Recommendation:*** *Generation and Implementation:* Recommendation for the identification of the root cause is needed in order to prevent the recurrence of the root cause of causal factor. Implementation of recommendation is also needed, otherwise the attempt to perform the analysis is waste.

2.3.2 Pareto Diagram

Pareto Diagram has been established by Alfredo Pareto, which his objective is to study the distribution of wealth in Europe. For the principle of Pareto, Andersen et al. (2000) states that "*most effects, often 80 percent, are the result of a small number of causes, often only 20 percent*". Dr. Joseph Juran identified Pareto principle, which can be simplify into the word "vital few and useful many", which means most of important factors normally come from a small part of the whole.

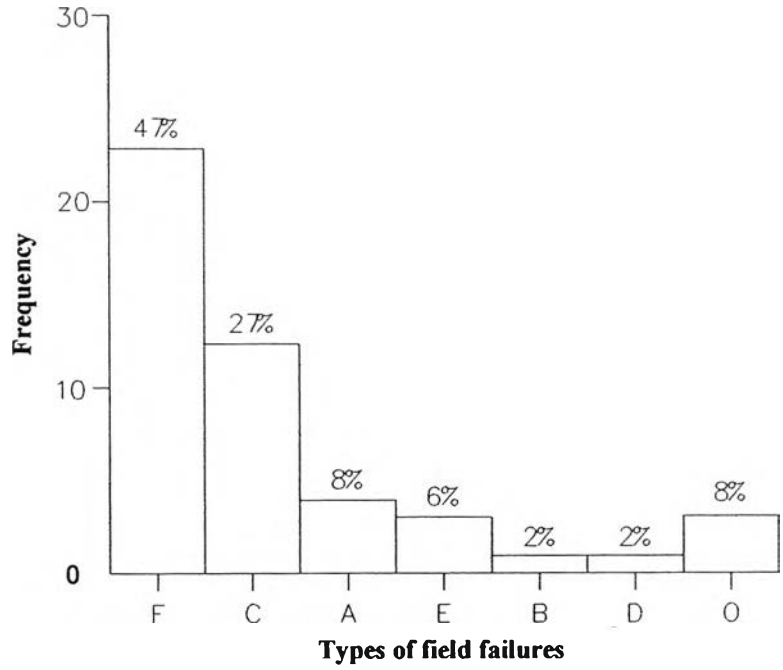

Figure 2.7 Pareto Diagram

Source: Besterfield, Dale H., Besterfield-Michna, Carol, Besterfield, Glen H. and Besterfield-Sacre, Mary (1995)

Possible data classifications of Pareto diagram are types of field failure, problems, complaints, causes, types of nonconformities, etc. (Besterfield et al., 1995).

The purpose of Pareto Diagram is to display the causes or factors that lead to the problem by rank those causes or factors by the degree of importance. The use of Pareto principle is a never-ending process. When the vital few target factor is corrected, next vital few will then be corrected, which is a continuous process.

There are fives steps to construct Pareto diagram (Besterfield et al., 1995):

1. Determine the method of classifying the data. There are many criterions to classify the data:
    - Problem
    - Cause
    - Nonconformity
    - Etc.
2. Determine the unit of frequency to be used to rank the characteristics, which could be the unit of monetary.
3. Collect data for an appropriate time interval or use historical data.
4. Summarize the data and rank order categories from largest to smallest.
5. Construct the diagram and find the vital few.

2.3.3 Fishbone Diagram

Interchangeable name of Fishbone Diagram is Cause-and-Effect Diagram. It is a process to identify the cause of factor, which affects to the desired objective, e.g. quality. Ishikawa summarized that process did not refer only to manufacturing, it also related to design, purchasing, sales, personnel, and administration. There are six categories involve in fishbone diagram, which are normally called "five M's and one E".

- Men
- Materials
- Methods
- Machines
- Measurements
- Environment

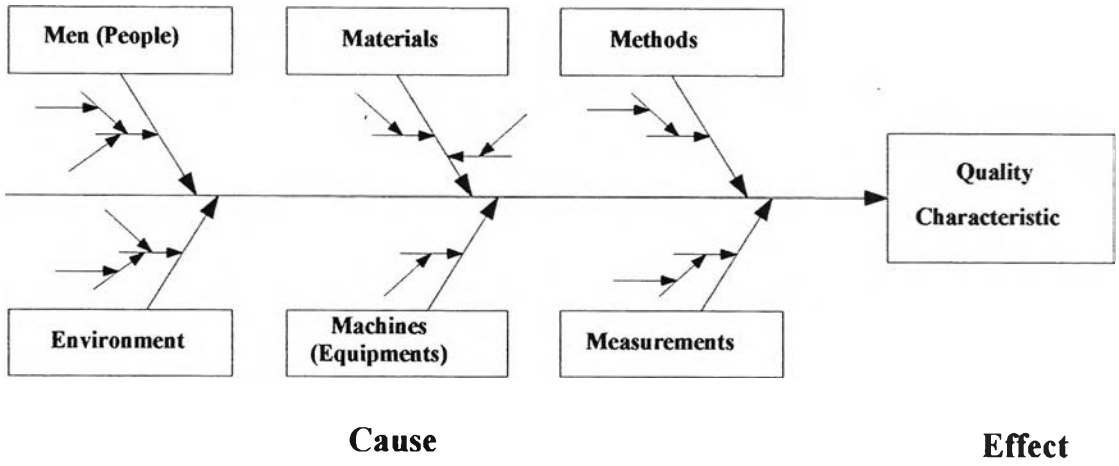

Figure 2.8 Cause-and-Effect Diagram (Fishbone Diagram)

Source: Besterfield, Dale H., Besterfield-Michna, Carol, Besterfield, Glen H. and Besterfield-Sacre, Mary (1995)

According to Brussee (2004), *"the purpose of fishbone diagram is to identify all the inputs variables that could be causing the problem of interest"*. The objective of this approach is to find the problem or cause of factor in order to prevent them before they actually occur, which shall be called "vanguard control" (Ishikawa, 1985). Due to the number of cause of factor is infinite, the important thing is to find the truly important ones that will severely affect to the objective by brainstorming, which is a suitable way. Fishbone Diagram is a useful process, which has nearly unlimited application in many fields. According to Besterfield et al. (1995), fishbone diagram is useful to:

1. Analyze actual conditions for the purpose of product or service quality improvement, more efficient use of resources, and reduced costs.
2. Eliminate conditions causing nonconformities and customer complaints.
3. Standardize existing and proposed operations.
4. Educate and train personnel in decision-making and corrective-action activities.

2.3.4 Failure Mode and Effect Analysis (FMEA)

FMEA is one of the most famous analytical tool to systematically identify and analysis the failure and its effect to desired objectives. According to Besterfield et al. (1995), "*Failure Mode and Effect Analysis is an analytical technique (a paper test) that combines the technology and experience of people in identifying foreseeable failure modes of a product or process and planning for its elimination*".

In FMEA, three major criteria are used to prioritize the importance of failure cause:

1. Severity (S)
2. Occurrence (O)
3. Detection (D)

Utilization of S and D probability criteria with S is to develop the risk prioritization numbers. Severity (S) is an assessment how serious of the effect of the potential failure mode, which is applied only to the effect of the failure, excludes the potential failure mode. Occurrence (O) is a possibility, which one of the specified causes/mechanisms will occur. Detection (D) is a relative measure of the assessment of the ability to detect either a potential cause/mechanism or the subsequent failure mode. All of three criteria will then be calculated as "Risk Priority Number (RPN)", which is used to rank the importance of various concerns.

$$\mathbf{RPN = (S) \times (O) \times (D)}$$

To execute FMEA, there are four stages to consider (Beterfield et al., 1995):

1. Specifying Possibilities
    - Functions
    - Possible Failure Modes
    - Root Causes
    - Effects

- Detection/Prevention

2. Quantifying Risk
    - Probability of Causes
    - Severity of Effect
    - Effectiveness of Control to Prevent Cause
    - Risk Priority Number

3. Correction High Risk Causes
    - Prioritizing Work
    - Detailing Action
    - Assign Action Responsibility
    - Check Points on Completion

4. Re-evaluation of Risk
    - Recalculation of Risk Priority Number

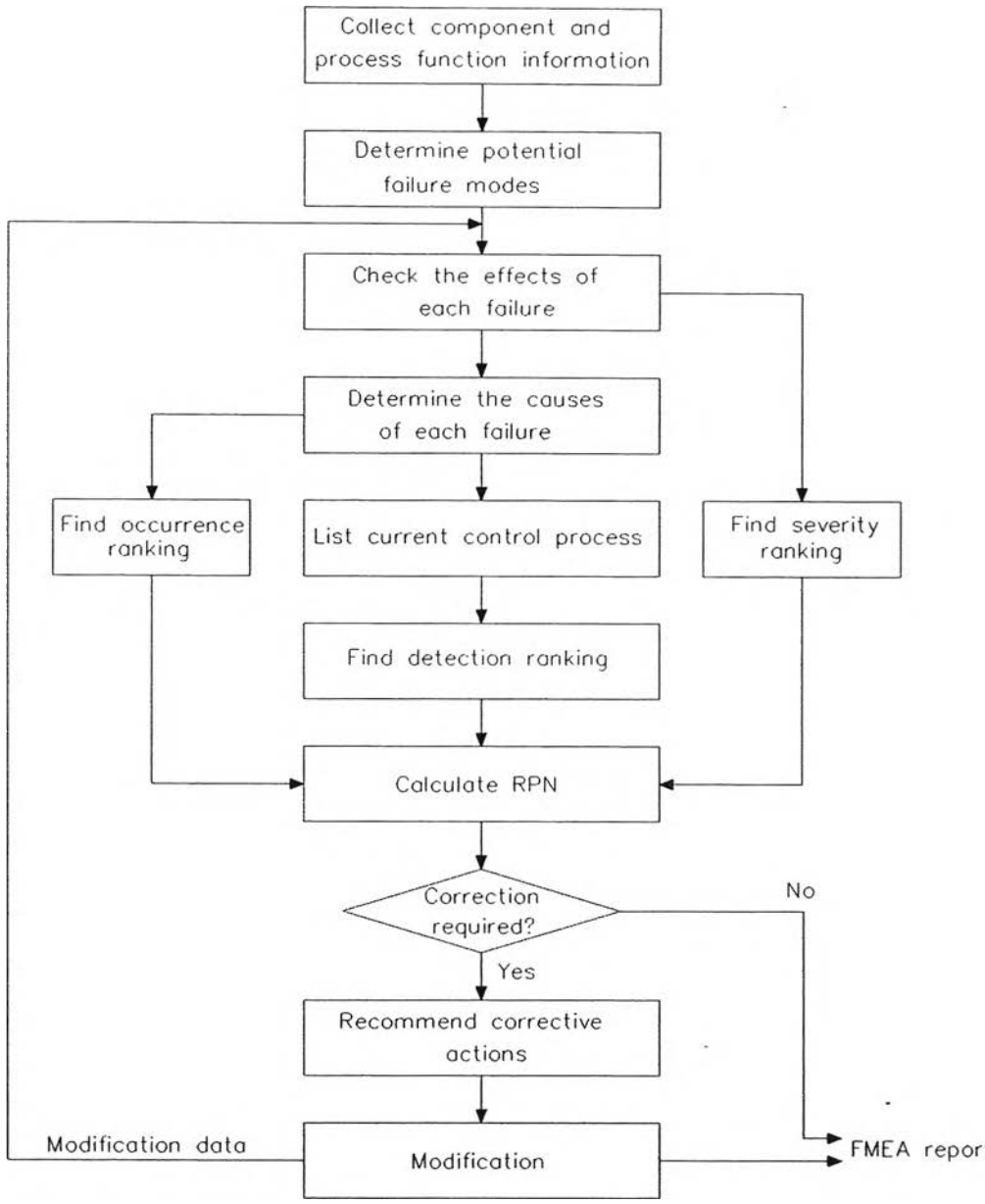

Figure 2.9 The FMEA Procedure

Source: Teng, Sheng-Hsien (Gary) and Ho, Shin-Yann (Michael) (1996)

2.4 Literature Review

For risk management, there are many models and methodologies to assess the risk for the project. Two main methods are the probability distribution model and ranking the score of prioritized risks.

The Office of Project Management Process Improvement creates a "*Project Risk Management Handbook*", which describes the basic concepts and processes that guide risk management planning and implementation during project development (Caltrans, 2003). The six steps of risk management compose of:

1. Risk Management Planning
2. Risk Identification
3. Qualitative Risk Analysis
4. Quantitative Risk Analysis
5. Risk Response Planning
6. Risk Monitoring and Control

Qualitative and quantitative analysis can be implemented as criteria to classify the risk, because all risks are variety depending on the project type. List of risk on each project is an important thing to be considered. Only ranking may not enough to indicate how important of risk on the task, level of risk (low, medium, high) from the probability may be required.

A systematic qualitative project risk analysis technique called "*The Risk Factor Analysis (RFA)*" which bases on graded approach is useful for early, pre-conceptual risk analyses, an intermediate-level, approach for medium-size projects, or as a prerequisite to a more detailed quantitative project risk analysis (Kindinger et al., 2000). This RFA model is an appropriate method for the risk management. It clearly shows the step from the beginning of risk analysis to the output how important of risk on each task. Risk factor evaluation shows that all risk factor on cost, technical, schedule and funding could relate

to all tasks of the project. This relation will be used as a basis for further research on the thesis.

The proposed risk ranking method by Fischhoff (1995), which involves six steps, is shown below.:

1. Define and Categorize the Risks
2. Identify the Relevant Attributes of Risk
3. Describe the Risks
4. Select the Groups of Rankers
5. Perform the Rankings
6. Provide a Reasonably Rich Description

Risk analysis can be used in many field, technology, industry even finance and management. Step in risk analysis of this paper is easy to use and understand, which would be more useful if properly combines with others. Step of selecting the groups of rankers (evaluators) is important. A selected case in this thesis covers only on the main task of project management. Number of risk evaluator in the section of risk evaluation would be limited in order to allow for active participation by all.

A methodology of Project Risk Ranking (PRR) by Baccarini et al.(2001), which is a part of risk management process to be applied to all contracting activities. A useful part of this paper, which could be applied to proposed thesis is a risk rating criteria. Rating for the way the cost, time and quality were established is used as a standard or guideline for the risk evaluator to evaluate risk factors for each task. The concept of the output from this risk analysis is quite similar to the others, which tells use how important of each risk.

Risk factor in project management is a part of risk management for overseas construction projects. Risks of the project in project management from Zhi (1995) are adaptable, because cost and schedule are included, while defective physical works are similar to quality. Steps in risk analysis of this paper are standard as general risk analysis. Although the project level is mainly considered in this thesis, external risks: Nation/Region and Construction Industry must also be considered, because they also affect the internal risks: Company and Project Level.

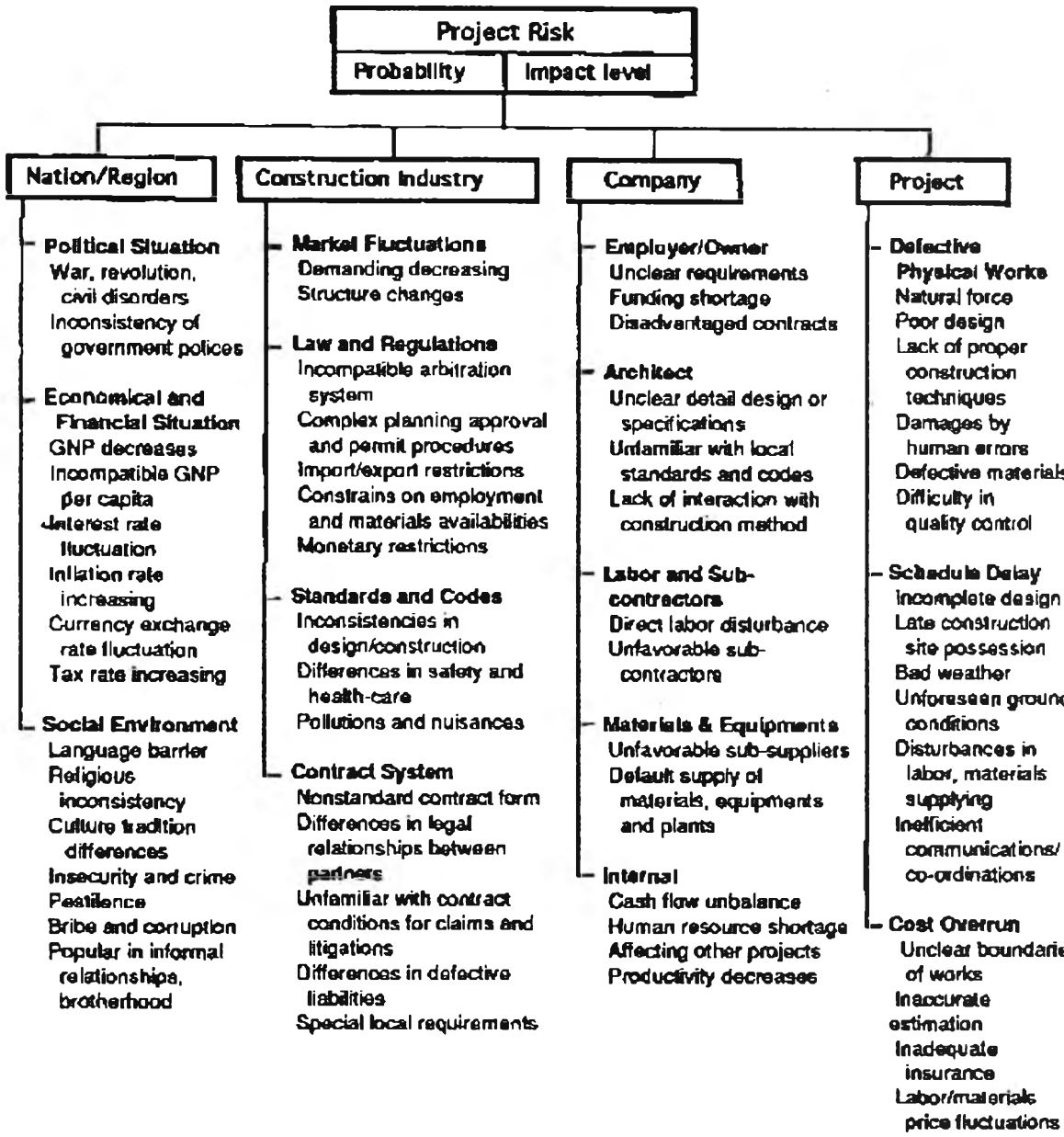

Figure 2.10 Risk Identification Hierarchy for Oversea Construction Projects

Source: Zhi, He (1995)

There have been a number of researches and literatures concerning the project management practice.

The nature and extent of project management practice in various industries are different to each other (Cooke-Davies et al., 2003). Model of project management is different, which depends on the type of industry. The domains, which each industry focuses on, are:

1. Extent of project culture.
2. Extent of business (versus technical) culture.
3. Organizational understanding of multidiscipline project management.
4. Strength of project versus line management.
5. Degree of authorization held by a project.
6. Extent of project management infrastructure, method and systems.
7. Centralization of project information for each project.
8. Competency of Project Management staff.
9. Ability to match project team to the needs of the development (stage and type).

Project Management Performance Assessment (PMPA), for assessing a quality management, which had been developed by Bryde (2003), based on EFQM business excellent model shows that there are variations in attitudes and behavior in each area, and the variations may be used to help measure levels of project management performance. Six criteria for assessing project management performance consist of:

1. Project Management Leadership
2. Project Management Staff
3. Project Management Policy and Strategy
4. Project Management Partnerships and Resources
5. Project Life Cycle Management Processes
6. Project Management Key Performance Indicators

For the quality in construction, it is related to time, cost and vice-versa (Abdul-Rahman, 1997). A poor quality project management can result in extra cost and time extension. It is very important for project manager to understand the client's requirements in terms of cost, quality, and time (schedule). The objectives of cost control are to:

- Enable corrective or cost-minimizing action.
- Act as expenditure vs. budget indicator.
- Establish a cost-conscious environment
- Minimize the overall project cost.

The quality performance management system (QPSM), which is the cornerstone of the quality movement in construction engineering, is the most important tool for Total Quality Management (TQM) (Willis et al., 1996). Two key issues of total quality management which are addressed by QPMS are:

1. The cost of quality
2. Quality performance

In order to achieve effective project management, there are some concepts to be considered. The major concepts of effective project management are shown below (Cicmil, 1997).:

1. Listening to the customers and understanding their requirements and expectations of the project outcome, meaning – linking the idea with the reality.
2. Planning realistically for time, budget, material and human resources while contemplating the re-planning of these to ensure the match with changing customer requirements and expectations throughout the project life cycle.
3. Ensuring project leadership skills necessary to build up effective project teams.
4. Having a sound communication system in place, that spans the project network.

Project management is not only relevant to middle management level. Nor does it fall only into the functional responsibility of production/operations management group. It should be communicated to all levels of organizational structure.