


**ADDIS ABABA INSTITUTE OF TECHNOLOGY**

# ASSESSMENT ON DESIGN MANAGEMENT PRACTICES OF NATIONAL CONSULTANTS

## FOCUSED ON BUILDING DESIGN PROJECTS

**By**

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# DECLARATION

This thesis is my original work, and has not been presented for a degree in any other university and that all sources of material used for the thesis have been dually acknowledged.

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# ABBREVIATIONS

| | |
|---|---|
| ADePT | The development of an analytical design planning tool |
| DM | Design management |
| I.I | Importance Index |
| MoWUD | Ministry of Works and Urban Development |
| QFD | Quality function development |
| RFP | Request for proposal |
| VE | Value Engineering |

## ABSTRACT

In recent years design become reason for the escalation of project cost and time due to inconsistent approach of design management of Consultants. Many projects must now be delivered fast track while co-ordinating increasingly complex fabric and content of buildings with a platform of accepted good practice to manage the design process. Thus, managing the design process plays a major role on the Ethiopian construction industry for delivering projects on time, to budget and to the specified quality.

There is a need to educate an increasing number of people in design management techniques to equip them to manage today's fast moving and demanding projects. However, many current design management tools are insufficiently developed for industry application. Therefore, to improve design management in the industry, current techniques must be modified to align them with the needs of the modern design manager.

This research has assessed the design management practice of different consultants with the aim of improving the practice and comprises contents of design process. From this practice of design management recommendations and strategies developed in order to fill the gaps between the practices.

This research work presents several issues related to current design management practices of national consultants. The practice of 34 building consultants was investigated via questionnaires. Existing practices related with managing and evaluating information through planning, monitoring and controlling, were assessed in view of identifying shortcomings and limitations associated with each functions. The results moreover indicated that most of the surveyed consultants have inconsistent approach to design management for their projects. Only 36% of the consultants have met the expected completion contract time of the projects they have undertaken so far. While the other 48% didn't meet the contract period expected to finish the design project, the remaining 16% of consultants do the design project without time boundaries.

According to the results of the research, factors contributing to the inconsistent design management are unfamiliarity with defining tasks, ineffective managing and improper evaluation of information flow, inadequate planning, monitoring and controlling for project design process. The results revealed that consultants' design controlling process is not integrated with the management and evaluation of information throughout the design process with considering the time constraints.

The survey results further revealed the very limited application of tactics for developing a project culture throughout the design process for facilitating the design management process.


**Key words**: **Project design management, design process, design brief, information management, design review.**

# CHAPTER ONE

## 1. INTRODUCTION

### 1.1 General

Consultant firms, being the key stakeholders of the construction design industry, are the primary agents for meeting the design demands made upon the industry. These firms in general, are project based organizations which are mainly devoted in production of design and supervising projects. This output of design, passes through sequential processes and need to be managed and controlled. The discipline called design management, plays a significant role for handling these processes. Design Management is an emergent professional discipline which separates the management function of a project's design phase from the design function. It is becoming increasingly important in modern construction projects (Gray and Hughes, 2001). It is closely aligned to project management, it must provide a fully co-ordinated design, on time, meeting all stakeholder needs and it does this by coordinating, controlling and monitoring design activities while interfacing with other project and external parties. It is a task typically carried out by a design manager or team of managers depending on a project's size and complexity. Gray and Hughes (2001) believe that Design Management is the responsibility of the whole project team, even though, point of responsibility to control the production of construction information is given to single person.

The only reason for the lack of design process performance measurement initiatives is perceived that design process has been relatively ignored in the construction industry. Some lie in the nature of the design process itself. The iterative and poorly defined nature of the design process (Austin 1996) makes it difficult to determine progress. Also, as design solutions are not absolute answers, but rather are the product of negotiation, agreement, compromise and satisfying, any assessment of success must be relatively subjective. Therefore, developing performance indicators that can effectively and objectively account for the complex intrinsic nature of the design process is potentially very difficult. Although the design process has been a relatively ignored area of

performance measurement and its monitoring is very challenging; it is vital that the industry addresses this issue.

The industry is being driven to change by clients expecting better performance (Gray and Hughes, 2001) making increasingly exacting demands in terms of time, cost and quality (Austin et al, 1994; Koskela 1999, Songer et al 2000, Stresemann 1995, Tluazca and Daniels 1995). The design process has the opportunity to deliver. Generally, current practice is characterized by poor communication, lack of adequate documentation, deficient or missing input information, poor information management, unbalanced resource allocation, lack of co-ordination between disciplines and erratic decision making (Austin et al, 1994; Cornick, 1991; Hammond et al, 2000; Koskela, 1997; Lafford et al, 1998). Therefore, a way to improve design process performance is to measure it (Miles, 1998; CIRIA, 2000). This can be done by providing an understanding of practices that provide competitive advantage (Camp, 1995) through which will address the ever-rising customer requirements and expectations for improvements in the cost, timing and quality of construction output (Mohamed, 1998).Accordingly, consultants need to have a design management approach which spans from the concept stage up to the completion stage and which integrates the works; defining the tasks ,managing information, evaluating information and presentation.

## 1.2. Background Of The Problem

There are several defining features of the design process that have been noted that interact and make it difficult to manage. Primarily, the process is iterative and poorly defined which can be attributed to two key factors; first, it requires the production of incomplete outputs to develop understanding of both design problems and alternative solutions second, this is undertaken by a diverse team (e.g. Architects, Clients, Mechanical, Civil, Structural, Electrical, Environmental and Process Engineers, Quantity Surveyors, Estimators and Planners) representing different disciplines, educational backgrounds and goals. As a result, the process is one of significant co-ordination, negotiation, agreement, and compromise often under uncertainty and time-pressure to achieve success. This can often result in changes, putting further pressure on the process and affecting progress and budget. Furthermore, if progress does falter then it can be

difficult to get back on programme, as individual design tasks cannot be accelerated by introduction of additional resources. This is further compounded by the difficulty in determining progress of a process with the potential for iteration and yielding only negotiated solutions and no absolute answers.

Poor communication; lack of adequate documentation; deficient or missing input information; unbalanced resource allocation; lack of coordination between disciplines; and erratic decision making; have been identified as the main problems in design management ( Austin, 1994, Koskela, 1997).

Poor design process performance has a significant effect on the performance of subsequent activities and the finished product. The cause of the majority of construction delays and defects can be traced back to poor design process performance (Josephson,1996; BEDC, 1987), with poor information alone creating problems more significant than those attributed to poor workmanship and site management. This can be attributed to the difficulty in controlling the nature of the design process (Baldwin, 1999).

Therefore, the complexity and uncertainty of the construction design process requires the application of significant management effort (Newton, 1995; Gray and Hughes, 2001) for project success. Considerable advances have been made in Design Management, but there are still few examples of total success (Gray and Hughes, 2001). This in part can be attributed to the complex and challenging nature of the design process. However, many current approaches are inappropriate for managing the design process. For example, the design process is typically unstructured which leads to insufficient understanding of the design process between parties (Karhu and Lahdenpera, 1999) and is a barrier to people working effectively together (Taylor, 1993).

An effective and workable design programme is essential to improve co-ordination between disciplines and exert managerial control over the design process (Austin, 1994). Yet it is usually programmed to achieve the required timings of information release to contractors, followed by the preceding procurement activities and finally the design (Austin, 1998). This low priority of design in project planning is attributed to construction accounting for the majority of the project costs. However, there is now an

increasing recognition that construction efficiency and costs are heavily dependent on the quality of the design solution and information (Austin, 1998) and therefore the quality of the design programme. Yet, little effort is given to planning the design in detail in the belief that it is not possible for such a creative and iterative process (Cole, 1993) - a situation perpetuated by a lack of understanding of design information flow, dependency and availability of suitable planning techniques (Austin , 1996).

Newton and Hedges (1996) claim that a poor understanding of information flow and dependency exists because each discipline does not understand how their work contributes to the whole building design process, causing a fragmented approach to planning. Therefore, the identification and co-ordination of cross-disciplinary information, essential for a fully integrated design, is left to the expertise of the design.

The motivation for this study has emanated mainly from experience and observations. This research will investigate the current design management practices of consultants in depth in order to identify the particular areas which demand improvement interventions. Accordingly, it will investigate the existing practices on defining tasks, managing and evaluating information and also planning, monitoring and controlling and identify shortcomings associated with each function. By assessing and improving their practice, consultants can minimize information flow problems, maximize quality and consequently fulfill firm and project objectives. And, this is realized, to a satisfactory extent, through the implementation of an integrated design management system, which facilitates clear understanding of projects and to solve problems which are arise from the different nature of projects before commencement of construction and efficient supervision during construction.

## 1.3. The Research Problem, Questions And Objectives.

This research work is intended to be an applied research which contributes knowledge towards solving a practical problem. Accordingly, the research problem statement and the research objectives are formulated based on facts discovered by investigation. Actually, this study will examine the current design management practice in detail, in order to identify the major weaknesses associated with the managing and evaluation of information through planning ,monitoring and controlling practices, which are major

functions of a comprehensive design management system. The research aims at addressing the problems by proposing improvement interventions, based on the concepts and theories developed so far in the area.

In this regard, the problem statement of the research is formulated as, inconsistent design management practice of national consultants. This results poor quality of design production and indirectly leads to cost and time escalation of projects. Based on the problem stated, the research is carried out in view of achieving the following three objectives:

1. To assess the project design management practices of national consultants.
2. To identify shortcomings, drawbacks and limitations of the existing design management practice.
3. To forward recommendations and interventions to improve existing design management practice.

Within the view of accomplishing these objectives, the research has posed the following three questions, which are to be addressed by the selected research instruments:

1. How is the existing project design management practices?
2. What are the shortcomings, drawbacks and limitations of the practices?
3. What possible adjustments are needed on the practice?

## 1.4.The Study Scope And Limitations

Improved design management capacity, though it is important for project owners and contractors, the research is undertaken only from the point of view of consultants. This is due to the researcher's notion that consultants play a major role for design management of projects. Despite the fact that design projects undertaken by consultants range from light residential buildings to complex and heavy projects, the scope of this research work is limited to and focused on building projects. The need for limiting the research to building projects arises mainly due to two major reasons. The first reason is tied to the work experience of the researcher on building projects. The other reason is associated with the number of activities or work divisions involved in building projects, which is

much higher than those in road or other projects. The high number of work divisions and items is accompanied by collection and interpretation of massive volume of information regarding resources' design, productivity standards and so on, which inturn demands the employment of an effective design management system.

The research work encountered problems and limitations during data collection. Questionnaire and interview were designed in such a way that desired information could be collected, However; some respondents didn't participate because of some reasons in filling questionnaires and shortage of time for waiting until getting the responses promised from the respondents.

## 1.5. Organization and Contents of the Research

This dissertation comprises six chapters. Chapter one is the introductory chapter which provides basic information about the research including background and statement of the research problem, research objectives and limitations of the research. The conceptual frame work of the research is presented in chapter two and chapter three. Accordingly, chapter two gives an overview of the process of building construction design. Chapter three presents theories and discussions related with the major functions of project design management system and elements or components of project design management. A brief discussion on design management practice through planning ,monitoring and controlling of design information flow is also included in this chapter.

Chapter four covers the research methodology. It presents an overview of the research process, the research's approach and instrument, questionnaire design and rationale of the questions, the research sample selection and methods of analysis of the research's data. Chapter five presents analysis of the research data, findings of the research and discussions. The last chapter is devoted to the research's conclusions and recommendations.

# CHAPTER TWO

## 2. THE PROCESS OF BUILDING DESIGN

### 2.1. General

The construction design process is a specialized and highly demanding form of problem solving (Pressman, 1993; Lawson; 1997). It is where stakeholders' needs and requirements are conceptualized into a physical model of procedures, drawings and technical specifications (Freire and Alarcon, 2000). It is a dynamic and complex multidisciplinary process, involving many parties and performed in a series of iterative steps to conceive, describe and justify increasingly detailed solutions to meet stakeholder needs (Sterman, 1992; Ogunlana et al, 1998; Baldwin et al, 1999). It is claimed to be the key project process (Morris et al, 1999; Cockshaw, 2001), defining up to 70% of the final product cost (Kochan, 1991) and adding value by delivering functionality, quality, enhanced services, reduced whole life costs, construction time and defects as well as delivering wider social and environmental benefits. (Treasury Task Force, 2000; Prescott, 1999).

### 2.2.The Characteristics Of Design

Design is primarily a personal task with the whole projects' design becoming a combination of the motivation and expressions of many individuals. It's also viewed by the separate members of the project teams from differ directions and, in particular, with regard to how well it will accommodate their own needs and wishes. It takes time to explore, understand and consider the impact of these differing views. A simplified definition is to say that design management is about managing people and information (Emmitt & Ruikar, 2013).People in this context are stakeholders in a building project and information being deliverables among stakeholders. Any manager involved in the design process, must allow the necessary time for discussion and consideration, so insuring that the designers aim's and expectations are met within the terms of the design brief. In this sense the design manager is in a supportive role, which allows the process to continue. The influence design manager cannot be ignored. This 'silent design' role ( Dumas and

Mintzberg,1992)describes the decisions taken by non-designers who enter in to the design process.

**A. Design Is A Very Personal Statement Of Ideas**

The final design is a culmination of design+ process that is often driven by personal motivation. 'thus we can see that, although designers may be commissioned and briefed by clients and may chiefly concern themselves with need of others, the design process is also performed for the personal satisfaction of the designer'(Lawson,1990).

What forms and influences the designer's character? What forms this inner motivation and how will it manifest itself in the designs that are produced? These are important issues to undersatand, not for the reasons used by many critics and writers to categorize by the styles they adopt, but rather to determine the nature and level of their commitment to their professed ideas.

Many designers ,often driven by their inner convictions about the way the world should beware determined to make a statement, whether political, social, monumental or aesthetic, through their work. This is developed during the process architectural education, which in the UK at least is dominated by the project-based. This system requires architects to develop their personal design philosophy and concepts and defend them strongly in open debate with their seniors and peers. here is a danger that this custom of vociferous defense may be perceived by non-architects as arrogance ,but it is often so strongly developed as to be very difficult to modify and adapt.

## B. Design Is A Form Of Art

Looking at a building should be a visual experience. The architecture is criticized and evaluated first and foremost on the basis of its contribution to the visual delight of the observer, either from the overall appearance of the external elevations or the way that space and light have been used in the interior. Great architecture is often liked to sculpture in the way that form is used to carry meaning, often abstracted from the initial concept and use of the building. However, architecture can seldom be the same art in the purest sense of original creativity, because buildings are primarily designed in response

to someone else‘s requirements. Perhaps in this way it is more akin to portrait painting, where the artist or architect uses representational skills to fulfill a commission.

What distinguishes architecture from painting and sculpture is its spatial quality. In this, and only in this, no other artist can emulate the architect. The view that architecture is both a profession and an art is accepted by sociologists, but regarded by them as its chief eccentricity’(pevsner,1968).

This is not to detract from the skills of the designer, but perhaps to present a word of caution in that little about architecture is pure art in the conventional sense. There is obviously a great deal of creativity and originality required on the part of the architect in the interpretation of the brief. Indeed, an architect occasionally manage to achieve such originality that the whole of architecture is led in a new direction.

## C. Design challenges the existing approaches

Much of design is concerned with using basic components and materials in new and different ways. It is by finding original combinations of products that designers can satisfy their own design philosophy. The range of technology available today, together the rate at which it continues to develop, helps designers to realize their inner demands through the building design they create. Many new ideas and thoughts will occur during the lengthy process of building design. However, problems often arise from the fact that not all ideas can be analyze and developed simultaneously. This may rise the dilemma as to whether it’s better to continue with the original idea, or to change to the new idea, which may well produce an improved design, but which may create disruption and uncertainty in the design process.

The need to satisfy the creative need is restrained within the confines of what is possible in the design process. There is underlying tension in most architectural design. Set against a general aim of achieving good design, innovation and high quality is a constant pressure to reduce the price of construction. Therefore, a designer must set out the priorities in meeting these twin objectives otherwise ambiguity is inevitable.

## D. Design Is A Realistic Solution To A Problem

In an attempt to understand the underlying methods used in the creation of a design a great deal of research has been undertaken in to the nature of the intellectual process used by designers. What is clear is that there is no single method or system used by all designers, nor does anyone designer appear to use any single method (Lawson,1994).a designer uses many methods simultaneously, directed towards solving the problem and arriving at an acceptable solution.

The creative leap is more a process of building a bridging concept between the problem and its solution (cross,1996).in an observation of design process, cross determined that there was an 'apposite proposal' from one member which grew in acceptance by the other participants In the group trying to resolve the design problem. Once the basic proposal has been accepted the whole group swing behind the idea and then put all its efforts in to making it work. This is contrary to the more conventional view of designers waiting for the blinding flash of originality, although the opposite proposal has to be derived from somewhere. But this was the result of an evolutionary process.

The strategies that appears to be used most consistently is on that focuses on identifying several solution or hypothesis. These 'protomodels' (March,1976)are evaluated and each evaluation is used to refine the proposed solution until an acceptable answer is reached. For this to be effective the problem must be clearly stated.

### 2.2.1.The Nature Of The Building Design Problems

Clients cannot always state requirements clearly or fully at the outset because of the many different interests that have to be satisfied. In many cases each problem is 'owned' by a group of people, each with varying requirements and ambitions for its solution. Each party will have a different role to play in the initial decision-making processes that inevitably lead to overlaps and gaps in the statement of requirements given to the concept designer. To help develop a working brief that can be agreed by all parties, a designer will often do solutions to the problem, largely to elicit where they fail and then, through a process of learning, offer a better description of the problem. External sources, such as

local authority planners or environmental agencies, may well also have important inputs at this stage.

Designing is a process of human interaction and, consequently, the outcome contains the interpretations, perceptions and prejudices of the people involved. The acceptability of the outcome is also based on a trade-off among the individuals about what they are willing to accept as satisfactory interpretation of their ideas. Inevitably, design is the trade-off between many conflicting needs until there is a solution that enables that everyone to move forward to the next aspect of the problem(akin,1986),a process known as (satisfying).each designer may have different perceptions of the problem and many ideas for its solution. Therefore, almost inevitably, features that one designer considers to be important may well be deemed unimportant by others. As Lawson(1990:89)put it, 'we should therefore not expect entirely objective formulation of design problems'. There may also be a cultural dimension from one country to another in the level of satisfying that is acceptable. This is subjective set of criteria, but must be considered when a designer from one country is developing designs to be built in another country. If the designer is setting higher standards then the adopting country accepts then cost, technical and practical restraints may be produced an intentionally in to the project by the designer(Fowler,1997).

A successful outcome to the design process is often determined by the choice of starting point in relation to the definition of client's problem. assessing the level at which to start is important and is a matter of fine judgment. It requires a clear definition of the boundaries surrounding the problem, because starting at low a level may lead to a misunderstanding of a real issues.

### 2.2.2. Strategies For Solving A Problem In Design

It seems essential to the design process that the designer should propose one or more possible solutions to the problem at an early stage, even if this is only to obtain a clearer understanding of the client's needs. Essentially, design is a cumulative strategy of developing a solution and critically appraising to see whether or not it meets the criteria of the designer(schon,1983).

The designer may use a particular idea primarily as a route into the problem. This may be a constraint imposed by the designer in arriving at the solution and which can be so powerful that it may be retained through adversity and criticism until it either proves unsuitable or becomes dominant. This may apply to whole buildings or to systems within the building. It is the seeming reluctance to accept alternatives that is often misinterpreted as the intransigence of the designer. The conjecture and analysis stages follow and are largely based on reflection and review. It is a complex process aimed at increasing understanding through attempts to change or to reframe the problem.

An alternative view is that the design process comprises stages of interpretation, generation, comparison and choice and the process is one of making a selection at each stage, as illustrated in table 2.1.However,the proposition that design is linear sequence can be questioned. It is possible that he designer thinks freely across around the boundaries of a problem and a complex cyclic model is more realistic and representative of the process.

Table 2.1..The four parts of the design process(from Hickiling,1982)

| | The choice | The product |
|---|---|---|
| Interpretation | what is the shape of the problem? | A definition of the problem |
| Generation | what are the alternative solutions? | A range of alternative solutions |
| Comparison | what makes them different? | A set of comparisons and preferences |
| Choice | where do we go from here? | A decision about policy and action |

There are two parts to this model: the iteration and evaluation within each part, and the iteration and evaluation between the parts. At any point it may be necessary to move to another part and evaluate it to understand the original problem, and so the process is one of continually cycling between and within the parts of the evaluation process. In practice this is tends to fall in to three stages: preliminary evaluation, probable solution and final solution. Table2.2 shows that the many tools that the designer uses to propose solutions.

If this interactive and reflective approach to design is typical, then it makes a methodical and analytical approach to management difficult to adopt. This is because the process is difficult to specify in advance and the evaluation against many criteria is likely to lead the designer in unexpected directions.

Table 2.2.Design techniques for the generation and comparison parts of the reflective process(from Bradbent,1973 and Hickling,1982)

| **Design solution Methodology** | **Description** |
|---|---|
| Pragmatic design | The use of available materials and methods without innovation |
| Iconic | The copying of solutions |
| Canonic design | The use of rules and systems |
| Analogic design | Use of analogies from other fields |
| Lateral thinking | Ideas from another field applied to the problem |
| Brainstorming | Ideas, many random, focused on the problem |
| Models | Physical representations of ideas |
| Mathematical techniques | Detailed analytical techniques |
| The Rhu barb principle | Moving forward to a solution before a rational linear process would allow |
| The Sutton Effect | Selective allocation of scarce resources to the area of greatest benefit |

## 2.2.3.Constraints on the design process

At any point in the process the designer is working within a set of constraints, both internal and external.

## A. Internal constraints

The internal constraints are imposed through want to work in a particular way, or with particular materials or technologies. These constraints may limit the range of solutions or may present the client with an appealing consistency. therefore, certain designers develop a particular style of design or approach to the design problem and their reputation is based on this.

## B. External Constraints

External constraints come from many sources, but essentially fall in to four categories; the client's need, the technology, the construction process, and statutory control. The requirements of the building itself will place constraints on the designer because of the need to satisfy the demands of the client. The nature and location of the site will also play an important part, as will any environmental conditions.

Further constraints are imposed by the methods of assembly of materials and products. There are also practical limitations in terms of spans, weights and sizes of components that make certain options less desirable. Finally, designers of buildings do not enjoy complete freedom ;various laws impose constraints on what they do, through planning ,building control, and health and safety legislation.

## 2.2.4.The Drawing Process As An Essential Part Of Designing

The need to express designs through solutions and to communicate these clearly to others means that the process of drawing is in extricable integrated with the design process. In fact, design is impossible without some representational medium. The process of making the drawing requires that design ideas are developed and decisions made. Nowadays drawings may be produced by computers, the way the images are generated greatly influences the mental process of the designer. Whatever methods are used, they place limits on the rang of designs likely to be envisaged.

# CHAPTER THREE

# 3.THE DESIGN MANAGEMENT IN PRACTICE

## 3.1.General

Compared to project management, there are only a few books written about building design management describing specific challenges in design management (Blyth & Worthington, 2001; Emmitt & Ruikar, 2013; Eynon & Building, 2013; Gray & Hughes, 2001; Sinclair, 2011).A simplified definition is to say that design management is about managing people and information (Emmitt & Ruikar, 2013).People in this context are stakeholders in a building project and information being deliverables among stakeholders. The final part of deliverables as drawings, models etc. are concrete and easier to manage than for instance ideas or evolving concepts from the creative minds of designers. "Design management is a complex social situation as value can be a socially constructed phenomenon and decision making to that end can be inherently unpredictable"( Kestle & London, 2002).

Design Management is an emergent professional discipline which separates the management function of a project's design phase from the design function. It is becoming increasingly important in modern construction projects (Gray and Hughes, 2001).In practice, the project will generally generate a core group of people who will form the core 'team'. others must be added to this group and will become involved for specific contribution to the project. the core team therefore has tremendous power though its long-term knowledge of the project and could dominate the contributions of others. Design management recognizes this and rebuilds the groups at key stages in the project to bring the necessary skills and knowledge of the project in to play at the right time. However, Gray and Hughes (2001) suggest that while there needs to be a single point of responsibility to control the production of construction information they also believe Design management is the responsibility of the whole project team.

## 3.2.Tactics For Developing A Project Culture

In developing an effective approach to the management of building design ,the strategies encompass communication, collaboration, technology clusters, location, and start-up meetings.

### 3.2.1.Communication

The issue of communication has already been addressed as an issue of organizational design where the structure of relationships allows good communication between the levels. However, this is only one aspect of the communication issue. The most common problem is the need to understand the network of communication and how it must be facilitated at each level. Most organization charts are two-dimensional in that they concentrate on the hierarchical issues and assume that the horizontal network issues are understood. Alongside these thoughts are those of teamwork and the 'design team'. we have tried to avoid the use of the phrase 'design team' because we believe that conventional team thinking is not appropriate for understanding how best to manage the design contributions. Design team is a loose collective team to describe the fact that the design process requires considerable input from a whole range of contributors. Most of the contributions come from a loose network of different organizations selected because of their knowledge, skills and manufacturing capability.

Teamwork is assumed to be required and until a team is formed the group will not function adequately. The view taken here is that the group needs to be integrated to ensure that it exchanges its skills and knowledge, but that within a temporary multi-organization of loose contributions, teamwork in the conventional sense will not occur. This is a subtle difference in terms, but has significant management implications because the assumptions associated with teamwork are not valid in multi-organizations.

### 3.2.2.Collaboration

Given the time constraints and the practical of developing teams, a realistic approach to the needs of modern design is to aim for a degree of collaboration that enhances the creative and decision-making process. specialization is the response to complexity(Lawrence anLorsch,1967;Scharge,1990).specialists cannot work in isolation,

they need to be brought together to achieve a product that is the result of a combination of their skills. The task of management is to provide a collaborative environment to allow for the transfer of knowledge. collaborators are constantly reacting and responding to each other and frequency of contact becomes almost as important as the nature of the contact. In practice, collaboration is a far richer process than teamwork. But the issue is not communication or teamwork; it is the creation of value. This is at the heart of the modern design process.

Collaboration requires people to work together freely to the maximum of their potential. This can only happen where there is mutual trust and respect for each other's capabilities. Management must provide this type of working environment for each collaborating group. Successful collaboration must allow the continual exchange of information and knowledge without any barriers being put in the way. There should be clear lines of authority but no restrictive boundaries so that the communication can flow freely between organizations.

### 3.2.3.Technology Clusters

Another view of managing complex and technologically-driven environments is to bring together all contributors to the development of the components at the systems level and ensure that the value chain remains unbroken from start to finfish(Gray,1996).the object is to merge together the group with the support function in to an integrated task group called a technology cluster.

'Acuster develops its own expertise, expresses a strong customer orientation, pushes decision making towards the point of action, shares information broadly and accepts accountability for results'(Mills,1991).

**A. Nature of technology clusters**

The technology cluster, by focusing on the specifics of the specifies of the technology within the manufacturing process, enables constant evaluation of every aspect of the process to ensure that the overall aims are not compromised by the desire to optimize a component.

The aims of technology clusters are as follows.

- Group all contributors together, preferably in one location.
- Elicit solutions to technical, quality and efficiency criteria to support innovative design solutions.
- Create a fully integrated system-level solution.
- Focus upon completion of the system as an integrated unit.
- Preservation of the value chain throughout the supply chain.

**B. Team Building And Location**

A technology cluster is a multi-functional team. All the characteristics of good team building must be available and used. All components of them must be present from the start. This requires an honest and open evaluation of the required knowledge and potential sources to be made at the start. a radical rethinking of purchasing of the contributors required, particularly the specialist contractors. They must be involved as early as possible if their capabilities are to be maximize, and ways must be found to achieve this .teams need to be adjacent to production; technology clusters require close physical presence to work .put teams together in a location be suited to making project-focused decisions.

**C. Skills**

The people who are involved in a technology cluster need to be multi-skilled, mith mastery of an area special competence. A technology cluster requires that only people with exceptional levels of skill are involved. They must be given a freedom to work, so their work must not be over-planned. however, management expertise ,both for management of the group and management of its contribution to the project, it's always an integral part of the group. All member of the group must transmit their knowledge to other people and organizations in the group. This requires good communication skills and ability to contribute freely to the group.

### D. Integration Of Technology Clusters

A construction project requires several technology clusters, each working on separate system within the project. The purpose of this integration is two-fold. the first is to achieve the design and technological integrity of the whole project's design requirements. This is achieved by linking the architect and engineering roles between each technology cluster. The second is to maintain the sub value-chain s within a whole value-chain. This is provided by management structure that embraces all aspects of the delivery of the project within one entity. Focused communication by physically adjacent people and groups of people speeds up the whole process. furthermore, the management structure is very flat thus aiding decision-making.

## 3.2.4.Developing A Unified Team

A group that is meant to collaborate must have a shared and understood goal that unifies their activity. This requires commitment and regular, frequent contact.

### A. Commitment

Each organization will have its own way of working and its own corporate objectives. These may be sympathetic to the project, but can often override it. Successful projects overcome those constraints and combine the contributors' identity with the project and its objectives. This can only be achieved through gaining the personal commitment of individuals.

The first team-building task is with the consultant design group. There is an assumption that because it is the originator of the design, there is an automatic commitment to the project by this group. In the concept stage this is easily achieved, but as the project progress the number of people involved will grow and their association with the project will be different. Their acceptance of the same motivation as the originators of the design may take a considerable time to achieve ,if it occurs at all. However, if the contribution is large and a lot of people are involved, considerable effort is needed to avoided any tail-off in commitment(Gray and Hughes, 2001).

### B. Co-location And Project Design Offices

A hurdle is in achieving integration is that most design professionals work in their own geographically separate offices. physical communication barriers have to be overcome by a variety of means. To manage effectively such a diverse and dispersed organization, it is essential to focus the efforts of each involved on the needs of the project.

Co-location is a project approach to providing a site-based working environment where everyone is in the same building or space. The advantage is that integrated working is easier to achieve; communication is immediate and genuine team spirit, that embraces the whole project, can develop. When this enhanced by the presence of the designers from the key specialists and subcontractors, and a representative from the client's office, considerable savings in time and effort can be achieved. If the site is located a long way from their home base, this will raise issues of travelling costs, absences from family and friends and the general social dislocation that this causes.

To establish a more formal approach to co-location, the client may chose ,as part of the organization strategy, to provide a central location, a project design office, in which all contributes to the design process can work(Gray and Hughes, 2001).

## 3.2.5 Start-up Meetings

Even without a project design office, much can be achived.it is important to identify each key stage in the process, the designers and the personnel in their teams and to introduce them in appositive way to the objectives of the project. This is most effectively done at formal start-up meetings.

A start-up meeting is a meeting initiated by the client or project manager and differs in purpose from all other forms of project meeting.

Start-up meeting have several practical benefits and results.

- To bring together the key contributions and to focus on the problems of organization and design which have to be solved.

- To identify the critical work tasks and interfaces that will need the majority of management attention in the future.
- To agree the sub-objectives and their scope, and to secure the team's commitment to their achievement.
- To foster and encourage communication within the team so that the exchange of information can take place smoothly on a regular basis and at the start of each key stage in the project.
- To focus on the need for production efficiency and quality of delivery.

## A. The Timing Of Start-up Meetings

The key stages during the design process when start-up meetings should be held are at the start of briefing, scheme design, and engineering design. At each of these points, new people from new organizations are introduced. If potential conflicts are not dealt with promptly, productivity may be lost through ambiguity, misunderstanding, and duplication of effort.

The designer should also be involved in the start-up meetings at the beginning of construction and ,on large projects, at the beginning of key stages: substructure, structure, envelope, plant rooms, and service risers and internal finishes.

## The Briefing Stage

The object of the start-up meeting at the briefing stage is to initiate the preparation of 'the statement of need'. this is the key document required by the project manager to enable him or her to brief the design team properly.

The purpose of the meeting is to bring together the key contributors so that a mutual, in-depth understanding of the client's development objectives can be achieved. This includes:

- The client,
- The client's representatives,

- Members of each of the client's departments who need to be consulted in the preparation of the brief,
- The client's advisors,
- the briefing team leader.

Is intended that the meeting will generate discussion, that ideas will germinate and that an understanding of the values and capabilities of the client and the design team will be achieved.

## At The Scheme Design Stage

Once the brief is clarified and the project approved for the next stage, meeting of the developed and enlarged team is necessary. This will bring together;

- the client's representative,
- the briefing team leader,
- the design consultant,
- the client's functional specialists,
- specialist advisors,
- specialist contractors,
- the construction manager(if appropriate).

The objective is to decide the scope of the individual studies necessary to develop the project to the completion of the scheme design. This stage of intense creative activity and evaluation of alternative strategies for the building ,requiring a harmony of thought and approach. This meeting is design to achieve the necessary collaborative working relationships.

## 3.3.Defining The Tasks

The most important phase is initiation of the project, as decisions made at this point will set the pattern for all subsequent activity. It is essential to provide a clear means for communicating the design and task objectives across the interfaces between one stage and the next. The task is divided in to different stages. The first three stages are; getting

started, statement of the need ,and the business case. However ,it is vital design stage as a very large amount of information is assembled, evaluated and integrated into a set of documents, which are crucial to success of the project. Whoever is involved at this stage must appreciate the design issues implicit in the process.

### 3.3.1.Getting Started

Comprehensive briefing is of fundamental importance to the success of the project(Duffy,1994).However, perfect knowledge is unattainable (cyert and march,1963) so it is impossible to establish every need in total detail at the outset of the project. The briefing process is a series of stages of increasing detail as issues and specific requirements are refined and stated.

The client and /or the project initiator should establish a working party to oversee the development of the brief. a working party may be set up consisting of need. The repot produced is used as the basis for either conforming or rejecting the need to proceed.

### 3.3.2 Statement Of The Need

The first step is to establish a set of criteria that will form the basis for assessing and establishing the need for the building. These may be:

- the function,
- the timing,
- the priorities.

This is followed by the preparation of a detailed description of the building's intended function. A detailed list that identifies everything to be accommodated both inside and outside the building envelope should be prepared.

At this stage, the project should not be thought of in terms of shape, size, or number of stories, but in terms of function. To understand fully the requirements for a building, it is helpful to prepare flow charts of the activates to be accommodated, together with diagrams illustrating the relationships between major areas of activity, core areas, circulation areas, entrances and items of plant and equipment. The number of people

involved, the size of the planet and equipment ,and the volume of information and materials they will process should all be listed.

In cases where activities need to be kept separate, the reasons should be given. The need for separation may be based on considerations like safety, confidentiality, status, comfort, and cleanliness. The acceptable limits of the incompatible activities should be specified.

The statement of need should say whether suitable land is available for the proposed development and its location. If the land is not possession of the client, the proposed method of acquisition and timing should be identified. If available, surveys of the land or any relevant information should also be supplied. The working party should then examine the statement of need from every point of view to establish whether or not a new building is necessary or financially viable. During this process many alternatives will be considered and options developed. The working party must also assess the level of risk to be incurred, based on the accuracy of the information available. Once the need is established ,a formal statement of need can be prepared and presented to the client for approval.

### 3.3.3.Business Case

The agreed statement of need should then be developed into a sound business case. This should consider the impact on the business both physically and financially. Financial recourses will be required and how they are to be provided must be considered. In many cases this document is no more than one page to be presented to the board of the client for consideration. Many clients have established procedures for this proposal, particularly if they have a large capital expenditure programme. This is a crucial stage in the project because once this stage is passed the budgets and priorities of the project are largely set.

Clients may try to use this stage to bring about a change in the way that the construction industry operates. They are not content with past performance or become aware that many clients are obtaining far better performance from the industry on their projects. Many clients use sophisticated business process reengineering of their business and seek similar responses from their construction operations.

### 3.3.4 Functional Brief

At this stage of the project the business objectives and the statement of need are translated in to a researched and comprehensive functional brief, which precisely defines the client's requirements. From this, a clear definition of the project and reliable budgets of cost and time can be produced for final approval. In projects where budgets and targets are particularly demanding or set at the leading edge of practice, there is a trend for a multi-disciplinary team to be established. Depending on the project, the team may include:

- in-house functional experts,
- an architectural team,
- structural engineering team,
- a services engineering team,
- specialist consultants, planning legislation, acoustics, landscaping,
- a cost management and cost engineering team
- project and construction managers.

This stage involves a large degree of conceptual analysis that draws up on past experience. Therefore the group needs to have a large experience base. Where this is not available, analytical methods such as value management and quality function deployment, can be used to structure the development of the functional brief.

This stage is an active time for all concerned. The client will be required to furnish detailed information and to make decisions about the acceptability of possible design solutions. A briefing stage usually ends up in briefing documents, on which a project is based. In some projects, this
process is short and very often only consists of a client and an architect. In this stage, the vast majorities of key decisions are made. Gilbertson (2006) argues that design cost is 20% of construction costs, yet maintenance and building operating costs are five times of construction costs and business operating costs can be as much a 200 times the construction costs. The research of El. Reifi and Emmitt (2013) revealed that the issues related to the design brief were responsible for almost 30% of the rework. Accordingly,

they also discovered that the client brief was the largest hindering of the design value by over 60%.

This highlights the importance of the briefing stage. client will be necessary to advise and make decisions on the fallowing matters such as:

- limitations imposed by existing buildings and services,
- land acquistation,
- finance,
- approvals procedure/system,
- consultation periods,
- workforce management,

In the early stages of the design phase, such as preparation, brief, concept design etc., processes are creative, iterative and innovative. These are processes which many solutions, thoughts and ideas are shared between stakeholders. These processes need to be open and to enable the best solution to arrive (Hansen & Olsson, 2011).The process has an iterative form (Kalsaas & Sacks, 2011) and each iteration will hopefully contribute to the end value of a project. Once the functional brief had been established, estimated and agreed, changes should be resisted at all costs. The use of value management or the discipline of quality function deployment techniques may help to control the need to revisit the earlier stages.

## A. Value Management

Value management is defined as: a structured approach to defining what value means to a client in meeting a perceived need by establishing a clear consensus about the project objectives and how they can be achieved(connaughton and green,1996).

Value management is a strategy of examining every aspect of the whole project to ensure that all of the expectations can be delivered in the most economical way.

A problem with traditional briefing documents is that contain any judgment as to the relative priorities in the requirements. The assumption is that all needs must be totally

satisfied irrespective of the costs or value attached to them. However ,many developer clients are questioning this assumption.

## B. Standard briefing documents

The purpose of a standard briefing document is avoid ' re-inventing the wheel 'for every aspect of the design. It is particularly suitable for clients who have a continuous development programme and who can benefit from carrying forward the experience gained on one project to the next. The advantage of this approach is that it avoids discarding valuable experience from earlier projects. The document can also contain experience and guidance gathered from recognized authorities in the industry.

Typically, alternative designs are evaluated on the fallowing

- Value,
- Improved flexibility and performance of the building ,
- Reduced costs of occupation,
- Improved speed of design or construction,
- Better quality or more reliability.

It is good practice to bind the statement of need together with the standard brief, suitably modified for particular project, in to all agreements and contracts for the project. As the functional brief is the culmination of the briefing process it is important that it covers all of the clients requirements and is totally accepted and agreed, and formally signed off by the client and the design team.

## 3.3.5.Concept and scheme design

The development of the functional brief in to a full scheme design is a substantial exercise that must be done carefully in conjunction with the client. however, for efficiency, once the basic concept and its feasibility are accepted, the various system designs can be developed in parallel, as long as the technical and physical interfaces between them are isolated and the boundaries defined.

The completion of the scheme design is crucial client decision point in a project. It is also a key point in the management of the process. The client and the designers must agree on the complete scope of the work. It is usual at this stage for the design consultants to prepare a complete set of project information that is formally agreed by the client and will include the following in the detail,

- Plans,
- Elevations,
- Specification ,
- Cost plan,
- Programme,
- Special studies and reports.

Once the scheme design has been reviewed and agreement has been achieved, the complete document set is signed off by the client and design team, and the next stage can begin on basis of certainty. After this stage, engineering design continues, which is the preparation of the details' necessary for site production.

## 3.4 Managing information production

The principal management activity of any project is the processing of information (Baldwin *et al*, 1994; Heath, 1994), yet in the construction industry this is poorly performed (Latham, 1994; Kagioglou, 1998). Management is predominantly through schedules (Ballard, 1999) programmed to achieve the required information release to contractors (Austin, 1998). It does not consider the internal logic of the design process – poor planning is a factor in poor information management (Formoso, 1998). As a result information transfer is not properly controlled; designers do not have the right information at the right time and are overloaded with unnecessary information (Huovila, 1997). This creates the risk of failure of design tasks, deficient analysis and wrong decisions with potential waste in the process due to rework (Huovila , 1997; BRE, 1995; O'Brien, 1997; Franken berger & Badke-Schaub, 1998). The erratic delivery of information and unpredictable completion of prerequisite design quickly results in the

abandonment of design planning (Huovila, 1997), therefore perpetuating a cycle likely to create further difficulties.

'it has long been appreciated that when the information provided to contractors is insufficient, conflicting or incorrect, this leads to problems on site with a consequent reduction in the quality of work, delays and increased costs'(Gordon,1987).

The production drawing code begins: 'the code is about the drawings that appear on every building site and contain drawn information for construction. Throughout the code they are referred to as the production drawings or collectively as the production set and include those drawings produced post tender by specialists and sub-contractors. Many of the decisions can only be made in the light of the particular circumstances and the code is design to assist in making those decisions and to show how these fit in to a programme for preparing and issuing the drawing.'

The codes includes the fallowing ,some of which are expanded below.

- Co-ordination of information on drawings.
- Drawings arrangement.
- Format of the drawings set.
- Example drawings arrangement.
- Drawings content.
- Planning, preparation and issue of the drawings set.
- Drawn information at tender stage.

### 3.4.1 Co-ordination Of information And Approval Of Inputs

The current situation over responsibility and liability for design makes the task of producing a set of co-ordinate information complex. Despite the basic assumption that all design is the architect's responsibility, the complexity of modern construction technology has led to an increased dependence on specialists at both the design and construction stages. As a result, the client will often give authority to an architect t delegate specified parts of the design to others, and it may even be emailed from the circumstances of the case. In recommending the appointment of a particular specialist ,architects owe their

clients the normal duty to use responsible care and professional skill. Although they may not automatically be directly responsible for the defects of the people they recommend, their overall obligation to co-ordinate the design will render them at least partially liable for all design defects.

Apart from recommending specialists, an architect's duty of care and skill involves the responsibility for directing and coordinating the expert's work in to the project as a whole. Thus any, if any danger or problem arises in connection with the work allotted t an expert, of which a competent architect ought to be aware ,then it is the duty of the architect to warn the client. It can be the architect, the lead designer, or a mutual responsibility placed on everyone. Whichever it is to be, it should be clearly stated in the agreements of all the parties including those of the contractor and the works contractors. Two aspects of coordination need to be differentiated.

- The need to produce information that fully interconnects the inputs of all the contributors in to one coherent and complete piece without ambiguity.
- Ensuring that all contributors are working to a co-ordinated schedule to achieve a timing of the information flow that allows the development of the co-ordinated information.

It may be necessary to produce specific co-ordination drawings that put interrelated information on to a single drawing. Techniques such as overlay draughting and CAD are suitable for this, but only the most complicated CAD systems include clash control, which automatically identifies situations where, for example, pipes pass through beams.

### 3.4.2 Review of design inputs

Given that the specialist contractors will be contributing design information, the role of the architect in incorporating their information can be ambiguous. The recommended terms of engagement ,given by the RIBA, require the architect to review the design of others. This adequate where the specialists design is self-contained and isolated

A common practice, particularly in the USA, is to use an A,B or C action category of review, where a specialist's drawing is classified as follows.

- A action – the contractor may proceed to authorized fabrication, manufacture and/or construction, providing the work is in compliance with the contract.
- B action - the contractor may proceed to authorized fabrication, manufacture and/or construction, providing the work is in compliance with the designer's comments and contract.
- C action - the contractor shall not proceed to authorize work to be fabricated, manufactured and/or constructed. The contractor shall re-submit revised documents.

### 3.4.3 Computer aided design

The computer is a powerful tool that is used increasingly as a drafting and co-ordination devise. Productivity in terms of drawing production can be multiplied by a factor of two, given experienced users. once major advantage for designers is the ability to change and modify the model of the building rapidly and so test alternatives.

The advances in co-ordination are very dependent on the mechanisms of data exchange between the contributors to the design. In many cases the individual design organizations will have invested in their own CAD systems and will be familiar with their operation. However, data transfer between them will have to be undertaken by paper in the normal way. This has the inevitable drawback of additional effort spent in transcription with the dangers of error creeping in.

### 3.4.4. Issuing Information

To assist in the supply of complete information, the drawings should be issued in sets bound for either the zone, the system in a zone, or the component within the system in the zone. When it is issued the lead designer for the work should authorize the set as complete and fully co-ordinated. This simple discipline is intended to avoided error.

Another problem to avoid is the separation of information in to different media. For example, information on drawings is often issued separately from the relevant specification. However, it is common practice in USA for specification information to produced on self-adhesive, transparent sheets that are added to the drawing film. The reader of drawing then has all the information needed in one place for quick and accurate

reference. This also saves time in the drawing office, as the specification can be produced faster by word-processor than by hand. a CAD system with a database facility would achieve the same solution.

### 3.4.5 Drawing control

Each organization must keep a precise record of the information it generates, its current status, the distribution and, where appropriate, the stage it has reached in the approval system, the distribution and, where appropriate, the stage it has reached in the approval system. for simple projects and small offices, a paper-based recorded system will suffice, however ,on large projects a computer database is desirable.

**A. Computer record system**

There is a need for a record system that covers all drawings from all contributors. An initial decision should be made about which organization has responsibility for maintaining the project record. As it will also be used for progress chasing ,it should be the responsibility of the project manager or the design management.

Most record systems use a computer database developed to the specific needs of the user organization and not necessarily the needs of the project as a whole. The features required enable the development of historical record for each drawing, showing its development ,approval and timing of distribution through all stages.

**B. Drawing storage and reprographics**

Most project generate a vast volume of drawings and other information that is difficult to organize, file and keep in good condition. Electronic archiving ( based on scanning source documents)is becoming commonplace. If this considered at the outset, it can be linked to the original distribution system. If all drawings are CAD or scanned before issue, then the printing system could be operated by a reprographics department or agency by just calling up the recorded and issuing the distribution instructions.

## 3.5 Evaluation of information

The independent review of the content of the design (to ensure that it is competent, gives value for money, and will provide long-term satisfaction in use)is requirement of modern design and must be approached in an orderly way.

### 3.5.1 Design Reviews

The convention of many design teams is to hold an internal session of the design at key stages, such as initial concept and schematic design. These are critical reviewers involving people both working on the project and from other projects. The object is to view the developing design, to share the ideas evolving within it, and to receive alternative views in order to improve the design.

A more formal system is that required by ISO9004(British standards institution 1987)which requires that design reviews be carried out the conclusion of each phase of design development by conducting 'a formal, documented, systematic and critical review' of the design results(cornick,1990).the reviewers should 'identify and anticipate problem areas and inadequacies and initiate corrective actions to ensure that the final design and supporting data meet client requirements'. The review process is divided into categories, which ,depending up on the stage ,can be interpreted as appropriate.

Items pertaining to customer needs and satisfaction include the fallowing.

- Comparison of client needs with standard or innovative technical specifications for materials, products or processes.
- Validation of design by building product or element prototype tests.
- The capacity of the designed building to perform under expected conditions of use and environment.
- Consideration of unintended uses or misuses by potential users.
- Building safety and environmental compatibility.
- Compliance with building regulations, planning regulations, health and safety law, national and international standards, and designer's corporate practices.
- Comparisons with other practices' comparable building designs.

- Comparisons with own similar designs, especially analysis of own and other practices'
- External problem history to avoided repeating past problems.

The following items pertain to product specification and in-service requirements(these relate to the engineering and specifying stages and ,if carried out in full, should assist in the prevention of errors).

- Reliability, serviceability and maintainability of the building structure, fabric and services components.
- Permissible assembly tolerances and comparison with process (materials/methods of assembly)
  Capabilities.
- Build ability; ease of assembly, storage needs, component life and disposability.
- Aesthetic specifications and acceptance criteria.
- Failure modes and effects, and fault analysis.
- Ability to diagnose and correct problems.
- Labeling, warnings, identification, and traceability requirements of building components or elements.

Items pertaining to process specification and in-service requirements include the following.

- Build ability of the detail building design, including special process needs, mechanization and automation of the installation of building components.
- Capability to inspect and test including special test requirements.
- Specification of building materials and components, including approved supplies and suppliers.
- The safe execution of building operations, especially operative safety and working conditions.

### 3.5.2 Value Engineering

All designs that are the result of extensive parallel working can benefit from a 'second look'. value engineering is a systematic approach that seeks to enhance value by eliminating unnecessary cost while maintaining function(Green and popper,1990).The greatest return from a value engineering exercise is during the early design stage and before 60% of design commitment is made. When value engineering occurs later it may be treated as a cost cutting exercise and will probably be undertaken in hostile climate that will prevent it from achieving the desired objectives.

Another approach to assemble an alternative design team that would undertake the critical review of the design. The merit of the existing design team undertaking the review is that it increases their involvement and commitment to the project through the intensive working sessions with all the key decision-makers.

**Value engineering methodology**

The recommended methodology has five stages.

- *Stage 1;information*-the start of the study is the isolation of the most significant items in terms of cost, programme or quality, and the identification of their function. Typical questions include:-what is it, what does it do, what else does it do, what does it cost, and what is its value.
- *Stage2;speculation*-this phase is used to generate alternative ideas .the key to it a success is the freedom to think widely, creatively and not to be inhabited by convention or previous knowledge of the project.
- *Stage3;evaluation* –once a reasonable range of alternatives is proposed they need to be evaluated against the criteria for value and their suitability for the particular project.
- *Stage 4;development*-the most significant alternatives are then developed in detail. Any solution that do not provide increased value or reduced cost either in the short-term or the life of the project will be rejected.

- *Stage5;presentation*-where an alternative design team has been used, they will have to present their ideas to the existing team so that they understand the thinking and significance of the alternative approach.

Value engineering is a positive contribution to the design process, but its timing is critical to avoid delay to the project or large amounts of abortive work.

### 3.5.3 Buildability

The site production activity is dependent on the detail of the design. The increasing use of design by workers contractors is one way of obtaining simple, easy to build details because contractors can apply their production experience to the details that they propose.

As long as the bid documents and the process of detail design are open enough to allow for adjustment of the details, then a buildable design will emerge. Most benefit is gained if the build ability evaluation is undertaken at the earliest opportunity, perhaps as a contribution to the concept stage.

Experience has shown that the essence of build ability decisions, taken in any earlier strategic analyses, must be maintained throughout the detailed design.

### 3.5.4 Hazardous Operations

In operations that involve complex process, dangerous substances, and potential risks, there is a need for a particular review of the design by those who are to operate the building and its processes. This needs to be done in increasing detail as the design progresses. However, must not be left too late as major changes during the construction stage will lead to delays and major cost increases. In the process industries, considerable effort is put into this review, with scale models of the plant used to test both process and escape procedures.

### 3.5.5 Life Cycle Cost

It was not until th1960s that it became common practice to set up formal procedures to plan and control the capital cost of construction work as an integral part of the design process. The methods that were employed enabled informed choices to be made

regarding the cost of alternative design solutions(at both outline and detailed levels)and their effect on the cost of the development as a whole.

By the end of the 1980s the term 'costs in use' was current, but was soon superseded by the more self-explanatory title' Life cycle costing'.

The basis of life cycle costing involves putting the estimated capital, maintenance, operating and replacement costs in to a comparable form, and bringing them together into a single figure which allows for the fact that these items of expenditure will take place at different stages within the time-scale.

### 3.5.6 Maintenance

The design should allow the maintenance of the building to be carried out in a safe and reasonable way. In the UK, This is a legal requirement ,imposing obligations on clients, designers and builders. The design review is undertaken to ensure that all parts of the building that will need to be maintained during its life can be accessed safely and with the last disruption to the users.

The first issue is to examine each component and assembly, determine its design life, and then examine the details to insure that the design life will not be reduced through poor attention to detail. This analysis will make many assumptions about the way that the building will be maintained. These should be recorded to form the basis of the maintenance manual for the building and they need to be incorporated into the health and safety file.

The owner or occupier of the building is responsible for the safety of any employee in the building. This includes visiting maintenance works(stavely,1991).there are three main issues to be considered access for inspection, external maintenance and service maintenance.

**A. Access for inspection**

Regular inspection of the key parts of the building by the maintenance team will be required, and inspection covers, doors in to interior spaces, access behind equipment and on to roofs must be provided to ensure that there is no barrier to the inspection.

**B. External Maintenance**

Powered cradles are a common feature of many large buildings and are essential for regular cleaning and inspection. Smaller buildings without this provision will need scaffold access that may need tying in to the building. permanent ties should be provided. Access to roofs should be from inside the building where possible. For non-load-bearing walls, access to the fixings will be required for regular inspection to ensure that they are not corroding.

**C. Services Maintenance**

There are three main areas of services maintenance to consider.

- All services must be zoned to enable areas to be taken out of service for routine maintenance without closing down the whole system.
- Access to service must minimize disruption to users and also not cause any damage or deterioration to finishes.
- Equipment replacement should be considered and doors should be provided which are wide enough to enable the equipment to be removed and new equipment delivered.

The design team must consider how the building is to be maintained and must compile the maintenance manual as the design progresses. Handing over the building to the client should involve educating the operating and maintenance organization that is going to manage the building. sufficient time and money should be built in to the budget for this activity. The construction (design and management)regulations lay down detailed obligations about how this information should be compiled and the timing of its transfer to those who are to use it.

## 3.6. Planning , Monitoring and Control

The planning of the design activity is fundamental to design management. At the outset there is a need for a strategic overall plan which considers all stages of the work, the interface to the construction process, and the activity of the key contributors of to the design, including the works ,specialist and trade contractors.

Once the agreed scheme design stage is reached, the planning becomes very detailed and should include every significant interaction between all designers, including every works and specialist contractor. This must be done, stage-by-stage and zone –by-zone, by the people responsible for the work and co-ordinated by the lead designer for the zone.

At the finest level is the requirement for a schedule of all drawings to be produced by each designer, which must reveal the linkages to other, interrelated, design work.

### 3.6.1 Methods Of Programming

The following methods of programming are commonly used;

- Network analysis
- Bar charts
- Procurement schedule
- Information –required schedule
- Information-transfer schedule.

The key to their successful use is whether the underlying framework of crucial activities, which provide the essential planning and control information, can be easily presented and interpreted.

**A. Network Analysis**

Design is a complex network of the interchange of information, but experience has shown that a critical path network, while useful for project control, is not a suitable form of programme for everyday use by the majority of designers. The strength of the method is its ability to show the essence of the interactions between the work of each designer. However ,as the work increases in complexity, particularly in the engineering stage, the volume of the interactions and their complexity can easily swamp a network, even for a small project. Network analysis ,particularly computer processed, requires great precision in reporting and data entry. This leads to great difficulty in providing the flexibility needed to cope with, for example, design interactions and partial completion of information.

### B. Bar Charts

Bar charts are the most common form of programme because they are very simple. They are most effective in the early strategic phases of the work to show the approximate disposition of the main sections. They clearly illustrate the activities to be done ,but have limitations in showing complex interconnections between activities. Also they are not very effective for showing the plan for production of large numbers of drawings and details, as it is difficult to keep them up-to-date due to the complexities of information interchange and iteration, particularly on a project wide basis.

Individual bar charts of up to 30 activities are quite effective, but with this approach there needs to be an overall co-ordination of the various programs to ensure consistency and the awareness of the necessary interactions between the individual sets of activity.

### C. The Procurement Schedule

This a schedule often seen on management types of contract, where each package of work and the stages to achieve its procurement have been identified. It is an extremely useful document as long as certain conditions are meet. Lead times to the construction are determined by two things; first, the manufacturing period for the components, which in some cases can be long ;and second, the specialist's shop drawing time and the need to obtain information from other designers, some of which may be other specialists. If this is the case then the lead time will be determined by the interchanges during the shop drawing stage.

### D. Information-required schedule

The most common design management tool is the (Information-required schedule)which is prepared by the contractor at the start of the job to assist the design teaming understanding the production information requirements. The drawings and information are listed together with a date for their receipt. This is monitored ,usually monthly, at the site meeting or design process review meeting.

This schedule is issued too late to influence significantly the production of complex sequences of information, particularly if design input from nominated or domestic

subcontractors is required, so delay may well occur. The design team should have its own production plan drawn up months before contracts are placed, which is sympathetic to the need of the construction process.

**F. Information – Transfer Schedule**

A method of planning the design process has been developed to overcome many of the deficiencies of the other methods. This recognizes that there is a network of transfers of information and at the same time does not attempt to monitor the production of each drawing. It divides the information in to sets of documents and information that are transferred between participants. The set comprise drawings, sketches, specifications and text. It is the role of the recipient of the information to establish the quality of the content, which is obviously related to the task to be performed once the information is available. This method gives the designers:

- The freedom to determine a work pattern related to the importance of the particular piece of information
- An ability to adjust their own priorities within the time-scale;
- A degree of flexibility that is compatible with the designers' inherent freedom.

At the same time the method ensures that the flow of information is carefully controlled to ensure that each designer is not delayed through the failure of others to appreciate the information needs. This method can be extended to all who make decisions, such as clients, contractors and external bodies.

## 3.6.2The Development Of An Analytical Design Planning Tool (ADePT)

Research is continuing in the development of specific tools to assist in the understanding of the interdependencies between design activities and to deal with the iteration necessary to produce co-ordinated information. a multi-stage approach has been developed (Austin et al.,1999a).it is aimed at the detail design stages where, in the analysis of four typical building designs, the number of design tasks averages around 350-400,but the number of information dependencies is over 2400.on larger projects, with over 750 design activities ,the design dependencies is over 10 000.clearly,not only it is important to identify the design activities, but also the information inter dependencies.

**The Design Process Model**

A process model that represents information requirements, i.e. constraints, without indicating how each task should be undertaken, is used. By using this method that is designed to separate the inputs from three sources(inputs from within a discipline, interdisciplinary inputs and the inputs from external sources ),a more realistic model of the constraints can be made(Austin et al.,1999c).

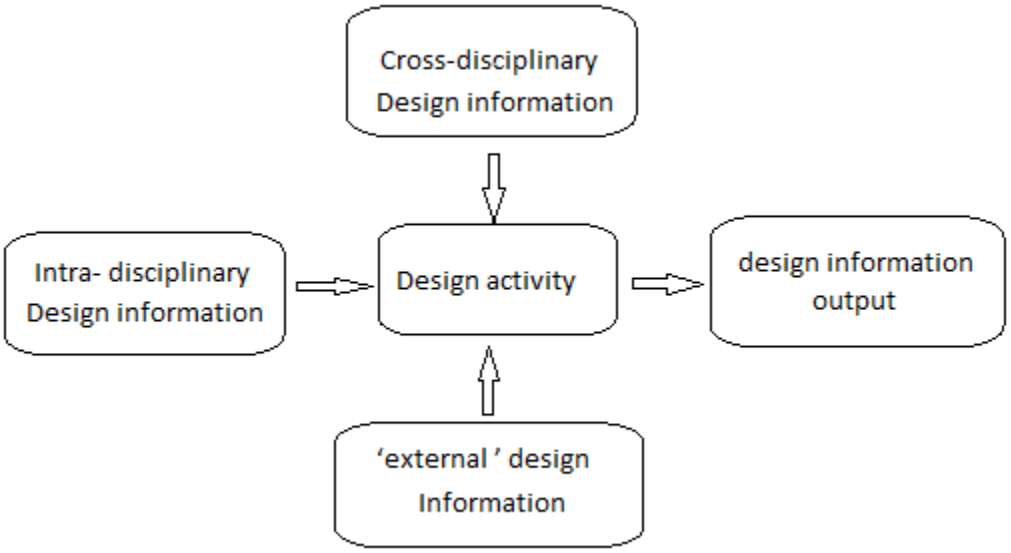



**Figure 3.1 Notation for design process maps**.

### 3.6.3 Work Package Design And Procurement Control

It is quite usual for the sequence of construction activity on the site to be used to generate the programme for the information production, whereas the information interchange requirements demand a different sequence to be established. The need to bring this information into the process often requires the specialist contractors to be appointed in different sequence from their normal pattern of site work to insure that their special knowledge is brought in to the design process at the right time. The interchange between specialist contractors must also be appreciated and should be included in the network of design activity.

Objective of the document is to keep a record of all decisions relevant to the work package, as well as a record of planned progress. The primary task is to avoid ambiguity and aid communication of the decisions that affect the work package.

The work package progress document shows the following:

- The scope of the work by concise description of its key features and they departures from normal expectations.
- A programme of the major activities leading to the placing of the work package contract.
- A record of major decisions affecting the programme that have arisen from any revisions.
- A brief record of all design decisions made during the progress of the various design stages, which concern the work package.
- A list of all information to be supplied to subcontractors as part of the contract so that all designers are aware of their contribution.
- A list of the information expected to be supplied by subcontractors and its relevance, to insure that the expectations of the designers are met.
- Decisions about the interface control and the responsibility for co-ordinating the design information sent and received from subcontractors to avoid ambiguity and to ensure that co-ordination is considered.

### 3.6.4 Cost Planning And Control

The budget may either be based on a developer's decision of how much finance is available, or alternatively, on an estimate based either on a statement of need or a preliminary design. The clients cost adviser should prepare the budget in consultation with the design team leader and the client.

It is necessary to obtain individual commitment to the separate cost targets. The aim is to set though, but achievable, targets, which individual designers, managers and specialist contractors are committed to achieving.

In developing cost plan, conflicts may emerge between the client's overall objectives, design considerations and the dictates of good management practice. Where any such conflicts arise, the client must decide how the budget is to be allocated in the cost plan. The cost adviser or project manager should arrange seminars on the project cost planning and control process to ensure that everyone understands the figures that apply to them. It is necessary to maintain an up-to-date recorded of costs committed against each cost target, so it is important to have fast feedback on changes.

When deviations from cost targets are identified(and this should be rare occurrence provided that the targets are set in agreement with the individuals responsible for the work covered by the target),the following steps should be considered.

- If an estimate of the cost of a proposed decision exceeds the allowance in the cost plan, the decision should be reconsidered to find a more cost-effective alternative.
- If it proves impossible to contain a part of the project within its cost target, part of the contingency fund must be used.
- If an estimate falls significantly below the allowance in the cost plan, and upon careful checking everything has been taken in to account, the saving should be added to the contingency fund.
- If it is impossible to contain overall costs within the overall budget ,even by using the contingency fund, the client must be asked to increase the budget or accept a reduced project.

As a matter of formal routine, the designers should receive a cost report every month. It should contain no surprises. Ideally it will report that the project's costs are on target. If there are problems, the client should have been involved in the discussions to find an answer before receiving the formal report.

### 3.6.5 Control Of Change

In controlling change, three separate issues must be dealt with:

- Change or variations,
- Development of the design,
- A request from the site for information.

Each must be clearly separated and their effect on the design process understood and assessed. They are all potentially disruptive to design and construction processes. if the type of change is not clearly identified, confusion can follow, because each source has different cost consequences for the parties.

**A. Change or Variations**

Change and variations are revisions on the design. These occur when the scope of the work changes or when the client revises the requirements for the building. variations can occur If the briefing stage has been inadequate, or the client organization is not managed effectively enough to give consistent and timely instructions.

Good client communication to the whole of the design and construction team is essential to ensure that they appropriate the reasons for the client certainty and late decisions.

**B. Design Development**

It is only when the final detail necessary for making the product is available that the detailed co-ordination between components can take place. This in turn may require adjustments to be made to the products or to other parts of the design.

Design changes are a significant problem having large administration costs (Machowski and Dale, 1995), accounting for 40-50% of total design hours (Koskela, 1992) and even in well-managed projects can cost between 5 to 15% of total construction costs (Morris, 1999; CIDA, 1994; Burati, 1992). When measured by cost, design caused defects are the biggest category of construction defects. Of design caused defects, those originating from missing coordination between disciplines form the largest category.

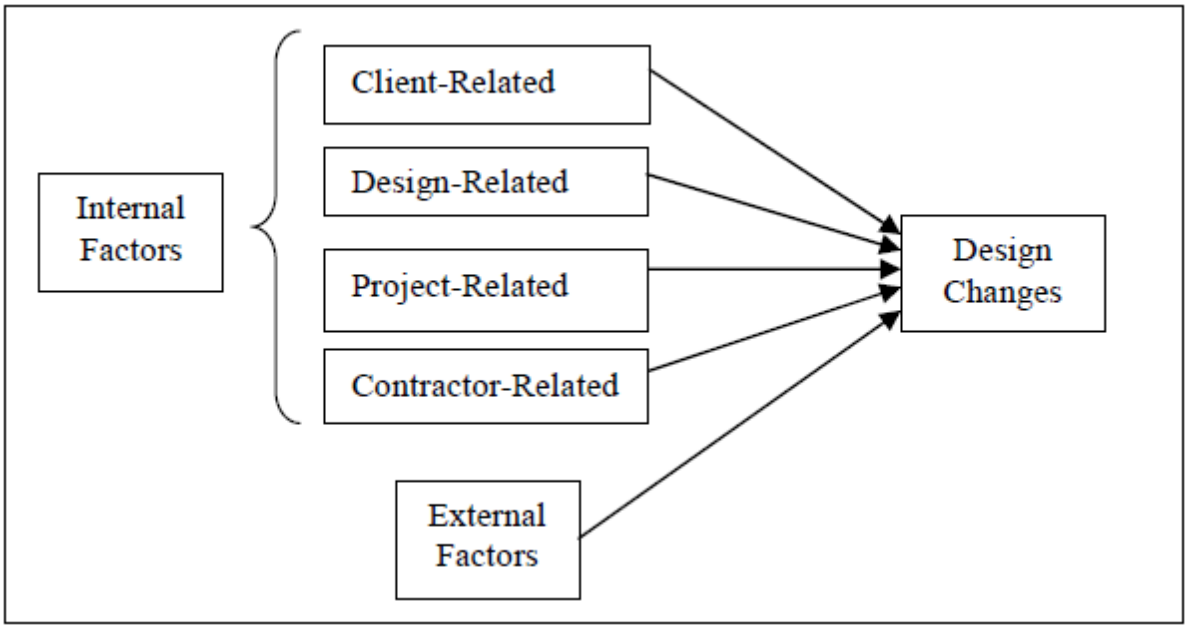



**Figure 3.2.Conceptual framework of causing factors influencing design changes (Source: JeffreyBoon,2016,Adapted from Alaghbari et al.)**

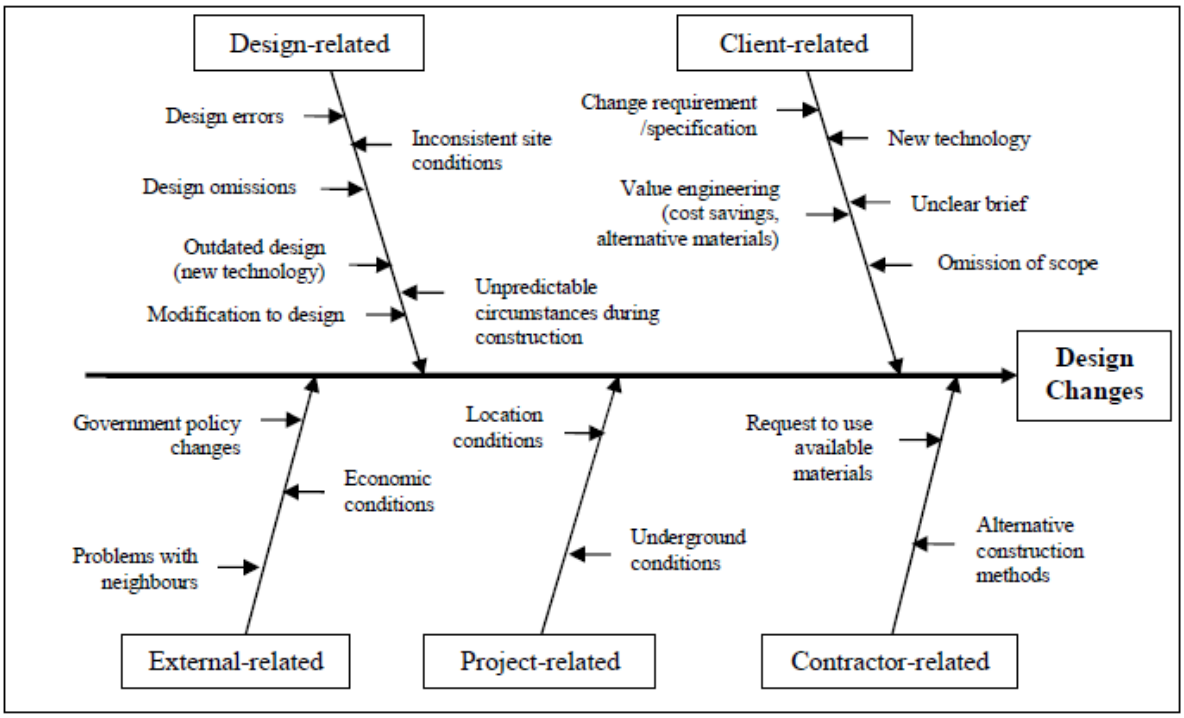



**Figure 3.3.Generic cause-and-effect diagram of design changes (Source: Jeffrey Boon, 2016).**

A symptom of insufficient planning is the reissue of large number of drawings containing continuous development during the construction stage. If this should happen, the design manager and the design team should review their planning process and adopt one of the programming methods.

### C. Requests From The Site For Information

With complex or intricate design it is very to detail every aspect of the project on paper and there may be occasions where a detailed may need to be resolved with the site team. a drawing may then be issued or verbal instruction confirmed. The important point is that the decision should be made quickly to enable the work to continue.

### Change Control Procedures

The need for a variation can originate from the client, architect, engineering consultants, specialists or contractor. the procedure will vary slightly in each case, but it must always be managed and the effect of any change should be understood and accepted by the client.

There is a fine line between design development and the clarification of intent and the design team must be aware of the distinct at all times. Also any variation to a contract, once it has been signed, must be avoided unless the full consequences are understood and accepted by all parties before the change order is issued. Contracts must also recognize the inevitable flexibility needed and they must be managed accordingly. The primary need is to identify the source of the requirement for change and establish its significance both materially and contractually.

Depending on the nature of the project and the problem, there may be a need to obtain input and information from specialists and formal 'request for proposals'(RFP) may be issued. This is more common on managed forms of contract, but it is good practice on all types of contract and enables the change procedure to be initiated in a controlled way. The RFP states the scope of the proposed change and requests suggestions as to how it may be resolved and accommodated into the design.

The evaluation of the options is a complex matter because of the effect, not only on the design, but also on the designers and their work and ,if they are already underway, the construction operations. The hidden effects of disrupting the supply and manufacturing processes must also be considered. The complete design team should evaluate the time and cost implication of each option. a formal evaluation and selection process should be adopted which leads to the decision whether or not to accept the change. All changes must be identified and communicated to all those affected, in a clear and unambiguous way, acknowledging the implications on cost and progress.

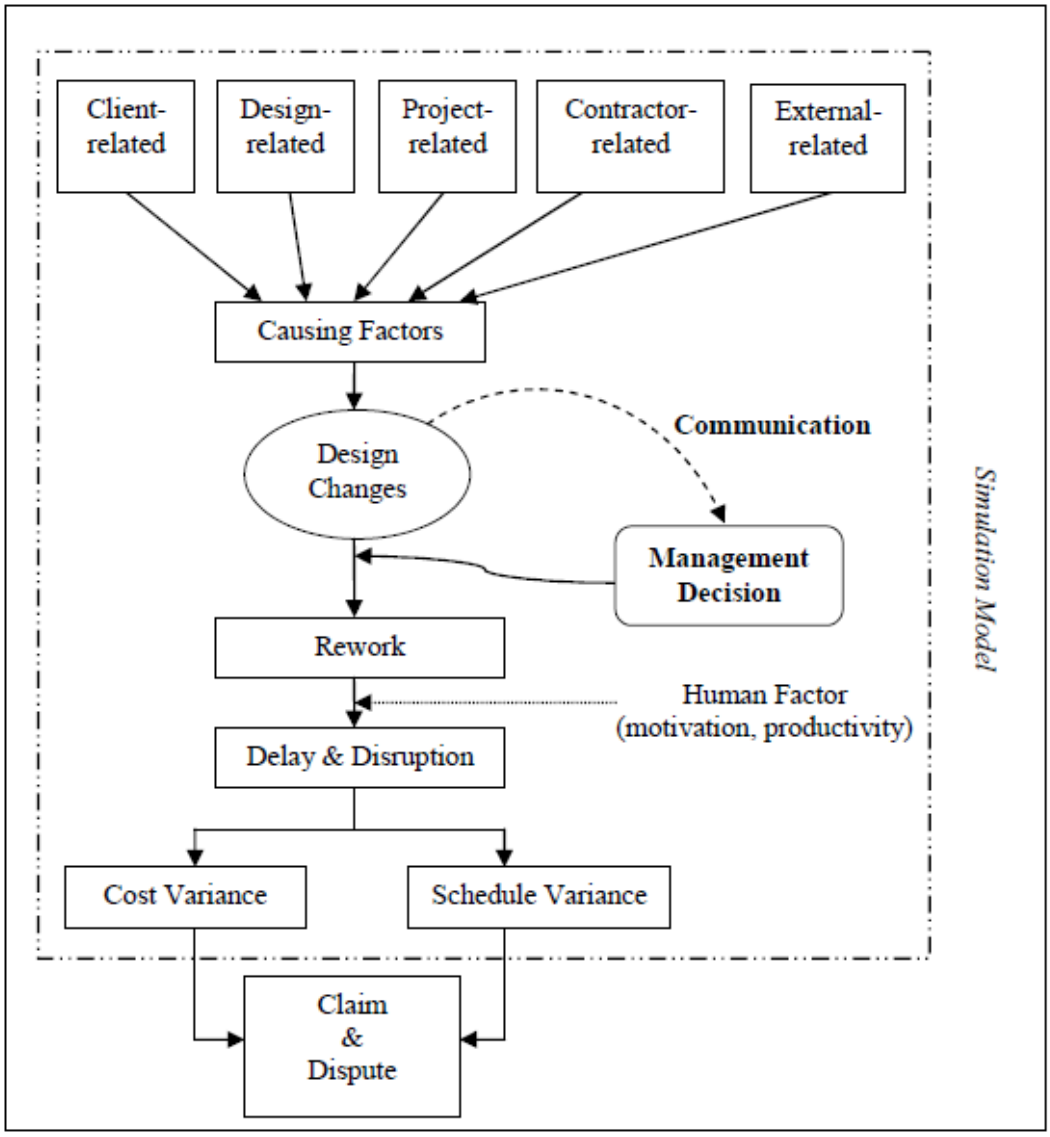



**Figure 3.4 The conceptual framework (Source: Jeffrey Boon,2016)**

**Client Functional Specialists**

The functional specialists are employed by the client as an integral part of its organization and thus have an implicit, though often ambiguous, power of decision on same or many aspects of the project. While this is often to benefit of the project it can become uncontrolled, and decisions made by functional specialists, either singly or in concert, can make the line of instruction from the client very confused indeed.

**Meetings And Decision Control**

The formal communication system needs to be matched closely to the needs of the project. While informal communication is more powerful, it is sometimes dangerous in that it can become uncontrolled and rely too heavily on subjective judgment. The formal system must be able to respond quickly, or formal bypass routines may be needed for emergency action. Essentially there are two types of meeting where decisions are taken: co-ordination and control.

**Design Co-ordination Meetings**

At this meeting the predominant objective is to co-ordinate the decision making of the design team. The person chairing the meeting should be the most significant designer at that time. preparations must be made for the meeting and only those who can contribute in appositive and constructive way should attend. The management role is to ensure that the project objects are not compromised.

**Design Progress Control Meetings**

At progress control meetings the review of progress compared with the programme must be held at the appropriate level and with the right people present, as the action to resolve failures can only be taken properly by those who have executive authority. The management role is to ensure that the people responsible for producing the design are actually doing it at the right time.

A positive approach to solving problems is always required. The manager has to guide others to the identification of the problem and what they should be doing to solve it.

### 3.6.6.Meeting and Decision Control

The basic rules are as follows.

- Every meeting should have a clearly stated purpose within either of the two categories discussed above.
- A purposeful agenda must be prepared beforehand.
- Time must not be wasted either through an ill-defined purpose or the introduction of extraneous matters, which are more suited to another kind of discussion.
- Determine the correct time for the meeting agenda and stick to it, as too much precious time is often wasted because of poor time keeping.
- The chairperson must have knowledge and control of the resources and be able to commit the designer or the trade contractor to the agreed action.

Another type of control meeting is the task force. This method of working is largely informal but results should be presented formally to avoid disrupting the existing working arrangements.

## 3.7. Design Management In Action

When developing a specific project plan, it is important to identify key points at which the process is drawn to a conclusion and everyone involved signs-off the stage. Each main stage is considered in detail below.

### 3.7.1.The Business Case

This stage is involved with placing the need for the building within the context of the business and the user's needs.

**Objectives**

- To establish an agreed need for a new build solution.
- To produce a specification of need and agreed business case.
- To set the vision for the project.
- To produce a plan of action to achieve the business case.

### 3.7.2 Outline Design

The business case sets the strategy to achieve the need .this must now be turned into a developed evaluation of the specific needs of all of the users. The initial brief must be developed.

**Objectives**

- To establish the detailed brief and functional brief.
- Set priorities for satisfaction in the brief.
- To develop the concepts and characters of the proposed building.
- To submit and obtain outline planning approval.

### 3.7.3 Scheme Design

At the scheme design stage, all the major systems in the building are specified and integrated in to final project scheme. It is an intensive stage of evaluation of alternative technological solutions.

**Objectives**

- To develop the system level briefs if necessary.
- To develop the elemental cost plan.
- To value engineer the project within the challenging targets.
- To submit and obtain detailed planning approval.

### 3.7.4 Consultants Detailed Design

Once planning has been approved ,the issue is to develop the detail of the systems in the building to ensure that they are fully co-ordinated, tolerances are compatible and any minor adjustments of spaces are made.

**Objectives**

- To obtain building regulation approvals.
- To obtain rationalization and integration of sub-systems.
- To provide a health and safety plan.
- To provide scoping information to appoint specialist trade contractors.

### 3.7.5 Procurement

A crucial stage in the effective development of the design is the purchasing of the technical knowledge input from specialist manufacturers and trade contractors. Procurement may need to occur in several phases rather than at one single point because the needs of the design process and supply chain interact.

**Objectives**

- To identify the knowledge inputs for advanced procurement.
- To sequence procurement based on design interface needs and long delivery scheduled items.

### 3.7.6 Specialist's Detailed Design

As buildings grow in complexity, the input of the specialists to the resolution of the working details of the components and their interaction becomes more important. The process involves several stages each with its own requirements. In UK over half of the total project information is produced by the specialists, while in the USA it can be over 80%.however,the two systems are not the same. In the USA the design team produces relatively few drawings and the specialists provide nearly all of the design, but only through known and acceptable 'standard' solutions. In the UK, projects use much higher levels of innovative application of 'standard' technologies, thus the relationship with the specialists is very different.

The interaction with the specialist takes place three stages.

- Discussion about the feasibility of using their products and techniques.
- The development of the individual components, and insuring fit and fixing co-ordination.
- The development of manufacturing or shop drawing information to enable the individual components to be manufactured.

**Objectives**

- To develop the design to enable the manufacture of every component in a defect-free manner to the schedule required so that delivery meets the site assembly schedule.

### 3.7.7 Construction

In practice over 70% of the total information for the project will be generated and issued once construction has commenced. all of the major decisions will have been made, but there will be a myriad of detailed issues to resolve .most of the issues will be at the level of the component and subcomponent interface with a constant need for the designers, and possibly the client, to be available to make rapid decisions.

**Objectives**

- To resolve all requests for information (RFI)as required by the demands of the manufacture and assembly process.

# CHAPTER FOUR

## 4.The Research Design and Methodology

### 4.1. Overview of the Research Process.

Owing to the desire of the researcher to undertake an applied research, which aims at contributing knowledge towards solving a practical problem, the research started by investigating a practical problem. Experience, observations and results of previous studies form the ground for formulating the research problem statement and the research questions. Based on the problem statement, first an extensive review of literatures on the subject was undertaken. Next, an investigation on the existing project design management practice of national consultants was carried out, with the view of discovering whether it matches to what has been discussed in the literature or not. Results of the investigation gave clear picture of the existing practice and assisted in identifying the major shortcomings and limitations of the practice, which were used to propose the improvement interventions.

### 4.2. The Study Approach and the Research Instrument

As described earlier, the motivation for the research has emanated mainly from observations and experience of the researcher serving as an architect and project coordinator in different design and construction projects. But, the need for proving the existence of the problem demanded a methodological approach for collecting, analyzing and interpreting data related to the subject under consideration. Accordingly, questionnaire survey was selected as the research instrument owing to its suitability to the level of information required, the high number of participants and cost and time limitations. In addition a selected desk studies together with Informal interviews were also conducted with some consultants. The desk study and interview provided additional information, either which were not included in the questionnaire or which participants failed to mention on the form.

## 4.3 The Research Questionnaire Design

The research investigated the design management practice of domestic consultants in depth by addressing questions focused on the four design management functions, development of project culture, defining tasks, managing and evaluating information through planning, monitoring and controlling. The questionnaire design was based on a combination of an extensive review of literatures dealing with project design management and the researcher's knowledge on the current design management practices of national consultants.

The questionnaire form, which was accompanied by a covering letter, consisted three parts. The questionnaire was a mix of structured (closed) and unstructured (open) type of questions. Basically, the questions were structured or closed type questions. But, in view of obtaining as much information as possible, participants were encouraged to give additional information or comments on the open spaces provided under each question.

## 4.4 Rationale of the Research Questionnaire

The questionnaire form consisted three parts, organized in a logical pattern which resembles the design management process.

The first part contained general questions regarding category and class of the firms and average annual number of projects. Information on annul number of projects was intended to reveal whether or not the practice changes with increasing number of projects. Moreover, as the research is focused on building projects, participants were asked to indicate the proportion of building projects out of total projects undertaken. This part also contained questions focused on the ways that design projects are awarded often and practices for managing them by the consultants. As discussed in the literature review section defining tasks and managing information have a direct influence on the design management practices of projects.

In the second part, participants were asked to indicate and/or rate factors considered during the design management of awarded design projects and success rate of the tender offers and factors contributing to the low success rate of tender offers, if their success rate is low. Moreover, participants were asked whether they obtain the anticipated profit

amount and quality from projects at completion time and to identify and/or rate major factors responsible, on a five point scale, if they don't.

last part of the questionnaire Part three, which is on design management practices, included questions on the tactics commonly used by the consultants, for managing information and evaluation information during design process and frequency of using checklists. Besides, participants were also asked to indicate the method/s employed for defining tasks, planning ,monitoring and controlling practices adopted by the firms and the application of software for facilitating the design management process. A question in this part has also explored current practices related details with keeping records of the details of the documents.

Finally, the consultants were asked to reveal their opinion on the importance of having a project's a defining tasks and managing information flow, for facilitating effective management of project design.

## 4.5 The Research Sample Selection

The population of the study was limited to building consultants of class II and above which are based in Addis Ababa. This is mainly due to the fact that these consultants, most of the times, involve in many projects which demand the implementation of an integrated and efficient design management system.

Participants of the research were selected from consultants' lists found in Ministry of Works and Urban Development (MoWUD) and construction proxy internet. The list published by MoWUD contained name and address of selected 44 class I consultant firms. As the research is focused on building consultants, seven road consultants were excluded from the selection list. Moreover, four consultants whose head office is located out of Addis Ababa were also excluded. Accordingly, the questionnaire was delivered to the remaining 32class I consultants, in person since one consultant were not willing to participate in this research. Of the 32 class Iconsultants who have collected the questionnaire form, 27consultants have returned completed questionnaire and two consultants has returned partially completed form.

Concerning class II consultants, among the consultants which were available on the list, the questionnaire was delivered to 14 consultants and among these, 7 have returned completed questionnaires. The relatively small number of class II consultants, is mainly due to difficulties in reaching the firms with the telephone address available on the list.

For the desk studies the population (5 consultants) were selected randomly among the class I consultants which were listed at MoWUD. These consultants are also a set of 34 class I and class II consultants who were participated on the questioners survey. Systematic random sampling technique was used for selecting the projects.

## 4.6 Method of Analysis

The descriptive statistics is a method of analysis which provides a general overview of results. Frequency distribution, which shows the frequency of observation of each response to each variable under investigation, is used to analyze the result of some questions. Rating scale is one of the most common formats for questioning respondents on their views or opinions of an event or attribute. In this regard, participants were asked to indicate the importance or level of influence of factors (research variables) by rating them on a four point scale, (O= Not important 1 = low important 2 =medium important and 3 =high important 4=very high important).

This statistical technique is intended to establish the importance of the factors. Each of the factors has been assigned an importance index or severity index, to help rank them according to their importance, as follows.

$$\text{Importance index} = \left(\sum_{i=0} W_i \times f_{xi}\right) \times \frac{100}{A \times n} \quad \text{.....[4.1]}$$

Where $W_i$= weight given to $i^{th}$ response; i = 0, 1, 2, 3 ,4

$f_{xi}$ = Responses frequency

A = highest weight value

n = total No of responses (34 responses)

For example the importance index of the factor for "low design quality practice" is calculated as shown in Table 4.1.

Table 4.1 Example for computing importance index of 'low design quality practice'

| Level of importance | Weight ($W_i$) | Response frequency ($f_{xi}$) | ($W_i$ x $f_{xi}$) |
|---|---|---|---|
| Very high important | 4 | 18 | 72 |
| high important | 3 | 12 | 36 |
| medium Important | 2 | 4 | 10 |
| low important | 1 | 0 | 0 |
| Not important | 0 | 1 | 0 |
| Sum | | 34 | 118 |
| $Note: importance\ index = \frac{118\ x\ 100}{(34\ x\ 4)} = 86.76\%$ | | | |

The ranking format was used for analyzing question in which respondents were asked to place a set of attitudes in ranking order, indicating their importance priories or preferences.

# CHAPTER FIVE

## 5. ANALYSIS AND DISCUSSION

## 5.1 General

### 5.1.1 Questionnaire Response Rates.

As mentioned in section 4.5, the questionnaire form was distributed to 46 consultants(32 class I and 14 class II) out of which 34 consultants returned completed forms, representing a 73.91% response rate. The response rate for class I consultants, 84.38%, is very good when compared to the response rate of class II consultants, which is 50%, Table 5.1.

Table 5.1 Frequency distribution of sample firms

| Class | Questionnaires issued | Responses | % of response |
|---|---|---|---|
| Class I | 32 | 27 | 84 |
| Class II | 14 | 7 | 50 |
| **Total** | **46** | **34** | **74** |

### 5.1.2 Respondents Characteristics

From the responding 34 consultants, 19 are building consultants and 15 are general consultants (building and road). The average number of design projects for the majority, 56%, of the building consultants annually is above 15projects, while all of the responding general consultants average number of design projects annually is more than 20 projects.

Initially, analysis of survey data was aimed to be carried out by grouping the consultants in two categories, large consultants and medium to small consultants, based on their annual number of design projects amount. But, as a significant number of the participants were not willing to notify their annual number of design projects amount, the analysis is done without considering annual number of design projects of the consultants. An assessment was made to reveal the proportion of building projects among the projects undertaken by the firms over the past ten years. For 90% of the surveyed building

consultants, building projects constituted more than 75% of their total work load. Building projects constituted major portion of the total work load of the general consultants too. As shown in Table 5.3, these projects represented more than half of the total work volume for 60% of the surveyed general consultants.

Table 5.2 Ratio of building works to total work volume

| Ratio | Building Consultants | | General Consultants | |
|---|---|---|---|---|
| | Frequency | % | Frequency | % |
| Below 25% | - | - | 2 | 13 |
| 25-50% | - | - | 4 | 26 |
| 50-75% | 2 | 10 | 7 | 47 |
| 75-100% | 17 | 90 | 2 | 13 |

The research indicated that consultants' approach to the acquisition on award of contracts is predominantly by tendering and competitions. 53% of the surveyed consultants procured most of the projects they have undertaken so far, through tendering and competitions, while the remaining consultants mainly by negotiation.

## 5.2. An Overview of the Research's Data Analysis Process

This section is inserted for the sake of creating continuity of discussion between the research's objectives and questions which were mentioned in section 1.3 and the subsequent analysis and discussions. The major objectives of the research were investigating the project design management practice of national consultants, identifying the shortcomings and drawbacks associated with the practice and forwarding interventions to improve the practice.

The research questions which were formulated in view of achieving these objectives were:

1. How is existing project design management practices?
2. What are the shortcomings, drawbacks and limitations of the practices?
3. What are and how wide are the impacts of the drawbacks and limitations?
4. What possible adjustments are needed on the practice?

Analysis of the data collected through the research questionnaire has addressed these questions. For the purpose of relating the research questions with the analysis and also for the ease of presentation, the results and discussions are presented under three major themes. Section 5.3 presents the first theme which is linked with research question No 1. Accordingly, it presents the research findings with respect to the practice of national consultants on the major areas of project design management. Moreover, analysis of factors responsible for good project design management in consultants, are presented.

Section 5.4 and 5.5 are devoted to the second and third themes, which are related to research questions No 2 and 3. Section 5.4 presents the findings and discussions made on the shortcomings, drawbacks and limitations of the practices of consultants. Section 5.5 presents the results of the investigation made on the impact of drawbacks and shortcomings of the practice and the relevant discussions. Figure 5.1 depicts the overall procedure used for analyzing the research data and addressing the research questions.

## 5.3 Design Management Practices

### 5.3.1 Tactics for Developing A Project Culture

In consultant firms' the quality of design production is closely linked with each working environment formulated for the professionals who contribute the design production. These firms usually obtain a number of design projects which are the need to be managed. Hence, their performance is highly demanded effective communication, collaboration through a unified team. These factors should be built inside the consultants firm through organized manner.

In the design process, there are important decisions that consultants have to make every time they receive a design project for quality design production within a specified time. The most common problem is the need to understand the network of communication and how it must be facilitated at each level. Accordingly, the design process should complement all the tasks that enable systematic and effective procedure to produce and submit competent design. good management recognizes this and rebuilds the groups at key stages in the project to bring the necessary skills and knowledge of the project in to

play at the right time. Collaboration also plays a significant role for peoples to work together freely to the maximum of their potential.

#### 5.3.1.1 The Start-up Meeting

A start-up meeting is initiated by the client or project manager and differs in purpose from all other forms of project meeting. it is important to identify each key stage in the process, the designers and the personnel in their teams and to introduce them in a positive way to the objectives of the project.

The key stages during the design process when start-up meetings should be held are at the start of briefing, scheme design, and engineering design.

In this study an assessment was made to investigate the practice of consultants' decision for making meetings in the design process period. Results are presented in Table 5.10. around 59% of the respondents practice a start-up meeting only at the briefing stage. The 17% of respondents perform start-up meetings at scheme design stage. The 6% of respondents perform start-up meetings at engineering design stage. 12% of respondents perform start-up meetings at briefing stage in addition to scheme design stage while the remaining 6% of respondents has a fulfilled practice of start-up meetings inside three stages of design process. At the briefing stage, Start-up meeting will generate discussion, that ideas will germinate and that an understanding of the values and capabilities of the client and the design team will be achieved. While start-up meetings at the scheme stage has a benefit to decide the scope of the individual studies necessary to develop.

Table 5.3 Timing of start-up meetings practice through stages.

| Timing of start-up meeting | Frequency | % |
|---|---|---|
| At briefing stage | 20 | 59 |
| At schematic design stage | 6 | 17 |
| At engineering design stage | 2 | 6 |
| At schematic and engineering design stage | - | - |
| At briefing stage and engineering design stage | - | - |
| At briefing and schematic design stage | 4 | 12 |
| At briefing, schematic and engineering design stage | 2 | 6 |

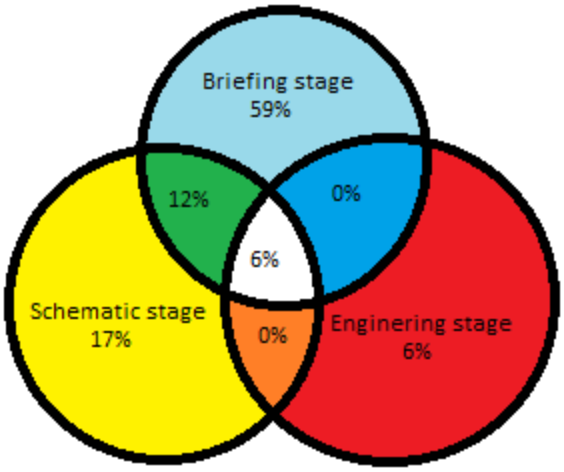



**Figure.5.1 Timing of start-up meetings practice through stages.**

### 5.3.2 Defining Tasks Practice

The detail design is the immediate work detail after the scheme is completed. The detailed designs are going to be regulated and permitted through an authorized office. An assessment has been made on the national consultants,58% of respondents states that they follow each steps of the design process in order to meet the client need by defining the tasks.23% of the respondents just focus on the schematic ,detail and final design stages while they receive a design project. 19% of respondents do the design process without defining the tasks, they just do the process as a whole. This brings the missing and order less of tasks. For example if they just start a design process without defining the statement of the need, finally they will miss the aim of design project.

### 5.3.3 Managing Information Production Practice

#### 5.3.3.1.Co-ordination Of Information and Review of Design Inputs

It is necessary to produce specific co-ordination drawings that put interrelated information on to a single drawing. The current situation over responsibility and liability for design makes the task of producing a set of co-ordinate information complex.co-ordination has two benefits; first one is to produce information that fully interconnects the inputs of all the contributors in to one coherent and complete piece without ambiguity; secondly it ensures that all contributors are working to a co-ordinate schedule

to achieve a timing of the information flow that development of the co-ordinate information.

The design inputs which is made by all the contributors should be also revised by the architect, this is due to every contributor has an isolated information towards a specific design which has to be reviewed. This helps that the isolated information has to be integrated to the whole with the help of the architect or design head.

An assessment has been made in the Co-ordination of information practice of consultants; from the responadants,45% have good practice of co-ordination with regarded to information flow, this has been notice by the period of interview and discussion with the professionals.38% of the respondents don't have consistent integrated co-ordination through each disciplines. This leads to an ambiguity between the works which are transferred through contributors. The remaining 17% of respondents do works individually and they only submit works to one center while they finish. The next work is also distributed from the design head. This also plays a significant role for misunderstanding between the works of contributor. Many disciplines are engaged on the design process and they should have enough flow of information through them in order to meet the need of the client.

#### 5.3.3.2 Drawing Control

Every national consultants must keep a precise record of the information it generates, its current status, the distribution and, where appropriate, the stage it has reached in the approval system, the distribution and, where appropriate, the stage it has reached in the approval system. completed drawings should be collected from each contributors, this is to accumulate the pure information without disturbance by others. An assessment has been made towards recording practice of national consultants and,67% of respondents records every part of building design throughout the project life and also after it is constructed. This is a good habit since it is helpful for the progress design and also for future carrier of the firm.19% of respondent consultants record the drawings only till the project completion. The remaining 14% of respondents don't have organized recording, due to the works are kept inside the individual catalog. This make a difficulty to find a part of drawing while it is needed.

### 5.3.4 Evaluation of information practice

Information which are already produced by the contributors has been evaluated through design reviews in order to bring a completed production of design. In the evaluation of information it comprise the information to be improved for the following activity.

#### 5.3.4.1 Design Reviews

Design reviewers should 'identify and anticipate problem areas and inadequacies and initiate corrective actions to ensure that the final design and supporting data meet client requirements'. Reviews mainly focus on validation of design by building product or element prototype tests and it also build the capacity of the designed building to perform under expected conditions of use and environment. It also Considers unintended uses or misuses by potential users. In the review the building safety and environmental compatibility also considered in addition it is review the external problem history to avoid repeating past problems.

ISO9004(British standards institution 1987)which requires that design reviews be carried out the conclusion of each phase of design development by conducting 'a formal, documented, systematic and critical review' of the design results(cornick,1990).

An assessment has been done that, from surveyed consultants 15% of the respondents review the design at the schematic level only ,12% of respondents review design at the detail design stage, only 6% of respondents review the design at the final stage. The majority, 35% of surveyed respondents review design at both stages, schematic and final stage of the design process.6% of respondents practice the design review at the detailed and final design stages. The remaining 26% of respondents practices a design review effectively in to three stages of designs, schematic, detail and final design.

The survey shows that the design review practice of national consultants don't have a consistent or standard way in which stages must be done .this leads to happen un clarity and also unnecessary items between information at the final stage of the design process. It is suggested that most of the design reviews should be done at the early stages of the design process.

Table 5.4. The practice of design review between design stages

| Stages of designs | Response distribution | |
|---|---|---|
| | frequency | percentage |
| Schematic design | 5 | 15 |
| Detail design | 4 | 12 |
| Final design | 2 | 6 |
| Schematic & detail design | 0 | 0 |
| Schematic & final design | 12 | 35 |
| Detail & final design | 2 | 6 |
| Schematic, detail design & final design | 9 | 26 |

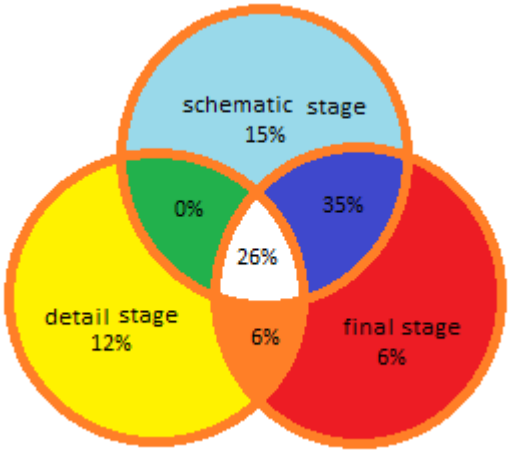



**Figure 5.2 The design review practice between the stages of design process**

### 5.3.4.2 Value Engineering

value engineering is a systematic approach that seeks to enhance value by eliminating unnecessary cost while maintaining function (Green and popper, 1990). It is a positive contribution to the design process, but its timing is critical to avoid delay to the project or large amounts of abortive work. The greatest return from a value engineering exercise is during the early design stage and before 60% of design commitment is made.

value engineering has four stages to bring alternative solution for a specific solution, these are information, speculation, development and presentation. The survey shows that

92% of respondents practice the value engineering informally to reduce the cost of the project. But this practice don't follow the correct methodology, they just communicate with the client, and the design head will make amendments if there is needed to change some alternatives. . The remaining 8% of respondents don't consider the cost minimizing tool of value engineering instead they mainly focus only on the quality and the completion time of the project.

#### 5.3.4.3 Hazardous operations Controlling Practices

Hazardous operations are a parts of a project design that should be considered in order to meet the environment health and safety conditions. If this operation is ignored it has a severe consequences on the inhabitants .38% of the respondents do practice this operation in different projects which needs to be considered.49% of respondents consider this operation for the inhabitants only but they leave the reaming consideration for the public or an authorized government. It is assessed that many difficulties has been raised due to the carelessness of these consultants. The reaming 23% of respondents don't get a chance of experience of design projects which needs hazardous operations consideration.

#### 5.3.4.4 Maintenance

The design team must consider how the building is to be maintained and must compile the maintenance manual as the design progresses. Handing over the building to the client should involve educating the operating and maintenance organization that is going to manage the building. Sufficient time and money should be built in to the budget for this activity. the construction (design and management)regulations lay down detailed obligations about how this information should be compiled and the timing of its transfer to those who are to use it.

The owner or occupier of the building is responsible for the safety of any employee in the building. This includes visiting maintenance works(stavely,1991).there are three main issues to be considered access for inspection, external maintenance, and service maintenance. The survey result shows that 32% of respondents follow the concepts of maintenance for the design projects in their firm,51% of respondents informally consider maintenance. But they mainly focus on the strength of structure in order to accommodate the inhabitants. They think 'once its designed with a maximum risk, it doesn't bring any

failure'. But it should be known that every structure must be maintained within a specified time whatever it is designed with a maximum risk. The remaining 17% respondents totally ignores the concept of maintenance once they focused on the strength.

## 5.4 Consultant's Performances With Regarded to Two Major Goals

Consultant firms' survival and growth is closely linked with the acquisition of sufficient or optimum volume of work or number of design projects. These firms mostly obtain works through computation. Hence their performance in the design process is decisive for ensuring continuity of works. On the other hand ,the sustainability of their business and fulfillment of the firm and project objectives is directly related with the amount or level of profit obtained from the design projects. Therefore consultants' business strategy should be directed towards securing optimum volume(with regard to organizational capacity) of work and ensuring that the design projects are generating sufficient amount of profit.

In this regard, an assessment was made to reveal the average number of competition offers made by the consultants annually and the associated rate of success. The survey results indicated that the competition offer success rate for majority of the consultants is low. As shown in table 5.6,the success rate for 79% of the consultants is below 50%,and 67% among those, have a success rate lower than 25%.

Table 5.5,success rate for submitted competition offers

| Range | Response distribution | |
|---|---|---|
| | Frequency | % |
| below 25% | 18 | 53 |
| 25-50% | 9 | 26 |
| 50-75% | 6 | 18 |
| 75-100% | 1 | 3 |

The major contributing factor for this ,as indicated by the consultants, is tough competition. though, it has not an exaggerated influence like tough competition ,level of low budgeting, is ranked second with an important index of 72.66.factors beyond

consultants' control(which are associated with wrong or unethical practice)are ranked fourth, table 5.7.

Table 5.6 Mean rank of factors responsible for low success rate

| S/N | Factors | Mean | Important index | Rank |
|---|---|---|---|---|
| 1 | Tough competition | 2.74 | 91.33 | 1 |
| 2 | Low budgeting | 2.18 | 72.66 | 2 |
| 3 | Shortage of time | 0.84 | 27.96 | 5 |
| 4 | Low information | 0.98 | 32.26 | 3 |
| 5 | Performance history of the company | 0.61 | 20.43 | 6 |
| 6 | Factors beyond their control | 0.90 | 30.11 | 4 |

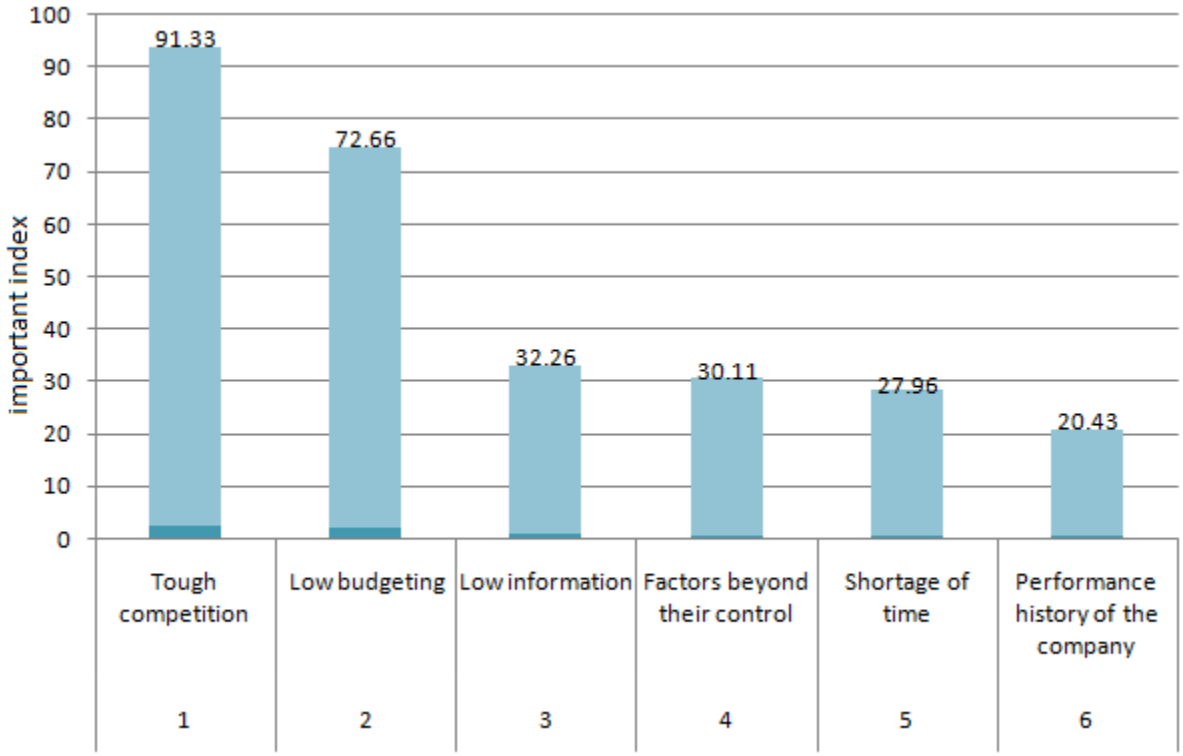



**Figure 5.3 Showing the mean rank of factors responsible for low success rate**

Regarding consultants' performance with respect to design management practice, the survey finding revealed that national consultants face serious challenges with regard to practicing the design management theories in their design projects. The survey results, as shown in table 5.7.indicated that inadequate evaluation of information has been ranked first with the important index of 89.66.the inadequacy of co-ordination of information has been followed as a second rank with the importance index of 71.55 while the un matured method of programming has got the third rank with the important index of 70.3 for the cause for low design management practice.

Table 5.7 The mean rank of factors responsible for low design quality practice

| S/N | Factors | Mean | Important index | Rank |
|---|---|---|---|---|
| 1 | Poor project culture | 1.76 | 44.0 | 8 |
| 2 | Inefficiency of definition of tasks | 2.73 | 68.3 | 4 |
| 3 | Inefficiency co-ordination of information | 2.86 | 71.55 | 2 |
| 4 | Ineffective design review | 2.68 | 67 | 5 |
| 5 | Inadequate evaluation of info | 3.59 | 89.66 | 1 |
| 6 | Ineffective methods of programming | 2.81 | 70.3 | 3 |
| 7 | Lack of cost planning and control | 1.66 | 41.38 | 9 |
| 8 | Inadequate control of change | 2.21 | 55.25 | 7 |
| 9 | Problems related with contract document | 1.28 | 32 | 11 |
| 10 | Delays due to the reasons related with clients | 1.55 | 38.79 | 10 |
| 11 | Deviations in resource profile. | 2.55 | 63.8 | 6 |

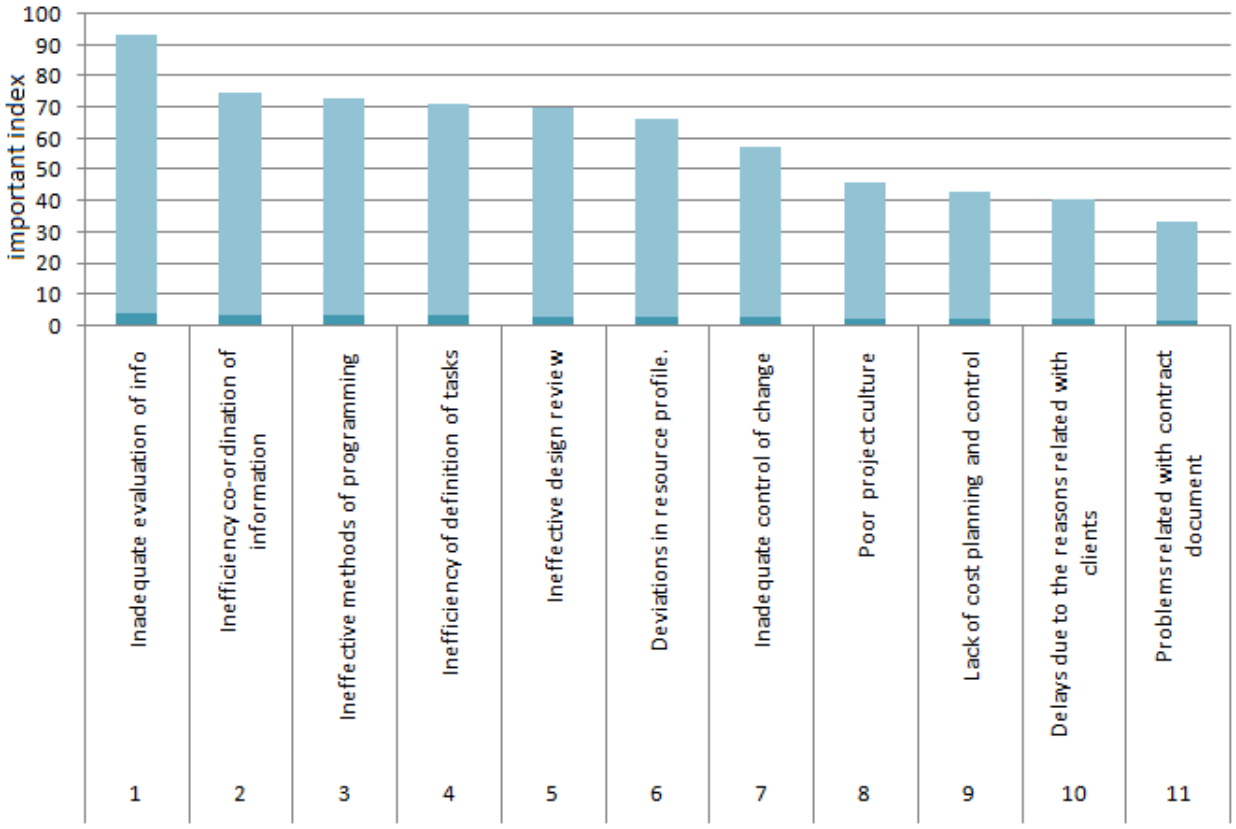



**Figure 5.4 the mean rank of factors responsible for low design quality practice**

Inadequate definition of tasks has ranked 4th with the importance index of 68.3.tasks should be identified and classified (by type, size and complexity) together with the schedule to produce a complete information in the design process. The consultants surveyed has problems of identifying the works and they have a trend of working in grouped manner. Un matured review of the design has been found at the 5th rank, with the important index of 67.it has been assessed in literature review part that design review is a mandatory tool for insuring the quality design in the design process. Deviations in resource profile, inadequate control of change, poor development of project culture and lack of cost planning and control has got ranks from 6th to 9th with the important index of 63.8,55.25,44.0 and 41.38 consequently.

Delays due to the reasons related with clients has ranked 10th with important index of 38.79.this happens when clients don't provide enough information at the time of statement of the need. in additions there are financial deficiencies with the client leads to

delays which finally brings poor design management practice. Problems related with contract document has ranked last with the important index of 32,this also plays a role for practicing of design management because it regulates the design process and helps as a bridge to meet the needs of client.

The two issues discussed above, success in competitions and practices of design management techniques, are the major concerns of a design management system, from the point of view of consultants. consultants' design management system should comprise all the tasks or functions that are required to ensure that optimum volume of work or number of projects are acquired and that he project are generating sufficient profit. In this regard, the research has investigated consultants managing and evaluating information practices and shortcomings and impacts associated with each functions.

The next sections will present findings related with project planning, monitoring and controlling practices.

## 5.5 Planning, Monitoring and Controlling Practices

As the Planning Initial stage progresses, information relating to the project is further developed and refined through research, analysis, tests and, if appropriate, additional design studies. It is critical that sufficient information is gathered to allow a full constraints analysis to be performed so that detailed design options are not developed with inherent flaws which might be costly to rectify or progress through later design or statutory process stages.

Where required, the Feasibility Study (or Preliminary Report) considers key quantitative aspects of the project in sufficient detail to inform a final and reasoned decision on whether or not to proceed. In the case of building projects it is not unusual for design input to be required in the form of various footprints of a facility or block plan options to identify the preferred option. Such design information is not intended to constitute formal design proposals at this stage-it consists merely of illustrative drawings or sketches to allow decisions to be made.

### 5.5.1 Methods of programming

There are five known methods for programming of design projects within the specified schedule in order to have an efficient usage of time throughout the project design process. These are network analysis, bar chart, procurement schedule, information–required schedule and information–transfer schedule. From the surveyed consultants 78% are familiar and working with the bar charts for scheduling the works to be executed.9% of respondents are informally focused on the information –transfer schedule for the works distributed to them. While the remaining 13% of respondents do not have a formal method of scheduling. Therefore, the remaining three schedule types are not known an practiced by the consultants which are surveyed.

### 5.5.2 Cost planning and control

Once the clients briefs the need for the project at the statement of the need, consultants focus should be directed towards controlling each project's design process ,so that they carried out according to the schedule of budget costs. moreover, the controlling method or system should be on which is capable of indicating activities or operations which suffer inefficiency and identifying the causes of the observed inefficiency. Among the participants of the study, 52% stated that they have a standard system for tracking, recording, controlling and monitoring project costs. But lack of an efficient cost planning and controlling system at the design process was ranked $9^{th}$ ,among the factors responsible for low design management practice, with important index of 41.38,in table 5.7.

The research revealed that the cost controlling by majority of the surveyed consultants is entirely focused on and limited to generating information regarding profitability only. However, the scope of a cost controlling system should be broader than this and encompass other related functions/purposes.

According to the results of the survey, the cost controlling by majority of the consultants, do not take these functions in to consideration, rather it is mainly focused on checking profit. Of the surveyed consultants,38% disclosed that, their controlling system is capable of tracking and indicating activities which suffer inefficiency and identifying causes of

the observed in efficiency.48% of the consultants use the reports of the controlling system to monitor only the performance of human resource.

### 5.5.3 Control of change

Control of change can be dealt with in three issues, by variations, by development of the design and by request from the site for information. Variations are design revisions that occur when the scope of the work changes or when the client revises the requirements for the building. In most contract conditions variations near to 10% of the total project cost is allowed by the consultants. If it's more the client should be the one who is responsible to handle this variation. the development of the design also brings a change while it is necessary and helpful for the works in the future. The design also changed with the need of site team in order to bring a better adaptation to the condition of the site. The main thing to be addresses is to control the changes which are happened because of the above reasons.

There are procedures to control changes, the primary need is to identify the source of the requirement for change and establish its significance both materially and contractually. Secondly the evaluation specialists should understand the effect of change with reared to cost and progress. They also inform the client and all the contributors regarding the change and the effect it comprise.

the survey result shows , respondents give first rank for variations, with the important index of 72.33, give second rank for development of the design with important index of 67.33,and they give third rank for the request from site information as a factor for a change.

Table 5.8, Different factors for a change

| S/N | Factors | Mean | Important index | Rank |
|---|---|---|---|---|
| 1 | by development of the design | 2.02 | 67.33 | 2 |
| 2 | by variations | 2.17 | 72.33 | 1 |
| 3 | by request from the site for information | 1.79 | 59.66 | 3 |

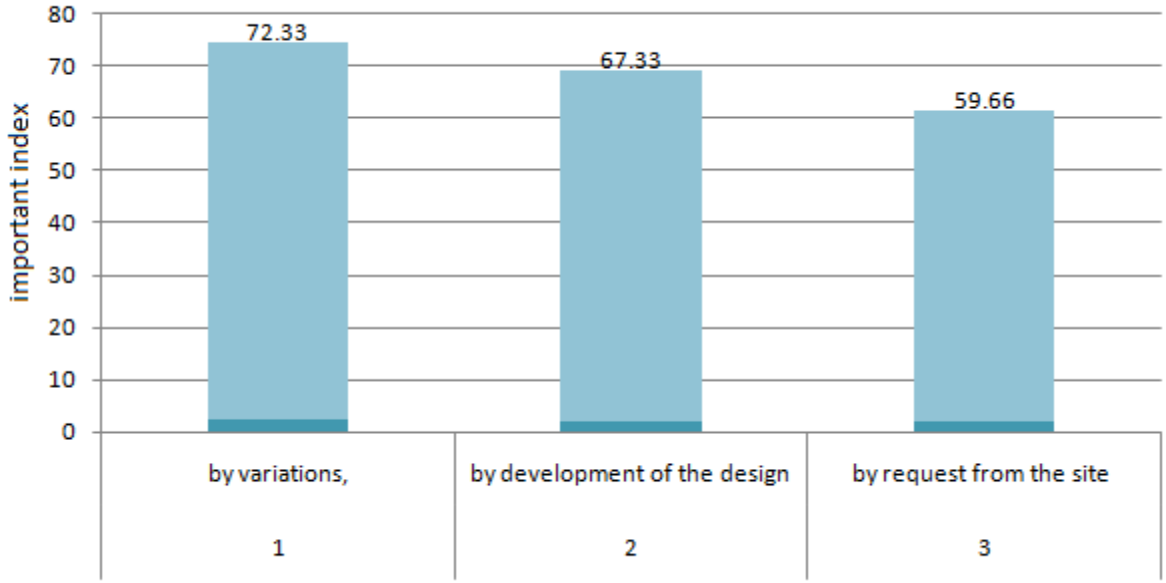



**Figure.5.5 Different factors for a change**

## 5.6 Results of the selected desk studies.

Desk studies were collected from five building design projects which are located in Addis Ababa under the execution periods between 2007G.C. to 2015G.C.The data were collected from archival documents, discussion with participants in the design offices and reports. The general profiles of the projects such as name of the client ,purpose of the building, the building height, project location, name of the consultant ,contract amount ,design start date and design finished date are included in the desk studies. The desk study's findings are mainly the practices of national consultants with respect to design management.

### Project A

| | |
|---|---|
| Name of the client..... | Ethiopian insurance corporation, EIC |
| Purpose of the building ..... | Office and commercial building |
| The building height..... | G+6 and G+7 blocks and semi basement |
| Project location ..... | Addis Ababa |
| Name of the consultant ..... | Consultant A |
| Contract amount ..... | An estimate of 1.3 bln ETB. |
| Design start date ..... | April,2015G.C |
| Design finished date..... | Feb, 2017, defacto, but scheduled to Nov.2015, de jure. |

**Project B**

Name of the client.....Tigray development association(TDA)

Purpose of the building .....Mixed use building

The building height.....G+10 and basement

Project location .....Addis Ababa

Name of the consultant .....Consultant B

Contract amount.....114 mln ETB

Design start date.....November,201G.C.

Design finished date.....May, 2015,de facto, but scheduled to Feb,2015,de jure

## Project C

Name of the client.....Water works design and supervision enterprise(WWDSE)

Purpose of the building .....Office building

The building height.....G+6

Project location .....Addis Ababa.

Name of the consultant .....Consultant C.

Contract amount.....97mln ETB.

Design started date.....Sep.2007G.C

Design finished date.....sep,2008,de facto, but scheduled to Dec,2007,de jure

## Project D

Name of the client.....Ministry of culture and tourism

Purpose of the building .....National archives and Library

The building height.....G+5 and semi basement.

Project location .....Addis Ababa

Name of the consultant .....Consultant D

Contract amount.....108 mln ETB

Design started date.....Feb,2007G.C.

Design finished date.....July,2007,de facto, but scheduled to April,2007,de jure

## Project E

Name of the client.....MK Trading plc.

Purpose of the building .....Semi commercial and apartment building

The building height.....G+9 and basement

Project location .....Addis Ababa

Name of the consultant .....Consultant E

Contract amount.....83mln ETB

Design started date.....April 2012G.C

Design finished date.....Oct. 2012, defacto, but scheduled to Oug,2012,de jure

Table 5.9 summarized desk study results on design management practices of national consultants

| S. NO | Design mag't bodies | Practices of design management in national consultants | | | | |
|---|---|---|---|---|---|---|
| | | **Project A (EIC)** | **Project B (TDA)** | **Project C (WWDSE)** | **Project D (MOCT)** | **Project E (MKT)** |
| 1 | Startup meetings | Formal meetings held only on briefing stage and final stage. | Informal meetings held only on problems on design occurs. | Formal meetings held on briefing stage and final stage. | Formal meetings held on briefing stage, schematic and final stage. | Informal meetings held inconsistently through design stages . |
| 2 | Defining tasks | Tasks not well defined due to limited No of staffs. Tasks not distributed as proportion. | Tasks managed and defined individually not as a team. | Tasks not well defined due to limited No of staffs. Tasks loaded to individuals not distributed as proportion. | Tasks were defined based on stages of design process. Tasks managed as a team and distributed to individuals. | Tasks were not defined well. Large amount of task loaded to limited Individuals. |
| 3 | Managing info. production | Information produced collected as an input and processed through stages of design process. | Information produced was difficult to manage due to much burden of individual. | Information was managed through stages of design process even though individuals loaded many tasks . | Well organized Information was managed through quality assurance body through stages of design process. | Information managed and reviewed through stages of design process by individuals not by team. . |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | Evaluation of info. | Inconsistent but proper evaluation of information practiced. | Evaluation of information practiced only when the design process finished. | consistent and proper evaluation of information through design process. | consistent and proper evaluation of information practiced by quality controller. | Inconsistent and improper evaluation of information practiced. |
| 5 | Design check lists | Disorganized check lists used. | Organized check lists used but inconsistently. | No written check lists used but design items checked ideally. | Organized and workable check lists used at a proper time. | No written check lists used.<br>Only by visual review. |
| 6 | Control of changes | Not yet.(project not executed) | Changes controlled through discussions. | It's been a cause for conflict due to a challenge to control a change. (still on process ). | Changes controlled through discussions and it was known that changes will appear. | Changes has been controlled through negotiation with the client.(it was material change) |

# CHAPTER SIX

## 6. The Research Conclusions and Recommendations

This chapter presents the conclusions and recommendations of the research which are based on the results of the data analysis and discussions made on the previous chapters.

## 6.1 Conclusions

As it is to be recalled, the major objectives of the research were to investigate the existing project design management practice of national consultants, to identify problems or drawbacks associated with the practice and to forward recommendations which can assist in overcoming or minimizing the consequences of the problems. In this research detailed assessments were made on the defining tasks, managing and evaluating information through planning, monitoring and controlling practices and, consequently, particular issues which demand improvement interventions were clearly pointed out. Moreover, consultants' performance with regard to defining the tasks, managing and evaluating information were also explored. These issues are crucial to consultants, for ensuring continuity and sustainability of business and even for ensuring their survival. The research's findings and conclusions made with respect to the above mentioned points and other related issues are summarized below.

### 6.1.1. Performance in Design management practice

**A) start-up meeting.**

The research revealed that the rate of reputations of start-up meeting for majority of the consultants is not satisfactory. The research findings indicated that the rate is 82% of the consultants practice the start-up meeting at the briefing stages. 12% of the respondents practices at both stages, briefing and scheme stage. The remaining 6% of respondents do practice at all stages, briefing, scheme and engineering design.

**B) Defining tasks practice**

Once the statement of need is known, the strategies first formulated by the design management team and the outline of designed will be followed. In this part the program

of the projects will be developed .after finishing the need of the client in the programe, the scheme design is followed this formulate the system of the project. The detail design is the immediate work detail after the scheme is completed. The detailed designs are going to be regulated and permitted through an authorized office. Survey result shows,58%of the national consultants practices definition of tasks for the works to be done on the design process. The remaining 42% of national consultants states that they only focus on the main stages of the design process. This may lead them to work an accumulated tasks of design lately. This brings wastage of time and also a cause for low quality of the design or output.

**C) Co-ordination of information and review of design inputs**

Co-ordination helps to produce information that fully interconnects the inputs of all the contributors in to one coherent and complete piece without ambiguity and also it ensures that all contributors are working to a co-ordinated schedule to achieve a timing of the information flow that development of the co-ordinated information. In addition of co-ordination, review of design inputs is mandatory to produce a quality design. Review of inputs also helps for integration of isolated information to the whole with the help of the architect or design head.45% respondents states that they have a good flow of information co-ordination between the contributors. The remaining 55% of the respondents don't have a good practice of co-ordination between the contributors and also the information flow. this brings a difficulty of understanding of information whenever there is an information flow. They are obligated to understand the information flow only by their perception.

**D) Drawing control**

A project can supply a bunch of drawings, but keeping and recording those drawings is mandatory for the purpose of reference in the future while it is needed. The practice of national consultants for controlling and recording drawings is low.67% of the respondents do recording of drawings while the remaining 33% of respondents don't have effective recording and keeping of drawings. Form those respondents most of them don't have a complete drawings after once it is finished the design process. This is due to

the carelessness of the contributors and they thought 'it is not needed once it is transferred to the contractors'.

**E) Design reviews**

Reviews mainly focus on validation of design by building product or element prototype tests and it also build the capacity of the designed building to perform under expected conditions of use and environment. The survey shows that the design review practice of national consultants don't have a consistent or standard way in which stages must be done. Only 26% of respondents do the reviews on the three stages of the design process, schematic ,detail& final design stages. The remaining 74% of the respondents do the design review ineffectively. The design review is expected to be done after each stages of the design. other ways, leads to happen unclarity and also unnecessary items between information at the final stage of the design process.

**F) Value engineering**

Value engineering is a positive contribution to the design process, but its timing is critical to avoid delay to the project or large amounts of abortive work. It increases value by eliminating unnecessary cost while maintaining function. It has four methods to be applied, information, speculation, development and presentation. The national consultants don't have a clear understanding and practice of value engineering by its methodologies.92% of respondents practices the value engineering informally without considering the methodologies to apply value engineering. They just minimize the cost of a project by the interest of the client, not accept as a concept. The remaining 8% of respondents totally don't consider on the value engineering while they design and they mainly focus on the quality and the completion time of the project.

**G) Hazardous operations controlling**

In design projects the hazardous operations are needed to be considered for the benefit of not only for the inhabitants but also for the outside environment. This days it becomes serious issues to be considered for the design projects for minimizing the negative effects on the environment. Only 38% of respondents have a practice for considering the

hazardous operation of design projects. This shows it is very low practice in the national consultants. The remaining 62% of respondents don't have a practice or experience of considering this hazardous operations while they are doing the design process. Majority of the respondents transferred the responsibility of keeping the environment free form hazards to the public or the government authority.

**H) Maintenance**

Consideration of maintenance concept plays a significant role for keeping the output of the design process to be utilized by the inhabitants and also for the aesthetics of the structure. There are three main issues to be considered access for inspection, external maintenance, and service maintenance. the national consultants consideration of maintenance concept at the design stage is very low. Only 32% of respondents do the practice of maintenance towards to design process. The remaining 68% of the respondents of national consultants don't have a clear understanding and practice of maintenance concept. They think that 'once its designed with a maximum risk, it doesn't bring any failure and it also be visible '.

### 6.1.2 Consultant's performances with regarded to two major goals

**A) Competition success rate**

National consultant firms mostly obtain works through competition. Hence their performance in the design process is decisive for ensuring continuity of works. On the other hand ,the sustainability of their business and fulfillment of the firm and project objectives is directly related with the amount or level of profit obtained from the design projects.

Tough competition and low budgeting are identified as the top two major causes for the low success rate, followed by low information made during the competition stage. Performance of consultants on previous projects has insignificant impact on the success rate. The average number of competition offers submitted, annually, by majority of the consultants is high when compared or viewed from the point of view of the failure rate. The results indicated that 53% of the consultants submitted competition has success rate below 25% and 26% of surveyed consultants has a success rate of 25%-50% and 18% of

the respondents has been registered from 50%-75% of success rate. Only 3% of consultants has above 75% success rate for submitted competition.

The results indicate the need for allocating proper attention to the design process, as such high number of offers with the accompanying failure rates will definitely results in high company overhead costs. Each competition for a project involves expenses.

**B) Design management practice drawbacks**

The survey finding revealed that national consultants face serious challenges with regard to practicing the design management theories in their design projects. The survey results indicated that inadequate evaluation of information has been ranked first with the important index of 89.66. The inadequacy of co-ordination of information has been followed as a second rank with the importance index of 71.55 while the ineffective method of programming has got the third rank with the important index of 70.3 for the cause for low design management practice. These results shows that national consultants have a lower experience of evaluation of information at the early stages. In addition they also don't have enough information co-ordination between stages of the design process.

### 6.1.3 Planning, monitoring and controlling Practices

In the case of building projects it is common for design input to be required in the form of various footprints of a facility or block plan options to identify the preferred option. design inputs has many aspects ,this has to be planned and monitored in order to bring a complete drawing and to fulfill the need of the client.

**A) Method of programming**

In the project design process there are different methods of programming, these are network analysis, bar chart, procurement schedule, information–required schedule and information–transfer schedule. From the surveyed results 78% are familiar and working with the bar charts for scheduling the works to be executed. Only 9% of respondents are informally focused on the information-transfer schedule for the works distributed to them. While the remaining 13% of respondents do not have a formal method of scheduling. This shows that national consultants are mainly depend on the bar char method of programming. This is mainly due to the simplicity of the program. From this

result we can see that the remaining three schedule types are not known an practiced by the consultants which are surveyed.

**B) Cost planning and control**

The research revealed that the cost controlling by majority of the surveyed consultants is entirely focused on and limited to generating information regarding profitability only. However, the scope of a cost controlling system should be broader than this and encompass other related functions/purposes.52% of respondents stated that they have a standard system for tracking, recording, controlling and monitoring project costs. The remaining 48% of respondents don't have a standard system to plan and record of project costs, but they informally focus on the profit of the design project.

**C) Control change**

Procedures to control changes are identifying the source of the requirement for change and establish its significance both materially and contractually. additionally to control changes, the evaluation specialists should understand the effect of change with reared to cost and progress. The survey result shows ,64% of respondents give first rank for variations, 21% of respondents give first rank for development of the design and the remaining 15% of respondents give first rank for the request from site information as a cause for a change. This shows that in most of national consultants variations are the main reason for a change from the expected contract.

## 6.2 The research Recommendations

This section presents the research's practical recommendations that are targeted at minimizing the consequences of the challenges and problems, which consultants face with regard to managing design projects. Improving consultants' design management capacity helps them to assume better quality design, which intern enable them achieve firm and project objectives. The recommendations forwarded by this research are from two perspectives, from the point of view of consultants' internal environment or the process view and from the view of the external environment which primarily encompass the various stakeholders.

### 6.2.1 The Process View / Expectations from Consultants.

As discussed in the literature review part, an efficient design management system for design projects should comprise and integrate the functions of managing, evaluating and controlling of information. Adequate and balanced consideration should be allocated to these functions. If information are not evaluated accurately during the design process, no matter how efficient the Information control is, design projects will not result in satisfactory performance with regard to design quality. Also, if planning of schedules are not properly formulated and controlled/monitored during the design process stage, the result becomes a challenge for completing the design project with an expected quality and project cost. Therefore, consultants need to be aware and considerate of all the processes. The research's recommendations which can improve the existing design management practice are presented below.

**A) Start-up meeting**

The research revealed that the rate of reputations of start-up meeting for majority of the consultants is very low. The national consultants should practice the start-up meetings through each stages of the design process. Which are at the briefing, at the scheme and at the engineering design. This helps them to understand what is going on each stages and to update themselves for the next practice of themselves. By repeating this practice it is possible to bring a common understanding of specific task.

**B) Defining tasks practice**

The practice of defining tasks is a mandatory step that should be followed by national consultants. If once the statement of need is known, the strategies first formulated by the design management team and the outline of designed will be followed. In this part the program of the projects will be developed. After finishing the need of the client in the programme, the scheme design is followed this formulate the system of the project. The detail design is the immediate work detail after the scheme is completed. The detailed designs are going to be regulated and permitted through an authorized office. This defining tasks is also very essential for clear understanding of details and for better visualization.

**C) Co-ordination of information and review of design inputs**

co-ordination of information should be practiced to produce information that fully interconnects the inputs of all the contributors in to one coherent and complete piece without ambiguity. It should also be practiced for ensuring all contributors are working to a co-ordinated schedule to achieve a timing of the information flow in a development of the co-ordinate information. In addition of co-ordination, review of design inputs is a mandatory tool that should be practiced to produce a quality design. Review of inputs also helps for integration of isolated information to the whole with the help of the architect or design head. Low co-ordination of information flow brings a difficulty of understanding of information whenever there is an information flow. By practicing co-ordination of information national consultants can minimize misunderstanding of the information flow.

**D) Drawing control**

The practice of national consultants for controlling and recording drawings is low. this is due to the carelessness of the contributors and they thought 'it is not needed once it is transferred to the contractors'. A project can supply a bunch of drawings, but keeping and recording those drawings is mandatory for the purpose of reference in the future while it is needed. Collecting each drawings at every stages of the design process makes easy for controlling the drawing. Each contributor is responsible for the work he/she supplies in recording process. Unless the drawings are collected and recorded at every stages, it will be difficult to control it while those stages are once passed.

**E) Design reviews**

The survey shows that the design review practice of national consultants don't have a consistent or standard way in which stages must be done. Reviews should mainly focus on validation of design by building product or element prototype tests and it also build the capacity of the designed building to perform under expected conditions of use and environment. the design review is expected to be done after each stages of the design. Other ways, leads to happen unclarity and also unnecessary items between information at the final stage of the design process.

**F) Value engineering**

value engineering is a positive contribution to the design process, but it should be practiced at early stage of the design process. Because its timing is critical to avoid delay to the project or large amounts of abortive work. It increases value by eliminating unnecessary cost while maintaining function. It should follow the four methods to be applied ,information, speculation, development and presentation. The national consultants don't have a clear understanding and practice of value engineering by its methodologies. They just minimize the cost of a project by the interest of the client, they don't yet accept it as a concept to be applied. The national consultants shouldn't only focus on the quality and the completion time of the project but also apply value engineering in their projects in order to minimize unnecessary costs at the early stage of design process.

**G) Hazardous operations controlling**

Hazardous operations has a very low practice in the national consultants. In design projects the hazardous operations are critical factors to be considered to guaranty the safe environment. It should be practiced for the benefit of not only for the inhabitants but also for the outside environment. This days it becomes serious issues to be considered for the design projects for minimizing the negative effects on the outside the project. Majority of the respondents transferred the responsibility of keeping the environment free form hazards to the public or the government authority. This can be more inspected by the government authority, and listed below on expectations from stakeholders.

**H) Maintenance**

consideration of maintenance concept plays a significant role for keeping the output of the design process to be utilized by the inhabitants for long period of time and also for the aesthetics of the structure. There should be three main issues to be considered access for inspection, external maintenance, and service maintenance. the national consultants consideration of maintenance concept at the design stage is very low. National consultants should have a clear understanding and practice of maintenance concept.

### 6.2.2 Stakeholder's view/Expectations from stakeholders

The construction design industry is characterized by the strong and multi directional relationships and interactions that exist among the various stakeholders. Hence,

interventions or measures from the consultants' side only, cannot result in improved outcomes, unless backed by pertinent or counter measures from the other stakeholders. The major steps to be taken or expectations from stakeholders are summarized as follows:

**I) Project Owners/clients**

a) Before awarding contracts to consultants, owners should give adequate and balanced weight to the performance of the consultants on past projects. This include evaluation of their performance with respect to accomplishing projects with the predetermined design quality, completion time, cost of design works and other project specific requirements. On the other hand, low budgeting is found to be the 2nd major factor responsible for low competition success rate of consultants. Form observations, design projects which were contracted to consultants offering extremely high budget for the competition, does not mean that they have quality design production.

Therefore, owners should award competitions on the basis of not only financial aspects but also critical evaluation of technical matters and performance history on previous projects. Awarding contracts by negotiation can also be a solution.

b)after once the owner gives the brief on the statement of the need consultants should practice their knowledge with freedom without the intervention of the owner. Therefore a client should give a full freedom for the consultants in order achieve his /her satisfaction based on the need of the project.

c) Delay caused by owners is indicated by the consultants, as a contributing factor to low design quality of projects. Therefore, owners to the extent possible should facilitate or provide timely responses to consultants' inquiries with regard to brief information or any other matter.

**II) Government**

a)The government authority should clearly announce the directives and manuals for the permit and control of the design projects. It has to be notified to the consultants whenever there is a change in directives and manuals, unless this condition happen, the consultants get difficulties to practice the design process with freedom based on the regulations.

Therefore the authority should call for meetings and participate those consultants to bring amendments. Hence, the government should act promptly to address this problem, otherwise in due course, it will undermine the capacity of national consultants irreversibly. Therefore, the government should work jointly with consultants, contractors, universities and professionals to prepare and revise such standards periodically.

b)On governments' design project, qualified consultants for award of contracts should not be selected on the basis of least bidder only. Additional evaluating and selecting criterions should be incorporated to the rules and regulations currently in use. For example, by consideration of environmental friendly concepts as one criteria. This brings consultants to consider it and to improve design management system.

**III) Professionals**

Professionals should acquaint themselves with recent design management theories and techniques (developing project culture, managing information, evaluating information, planning, monitoring and controlling methods and so on) which are available in books and articles, instead of practicing with the rule of thumb.

## 6.3. Recommendations for Further Works

This research has identified major shortcomings of the national consultants'' practice, with regard to project culture, management and evaluation of information and controlling. The research moreover, has forwarded (qualitative) theoretical interventions and recommendations that can improve the practice and result in improved out comes from projects. However, the issues covered by the research are so vast that it became difficult to present all relevant interventions in a comprehensive and exhaustive manner. Therefore, the following points are recommended to be assessed in detail, as they can be focal points for further research, to improve the design management practice of consultants.

- The application of various design management techniques or introducing programming methods to the design-construction industry of Ethiopia.
- Developing and introducing contextual project management or classification system for facilitating project design management and controlling system.
- Developing a system for design information integration between each design process stages.
- Developing computerized design and output standards library.
- Developing a system or design reviewing manual which integrate resources costs, time and quality, for facilitating project design management system.
- Developing system for controlling professionals productivity and co-ordination of information through them.

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# APPENDIX

# Questionnaire survey

This questionnaire survey is part of the research conducted for fulfilling the requirement of MSc. Degree in Construction Technology and Management at AAU.

The Research Topic

Assessment on Design Management Practice of National Consultants

Focused On Building Design Projects

The Research Problem

The inconsistent design management practice of national consultants with in building design projects.

The Research Background

The motivation for this research has emanated mainly from personal experience and observations. Thus, this study is aimed at contributing knowledge towards assessment on the design management capacity of consultants.

The Research Objectives

- To assess the project design management practices of national consultants.
- To identify shortcomings, drawbacks and limitations of the existing design management practice.
- To forward recommendations and interventions to improve existing design management practice.

Regarding confidentiality, any data or information provided in this survey, is solely used for Academic purpose of the research under consideration.

If you have questions or seek clarifications, please contact me on

AAIT, Department of civil and environmental engineering , MSc on construction technology and management , Email: Archversatiles@Gmail.com Mob.0988 24 52 83.

I thank you in advance, for your invaluable cooperation.

# PART I General information

Please give your response for the following questions either by writing your answers in the space provided or by putting " ✓ " marks at your choice rectangle shown for questions having choice.

1. a. Name of company (Optional) _____

   b. Category and class of company _____

2. Average annual number of projects executed, over the past five years.

   ☐ Below 5 project ☐ 5-10 projects ☐ 10-15 projects

   ☐ 15-20 projects ☐ Over 20 projects

_____

3. Proportion of building projects, among all projects undertaken over the past five years?

   ☐ Under 25% ☐ 50% - 75%

   ☐ 25% - 50% ☐ 75% - 100%

4. a. Through which way that design projects awarded to your company, most of the time?

   ☐ Through invitation ☐ Through Competition ☐ Through Tendering

   b. Please give a fair indication of the proportion ratio of building works to total work volume.

   ☐ Under 25 ☐ 25% - 50%

   ☐ 50% - 75% ☐ 75% - 100%

5. What is your company practice on the managing of information in the design process? Does your company have special techniques for controlling information?

_____
_____
_____.

6. Do your company have a practice to define a task of a project? If yes what kind of system do u use?_____
_____
_____.

7. Do your company have a practice of evaluating information? Please explain how the evaluation is practiced.

_____
_____
_____.

## PART II Factors For Design Management Practice

8. A. what kind of environment for project culture do your company have or what techniques do you apply to create good project culture? _____

_____

_____.

B. How is your company practice towards start-up meetings? At what stage do you practice start-up meetings?

☐ At briefing stage ☐ At schematic design stage ☐ At engineering design stage

C. How is your company practice towards defining tasks? How do you define tasks in related to each stages of the design process? _____

_____

_____.

D. How is your company practice towards Co-ordination of information? How is the practice in flow of information? _____

_____

_____.

E. How is your company practice towards drawings control? What is your technique to control and record drawings of design projects? _____

_____

_____.

F, 1, How is your company practice towards design drawing? What is your technique to review the design projects?

2. At what stage of the design process do your company apply the design review?

☐ At schematic design stage ☐ At detail design stage ☐ At final design stage

G. How is your practice towards value engineering? Which types of methods you use for value engineering in design projects? _____

_____

_____.

H. Do your company have experienced controlling the hazardous operations? If yes, what factors do you consider?

_____

_____

_____.

I. Do your company consider maintenance concept in the design projects? If yes, what is your practice on applying the maintenance concept on the design projects? _____

_____

_____.

## Part III Consultant's Performance with regards two Major Goals

9. Give a fair measure of rate of success rate for submitted competition offers.

☐ Below 25%. ☐ 50% - 75%

☐ 25% - 50% ☐ 75% - 100%

10. If your success rate is low, say below 25%, what do you think are the major reasons?

_____

Assign level of influence for those listed below, and identify, if there are others.

O = Not important 1 = low important 2 =medium important and 3 =high important 4=very high important).

☐ Tough competition ☐ Low information

☐ Low budgeting ☐ Performance history of the company

☐ Shortage of time ☐ Factors beyond their control

If others, please mention and rate them_____

_____

11. Among the factors listed below are cause for low design management ,Assign level of influence for those listed below, and identify, if there are others. O= Not important 1 = low important 2 =medium important and 3 =high important 4=very high important).

Poor project culture

☐ Inefficiency of definition of tasks ☐ Lack of cost planning and control

☐ Inefficiency co-ordination of information ☐ Inadequate control of change

☐ Ineffective design review document ☐ Problems related with contract

☐ Inadequate evaluation of info ☐ Delays due to the reasons related with clients

☐ Ineffective methods of programming ☐ Deviations in resource profile.

If others, please mention_____

_____

12. How is your company practice towards method of programming for design projects? Which types of methods you use for programming in design process? _____

_____

_____.

13. a. Do you have a standard system for accounting (tracking, recording and controlling) project?

Costs/expenses?

☐ Yes ☐ No

14. If you have, give a brief description of the system together with, the inputs and the out puts

of the system

_____
_____
_____

15. How is your company practice towards control of changes? Which type of common cause for change in the design projects? Assign level of influence for those listed below, and identify.

O= Not important 1 = low important 2 =medium important and 3 =high important

☐ By variations,

☐ By development of the design

☐ By request from the site for information.

If you have any ideas about design management system, please explain.

_____
_____
_____