

THE EFFECT OF PLANNING AND RESOURCE LEVELING
ON UAE CONTRACTORS

by

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Abstract

PLANNING AND RESOURCE MANAGEMENT

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In such a financial turmoil, resource management in contracting companies has gained great importance. Many researchers have been exploring concerned planning methods to identify best practices that enable organizations enhance performance, profitability and competitiveness. The purpose of this dissertation is to identify resource leveling practices used and their effect on performance. This approached by attempting to improve resource management and control through leveling in these contexts. The research process used a qualitative research method to suit the nature of selected sample and attain comprehensive results. It includes a review of literature, followed by three case studies which involve interviews, documents and project papers among others. The major finding is that minimum slack first as a priority rule is still being used serving the planning aspect of projects and organizational structure is the main enabler of implementing a proper resource planning method. Moreover, a set of directions are suggested to effectively plan resources and enhance profitability. A topic for future study is suggested to further extend the circle of knowledge in this particular area.

DEDICATION

I dedicate my dissertation to Hana and Hana. A special feeling of gratitude to my father, whose patience, words, support and encouragement made this possible. My sisters and brothers, for taking interest in putting their ideas, thoughts and knowledge into my dissertation. I also dedicate this dissertation to my wife who has supported me throughout the process. I finally dedicate this work to all those who have helped me achieve my goal.

Thank you

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Chapter 1

INTRODUCTION

The introduction chapter begins explains the writers reason of conducting this study and then provides a general over view of project management that the reader needs to understand as the base knowledge. It further develops into an argument that defines resource leveling and types of resources in addition to clarifying research methodology, aims and objectives, research steps and structure.

1.1- Introduction:

Resource management is one of the most popular topics that project management has always embraced. Since it is at the heart of project management, it forms the golden triangle of time, cost and quality. Time and money are formed in their essence and quality is in the retention of human resources in addition to workmanship as a significant part of any project.

The Dubai Construction market in the past four years ending by November 2008 was in a continuous boom consequently resulting in making needed resources available with a time constrain only.

The fact that contractors and sub contractors where operating at high profit margins due to demand exceeding supply resulted in giving them the ability to secure needed resources when available in the market, quite easily to achieve their project goals. It is believed that this dominant situation resulted in negligence of using proper planning and control methods leading to the miss use of resources, often by over allocation.

This situation clearly shows that projects were time limited in nature and other needed resources were made available on demand.

Since the start of the financial turmoil projects started in either being frozen, delayed or cancelled due to various reasons excluding the time constraint. The Guardian (2009) state that “Half of all the UAE's construction projects, totaling \$582bn (£400bn), have either been put on hold or cancelled, leaving a trail of half-built towers on the outskirts of the city stretching into the desert”. Due to unavailability of cash and absence of bank support, developers, private investors and companies were left to tackle their credit problems. This situation has resulted in clients and main contractors holding monies where they were lastly left in the payment cycle and delaying future payments.

Stoppage of payments and the dearth of new projects consequently resulted in the supply (number of contractors) to exceed demand (number of projects available) for the first time since the start of the boom in 2004. In such an environment the time

element lost its importance and planning and control started gaining new emphasis. Competition played as well a vital role in steering companies back to the use of proper control and planning methods since budgets allocated to new projects were significantly lower in comparison to what they were as clients seek to benefit from increased competition among supplying contractors.

The overall market shift consequently changed projects nature emphasizing resource constrained planning methods.

1.2- History of Project Management:

Project management plays a vital role in achieving company's project success. A demonstration of such achievements is seen in building the Pyramids, design of old cities, architecture of magnificent mosques and churches and the work of the Great Wall of China among other wonders (Morris, 1994).

Considered the world's highest structure for 4300 years built in 2560BC. The construction of the Giza pyramids required two million stone blocks weighing two tons each used in building the necropolis for the Pharaoh Khufu which was 481mtr high. It is argued that, there were artifacts showing evidence of controlled productivity and technical execution of projects (Ireland, 2006). A project like the pyramids required many abilities such as planning, making food, medical care and stone curving to complete (National Geographic 1998).

In 1917 Fayol managed to turn a local French mining concern from almost bankruptcy to a successful organization. He used a planning systems which led to this success through including forecasts from different managerial levels viewing fiscal activities to enable the chief executive officer establish a five year plan. Consequently monetary estimations and managing of sectors were considered the basis of future projections (Sullivan, 1989). The work of Fayol was considered pioneering at the time since it was the only method that relied on restructuring information flow to enhance future forecasts and planning techniques. Later the scientific school,

pioneered by creating two project methods first, Gantt improved the bar chart for a production plant at Frankford Arsenal. Second, in 1917 Adamiecki improved the Harmony Graph Theory. Gantt's bar chart is still being used in an unchanged form, whereas the Harmony graph was held known due to its connection to critical path method and program evaluation and review technique (Morris, 1994). Looking at identified planning methods it is seen that time was considered to be the bases upon which projects are scheduled ignoring the availability of needed resources. This was due to unavailability of needed computing power or needed priority rules. As mentioned earlier due to the importance of resources the study will start by identifying types of project resources.

1.3- Resource types:

Resources are categorized into (1) renewable, (2) non renewable and (3) doubly – limited resources (Blazewicz et al., 1986). Renewable resources exist on a period by period foundation which means that the quantity can be renewed from time to time. The entire resource use is limited at every time interval, which can also be defined as resources that can be replenished or reproduced easily. Such as sunlight, air, wind, is continuously available and its quantity is not affected by human consumption. Many renewable resources can be depleted by human use, but may also be replenished, thus maintaining a flow. Some of these, like agricultural crops, take a short time for renewal; others, like water, take a comparatively longer time, while still others, like forests, take even longer.

Non renewable resources are needed throughout total project duration and can be used in a controlled manner for the whole project. One example of a non renewable resource is money.

Also, non-renewable resources are formed over very long geological periods. Minerals and fossils are included in this category. Since their rate of formation is slow, they cannot be replenished once they get depleted. Out of these, the metallic

minerals can be re-used by recycling them, but coal and petroleum cannot be recycled (Demeulemeester & Herroelen, 2002).

If gas and petroleum were considered they both have limited quantities over a time interval and both require long time to get renewed if ever. Containing such constraints indicates a doubly constrained resource.

In practice project resources consist of a combination of renewable and non renewable resources but only those who are non renewable are the ones that matter. For example having a certain specialized worker to perform a task is considered limited within a particular time period hence non renewable, which demand the planner to consider planning of needed resources to achieve project objectives.

1.4- Research purpose:

The purpose of this paper is to study resource leveling approach adapted by contractors and specialist contractors and its effect on performance.

The research is focused on resource constrained leveling to reflect the current business environment.

1.5- A definition of resource leveling:

Resource leveling can be defined as the process that ensures resource demand does not exceed resource availability. A view of an ideal scenario would be a buildup of resource usage at the beginning of the project and a reduction at the end of the project. However, the approach to resource leveling will also depend on whether resources are dedicated to a particular project or shared across several projects and whether there is a need to keep all resources fully utilized (Pennsylvania, n.d).

Resource leveling is mainly implemented to overcome the time and resource constraints due to clients, contractors, micro environment and macro environment of the project in addition to enhancing the organizational overall performance, competitiveness and profitability. The following graph depicts in practice project

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constrains that project manager have to deal with while fulfilling set conditions such as quality, time and budgets:

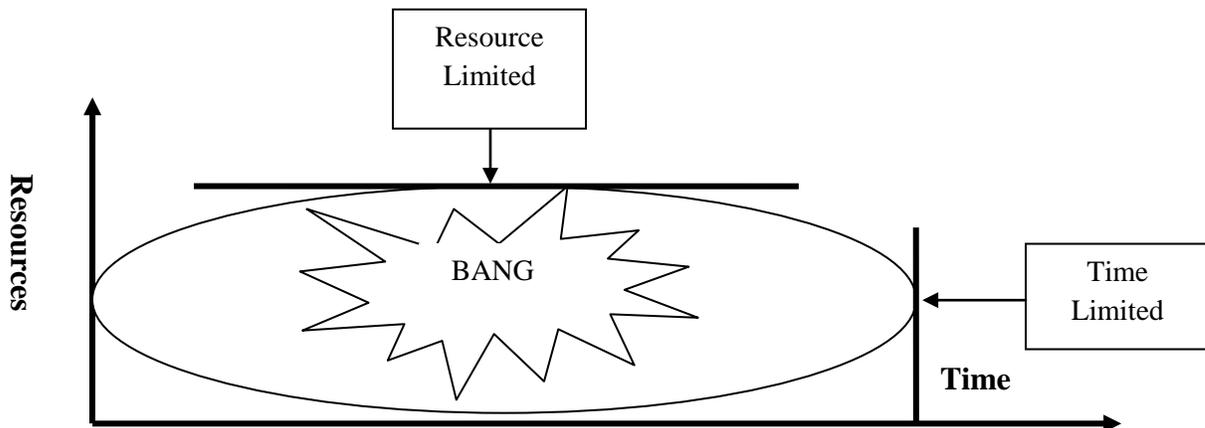


Figure 1: Time-limited and Resource-limited scheduling

(Burke, 2003)

Dealing with such a dilemma has emphasized the use of various leveling techniques that enhance the overall project and organizational performance. The used techniques to level resources are either based on time constrained leveling or resource constrained leveling:

- **Time-constrained resource leveling:**
This situation is based on a preset project duration identified using network analysis to achieve project completion. Alterations affecting activity durations and required resources at a given time interval shall be adjusted within available slack exempting those on the critical path.
- **Resource-constrained resource leveling:**
Project duration is considered here of no importance sine project criteria is limited to resources available. Consequently if demand exceeds availability, activities will be delayed till needed resources are made available.

(Gray and Larson, 2006)

1.6- The UAE Mechanical Electrical and Plumbing (MEP) market:

The MEP sector is very important to any civil structure whether it is a road, a building or other structure. The significance of the MEP contracting market in GCC is anticipated to rise to \$14.5 billion in 2008 (MEED, 2007).

Prior to the October 2008 credit crunch in the UAE about \$1.5 trillion was the value of projects under construction in the GCC, the regional MEP contracting sector was almost one third of stated value. Currently the economy of UAE is showing the ability for less growth in the construction and real estate field increasing the importance of resource planning (Raina, 2008).

1.7- Research aims:

The research aim is to emphasize the importance of planning resources and identify the most effective planning techniques to be used during the financial crisis.

1.8- Research objectives:

The research objectives are:

- a. Examine the various approaches (models) to resource leveling and their advantages.
- b. Evaluate the effective implementation of resource constrained leveling by contractors and sub contractors.
- c. Investigate the implementation of project planning on organizations performance and competitiveness.

The case study sample is based on the UAE chamber of commerce company classification which states that a contractor is deemed large if his registration i.e. trade license at the ministry of commerce is unlimited which means that the contractor is not limited by how tall is the building or how does it look rather he is

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able to build any needed structure. As for specialists the classification is made based on invested capital and allowed for by the ministry of commerce scope of work.

Three UAE based contractors who have been operating in the market for more than ten years will form the sample of this study.

Research sample details:

- 1- Two large scale companies with a minimum yearly project turnover of one hundred fifty million AED, one with an internal MEP department and the other without.
- 2- One medium scale companies with a maximum yearly project turnover of one hundred fifty million, also one with an internal MEP department and the other without.

Three organizational levels are targeted through conducting interviews with planning engineers, project managers and general managers. In my opinion planning engineers and project managers are capable of explaining used resource planning techniques and strategies whereas general managers can describe the general effect of resource planning on their organizations. Consequently delivering needed understanding.

1.9- Methodology:

The research will start with literature review resulting in the following research questions:

- 1- Is resource leveling contributing to the benefit of projects or not?
- 2- How resource leveling should be used in order to maintain and improve competitive advantage.

To achieve research objectives, qualitative methods will be used. In which the research undertook several case studies based on contracting firms of various sizes identified in the research sample. A number of employees of different departments were interviewed, each contributing to this research from their experience, project

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documentation and company procedures. Collected information will be used in answering mentioned questions allowing “retention of holistic and meaningful characteristics of real-life events such as individual life cycles, organizational and managerial processes, neighborhood change, international relations and the maturation of industries” (Yin, 2003) through the use of case studies.

1.10- Research steps:

The research steps will be conducted as follows:

- 1- Establish case studies through implementing interviews with sample companies:
 - a. Identify used resource leveling techniques.
 - b. Measure the effect on overall company competitive advantage and performance using Porter model
 - c. Find out to which extent planning is enforced through weighing importance of planning costs to resources costs.
 - d. Validate identified leveling challenges.

1.11- Dissertation Structure:

This study is consisted of seven chapters. The first chapter starts with a general appreciation of project management and clarifies the purpose of this study. It further develops into an argument that defines and negotiates resource leveling and types of resources in addition to clarifying research methodology, aims and objectives, research steps and structure. Second chapter, Project management is defined with an aim towards emphasizing the importance of planning, control and most used planning techniques in an overall frame work that reflects the relationship between competition and planning. It further develops into defining resource allocation, types of available resource leveling models and their advantages while focusing on various heuristic and optimization methods. A number of resource leveling challenges faced by contractors and subcontractors are identified in chapter three showing how the resource leveling process

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is hindered due to reasons such as lengthy payment terms among others. Afterwards comes the research method chapter four extensively explaining selected research methods and why were they selected giving the reader a reason for such a selection and its dimensions on this study. The fifth chapter is concerned in data collection and how will this data be used in leading into chapter six which is data analysis that deals with collected data and proof collected theory consequently leading to the discussion and conclusion chapter, the last chapter of this study, chapter seven which shall also include recommendations for further work and research.

Chapter 2

PLANNING AND CONTROL

In this chapter Project management is defined with an aim towards emphasizing the importance of planning, control and most used planning techniques in an overall frame work that reflects the relationship between competition and planning. It further develops into defining resource allocation, types of available resource leveling models and their advantages while focusing on various heuristic and optimization methods.

2- Planning & project management:

Planning has been for a very long time considered to be the cornerstone of project management. Wikipedia (2008) defines project management as “a cautiously planned and structured effort made to accomplish a specific goal”. The project may be constructing a building or implementing a new computer system or organizing an event. Through project management, project plans which include, defining project goals and objectives, specifying tasks or how goals will be achieved, what resources are needed, dedicated budgets and timelines for completion, are developed. Also it includes implementing a project plan, along with careful controls to keep on the "critical path" that is to ensure the plan is being managed as planned. Typical project management phases are divided into four phases. It starts with the inception phase also known as feasibility study. Secondly establishing a project plan and then comes the implementation phase followed by the support and maintenance phase. Atkinson (1999) states, many have attempted to define project management. For example, Oisen attempted at an early stage in the 1950s to define Project Management as "the application of a collection of tools and techniques (such as the CPM and matrix organization) to direct the use of diverse resources toward the accomplishment of a unique, complex, one-time task within time, cost and quality constraints. Each task requires a particular mix of these tools and techniques structured to fit the task environment and life cycle (from conception to completion) of the task”. Another definition has been offered by Reiss (1993) who suggests that using a simple description to understand a project behavior is hard since he compares a project to human activity that achieves a clear objective against a time scale. He defines project management as "a combination of management and planning and the management of change". The opinion of Lock (1994) was that project management had progressed so as to plan, organize and manage the difficult and varied activities of recent industrial and commercial projects, whereas Burke (2003) believes that project management is a specialized management system created in order to plan and manage projects executed in a changing project environment. Different definitions have been given for

project management, but always the actual description has consisted of norms of success, which are cost, time and quality. This indicates that the definition of PM provided by Oisen has been either accepted, or has not actually been changed in approximately fifty years.

2.1- Importance of planning and control:

Since they are inseparable Harrison & Lock (2004) stated that Project management needs a reasonably structured succession of processes. Structure is obviously the leading characteristic when considering a project organization. However, nowhere is the structured method more significant than in the planning and management functions. They state that the keywords for every project manager are structure and logic. In ideal conditions with a low level of risk, high-quality management support and defined scope of work, a lot of problems are required to be solved alongside the course to achieve effectual arrangement and management. The bases for control can be made only by an organized, planned method that represents scope of work, resources and financial plans.

At a certain point of time one has to stop continuous planning and actually begin achieving something. As a consequence of time limitation, one frequently must take a step forward and start “achieving set plans” even while still being in the planning stage. Usually, this engages the arrangement of several long-lead items that project managers are familiar with (Ghattas & Mckee, 2001).

A plan might possibly be implemented without any problems however such an occurrence might rarely happen due to the effect of a project macro and micro environments. The process of managing a project plan is known as project control. It engages supervising progress, predicting, finding out and solving problems and difficulties, and using emerging plans to tackle deviations. Contractors depend on mentioned project phases to effectively execute a project. While every one of these phases is important, setting a work program i.e. project plan, is particularly vital because it prepares the systems which are utilized to run and manage the job up to

completion. Yet there is still proof that projects are completed without any proper planning and these not planned projects are likely to face many problems such as transformation, over crossing budgets, delaying work, and poor (or no) benefits (Menches et al., 2008).

The control of a project's macro and micro environments is considered a complicated task when related to the use of the least possible resources and achieving an objective on time. Bandelloni et al. (1994) since resources such as people and tools need money and time therefore project managers require a plan to attain the best use of resources needed to accomplish their projects. For example linking project groups to a project plan is based upon selecting the proper planning instruments. Achieving the proper selection is done through the visualization of plans by people who will practice them. It will result in developing a project group interested in seeking answers, taking part in plans, making official decisions grounded on agreement and avoid discouragement, ignorance of plans and 'not modeled here' attitude (Burk, 2003).

They further state that even if one could ensure the needed resources, the systems to manage them in best economical terms might not exist, resulting in weak resource utilization. In practice the number of either human or material resources is limited, and in any situation human ability does not necessarily deliver needed productivity throughout the project time. Therefore resource planning and resource leveling are important.

2.2- Most used planning techniques:

The Gantt chart, Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT) are known as the most used planning methods. Gantt or bar diagrams are used in showing project development and usually contain information such as activity lists, period, time table and development up to date. They are considered of easy use due to their flexibility in adapting to change, illustrating

development and effortlessly be enlarged to explain a certain activity that maybe at the end or beginning of the table (Chiu et al., 2002).

Abeysinghe et al., (2001), state that the conventional CPM and PERT begin with an assumption of unlimited resources for every project activity, i.e. the project plan is based upon time demand of activities apart from the resource requirements of every activity. The first and last dates given in the critical path algorithm are based on critical activity durations in the project linked to the overall project duration. In these considerations, the problem of resource accessibility is ignored. Several issues with reality projects come up when activities need resources that exist solely in constraint amount and the needs of parallel activities cannot be achieved.

Considering these techniques it is noticeable that the selection of the proper resource management tool can enhance the organizational ability to control performance, increase competitiveness and maximize profitability.

2.3- The relationship between Competition and planning:

"Resource management is considered to be one of the most essential components for planning, competitiveness and profitability in any construction project" (Savin et.al, 1997). Linking competition to planning enhances the execution of project strategies. Since a limited budget is always a fact in real life projects, budgets can be cut down using suitable planning techniques and focusing on best use of available resources. Porter (1985) state, the success or failure of companies is connected to competition. It decides the suitability of the company activities that can assist to their acts, like creativity, solid culture, or fine practice. If a competitive strategy is implemented a high competitive advantage will be maintained as the basic ground in which competition happens. Competitive strategies target a beneficial and lasting position against the powers that decide business success. Organizational aims vary due to competition. It is important for every business to change ideas of its source of

advantage. The fierce competitors who achieve more are aware of the way to keep changing and how to always be ahead (Stalk, 1988).

Time management strategies used for production outcome, lounging, purchasing and allocation shows the most effective new ways of competitive advantage. Ansoff et al. (1970) state, when companies are involved in planning acquisitions they usually select a single technique of two available techniques to plan acquisitions. First is the unplanned prospective technique and the second is a methodical programmed technique. If a company fails to program at any stage it is probably to give up planning totally, whereas if all stages were programmed, it is probably to create a planned and functioning program. Companies which program prefer to utilize these programs and to show planned and systematic gained performance. Even if subjective estimation of outcomes does not vary so much between planners and non planners, objective financial capacity represents a considerable variation. Planners do well on average and they act more expectedly than non planners. Therefore, planners seem to have minimized the risk in gaining performance.

A similar case is planning projects. Using suitable planning methods to control resources through allocation and leveling reflects on the overall company performance, profitability and competitive advantage. "Good project management can cost less" (Ibbs & Reginato, 2002).

2.4- What is Resource allocation?

Soanes and Stevenson (2003) state, allocation is "the action or process of allocating or sharing something". In projects, allocation refers to the process of allocating or sharing needed resources among projects based on a work break down structure that shows the sequence and duration of each activity (Heerkens 2002). The variation in utilization of these resources and often occurrence of low troughs and high peaks is not desired in any project. Since the process of managing such changes can distract

the management greatly in way that may cause suffering to other aspects of the project (Hamilton, 2001).

The resource allocation process is done in time and constrained limited projects, but in both cases it suffers from two major draw backs. The first is to achieve a level demand of materials, plant and labor knowing that only a favorable solution will be achieved. The second would be optimizing the duration of a project without having any restrictions on the quantity of resources needed during the project.

What is resource leveling?

Resource leveling is a method for developing a schedule that attempts to minimize the fluctuations in requirements for resources. This method levels the resources in such a way that we can apply them as uniformly as possible. It is also defined as a trial and error method in which we delay the noncritical activities past their early start time to maintain a uniform level of required resources. We can also delay activities to an extent that all their positive slack is exploited like any other delays which hold up the project beyond its due date. Gido and Clements (2003) state that optimizing the use of people and equipment of the project is at the heart of resource leveling. Resource leveling works to establish schedules in which resources become as level as possible without changing the original completion time of the project. It starts with assuming that having continuous and consistent use of the fewest resources is most productive, also avoiding any addition or deletion of resources, especially people and time throughout the project. Moreover it adjusts the schedule to achieve compensation as well as facing the fact of limited people and equipment. Ver Zuh (2003) state that project managers must avoid resource troughs and peaks. They should use a set of people on a consistent rate. This would be more efficient and realistic, because every upswing has a cost in resources whether it comes from bringing new members to the site of the project or procuring more equipment. The costs of learning can be the steepest.

Meredith and Mantel (2003) state that with a Look at a hypothetical project, the fundamental method for resource leveling is easy and simple. For instance, study the simple Activity on Arrow (AOA) network shown below (see figure 2). The activity time is shown above the arc, and resources usage (on resources, workers) is in the brackets below the arc.

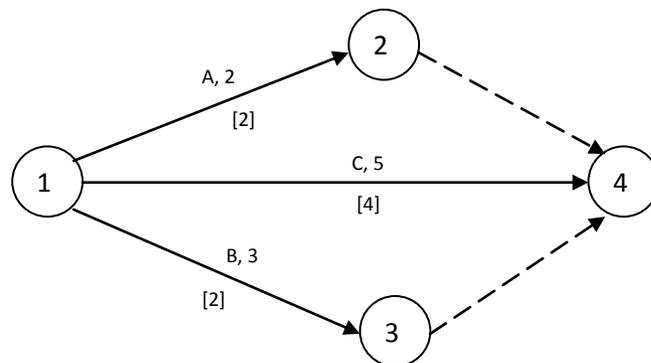
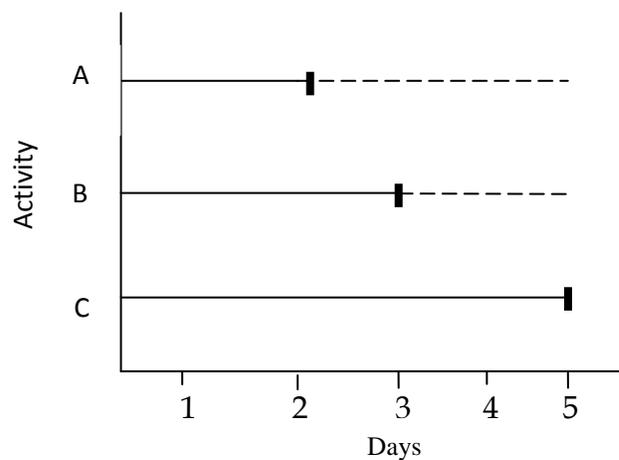


Figure 2: Activity on Arrow diagram (AOA)

Event one is precedent to activities (a), (b) and (c), and all are precedent to event four. Activity (a) needs two days and two workers. Activity (b) needs three days with two workers. Activity (c) needs five days with four workers. In case all these tasks are started on their early start dates, the resource loading diagram will appear as shown in figure 3:-



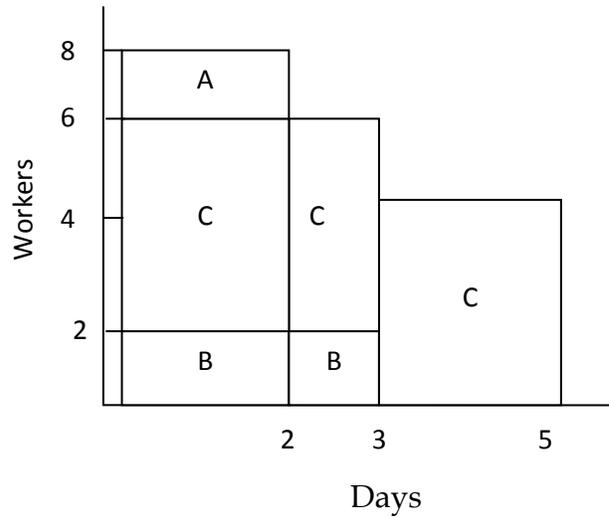
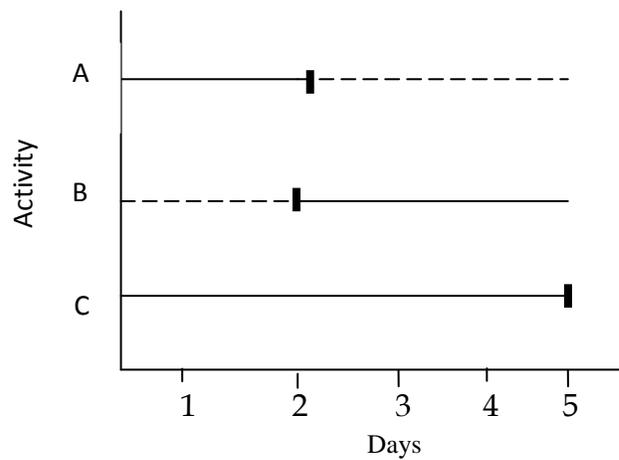


Figure 3: Resource Loading Diagram

Procedures of decreasing labor need varying from eight workers to four workers. However, if task (b) is postponed for two days, the complete length of its slack, the resource loading diagram will be leveled as shown in figure 4:



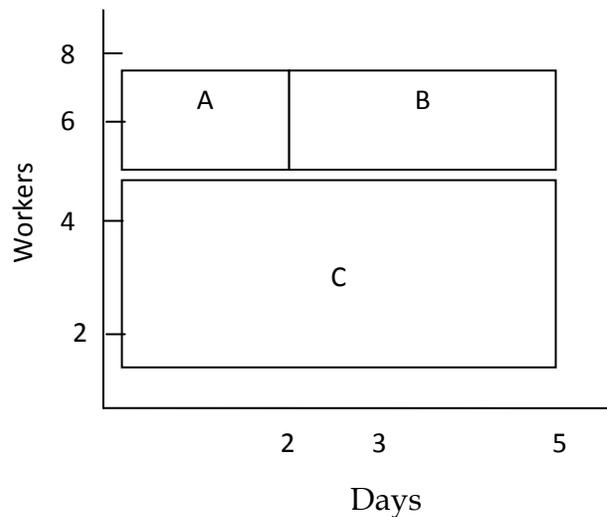


Figure 4: Levelled resource loading diagram

The same would have resulted if (b) begun as early as possible and (a) is postponed by three days. Resource leveling can be used for all projects, whether or not resources are constrained. In case that the network is not big enough and a few resources are available, the leveling process can be achieved manually. As for bigger networks and multiple resources, resource leveling gets complex, beyond manual solutions capability.

It is significant to lay emphasis that if the network under study is too complex and number of resources to be leveled is practically large, then manual leveling is out of question. In this case leveling using a computer is not only mandatory, but it is helpful as it permits the PM to experiment with different patterns of resource usage through simulation (Hamilton, 2001).

2.5- Time-constrained leveling

As stated by Field & Keller (1998), there are two goals of scheduling time-limited projects:

- Calculate the resource requirements to make them available when needed.
- Schedule possible activities to achieve a smooth resource loading process.

Despite the assumption of unlimited resources in time-limited scheduling, the purpose is to achieve most economical use of resources, and this practically means trying to achieve the lowest peak usage of all the resources. Actually, it is costly to employ and train people to work on a project; as a result, it is a faulty act to schedule the work, so that throughout the peak period, people are occupied while later most of them are idle. Such a situation could take place in the following cases:

- Contracts oblige delayed parties to pay penalties
- The project is considered to be complementary to another.
- Seasons trading is a criteria to meet i.e. projects must be ready in that particular season
- Project is related to a certain event.

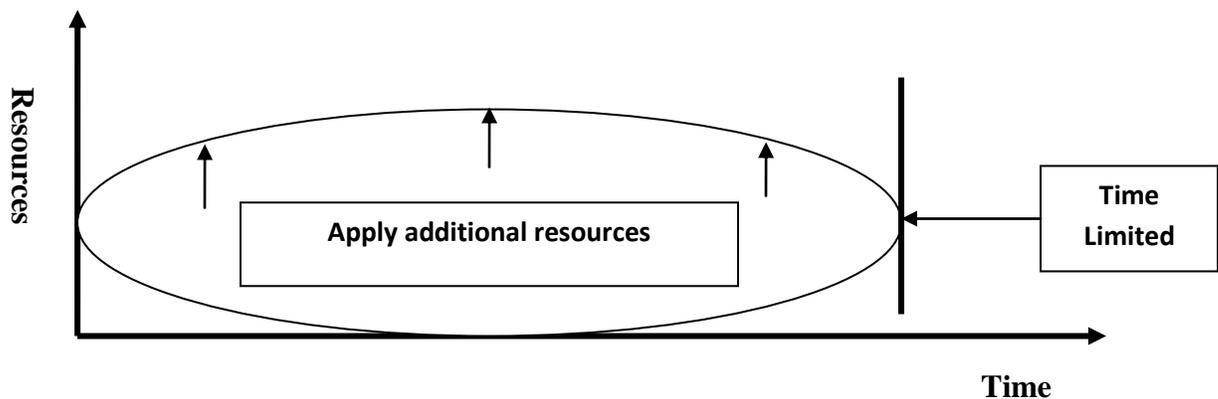


Figure 5: Time-Limited Resource Scheduling

(Burke, 2003)

In simpler terms "Time-limited resource smoothing is used when the end date of the project cannot be exceeded. In which case any resource overloads will have to be addressed by increasing the resources when they are required". (See figure 5).

2.6- Resource constrained leveling:

Looking at developments a remarkable number of residential and commercial projects were achieved either through private investors or governmental funds. The UAE construction market is currently facing the credit turmoil just like others. Consequently ongoing developments were frozen, delayed or cancelled. Further it is expected to change the nature of projects giving non renewable resources such as money higher importance over other aspects such as time due to the dearth of projects. "Resource constrained leveling or resource-limited scheduling is a method for developing the shortest schedule when the number or amount of available resources is fixed" (Burke 2003). This way is most suitable when the accessible resources are restricted and the limits not exceeded. This technique will expand the project accomplishment time if required so as to stay within resource limits. Gido & Clements (2003) state resource constrained leveling is an iterative procedure of assigning resources to activities found on the least slack. In case two or more activities require the same limited resource at the same time then the activities with the least slack have precedence. Balance resources will be assigned to the activities with the second least slack and so forth in case of other activities require the resource but the resource is completely allocated to higher-precedence activities, the lower-precedence activities will be postponed. As their slack becomes worse they sooner or later lift up the precedence steps extending the project completion time. (See figure 6)

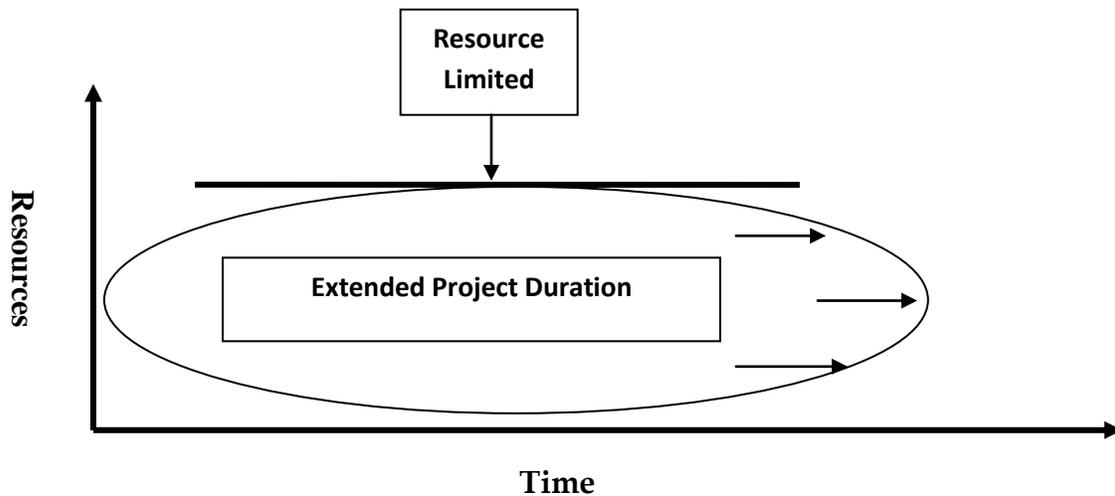


Figure 6: Resource-Limited Resource Scheduling

(Burke, 2003)

This situation could take place in the following cases:

- Physical deployment is no longer possible due to narrow space and lack of work fronts.
- Site facilities cannot accommodate available work force.
- Needed working tools are insufficient, e.g. the number of computers, machines, drawing boards, lifts or scaffolding.
- Problems in logistics due to health and safety matters.

The basic leveling rules are typical for both time and resource constrained projects. Time constrained leveling is achieved upon leveling all resources without extending the overall projects duration. Resource constrained leveling is achieved upon achieving a complete work program without the need of additional resources than those accessible. If the leveled histogram still demands additional resources than those accessible, a set of rules has to be followed to achieve needed leveling.

2.7- Advantages of resource leveling:

Resource leveling advantages affect the overall organization resulting in enhancing overall operations. Starting at the management level it is noted that organizations implementing proper leveling techniques require less management attention giving them more time to concentrate on other organizational aspects to develop the organization rather than being overloaded in tackling day to day work. It further reduces company overheads through enabling project managers plan their material deliveries to become direct orders from suppliers eliminating the cost of storing and insurance or even implement a just in time inventory policy. In addition, workers morale increases while working in a leveled environment which promotes fairness and equality between workers resulting in human retention and avoiding the costs of learning. Lastly the cost of errors is almost eliminated throughout the project lifetime increasing profitability and saving the cost of rework.

2.8- Heuristics and optimization:

Introduction:

There is no guaranteed method which gives the best scheduling in all circumstances, unless for the blockbusting heuristic model which calculates every feasible solution to each activity consuming massive computer power. On the other hand, there are two main approaches to constrained allocation problems. They are the heuristics approach and optimization models. In simple terms the first one uses rules of thumb which have worked in similar situations. Whereas optimization cannot handle complex leveling problems particularly well (Meredith and Mantel 2003). However, both models shall be discussed.

2.8-1. Heuristics approach?

Since Kelly's (1963) scheduling generation plan many heuristic algorithms have been introduced in literature based upon a common benefit which is the ability of heuristics

to solve complex leveling problems. Heuristic approaches to constrained resource scheduling problems are widely and generally used for many reasons .first, they are considered the only feasible methods to attack the big, nonlinear and complex problems which occur in reality. Second, Heuristic schedules may not be optimal, but they are very good, for most purposes. Commercially existing computer programs deal with big problems and are used remarkably in industry. Furthermore the new simulation techniques permit the PM to develop quickly many different schedules and to decide which ones are better than the present availability. In case a remarkable number of simulation runs fail to get important improvement, the PM can feel satisfied with the current solution that it is an affective one the majority of heuristic solution methods begin with PERT/CPM schedule and analyze the usage of the resource period by period and resource by resource.

The Branch – and – bound and Priority Rules are described hereafter due to their ability to solve combinatorial problems with separate, non – linear or non – mathematically defined objective functions.

The branch and bound heuristic:

The branch and bound approach is used by other heuristics in which they generate various types of solutions and eliminate poor infeasible solutions. This is achieved through a tree search pruning the infeasible solutions and replacing them with dominant ones. This heuristic method narrows solutions region to an extent where we might find good feasible solutions (Meredith and Mantel, 2003). They further state in case the tree is not too big this approach can locate best solutions, through using longer computer search time. Heuristics are normally implanted in a computer simulation package which comments on what is going to happen to the project priority rules or if definite schedules were followed. In order to get a possible group of solutions different priority rules can be tried in the simulation. As previously

explained branch-and-bound could be the most used technique in solving the project scheduling problems.

The resource constrained project scheduling problem is related to a group of complex combinatorial problems and branch – and – bound is the only technique which permits the production of the best solutions with in an acceptable computation period. In describing the branch – and – bound methodology Again (1966) says that “a combinatorial problem is here defined to be one of assigning discrete numerical values to some finite group of variables X in a way to satisfy a group constraint and minimize some objective function, $z(X)$. A great deal of flexibility is allowed in the constraints set and the objective function. $Z(X)$ is used just to be uniquely determined by a group of values given for X . Many branch and bound applications exist in which $Z(X)$ is defined to take on values of Zero or $\langle \rangle$ just to indicate whether a solution is feasible or not. The ability of solving combinatorial problems with separate, non – linear or non – mathematically defined objective functions should be known as a significant advantage of branch and bound methods .However, typical flexibility exists in the constraints”.

The restrictions of the combinatorial problem will be drawn as being either implicit or explicit. Implicit restrictions are to be satisfied through the construction of the branch-and-bound method priority restrictions are an example of implicit constraints. These constraints can be satisfied easily by a branch – and – bound procedure by applying PERT \ CPM like temporal assignments.

On the other hand, explicit constraints are defined as restrictions which require procedures to them as an integral part of the branch – and – bound algorithm. The resource constraints are an example of explicit constrains. It is clear that difficulty occurs when a branch – and – bound solution method is selected.

A specific branch – and – bound algorithm can be defined as a set of rules that starts by branching from current nodes to new ones after determination of new nodes lower

bounds and choosing another node to branch next to. Also it identifies node containment of infeasible/ feasible and non optimal/ optimal solutions at intermediate and final nodes.

The combinatorial problem can be solved by the branch and bound algorithms as defined above. The dichotomy is based on choosing the intermediate node to branch from the next. The first kind is a depth – first or back tracking strategy which chooses one of the intermediate nodes that have been created at a proceeding stage, thus moving on node by node down a branch. The second kind of strategy is called traditionally a best - first frontier search or skip tracking. This strategy always chooses the intermediate node which has the lower bound. In case many intermediate nodes exist with the typical (best) lower bound, the choice depends on a second characteristic. The last strategy has two main disadvantages: First it needs more storage capacity than a depth – first strategy. Second, the best solution can be gained just at the end of the search, while no other feasible solutions are found during search course (Demeulemeester et al., 2002).

A survey by Kolisch and padman (1997), state that a big number of optimal approaches were mainly used for introducing benchmark solutions. This survey concluded that at present, the most competitive correct algorithms are the ones of Brucker et al. (1998) Demeulemeas and herroelen (1997), Mingozi et al. 1998) and sprechev (1996).

Priority rules:

Heuristics are differed according to some priority rule. At particular project duration as demand exceeds an available resource. The used heuristic examines balance activities and start assigning scarce resources to them sequentially based on a priority rule. Priority rules are methods followed by project managers to level over allocated resources, which can either be done manually or through using a computer program (Meredith and Mantel, 2003).

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Usually priority rules are embedded in software's making the leveling process of over allocated resources easy to implement. They state that the most familiar priority rules are:

1. As soon as possible: is considered to be the standard leveling rule, where all activities start at their early start times and resources are assigned bearing that in mind.
2. As late as possible: Unlike the first rule, this rule aims at delaying cash outflows and preserve resources through starting all activities at their Late start time without extending the overall project duration.
3. Shortest task first: is considered to be implementable in technological precedence, which is not applicable to this study.
4. Most resources first: this rule is based on the idea that activities of high importance demand more scarce resources.
5. Minimum slack first: in this case slack available and resources needed have a negative relationship i.e. the longer available slack, the less needed resources. This rule aims at reducing late activities to avoid the "student syndrome".
6. Most critical followers: Herein the activity with more preceding activities is assigned needed scarce resource first. It is believed that activities in such a case can cause damage to project performance if delayed.
7. Most successors: This rule is just like rule six, but in this case the activity with less preceding activities is considered first with the same rational.
8. Arbitrary: In arbitrary neither early start dates nor late start dates is of importance. The importance lies in the value of the task to be performed and what effect does it have on the organization. For example the delivery of a major item to a construction site such as steel is going to generate a certain

amount of income which serves the company's objective. Here needed resources to achieve such deliveries will be made available first.

It is believed that point eight reflects the status of actual execution. Project managers always try to cover project financing through work done i.e. the project manager is responsible to arrange the project cash flow to secure needed resources throughout the project. This is achieved through early delivery of major materials to site to increase project cash flow and guarantee highest amount is paid by clients at early project stages.

Several priority rules like these are employed in scheduling heuristics. From time to another, researches examine them based on management application programs to set their ability to deal with such tasks as allocating constrained resources and resource leveling. The result of such tests are normally announced (e.g. Farid and Manoharan, (1996). Johnson (1992) but they are very short lived. Based on a research by Fendly (1968), Kurulus and Davis (1982) and Kurtulus and Narula (1985), it was agreed in common that the minimum slack first rule is considered the best. Using the minimum slack first rule resulted in various advantages such as reduce poor performance, minimizing project schedule slippage, best utilization of facilities and minimum total system occupancy time (Meredith and Mantel, 2003).

2.8-2. Optimizing Model:

The method of finding best solution to the constrained resource scheduling problem falls into two groups, mathematical programming and enumeration.

The outstanding problem with the combination of approaches which use optimization is that the characteristic of problems that can be usefully addressed with these methods are still greatly unknown (Meredith and Mantel, 2003). We can apply the mathematical programming methods to get best solutions in granting resources, most of these models use 0-1 (integer programming) to refer to whether an activity was

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scheduled in a certain period or not. By doing so, three minimum common objectives have to be satisfied according to them those are:

- 1- Minimum total through put time (time in the shop) for all projects.
- 2- Minimum total completion time for all projects.
- 3- Minimum total lateness penalty for all projects.

While constraint equations make sure that every schedule meets all of the following constraints, given that the group of restrictions permits a feasible solution.

- 1- Limited resource.
- 2- Precedence relations ships among activities.
- 3- Activity – splitting possibilities.
- 4- Project and activity due dates.
- 5- Substitution of resources to assign to specified activities.
- 6- Concurrent and non concurring activity performance requirements.

Though mathematical programming provides best solutions, it has serious draw backs like requiring great power and computing time (Meredith and Mantel, 2003). The following table (see table one) provides a summary of available heuristic approaches and optimization models:

Leveling Technique		
Optimization	Heuristics	
Linear Programming approaches	Branch and Bound Schemes	Other Approaches
1-Conceptual formulation 2-The formulation by	1- Precedence tree 2-Extension alternatives	1-Schedule generation scheme Serial Schedule Generation Scheme Parallel Schedule Generation Scheme

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<p>Pritsker et al. (1969)</p> <p>3-The formulation by Kaplan (1988)</p> <p>4-The formulation by Klein (2000)</p> <p>5-The formulation by Alvarez-Valdes and Tamarit (1993)</p> <p>6-The formulation by Mingozzi et al. (1998)</p>	<p>3-Minimal delaying alternatives</p> <p>4-Minimal forbidden sets</p> <p>5-Schedule schemes</p> <p>5.1-The basic version</p> <p>5.2-The binary version</p> <p>6-Float splitting</p> <p>6.1-Heads and tails</p> <p>6.2-The n-machine problem</p> <p>6.3-Jackson preemptive schedule</p> <p>6.4-The branching scheme</p> <p>7-Binding precedence relations</p>	<p>2-Priority Rule Based Heuristics</p> <p>2.1-Priority Rules</p> <p>2.2-Proposed methods</p> <p>2.2.1-Single pass methods</p> <p>2.2.2-Multi pass methods</p> <p>2.2.1.1-Multi priority rule methods</p> <p>2.2.2.1 Forward – Backward scheduling methods</p> <p>3-Metaheuristic Approaches</p> <p>3.1-General Metaheuristic Strategies</p> <p>3.1.1-Simulated Annealing</p> <p>3.1.2-Tabu Search</p> <p>3.1.3-Genetic Algorithms</p> <p>3.2-Representations</p> <p>3.2.1-Activity List Representation</p> <p>3.2.2-Random key Representation</p> <p>3.2.3-Priority Rule Representation</p> <p>3.2.4-Shift Vector Representation</p> <p>3.2.5-Schedule scheme Representation</p> <p>4-Other Heuristics</p> <p>4.1-Truncated Branch-and-Bound Methods</p> <p>4.2-Disjunctive Arc Based Methods</p> <p>4.3-Integer programming by Oguz and Bala (1994)</p> <p>4.4-Block structures by Mausser and Lawrence (1998)</p> <p>5-Computational Analysis</p>
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Table 1: Leveling Techniques

(Field and Keller, 1998)

Chapter 3

PLANNING FOR CONTRACTORS AND SUBCONTRACTORS

In this chapter challenges to planning faced by contractors and subcontractors are identified. Using available theory hindrances to resource leveling are further discussed. Lastly it negotiates the effect of planning on organizations competitiveness and performance.

3. Planning for contractors and subcontractors:

Contractors are companies or sometimes individuals who offer agreed services to a customer against a set fee and duration under a services contract. Sub contractors are companies that go into contracts with general contractors. Sub contractors play a vital role in most construction projects offering up to 90% of works performed (Clough and Sears, 1994). They are hired to achieve certain tasks on a project normally general contractors cannot perform (Arditi et al., 2005).

The increase in the technological sophistication of contracts led to proliferation of subcontracting strata: work contracts are planned, designed, produced, tested, delivered, then assembled and maintained by specialist contractor companies. Eccles (1989) says since the specialization in certain skills and tasks becomes greater, the complexity and uncertainty gets also greater. Consequently the use of the sub contractors increased remarkably. The new specialist companies compete to supply buildings with equipments and play an effective role in designing and managing processes of construction. This tendency was represented in moving from construction activities to engineering and assembly work with higher proportion of the value of new building in mechanical and electrical systems.

‘The increased use of subcontracting shifted both risk and responsibility from the main contractor to the subcontractors. A power shift has occurred to some degree too- during tendering, many packages of work are bid by subcontractors, the main contractor assembles the selected bids to form the base cost for the tender. Uher (1990) noted that such process gives power to major subcontractors, whose bids will form a significant proportion of the total cost of the project, to submit differential bids to tendering main contractors and thereby, potentially, determining which contractor will submit the lower tender and so be awarded the work. However, such power will be highly constrained, especially during recessionary periods, during which competition for work amongst all firms will be very keen and main contractors may

hold ‘Dutch auctions’ amongst subcontractors once the main contractor has been awarded the work’ (Fellows et al. 2002). Bresnen et al. (1984) states, Risks related to projects are passed on to assigned subcontractors increasing required project control and effecting quality of work.

The increased use of subcontracting

Likewise, Clarke (1980) says that excessive subcontracting reduces general contractor`s control resulting in cost and time overruns. Eccles (1981) looking at subcontracting, builders acknowledge that subcontractors works are significant to work flow coordination and control. Thus, the methods of control and bounds of control over subcontractors emerge as serious considerations to sub contracting decisions (Usdiken, 1988).

3.1- Challenges to subcontractors:

Introduction:

It was observed in theory that contractors and sub contractors face several challenges in planning and resource leveling which affect the overall organization performance, competitiveness and profitability issues such as lack of skilled resources, lengthy payment terms, supply chain management and trust among other can cause major disruption to the planning process which reflects on the organization micro environment.

3.1.1- Project resources:

Competence in supplying and controlling resources is essential to project success. Each project will need a different blend of quality and quantity of resources. Some projects are clearly money centered while others depend broadly on technology. Modern procedures, tools or the practice of expert learning and skills, or whatever the project direction, resources generate project income; they should be thoughtfully picked, exactly determined and their gain is well planned. They should be always available and utilized appropriately. Project management requires exactness, concentration and a constraint life cycle; every aspect is helpful to determine clearness and expecting projects requirements. Using extra resources is inefficient due to encouraging resources inequality, wasting, weak management and sometimes, deception. Other results contain loss of cost control and sometimes, postponing in accomplishing projects. Under resourcing, on the other hand, will restrain the project and lack of basic materials may cause a complete failure.

Every project encounters the reality of constraint resources. The notion is to escape unlevelled allocation. The over allocation issue can be particularly serious if project managers think that they got unlimited access to resources. Like that not only the table become impractical, but the manager may also have over packed a main resource. (If the project group isn't too occupied on your project, it will probably be reallocated and not exist when the next top comes. Or, in worst situation, through slow times in the project, some of the unallocated people may get out of job, becoming lastingly not existing taking important facts about your project with them). Another issue comes up if people were assigned to this project and doing other projects at the same time. It is not easy to shift people between projects, if each project in the company has varying resource needs. As an alternative, workers are taken from one project to assist another uncompleted one and work at another project that has been also delayed (Keeling, 2000).

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Resource management won't be powerful if it only focuses on projects most complicated or ruling to the elimination of less clear but vital materials which, even if small, and not important to the process. As the project progresses, managing decisions will be impacted by the accessibility and utilizing of resources in connection to cost, duration and quality. Appropriate addition of all resources requirements at the planning phase will prevent several probable hardships to project execution.

Following are seven logical steps towards establishing a project resource schedule (see table two):

Number	Step	Preferred Method
1	Define the objectives: <ul style="list-style-type: none"> • Technical • Financial • Time 	<ul style="list-style-type: none"> • Solution, conceptual or feasibility engineering, with the results documented in a project specification. • Initial evaluation of the proposed solution. To be revised, refined and developed into budgets after step2. • Summary bar chart or simple network diagram, based on experience from similar past projects if possible.
2	Divide the project into its constituent tasks	<ul style="list-style-type: none"> • Prepare a coded work breakdown structure (WBS)
3	Put all the identified tasks into their logical working sequence	<ul style="list-style-type: none"> • Draw a detailed network logic diagram. This might require a brain storming meeting. • Ensure that every task in the WBS is considered.
4	Estimate the duration of every task	<ul style="list-style-type: none"> • Forecast the calendar time needed from start to finish of each task on the

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		network. Task resource requirements should also be estimated but at this stage ignore the possible effect of these on the schedule.
5	Calculate the timing and priority of each task	<ul style="list-style-type: none"> • Enter the network data into a computer and carry out time analysis using suitable project management software. • Re-examine the network and task times if the forecast completion date is unacceptable.
6	Reconcile task needs with the resources that can be provided	<ul style="list-style-type: none"> • Use the computer to allocate resources to tasks, using the float from network time analysis to determine priorities when resources are insufficient. • Filter reports to produce work-to lists that are specific to every line manager.
7	Assign each task for action	<ul style="list-style-type: none"> • The important step is best left to line managers and supervisors, especially for human resources. • Matching people to tasks usually demands personal knowledge of individual characteristics, capabilities and skills.

Table 2: Establishing a project resource schedule (Keeling 2000)

Another strategy to resource management is using computer software, which permits many resource groups to be determined and progressed. Network charts, tables and reports will become very hard to run if every kind of resource in the association is joined in the tabling procedures. The computer will not be able to make workload

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levels that are easy and please everyone. The procedures duration and the danger of mistakes are probably to rise over satisfactory levels.

3.1.2- Lengthy payment terms:

Any successful business needs a healthy cash flow. However, since the Haulage industry contemplates the consequences of a world credit crunch, it hasn't been more crucial. The late payments are one of the problems that are under the great scrutiny. Simms (2008) state "Late payment and messing about with payment terms is unethical, unprofessional and ultimately uneconomic. Starving smaller suppliers of funds to try to boost your own liquidity and earn extra interest on their money is inconsistent with corporate responsibility."

As well as, refusing to give cash by the customers who used to ignore credit terms and pay up only when they like is another significant issue. The customers respond and react to the world credit crisis by using "manipulative tactics" she further states.

One of the specialists engineering contractors group, chief executive, Rudi Klein said that there was big rise in contractors reporting that public and private section customers had been delaying payments.

The office of government commerce's fair payment charter declares that public sector customers and their contractors should ensure a maximum of thirty days elapses on due date of bills, which is a week after they are presented and the final payment date.

"Legislation allows businesses to charge interest on overdue payments, but few use the law for fear of damaging their relationships with customers" (Simms, 2008).

For example, as act of late payment currently dominates, a new research shows that four out of ten specialist building contractors fail to achieve their tasks due to shortage of skilled labor and their inability to spend cash on training their own labor.

The findings of the latest trade survey by the National specialist contractors council (NSCC). Suzannah Nichol, NSCC chief executive said: "lengthy payment terms and

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skill shortages are linked. Specialist contractors find extreme difficulty in investing in the training of their necessary work force to achieve the needs of the industry when they continuously fight to get the money they are owed ‘‘.

Prominent contractors who work in Dubai say that they are owed billions of dirham’s by government controlled real estate developers, and they want a state - backed financial rescue package to prevent and stop bankruptcy of companies (Foreman, 2009).

The great effect on contractors appeared recently. However, typical payment terms in Dubai give twenty eight days for a consultant to issue a certificate that a contractor has completed a certain percentage of his site work, followed by a sixty days payment period, a total of eighty eight days. Contractors say: ‘‘ during those eighty eight days you continue working and getting certificates, but at the end of that time, you do not get paid, if the contract ended, it may take four or five months of negotiations before you get your money ‘‘(Foreman 2009).

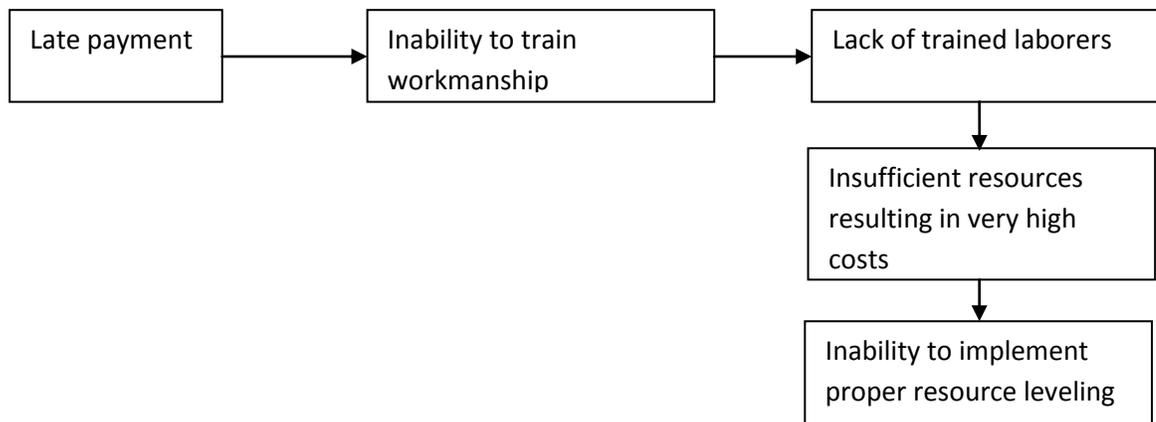


Figure 7: Late payment consequence

3.1.3- Partnering:

Partnering aims at enhancing relations between projects parties through the use of a collaborative, open, less managerial and less hierarchical approach. Partnering advocates say that advantages to project participants are better communication which leads to improved learning, more informal decision making resulting in higher effectiveness. However, the weaknesses of many partnering relationships are considered as changing commercial pressures. Since the behaviors of careless customer can quickly damage partnering. (Niel et al., 2007)

Due to variance of project environments, the issue of partnering can contribute as a resource leveling barrier if following points dominate the project environment. (Ng et al., 2002)

- 1- Lack of continuous open and honest communication.
- 2- Stake holders not developing a ‘ win – win ‘ attitude.
- 3- Stake holders are not committed to the partnering arrangement.
- 4- Lack of intimacy in the partnering relationship.
- 5- Issues are allowed to slide and escalate.
- 6- Some partners are unwilling to compromise.
- 7- Lack of empowerment in the client’s controlling bodies
- 8- Dealing with large bureaucratic organizations
- 9- Commercial pressures compromising the partnering attitude
- 10- Controlling body’s lack of technical knowledge
- 11- Lack of training and guidance in the project partnering arrangement
- 12- Problems withdrawing s and specifications
- 13- Key subcontractors not included in the partnering process
- 14- Partnering is not suitable for a particular project

(Ng et al., 2002)

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Looking at mentioned points it is noticed that advantageous partnering to resource leveling is only achievable if such barriers were properly controlled.

3.1.4- Supply chain management SCM:

The act of buying and supplying goods has been under long studies due to demanding markets. Both require a variety of operations but SCM is the only ranging method concerned with enhancing companies' competitive advantage using its suppliers' plans, technology and potential to increase competition.

Tan and Kannan (1998) believe that all the strategic providers can cooperate to perform as a unit and increase the whole functioning in SCM (Houlihan et al., 1985).

SCM is defined by La Londe (1998) as: "The package of improved customer and economic value by having harmonized management of the running of material goods and connected data from tracing through usage". Another definition by Johnston 1995: "The process of strategically managing the movement and shortage of materials, parts finished inventory from the suppliers, through the firm and to customers. And accomplished account from providers through the company and to consumers".

Burgess 1998 thinks that SCM provides faster achievement of competitive advantage, consumer services and supply chain synergy. The following table shows hindering factors to an efficient and successful supply chain management process (see table three).

Function	Overall	Turn (£millions)			F stat.	Sig.
		Less than 100	100-250	Greater than 250		
Lack of top management commitment	4.03	3.86	4.40	3.73	1.921	0.161
Poor understanding of the concept	3.98	3.86	4.13	3.91	0.258	0.774
Inappropriate organisation structure to support system	3.90	3.57	3.93	4.27	1.851	0.171
Low commitment of partners	3.85	4.00	3.80	3.73	0.169	0.850
Strategic benefits unclear	3.48	3.36	3.53	3.55	0.122	0.886
Lack of appropriate information technology	3.13	3.36	3.07	2.91	1.280	0.290

Table 3: Hindering SCM (Burgess, 1998)

The problem in creating a rising supply chain company was firstly poor management commitment; secondly establishing an understanding of the idea since the concept clashes with the firm structure. Thirdly, no factual interest is exercised by partners. Lastly, considered a less significant reason is using primitive information technology and vague strategic profits.

Goldratt's critical chain (1997) is known for its attack on resource-constrained scheduling. A number of identified hindrances raised by project managers as per Goldratt have a direct relation to SCM. He stated that management tends to change its project scope and budget without proper consultation and exchange of information with its own project managers, reflecting a poor understanding of the project concept and lack of top management commitment.

Further concerns such as work loads and due dates are placed by external parties not directly related to the project such as sales group, raising the fact of not having an appropriate organizational structure to support the system (Meredith et al., 2003).

3.1.5- Effect of trust and control on planning:

Kuaatz, 1998 says that solid network ties among self – governing entities possibly (1) promote long term communication and (2) make the information exchange easier. It is noticed that any transaction in which the performance of the two parties is separated by time involves an element of trust (Nohria and Eccles, 1992).

A well built stable relationship is linked to the investment in trust by the concerned parties. As Lado et al., 1997 says, companies look for cooperative advantages. So point (1) and (2) result in the following:

- 1- Early integration.
- 2- Enhanced coordination of services.
- 3- Better use of resource i.e. proper resource planning and leveling techniques.
- 4- Risk mitigation.

Manufacturing or product delivery demand makes complete integration of separate design contributions more complicated. Some specialists need many months to produce materials or components to be able to meet demand of an individual project. While other specialists work to a shorter time scale.

Occasionally scholars might use the word "Trust" to describe wrong ideas which lead to some confusion (Sitkin & Roth, 1993). It's obvious that trust is essential for different reasons: it encourages collaborative acts (Gambetta, 1998); recommends adjusting company groups like network affairs. (Miles & Snow, 1992); discourage violent struggle; drop down contract prices; provide fast combination of ad hoc work teams. (Meyerson et al., 1996); and encourage strong replies to disasters.

In construction, project activities are divided into work packages assigned to various specialist contractors through individual contracts each stating scope of work, duration and closing date. (Üsdiken et al., 1988) Hence, doubts associated to achieving those contracts seem to diminish through higher levels of trust (Eccles, 1981). Dyer and Singh (1998) agree that enhanced performance and cooperative protection are certain through trust and friendliness given that following fourteen trust characteristics identified by Wong et al., (2005) are considered:

1. Competence of work.
2. Problem-solving ability.
3. Frequency and effectiveness of communication
4. Openness and integrity of communication
5. Alignment of effort and rewards
6. Effective and sufficient information flow
7. Sense of unity
8. Respect and appreciation of the system

9. Compatibility
10. Long-term relationships
11. Financial stability
12. Adoption of ADR techniques
13. Reputation
14. Satisfaction of contract terms and agreement

Mantel et al., (2001) states “There are two primary purposes of control: The stewardship of organizational assets and the regulation of results through the alteration of activities”. Given the possibility of not achieving mentioned criteria the level of control on physical asset, human and financial resources varies and appears to be an evidence of the level of trust between companies. For example, a main contractor might require a new subcontractor to provide daily progress reports, whereas other subcontractors are only requested to submit monthly progress reports saving him time and effort. Such situations of high trust and low control demonstrate trust disadvantages and their negative effect on project and resource planning. Control parameters such as performance, cost and time are the main drivers of control. First, performance problems arise through unexpected technical problems, insufficient resources are available when needed and client requires changes in system specification. Second, cost increases through immediate need of extra resources, alteration to scope of work and inadequate budgeting. Third, time also extends due to similar reasons such as change of scope, improper task sequencing and unavailability of inputs such as material equipment and personnel (Meredith and Mantel, 2003). “When subcontracting the contractor has less control in terms of standard of workmanship, output and performance generally; coordination is more complex and so more highly skilled management will be required; the reputation of the contractor is, to some degree, in the hands of the subcontractors and the subcontractors themselves aim to make a profit” (Fellows et al. 2002). Subcontractor’s aim to achieving profit is a fact. Based on personal experience and referenced literature the

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logic behind every business is to achieve profits unless for welfare and nonprofit organizations. The current financial turmoil has put companies under financial pressures obliging them to use all possible tactics to increase their profits in order to cover for lost money value or money in its essence. Consequently main contractors and clients are left with no choice but to increase supervision hence increasing their project costs. The dominant situation consists of having enhanced profits through trust but this has changed making companies to some extent take advantage of that trust to cover incurred losses.

The following figure illustrates the trust/ control effect (see figure 8):

	Low control	High control
High trust	1-Negative effect on Project and resource planning	2-Increase time, cost & performance
Low trust	3-Low performance and high time/cost	4-Positive effect on project and resource planning

Figure 8: Trust control effect

3.1.6- Ignorance of network methods to capacity constraints:

Many planning and program methods have been enhanced and practiced by contractors. Several academics reported that critical path method (CPM) & Program evaluation and review technique (PERT), are currently the most used scheduling techniques.

McCullough (1999) claimed that CPM has the ability to plan projects of various sizes, whereas Loulakis (1993) argued that CPM plans are essential aids to planning, execution of projects and validating construction delays. While Shash and Abdullatif (1993) said that development of PERT using a mixture of network and possibility

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theories enabled it to handle probabilities while accomplishing activities in accurate time. PERT is based upon repeated network of occasion and activities, having a predicted value and time variance limit for every project which is set by a technique stream plan (Wayne, 1999).

A survey conducted by Galloway (2001), has identified contractors reasons to the use of CPM/ PERT in planning their projects. The following figure explains the same (see figure 9):

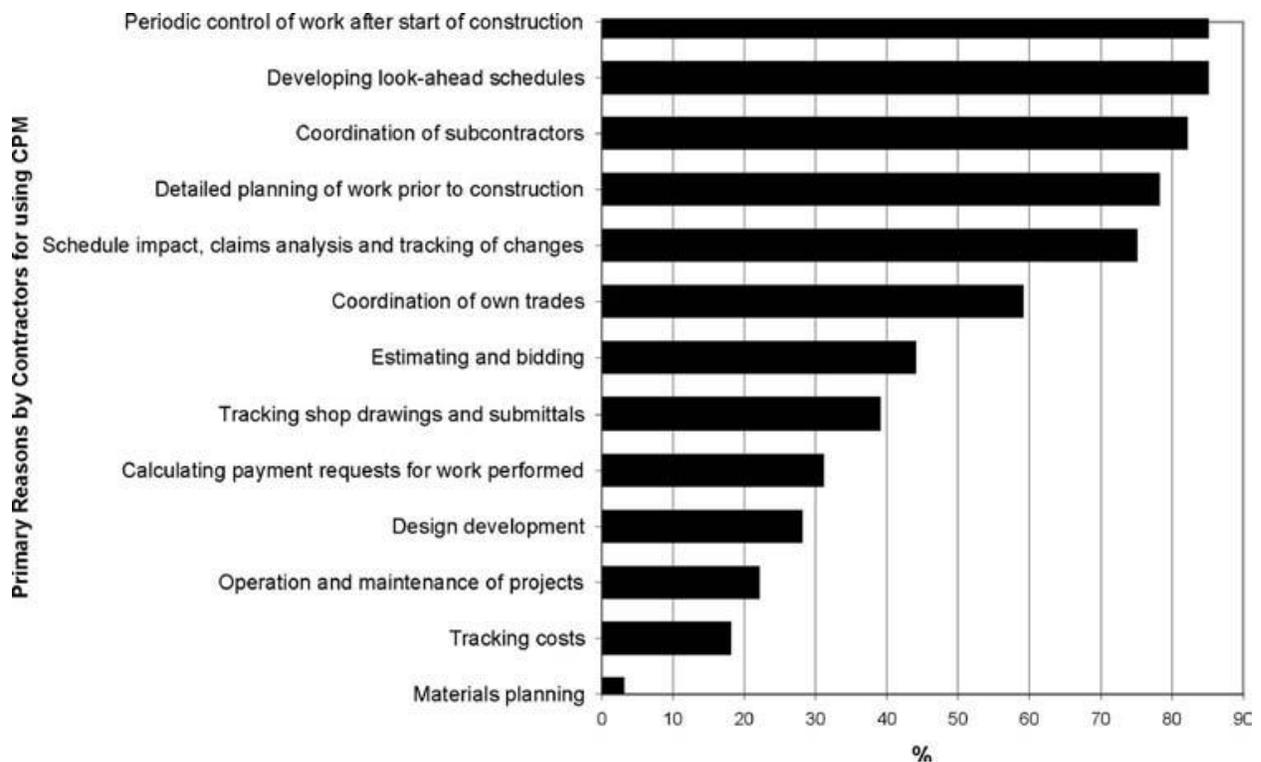


Figure 9: Primary reasons by contractors for using CPM

Looking at scholar's definitions and conducted survey it is noticed that mentioned advantages are aiming at acquiring the project along with a current achievement standard without considering the recent situation of resources or limitations to resources. Since the selected sample has resemblance to the sample of this study it is valid to note that the issue of materials planning, resource levelling, has been barely

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addressed as a reason to select CPM or PERT as best planning tool. Indicating materials' planning is less cared for, although it forms a great deal of any construction or MEP project value.

A number of disadvantages have been identified by Schoderbeck (1965), which concluded following PERT drawbacks:

- The main problem recognition is lost with the many detail
- Promotes extra detail if not strictly managed.
- Time needed to unite (PERT networks) and hardship of reasoning teams to administration.

(Schoderbek, 1965)

Further Stub Avraham et al., (2005) Said that PERT and CPM are built upon following assumptions, extending their negligence of capacity constraints:

1. Project activities can be described as a unit that has an obvious start and closing point for each activity.
2. Project activity –sequence connections may be focused and organized in a straight network.
3. Project management must concentrate on the Critical Path.
4. The activity times in PERT are proceeded by the beta allocation, with the difference of the project presumed to be of the same amount of the differences along the Critical Path.

(Avraham et al., 2005)

3.1.7- Inheritance of site conditions:

Inheritance of site conditions is passed along the construction hierarchy starting from the client reaching to raw material suppliers. Since clients are driven by market demand their projects requirements may vary during the project execution period making them impose changes on the consultant engineers hence on the complete project hierarchy. If these site conditions were to lead to poor productivity, the subcontractor has no choice but to reduce project resources till site conditions improve. Site conditions control resource allocation choices of subcontractors, creating a complex interaction between site conditions, capacity allocation, costs, and schedule performance.

In some situation improvement of site condition might be radical in a short period of time causing delays in other trades consequently dragging project completion date and increasing claimed variations due to lack of needed resources.

Furusaka and Endo (1990) argued that uncertainty controls general and sub contractor's judgments throughout project procedure till accomplishment of their targets. It is further argued that, subcontractors are significant entities of project organizations, who demand achievement of needed coordination levels in the project supply chain management to determine characteristics of the construction system.

To achieve balance among project parties Winch (2001) used transaction rate economics and argued that multiple transactions during the structure of a project lifecycle require to be ruled firmly to deliver value to customers.

Value is delivered through ruling of vertical and horizontal transactions. Vertical transactions are summarized in direct contact to the client i.e. consultant, project manager and main contractor whereas horizontal is fulfillment of responsibilities towards the client (Campagnac et al., 2002).

According to Reeves (2002) Project conditions are set by general contractors, controlling vertical and horizontal transactions, specially the supply chain of subcontractors unless demanded by customer or a complicated project, general

contractors seek horizontal external ruling other than traditional contracting techniques.

3.1.8- Unawareness of the management based approach strategies and dominance of change:

The management of a construction company is thought to be “management of change, coping with changes in the environment and making adjustments to its strategy, diversifying as necessary, modifying...operations, altering its methods of employment of manpower, updating its approach to managers, changing its organizational structure and making constant adjustments to its financial and pricing policies. It is argued that given level of risk related to construction activities and volatile environment in which they function strategic planning should have been sustained by construction companies” (Betts and Ofori, 1992).

In a UK construction industry study it is noted that “the greater use of sub-contractors has caused not only changes in the estimating process but has also had an effect on the nature of site management. The changes show the flexibility and resilience of an industry that is more often than not criticized for its resistance to change’ activity variances, shortage of skilled manpower, construction low productivity, identification of markets and poor continuous development are indicators that construction industry lags behind other industries in systematic strategic planning” (Abdel-Razek and Mccaffer, 1987).

Although Management-based project organizations demand technical and organizational coordination between various trades and benefits are only realized through achieving close coordination between construction managers, management contractor i.e. consultant and specialists. Construction managers and management contractors still believe that only a framework has to be provided to specialists since it is their responsibility to identify further details of work programs and troubleshoot faced difficulties. Yet it is realized that although not many people knew strategic

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planning and many companies never record their strategies, they speak about strategy excitedly when asked about it. It is noticed that the combination of a general work frame and vague inheritance of site conditions by specialists leaves them unable to plan their resources efficiently intimidating project success.

3.2. Planning effect on competitive advantage and performance:

Considering cost of resources is important since it relates project costs to overall firm performance. ‘Despite the open bidding system which forms the basis of many construction markets, cost leadership is the only strategic approach used for construction, or for which there is scope for application, especially in recent times’. (Tatum, 1988)

Porter (1985) stated that strategic competitiveness enables organizations to measure their strategic targets by either setting industry wide approaches or identifying industry segments. The second approach is preferred considering money value i.e. comparing relative cost to customer product perception. This analysis led to the three generic competitive strategies of product differentiation; overall cost leadership and product focus as figure 10 shows:

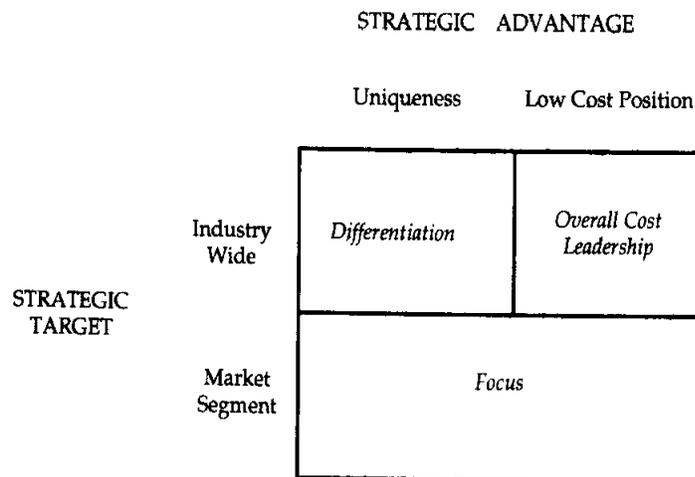


Figure 10: the three generic competitive strategies (Porter, 1985)

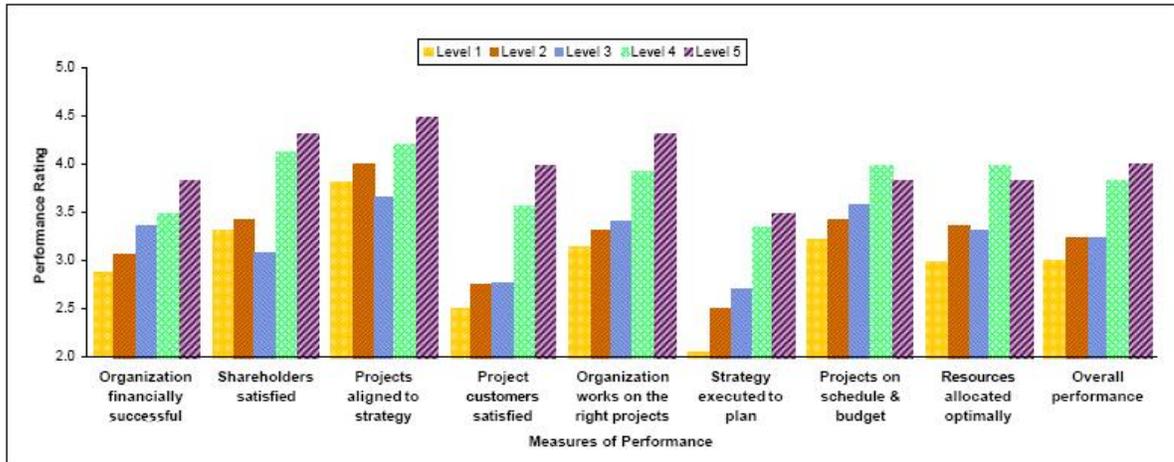
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Due to emerging markets interest in quality and money value identified strategies relevant to the construction industry have increased making corporate planners of various industries follow these approaches towards achieving successful strategic planning.

The three generic competitive strategies have clear applications for many type of construction enterprise. But, one could ask what product differentiation means to a contracting company which does no design, and provide one-off projects to clients' demands. The answer must be that the enterprise should take a critical look at its strategic position in relation to markets and competitors and consider whether one or other of the generic strategies should be followed. Is it the best strategy to simply aim for cost leadership for one-off projects? Are circumstances appropriate for the company to start offering design or other services or looking for alternate relationships with clients other than one-off construction services? These are the ways in which this and the other strategic planning techniques contribute, by making us change our view of construction strategy to meet the new business climate rather than dismissing new techniques because they fail to fit with traditional ways in which construction does business.

3.3. Summary of literature review:

A correlation between organizational performance and resource management can be noticed as companies tend to perform better when they are able to manage their resource more wisely figure 11 explains this correlation:



(Figure 11: performance to resource management correlation) (Cbp, 2009)

Referring to the dissertation objectives it is noticed that selected literature in chapter two mainly focused on fulfilling the examination of various approaches to resource leveling and their advantages. It was noticed that planning techniques such as CPM and PERT are still being used as standalone planning tools but with an understanding that such tools do not possess the ability to plan resources of complex problems. Therefore planners have integrated heuristic approaches which have the capability to solve large planning problems using specialized software such as Primavera which is built upon a minimum slack first priority rule which has proven to be best in implementing resource leveling.

Two types of resource planning were identified, time constrained and resource constrained planning upon which planners have to set a criteria of either fixing time and assigning resources to achieve set time or identify available resources and allocate activities based on them affecting the overall project duration.

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The opportunity cost related to such decisions has to involve project stake holders delivering project priorities since all contracts tend to be resource and time constrained in real life projects.

Further, advantages of leveling have been identified emphasizing the overall effect on project and organizational performance. It is noticed that a direct relationship of cost and human retention can be identified greatly affecting organizational profitability and competitiveness.

In chapter three various challenges to planning have been identified (see figure 12):

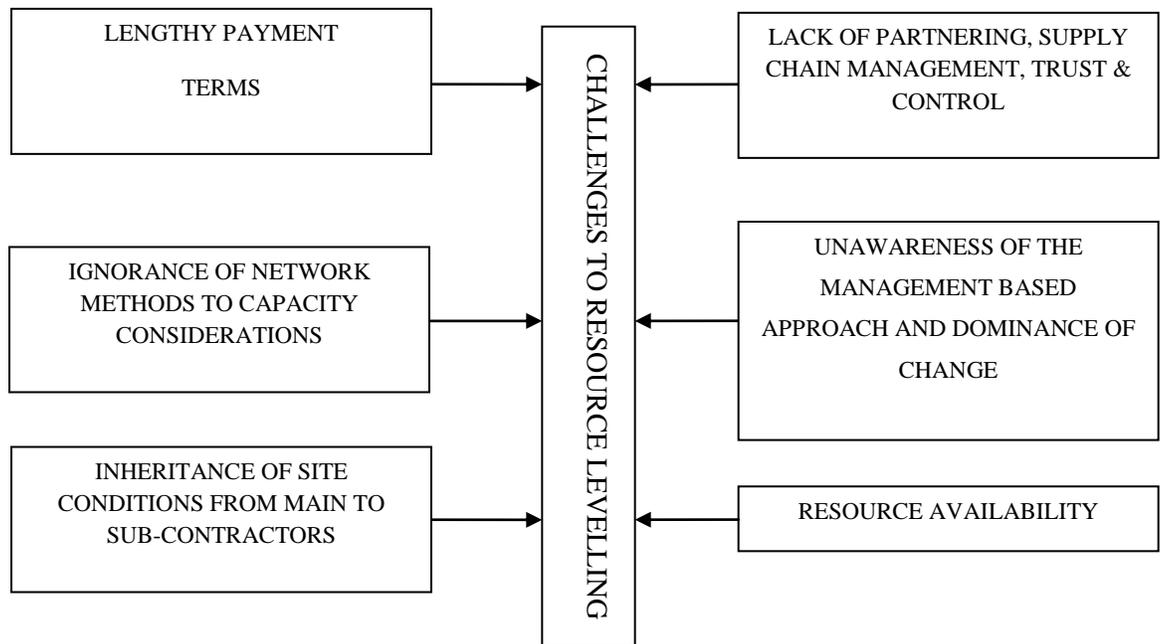


Figure 12: Challenges to leveling

Providing a stepping stone to evaluating contractors and subcontractor's ability to implement proper planning methods to overcome associated losses of not planning

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and estimate the effect on such implementations on the overall organizational performance, competitiveness and profitability.

It is believed that project nature and organizational structure are key issues in the implementation of planning and resource management.

Chapter 4

RESEARCH METHODS

This chapter begins by explaining why is the selected research method considered to be best in this situation and then evolves into identifying the dissertation sample, case study questions and the methods followed to answer these questions.

4.1- Research Method:

This section aims at answering previously mentioned research questions in chapter one explaining how answers are obtained. An attempt to define the distinctiveness of qualitative research from quantitative research is problematic (Silverman 1993). However outcome achieved from qualitative approaches can be identified in comparison to quantitative results. Distinctions between quantitative and qualitative methods can be summarized in table 4:

Quantitative data	Qualitative data
Based on meanings derived from numbers	Based on meanings expressed through words
Collection results in numerical and standardized data	Collection results in non-standardized data requiring classification into categories
Analysis conducted through the use of diagrams and statistics	Analysis conducted through the use of conceptualization

(Table 4: Distinction between quantitative and qualitative data)

Dey (1993); Healy and Rawlinson (1994); Saunders et al. (2003)

The main aim of qualitative objectives is to gain insights on people's ideas towards various issues. In such a method views, understandings and opinions are gathered and investigated. It may be that the collection is unstructured, but the content is considered to be rich and detailed. Since the process of filtering such data is considered laborious researchers might question the objectivity of such a method (Fellows and Liu 2008).

Given that the research sample aims at dealing with planning departments and managers who tend to control project progress and overall organizational strategies

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through evaluating overviews. A qualitative method can better illustrate their understanding of issues such as planning effect on performance, competitiveness and profitability. Therefore the case study approach is selected to be used in an effort towards achieving the research aims and objectives since it is also believed that it adds strength, novelty and empirical evidence (Eisenhardt, 1989).

The study sample is formed from three UAE based contractors. Planning departments and top management were targeted to enable view actual implemented planning steps and understand top management awareness of the importance of planning and resource management effect on performance, competitiveness and profitability.

Selected organizations are currently executing projects mainly in the emirate of Dubai fulfilling selected criteria of scale and structure:

- 1- Two Large scale companies with a minimum yearly project turnover of one hundred fifty million and above, classified as large by DCCI.
- 2- One Medium scale companies with a maximum yearly project turnover of one hundred fifty million, Classified as medium by DCCI.

These organizations where selected due to fulfilling preset criteria in terms of departmental structure, yearly turnover and DCCI classification.

4.2- Case Study Questions:

The case study questions shall cover the following issues in each organization as stated in the selected research sample.

At the Project and Planning Department Level:

- a. Explore awareness of leveling techniques
- b. Identify barriers to resource leveling
- c. Investigate solutions to overcome resource leveling barriers
- d. Identify advantages of leveling models

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- e. Examine the consequences of projects shifting from time-constrained to resource-constrained projects due to the current financial crisis.

Department heads and General Management Level:

- f. Examine the effect of planning on corporate performance and competitiveness.
- g. Evaluate seniors opinions on proper planning and its importance
- h. Investigate the impact of the current economic crisis on the company
- i. Examine the consequence of the company changing its emphasis at project level

These issues will fulfill the purpose, aims and objectives of the study.

Questions 1, 2 and 3 cover capacities a, b, c, d and e:

- 1- Explain the resource leveling techniques used for your projects and comment on their effectiveness.
 - a. Do you believe that contractual violations or procurement methods might cause problems to planning? What are some of those problems?
 - b. The following challenges to planning have been identified in theory please explain to what extent do you agree with identified challenges and why?
 - Lengthy payment terms
 - Resource availability
 - Ignorance of network methods
 - Inheritance of site conditions
 - Problems in partnering, supply chain management, trust and control
 - Management style and change
 - c. What are some methods to overcome such challenges?

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- 2- How do you plan and manage your project resources?
 - a. What are some of the used planning methods in your organization?
 - b. Which resource leveling (smoothing) model is used to manage your project resources?
 - c. Please identify resource leveling advantages, and how can they be used to overcome the financial crisis?
- 3- In what way the planning of your project have changed due to the financial crisis?
 - a. Projects are of two natures either resource or time limited, in your opinion what would be the current dominant project nature? And why?
 - b. If a change in project nature is applicable how did you manage to shift in nature? And what are the new implemented strategies?

Questions 4 and 5 cover capacities f, g, h and i:

- 4- Can you explain how your company decides on the approach and method of planning a particular project?
 - a. How such an approach helped you achieve better results at project and corporate levels?
 - b. Does planning affect your pricing strategies or do you depend on execution strategies to enhance competition?
- 5- Embracing quality and the delivery of unique work, reducing prices as much as possible i.e. cost leadership and focusing on certain project types are three generic competitive strategies used by organizations to set their strategic plans. In what way did the financial crisis affect your planning approaches and techniques for ongoing projects and new projects?

In order to answer these questions a number of steps have been carried out.

The first step was conducting interviews with two planning engineers, one project manager and the general manager from each organization. In addition, where

necessary, the research has examined documents, company reports and corporate websites.

As noticed, two interview papers one containing two questions and the other three were used, in which the first paper was used to interview department heads and general managers covering capacities a, b, c and d . As for the second set of questions it was used to interview project managers and planning engineers covering capacities e, f, g, h and i.

Secondly an analysis of collected data will be used to support in research identified issues and evidence to what extent the theoretical framework for the research is a reflection of the dynamics of planning the case studies. The sample represents contractors whom are known to be of large and medium scale based on the Dubai Chamber of Commerce classification criteria. The research conducted interviews with senior personnel from another 3 companies to expand on issues that emerged during the case studies. Furthermore data will be used to generate solutions to overcome identified resource planning and leveling challenges. Lastly a suggestion of future research proposals will be made.

Chapter 5

DATA COLLECTION

This chapter summarizes data collected through conducted interviews and provides a stepping stone to the next chapter that deals with analyzing this data.

5. Data Collection:

5.1- Case study one:

Company (A) overview:

The herein examined organization is a contracting company established on 1975 in Dubai-UAE with a license to build an unlimited number of stories as per the UAE government rules and regulations. Unprecedented growth throughout 35 years of operation resulted in branches spread across the U.A.E and Amman-Jordan. Together with its industrial arm comprising of carpentry, joinery and concrete pre-cast, they are at the forefront of the construction industry.

Currently 1.2 billion UAE Dhs annual turnover is being achieved including the industrial arm in turnover. The current employment is at 7,000 employees. The organization aims at maintaining an array of professional talent, along with needed resources to successfully complete even the most complex projects. With an extensive network of labor, material and equipment and its expertise encompassing general building, turnkey projects, structural, finishing, electrical, air conditioning, plumbing, external and all other related works.

As this research targeted sample comprises of general managers, planning engineers and project managers as previously mentioned, it has been identified that a total number of seven planning engineers, fifteen project managers and three department heads were available to serve the company's total turnover.

5.1-1. The Research Process:

A total number of three interviews were performed where each interview required an approximate period of 90 minutes. The first interview was conducted with department head of planning. Whereas the second one was with the operations manager, and the third was with the company's general manager. All interviewees consent that planning directly impact performance, profitability and competitiveness. They further raised their concerns comparing previous project planning strategies to currently used strategies under the current financial crisis. Some of the major points discussed were the change in ongoing projects type from time and resource constrained to become budget constrained, validity of time constraint on future projects to enable clients benefit from current resources price fall, the effect of planning on performance and profitability, resource leveling techniques used, challenges to planning and the approach in overcoming the financial crisis.

According to all three these have affected the long-term organizational strategies significantly.

First interview:

Examine the consequence of the company changing its emphasis at project level:

For example the company's general manager took this opportunity to state that the current situation of the financial crisis is healthy in the long run of his organization since he believes that what was happening during the construction boom was unreasonable, he further state the "now is a good time for resource filtration". Whereas other interviewees coming from a different mindset disagreed by giving examples that harsh decisions have to made in order to maintain the company's endurance. Hence being under financial pressure has caused loss of quality, time and profitability i.e. increase in cost.

Evaluating senior's opinions on proper planning and its importance:

The general manager commented on projects planning methods by dividing them into two main stages. First is tender stage and second is after contract. He stated that the company has followed a standard approach in selecting a project to participate in. Starting with the receipt of an invitation from various clients a project is quoted only if it is within the company's specialization; resources needed to execute the job are available or can be made available, expected contract value has to be large enough i.e. not less than fifty million UAE dirham, to cover the companies overhead enabling it to be competitive, project duration must be clear to enable the company study the project cash flow and compare it to preset company expenses. Finally calculate material prices as per provided bills of quantity and design drawings to have an initial price. If set criteria is achieved the project goes into the bidding and negotiation stage, where budgets and project duration are discussed and agreed upon. He further mentioned that both re-measurable and lump-sum contracts have to go through the planning department for activity checking prior to agreeing on any final negotiations.

Investigate the impact of the current economic crisis on the company:

He further stated that during the construction boom a gamble has always been taken by contractors to enhance competitiveness considering that a certain amount of discount can be recovered through achieving special material rates from suppliers. In case of not achieving these discounts losses were covered from the high profit margins secured in contracts. Under the current economic crisis "such gambles are no longer an option and all projects will be entertained" he stated.

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Examine the effect of planning on corporate performance and competitiveness:

Due to his belief that now is the time to tailor organizations to fit available projects and not vice versa, he continued “being aggressive is how we need to be with our pricing strategies in order to secure the largest market share i.e. cost leadership is our current main focus”. The after contract stage is transferring secured projects to the execution and planning departments who become responsible for the project. It is noticed that extensive planning is done prior to securing any project in order to enhance competitiveness and performance. He further stated that current projects did shift in type to become neither time nor resource constrained but budget constrained. As mentioned earlier all three interviewees agreed that projects have to be properly planned to achieve required competitiveness, performance and profitability i.e. success.

Second interview:

The planning department head and the operations department head were joined in one meeting in an attempt to generate a detailed negotiation session.

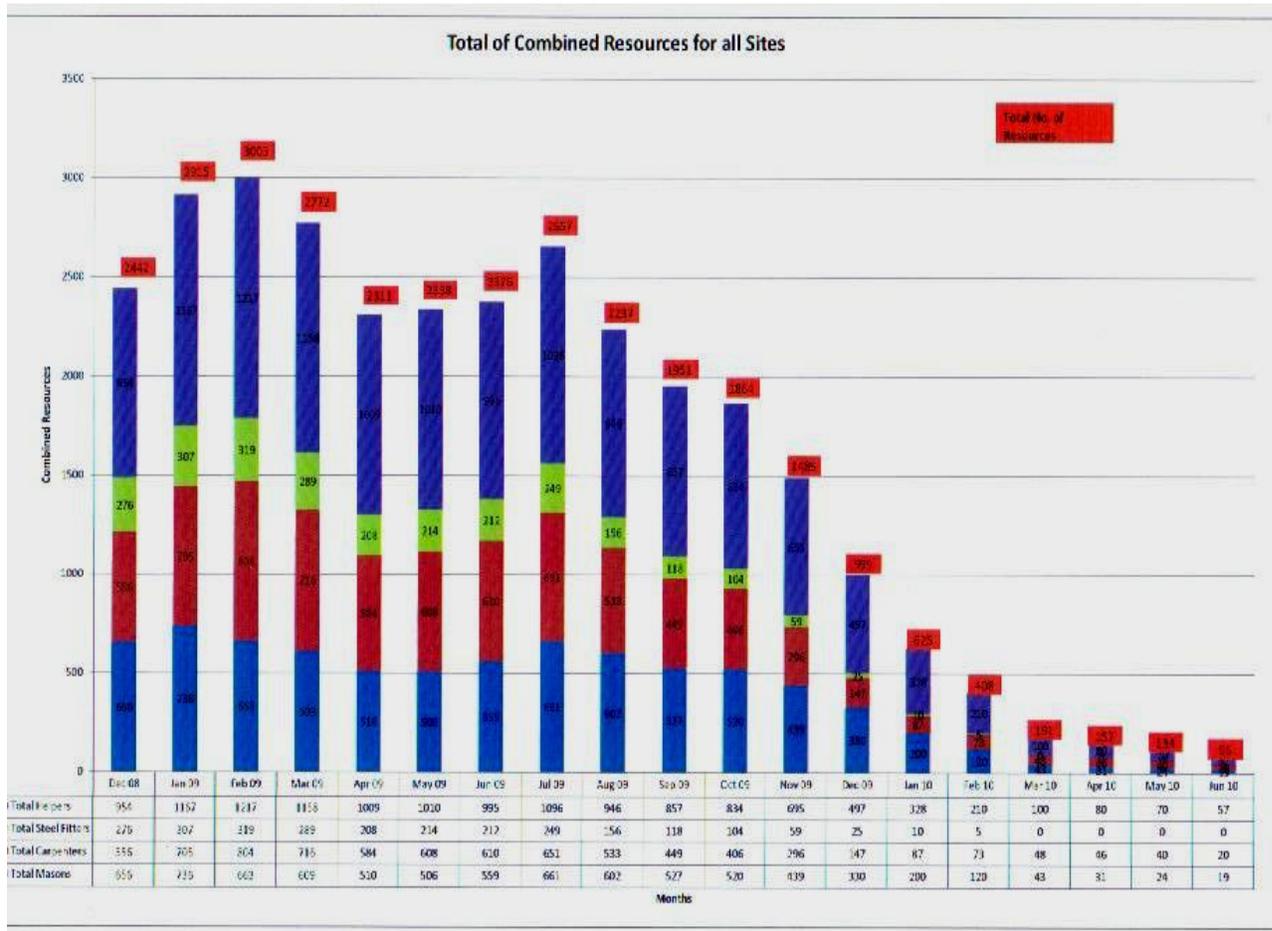
Explore awareness of leveling techniques:

Through that heuristics used were identified as the used resource leveling method in the organization. It was further discussed that although heuristics requires computing power and time it is still the most preferred solution to project managers and planning departments. Primavera and RAY (in-house developed software) were the selected software being used to establish work programs and activity resource loading. The planning section head stated that resources are assigned to activities based on preset durations generated on assumptions of expected activity durations. Amendments to resource loading has to be repeated until needed results are achieved through the

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manipulation of available slack and float within activities durations based on a minimum slack first priority rule. This scenario uses the available slack in activities pushing them to become critical and then starts utilizing available slack of other activities. This procedure is repetitive using primavera till achieving designated outcome.

They further stated that after the assignment of any new project to the execution and planning departments a histogram showing the resource allocation of each project is prepared showing needed resources quantity and type over assigned project duration. Afterwards a combined histogram is prepared illustrating the overall organizational resource demand. (See figure 13)(Appendix I, II)



(Figure 13: Combined resources) (n.a, 2010)

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Identify advantages of leveling models:

It was also agreed that resource leveling has a direct relationship to project costs enhancing their competitiveness and profitability among other advantages such as:

- Less management attention is required
- Increasing staff morale
- Saving the cost of learning
- Operating at peak
- Enhanced overall organizational strategic planning
- Better view of future projects

Combining that with resource control it reduces the company's overhead and increase profitability. For example company overheads can be controlled through planning project time and resources. If a resource such as labour and staff were properly assigned to activities it will be neither over allocated nor under allocated making the project hierarchy built as required. Such an issue was seen in some of these projects.

(See figure 14)

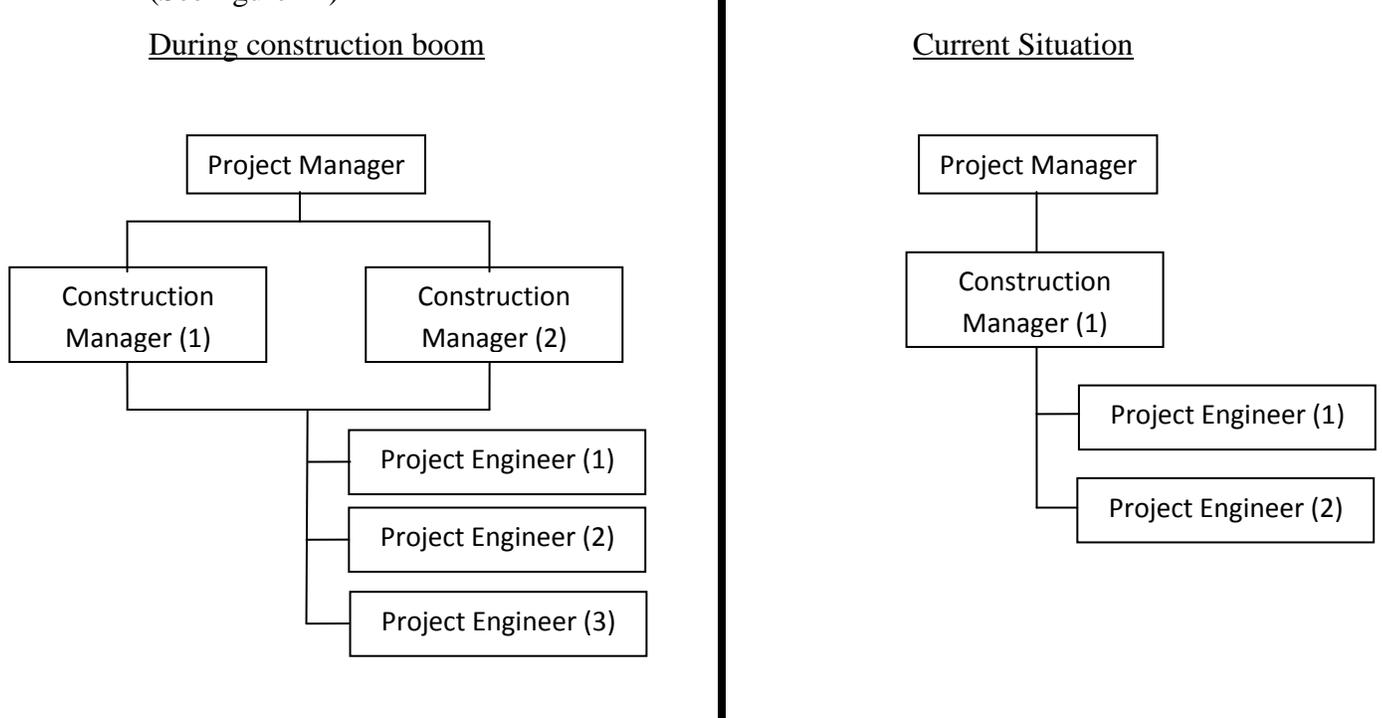


Figure 14: Projects hierarchy)

Examine the consequence of projects shifting from time-constrained to resource constrained due to the current financial crisis:

This process of restructuring project hierarchies to reduce cost has been implemented to accommodate the change in project types to budget constraint. The Planning department head stated that they currently have some projects where they were asked to achieve a fixed monthly amount of work done and shall not exceed that even if the project time extends significantly. The only way they found most suitable was to reduce their supervisory staff and labour consequently reducing facilities needed and their machinery costs, likewise acted their specialized departments to accommodate the changes in project type.

Identify barriers to resource leveling:

Challenges to leveling have been afterwards discussed showing that lengthy payment terms, resources availability, and ignorance of network methods were the main three reasons hindering planning. Starting with old planning methods used the planning department head stated that the company used to plan projects based on time isolating material resource demand which is considered a drawback in project planning. It is also agreed that late payment has the most important effect due to supply chain demand. In addition companies require cash to train and develop needed work force in order to expand its market share. As for resource availability it has a direct impact on individual project activities consequently delaying the overall project duration given that the activity is on the critical path. This also relates to human retention and recruitment of suitable experiences needed during the construction boom. It has been agreed that such situations are permanent in boom and crisis but a change in the importance of the time factor and high risks associated to procured contracts is noticeable.

Investigate solutions to overcome resource leveling barriers:

Both interviewees agreed that good communication and transparency between project stakeholders is very important to overcome any planning problems and achieve project objectives.

5.2- Case study two:

Company (B) Overview:

The second organization is a UAE based contracting company established in 1975 which has completed projects including but not limited to; High Rise Developments, Hotels and Hotel Interiors, Residential Complexes, Office Blocks, Commercial and Industrial Projects, Major Airport Developments, Stadiums, Infrastructure and Drainage works, Offshore Oil and Gas Installations, Residential Complexes, including the largest communities in Dubai.

With a current workforce in excess of 52,000 people and a backlog in excess of \$7.7 Billion (28.2 Billion UAE Dirham's) in booked work, it is clearly considered the leading contracting company in the UAE, and one of the top five in the GCC. In the past few years the company diversified geographically and started working in other countries such as Qatar, Jordan, Syria, Pakistan and St. Petersburg in Russia, and most recently in Saudi Arabia. Some of their projects are considered to be most prestigious worldwide. Because of their commitment to providing high quality work, on-time and within budget, they have preserved a healthy client base which continues to grow and repeatedly awarding them with work. Their Plant Department's fleet is amongst the largest in the area, with the latest construction equipment backed up by highly qualified and professional teams who continuously monitor service and maintain this equipment. Stringent Health and Safety regimes are followed in addition to the Quality and Environment procedures. The ISO 9001:2000; Quality Management System (QMS), ISO 14001:2004; Environmental Management System (EMS), and OHSAS 8001:2007; Occupational Health & Safety Management System was granted as a proof to high standards and management commitment. It is believed that they are one of the very few construction companies in the region whom are fully certified in all three areas.

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As this research target sample comprises of planning engineers, project managers and department heads, it has been identified that an approximate number of 10 planning engineers, 35 project managers and 20 department heads i.e. project director are available to serve the company's total turnover.

5.2-1. The research Process:

First interview:

The process started by meeting the acting general manager who is also the chief financial officer (CFO) where major issues such as planning effect on competitiveness, performance and profitability in addition to discussing the current project drivers under the current financial crisis and how did it directly influence the company's operational decisions and strategic decisions.

Evaluate senior's opinions on proper planning and its importance:

Due to the company being publicly listed the planning aspect was found to be based on the company's financial plans. Hence the project value and availability of financial resources were the main drivers of planning and executing projects. The CFO strongly agreed that pre tendering planning and pre project planning are the basis upon which the company depends in selecting bidding projects. He further stated that due to the company's financial strength and experience no project was hard to implement and finance, on the contrary the company has benefited from every project it got through the proper disposal of resources and wise buy or rent decisions. For example in many of the projects a decision was made to build a dedicated batch plant that would serve the project and any geographically neighboring project even to various clients. Such an agreement with project developers and owners gave the company the ability to share profits with their clients establishing a long term relationship based on mutual benefits. Here it can be seen that the company's policy is not only to focus on the gained benefit from the main contract but also on the investment opportunities at the project macro level.

Investigate the impact of the current economic crisis on the company:

He further stated that since we were only specialized in commercial and residential buildings a project was only quoted for if it fits into the company's sector in addition to other aspects such as client mentality and work professionalism also the project cash flow. Nowadays the criteria have changed putting the project scale i.e. expected contract value and available banking finance on top of the list as a selection criteria.

Examine the consequence of the company changing its emphasis on the project level:

With regard to the current financial crisis effect on project nature, projects were divided into two main categories. First is ongoing projects and the second is new projects. Since most of the clients started asking us to hold and delay their projects due to shortage in cash and high risk in returns on investments we were left with no other choice but to accept compensation of our actual costs on cancelled projects and await resumption of delayed ones. Actual costs were accepted since we believed that time and money spent in law suits will cause loss of other opportunities and might damage relationships with the largest client base in the country. As for new projects we believe that projects are still to be classified as time constrained since the cost of construction has drastically dropped giving us and our new clients an edge to achieve cost leadership as our new strategy.

Examine the effect of planning on corporate performance and competitiveness:

Although it is believed that time is the main project driver, effective implementation of resource leveling was our main concern in adjusting our company expenses to fit the market situation. Due to the firm being public in nature we were able to expand to international markets but with an aim to execute iconic projects following our typical inception strategy of building reputation and then gaining profit. Focus was the main strategy followed in expanding the company's market share which is no longer an option in the local market. Consequently we were able to tackle our expenses through

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a series of expansions to avoid layoffs and cost of human retention. Although during the boom and crisis finding needed resources was not an issue but the quality of gained human resources effected performance, quality and profitability. As mentioned earlier we did avoid laying off any of our staff members to ensure the retention of knowledge through the retention of human capital. At the same time we leveled our resources through controlled expansion to other markets to keep our employees busy. The leveling was made based on a planning tool developed by our planning department that basically depends on optimal solutions.

Second interview:

The second interview included the projects manager, planning section head and planning engineer. The Leveling techniques and their advantages, barriers to resource leveling and how to overcome those barriers, and the change in project type were the main issues tackled in this meeting.

Explore awareness of leveling techniques:

All three interviewees concurred that resource leveling is not heavily used in practice. They further elaborated that the company policy mainly depends on leveling human resources since they believe that knowledge loss is the costliest loss. After a project is assigned to the planning department a detailed work breakdown structure is made available to enable the allocation of human resources to the awarded project. The process is done for each project individually depending on a heuristics approach using minimum slack first as a priority rule. This heuristic among others is embedded in the used project planning software i.e. Primavera. Since our projects activities usually range between 2000 and 4500 activities we find that constraining time and allocating human resources based upon that result in more realistic solutions to resource leveling. The reason is that even if projects were delayed due to shortage of funds or new projects durations are longer than needed, costs related to resources and cash flow will depend on the project expected time to complete. After human resources are

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allocated the project plan is shifted to the concerned project manager. The project manager starts allocating needed materials such as fixing and long lead items across the project duration taking each activity into consideration. These materials are allocated based on activity type and allocated human resource through feeding needed resource into the same project planning software tool used by the planning department. Using the same heuristic a repetitive process is adapted by the software till achieving most optimal solution. At this stage an initial project plan is made ready and returned to the assigned project planning engineer who is responsible for communicating daily, weekly and monthly update of the work programs to the planning department who works closely with him to maintain a realistic project plan. Based on these updates related project costs are monitored closely in addition to enabling the use of tools such as the delay analysis (see appendix III). After individual projects are planned and various resources are allocated the planning department establishes an overall human resource allocation plan that combines all projects. The main aspect this method should achieve is based upon information received from the financial department which has to set a certain limit of productivity to ensure that cash flow covers the company's running cost.

As for the current market situation this company needs to ensure that an average number of 27,000 laborers are kept busy to cover their overhead.

Identify barriers to resource leveling and solutions to overcome such challenges:

During project execution the project macro environment directly effects project planning. Since the company cash flow depends on project inflows a delayed payment will directly affect the project plan and extend the project completion time. In addition to that the sudden consequence of such delays stops the organization from implementing its resource development plans for example training employees on specific jobs such as underwater welding and the cost of job rotation to avoid stoppage of any work front. On the other hand if the delay in payment was properly communicated to the contractor ahead of time it would enable us cooperate and

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reassign our resource in a fashion that fits the new project situation. This can affect the project duration but it costs more not to communicate such information. In practice no client or developer would communicate such information. They always try to relate a late payment either to unacceptable reasons such as the authorized signatory is out of station or we are waiting for a new cheque book or even communicate that the payment will be ready in a couple of days whereas it takes weeks and maybe months to arrive. Such non contractual behavior affects the plan drastically and the overall company operation.

They further added that other challenges to planning have been faced which are attributed to the micro and macro project environment. At early planning stages the planning department used Gantt charts and critical path methods without taking into consideration the importance of resource allocation and leveling. Since projects are initially planned in ideal situations we believe that CPM as a standalone method does not operate to the best interest of the project since it takes only the time aspect into consideration and disregards resources if not assigned by the planning department. Referring to trust and control it is noted that during the construction boom the level of trust had a direct relation to control. Therefore we were able to reduce our costs by exercising less control on trusted specialty contractors. We knew that such arrangement could induce misuse of resources and lower project quality but yet it was done because resources were needed to be used somewhere else to cover the shortage of other projects.

Examine the consequence of projects shifting from time-constrained to resource constrained projects due to the current financial crisis:

In the current situation we are left with no choice but to control every activity since our profit margins became drastically lower or even diminished. Looking at the macro environment a general saying would be “an unclear project scope and specification leads to delay”. Site conditions are inherited from the client or developer and travel through project levels till reaching the bottom of the hierarchy.

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Consequently each party deals with the change in conditions in various ways leading to various outcomes that cause project conflict and problems in SCM therefore project delay.

In the current market situation our planning methods have not changed but a more aggressive approach is being implemented to ensure that no extra costs are being incurred due overseen aspects of any project.

5.3- Case study three:

Company (C) Overview:

The third organization is an MEP contracting company founded, in the Emirate of Dubai in January 1995. Pursuing a policy of planned expansion two branches were established one at the emirate of Sharjah and another in the emirate of Fujairah in the year 1998.

A fully equipped workshop and storage facility was opened at Sharjah in 1996 to meet continuous needs of the increasing workload. In September 2000, a new trading section to support its MEP contracting business was established to trade with specialty doors, environmental engineering and fire insulating materials representing principal suppliers from USA, Europe and the GCC countries.

Due to the relentless efforts of Management and staff for innovation and quality, a quantitative leap took place in 1998 where the turnover rate exceeded 50% growth since its beginning of operations in 1995.

In January 2005 a remarkable increase in the company turnover was achieved and all resources were geared to complete more than 50 Million Dhs worth of MEP Works, which included hospitals, substations and high rise buildings.

As part of its dedication to quality, a committee qualified their quality management system for the ISO 9001: 2000 certification on 12th November 2002.

The organization is considered to be of medium scale due to achieving an annual turnover of 80 million and employing almost 500 employees located in Dubai, United Arab Emirates. As this research target sample comprises of planning engineers, project managers and department heads, it has been identified that a total number of 1 planning engineer, 4 project managers and 1 department head i.e. project director are available to serve the company's total turnover.

5.3-1. The research process:

In this company a total number of two interviews were conducted due to the projects manager being on leave in that period. The interviewees were the general manager and the planning engineer.

First interview:

Evaluate senior's opinions on proper planning and its importance:

The general manager started by mentioning that the approach of planning a particular project is governed by the following aspects:

- Evaluation of the project parties (client, Consultant and developers) depending on either previous experience or questioning the market competitors.
- The job volume and construction period to meet our resources.
- The type of the project whether commercial, residential or industrial.

If those aspects were found to be favorable we start by collecting initial material prices from our suppliers after a quick revision of the project scope and design. In some cases we find that the project design is not suitable since we are operating in a specialized field. If found feasible we compile a price based on our suppliers feedback and estimate labour as a percentage of total material price since we have the experience and knowledge of the activities needed to execute any project in our scope.

The nature of the job differs only in sophistication depending on the structural design of the building and the purpose of its use but the type of skilled labors needed do not differ and their number (needed resources) can be assumed depending on activity size and experience.

The process of inviting material quotes helps us provide realistic budgets to our clients giving us more chances to secure new jobs. It also makes us more competitive.

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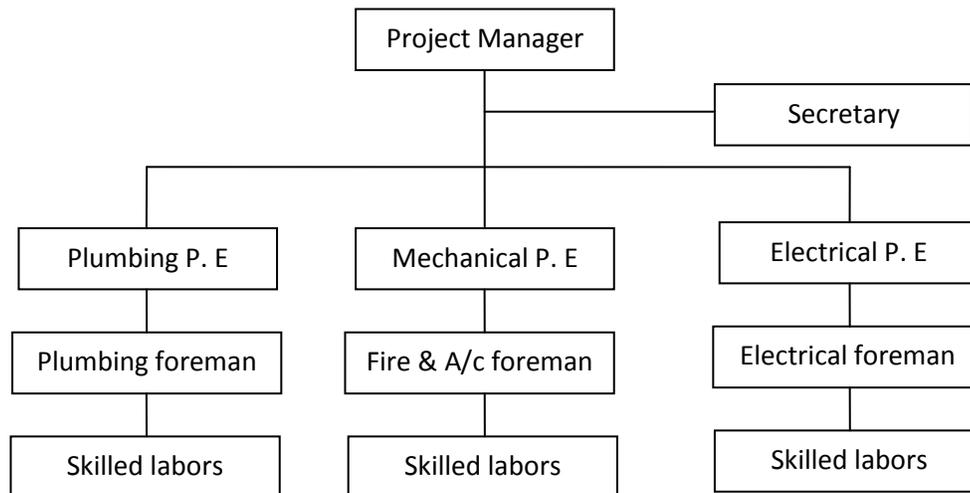
At this company size and due to job enlargement we have an edge over our competitors since our overheads are considerably lower than others which reflect on our pricing and planning strategies.

Investigate the impact of the current economic crisis and examine the consequence of the company changing its emphasis at project level:

During the construction boom we were able to maintain our working staff with an increase in labour only although our turnover has exceeded the double in comparison to previous years enabling us to retain our staff during the current financial crisis which will be available to welcome the next construction boom. It is also worth mentioning that we were less affected than others in terms of layoffs and reduction in remuneration. In regard to our planning method it evolves through fulfillment of the following issues:

- Finalize material prices with suppliers and set lead delivery periods of major items
- Establish a work program based on the main contractor given work program
- Prepare the work histogram
- Prepare the cash flow curve (revenue/time)
- Arrange additional human resources needed to meet the project target
- Issue execution drawings and purchase orders for equipment, material and specialized services

He added that additional resources are arranged based upon experience only using general rules of thumb. For example, based on experience it is assumed that a contract worth a million Dhs requires 25 laborers and staff is estimated as project preliminaries. The following figure (see figure 15) explains a standard project preliminaries.



(Figure 15: Standard project hierarchy)

The approach followed helped the organization in reducing risk factors, management intervention, cost of study and preparation of tenders, and achieve successful results in project targets.

Although no resource leveling technique is currently followed we do implement international accounting standards in preparation of our balance sheets which demands preparation of cost to complete estimates which generally give us an idea how long are we still going to be occupied and when do we require additional resources to fulfill our obligations.

The current market situation left our projects unplanned to a certain extent due to the fact that our clients were heavily affected by the financial crisis. On the other hand we did not have any major changes in our available resources but we lost the job enlargement culture which might cost us later on if we are to work under pressure once again.

Examine the effect of planning on corporate performance and competitiveness:

Currently we consider that differentiation is considered a lost luxury due to projects being standard in nature and little if no development in technologies related to our scope of works. As for focus and cost leadership both are considered to have major

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effect on our strategies. Focus is considered since competition seem to be less noticed in high specialty projects and cost leadership is the current new driver of the market since budgets seem to have gained higher importance than time and quality.

Second interview:

Since the project manager was out of station a particular project has been taken into consideration in this case study to discuss with the planning engineer in an attempt to identify issues such as embedded resource leveling models and their advantages, challenges to planning and how to overcome these challenges and lastly examine the new project drivers if any. The project considered consisted of a basement, commercial ground + 3 podium, residential ground + 21 tower 1 and residential ground + 25 tower 2. The MEP contractor scope of work consists of supplying and installing all MEP services within the building and maintaining those services for one year after the initial handing over of the project. The project contract value was 59 million UAE Dhs rating it to be of medium scale. The project execution period was set at 16 months and a total number of 200 employees including 170 laborers and 30 staff workers of who were fully dedicated to the project.

Explore awareness of leveling techniques:

The responsible planning engineer started by explaining the implemented planning method. He started from tendering reaching to project award and contract signature where he stated that a work program is always an integral part of all our contracts upon which we build our internal work programs which are usually in line with the main contractor's program of works.

He further stated that the current representation used in illustrating a specialized contractor scope of work is an empty block on a Gantt chart that represents only the main contractor activities upon which our program is prepared with a breakdown of

The effect of planning and resource leveling on UAE contractors

all major activities listed but without any planning of needed materials. Taking DEC towers into consideration in this project the planning method has slightly changed since the received program of works was made using primavera. Our planning department neither had needed experiences nor the software to prepare such a program therefore all programs were prepared using our excel software. After our first program submission to the main contractor it was rejected because he was not able to integrate the same program into his own, unless all activities were reprogrammed once again. Consequently the company management decided to include the new system. Although Primavera was used the only purpose it served was identical to the use of our regular planning tool which is based on excel i.e. rather than planning activity durations using excel, durations got planned using primavera.

Materials were delivered and planned based on material requisitions issued from the site engineers to fulfill actual work needs and urgent needs which always puts us in trouble with our purchasing department because everything seems to be an urgent site need.

Referring to the last statement he stressed that such problems only occur with day to day material requirements but not with long lead items. Long lead items are based on known times set by the main contractors and the contract. In order to achieve proper delivery of long lead items the following issues have to be satisfied:

- Design of major requirements must be made clear and available by the consultant
- On site access and storing facility has to be made available upon arrival of equipment
- Payment by the main contractor has to be done on time
- Authorities approvals have to be obtained prior to placing any orders

He further stated that their contracts are divided into 70% material and 30% labor. The material percentage is further divided into 80% long lead items and 20% fixing equipment and accessories.

Identify advantages of leveling models:

He further agreed that it is very important to manage the company resources and materials. During the execution of the DEC towers an adjacent job was awarded to the company which gave them a great advantage of shifting their laborers upon need between projects to achieve resource leveling.

When asked about resource leveling it was found that no proper technique is being used in planning the movement of resources from one project to another since there is no update from the sites to the planning department upon changes in scope of work or time schedules.

Identify barriers to resource leveling:

A consensus was made that there are a number of planning challenges faced by specialized contractors and those challenges seem to grow the lower we move in the construction hierarchy. Starting with a clear conformity that lengthy payment terms is considered to have a direct negative impact on planning. Some of the challenges faced by this particular contractor were observed to be different in nature since it was mentioned that 90% of the company turnover is related to one of the partners who took share in complementing and developing companies to broaden his company's market share.

Examine the consequence of projects shifting from time-constrained to resource constrained due to the current financial crisis:

Under the current financial crisis our planning techniques have not changed but our internal methods of logistics have become more stringent and issues such as clarity and contractual rights are being aggressively enforced by us to ensure that our resources are being used in the right place and in the right form. Unfortunately the

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current financial crisis drove each company of these to hold payments against its partner company to save its own cash flow putting its partners in hardship. As such partnering has been classified herein as a barrier to planning due to the direct relationship between lengthy payment terms and planning.

It is further noted that in the DEC towers the client selected a different method of control. The project got awarded to partially owned companies by him. Due to the government laws he was obliged to appoint a project consultant, the client complied with these rules through appointing a consultancy façade through renting a consultants trade license against an agreed fee. This arrangement was found best to the client due to the following:

- Expected financial returns are higher than planned
- Less control is needed due to contractors being considered partners
- Workmanship quality is expected to be at a high standard due to partnership.

Taking this into consideration and comparing it to the actual site conditions the planning engineer stated that none of the client's expectations were fulfilled. He claimed that it is a fact that contractors aim at maximizing their profits in the absence of control through altering designs. "They do not deliver unworkable systems but they might compromise on quality".

Taking mentioned points into consideration it is seen that the issue of trust and control have evolved as a barrier to planning.

Investigate solutions to overcome resource leveling barriers:

When asked about overcoming these problems he chose DEC towers as an example where he stated that during the project execution we found that the initial project plan was void prior to our access to the site and this can be seen in our program of works that the contract start date and the project completion date vary by one month only. This has been repeatedly raised to the client with a request to adjust the project plan but the client did not respond to avoid delay claims by the contractors. This

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unrealistic program drove the project to major delays extending the project completion date by 16 months and delay claims by contractors in excess of 25% from the project value.

Looking at this example it is noticed that the client and contractors would have been better off if a realistic program was made available and updated to suite the project requirements. Proper communication and understanding of contractual rights are the main two issues that the construction market misses.

Based on the current projects in hand we found that time and quality lost their importance in comparison to budgets. Since we have not been awarded any new projects yet I am only able to state through personal experience that time will always be of importance because it makes sense to execute projects in recession time where everybody is trying to be competitive and material prices are low.

Chapter 6

Data Analysis

This chapter discusses and explains understandings from gathered information in the previous chapter with an aim to reach towards a final conclusion and achieve the research objectives.

6- Introduction:

Data collection was commenced with an aim to cover two issues in each case study. The first issue is exploring awareness of leveling techniques. This included identifying barriers to resource leveling, how to overcome these barriers in addition to discussing various leveling advantages and the shift in projects type due to the current financial crisis. Second, identify planning effect on organizational performance and competitiveness. This included investigating management opinion on planning importance and how it would affect their projects and organizations in the current financial crisis.

6.1- Case study one

The effect of resource leveling on project planning

In this case study two organizational levels have been assessed explaining the organizational structure and to what extent does resource leveling effect the organization. A heuristics approach was found to be used in this organization through the use of adequate planning software such as Primavera and RAY. As noticed through the interview CPM is identified at the beginning of each project after establishing an extensive work breakdown structure to which resources are allocated and combined with other projects. The assignment of resources of each individual schedule is afterwards combined to identify the overall organizational resource requirement. The minimum slack first priority rule is integrated into the leveling procedure to level resources using primavera as their internal leveling tool. As a result an average of five hundred laborers has to be maintained in order to cover the company overheads. As seen the identification of human resources has been the main concern of the planning department since materials needed in construction are well known to contractors. Still the issue of material planning is considered to organize the supply chain in order to ensure continuous work for set working average and maintain efficient use of deployed resources. Therefore the company herein established its own software tool based on the same priority rule to control and level material resources. RAY is a resource planning software used in planning and assigning resources to projects. It essentially works based on the same priority rule as Primavera and has the same programming language. RAY is used by the cost control department whom responsibility is to estimate, assign and track material requirements from project inception up to completion. Whether it is renewable, non-renewable or a doubly constrained resource it is the cost control department job to decide upon the way of use, period granted and costs associated. For example the cost control department decides upon buy or rent procedures of major equipment and whether they are feasible or not. Another important fact is maintaining a database tracking material

The effect of planning and resource leveling on UAE contractors

prices used as input to the tendering process enhancing competitiveness. In addition to that, profit making opportunities embedded in buy or rent decisions can be shown to management supporting their price gamble as mentioned in the case study.

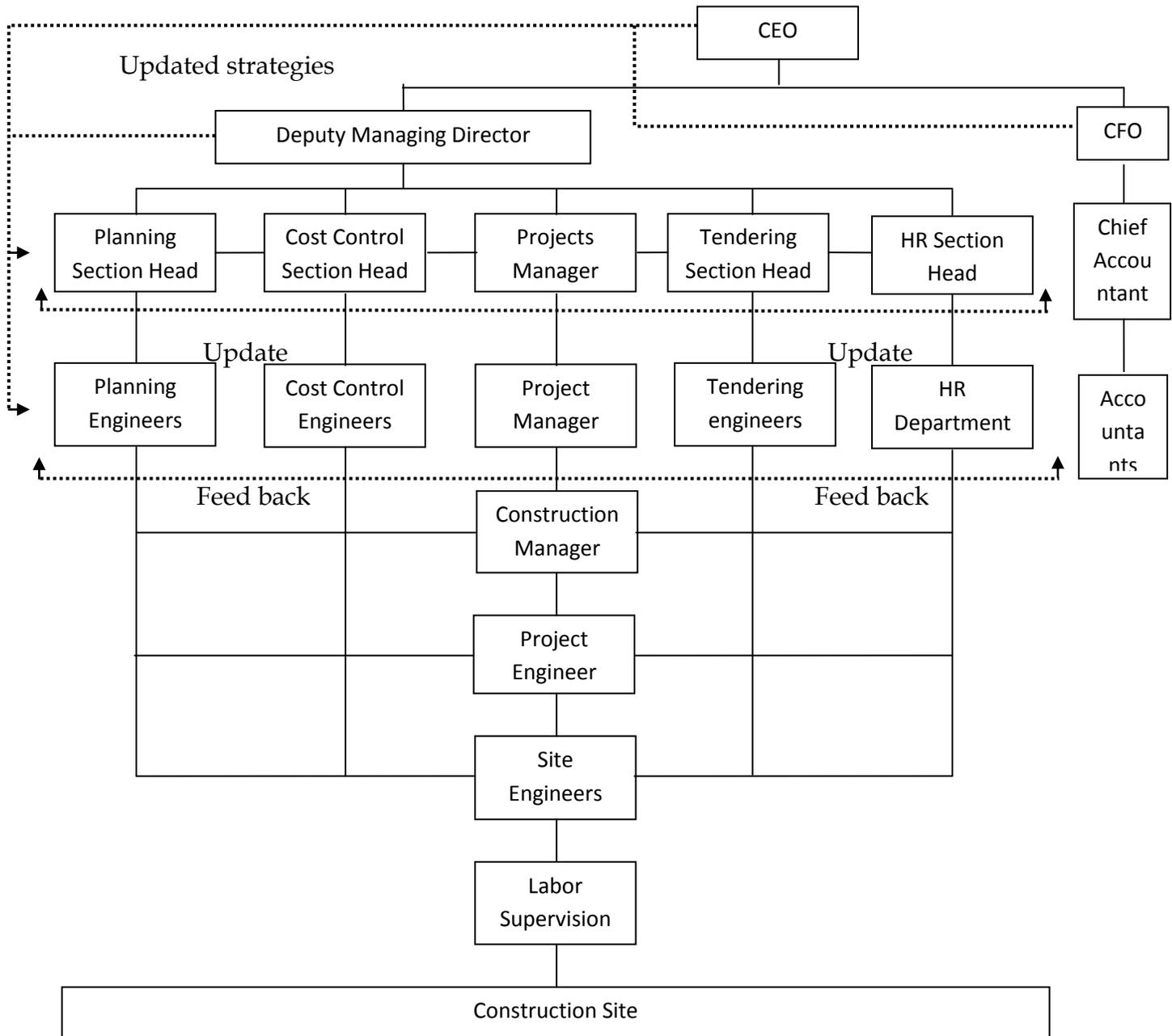
The management awareness of planning and leveling effect on performance, profitability and competitiveness in addition to their understanding of previous and current project types and their overall effect on organizational strategies led to the establishment of a proper organizational structure.

Although all interviewees agreed to planning challenges such as long payment terms, inheritance of site conditions and supply chain management it is seen in this case study that the organization was able to overcome those challenges through the establishment of specialized departments, ensuring proper information flow between them and transparency to their clients.

Starting at the project level it is seen that a plan is set initially in an ideal scenario clearly showing the demand of needed resources for each individual project. Given the management commitment and site engineer's reports being sent to the planning and cost control departments to update and communicate the individual projects changes an overall strategy can be continuously updated resulting in an enhanced communication of changes to various departments for future decisions i.e. based on the updated plan all departments such as human resources, finance, purchase and management set their work strategies and priorities.

The effect of planning and resource leveling on UAE contractors

The following diagram explains the established organizational structure (see figure 16):



(Figure 16: Organizational structure)

The effect of planning and resource leveling on UAE contractors

For example the HR department uses the staff and labor histograms to identify shortages and surpluses in human resources and when do they require amendments giving them the edge over other recruitment competitors of recruiting needed skills and experiences prior to them.

As a result the following advantages can be achieved:

- Higher experiences at lower remuneration rates can be achieved
- Enhancing the overall organizational profitability and competitiveness
- Lower involvement of top management in taking project decisions
- New entrants bring new ideas enhancing overall competitiveness
- Reduction of errors
- People morale is increased
- Reduction of problems such as payroll

On a different scale the purchase department can also benefit from resource leveling as follows:

- The PM can make the resource available when needed
- Can make the supplier provide constant amounts and arrange for back up supplier if needed
- Just-in-time inventory policy can be adapted saving inventory costs

Taking mentioned advantages into consideration enhances the management ability to become more aggressive in securing larger market share and maximizing their profits especially in times such as the current financial crisis.

Identify planning effect on organizational performance, profitability and competitiveness

As seen from above discussion planning has a vital role in setting organizational strategies and achieving set goals Tatum, (1988) state ‘ Despite the open bidding system which forms the basis of many construction markets, cost leadership is the

The effect of planning and resource leveling on UAE contractors

only strategic approach used for construction, or for which there is scope for application'. In our case study Tatum suggestion of cost leadership has been agreed upon in the current financial crisis due to the fact that supply (available contractors) have exceeded demand (available projects) leaving clients in a stronger position to bargain and reduce their project costs i.e. projects dearth. Opposed to being selective in projects the management decided to tailor their organization to suite the current construction market.

The following measures have been taken to achieve the same:

- Reduction in project hierarchies through job enlargement
- Implementation of new technologies to reduce the cost of error
- Lower overheads through geographical reallocation of rented assets

Taking those into consideration it is seen that the organization has reduced its costs to secure a sufficient market share.

During the construction boom it was claimed that the organization did not aim at cost leadership to secure projects on the contrary they chose to be selective in projects taking into consideration the mentioned project selection criteria. This course of action seems to contradict with Tatum's theory. In fact it further enhances Tatum's theory, the latter is that clients whether during boom or crisis always aim at achieving lowest price keeping in mind a certain level of quality setting the competition level, but due to shortage in contractors during the boom period contractors were able increase their profit margins leaving the clients with no choice but to accept the new pricing level. For example, based on a quick market survey and my personal experience it is shown that during the construction boom the price per square foot is around 1900 UAE dirham's whereas it dropped now to 1200 UAE dirham's for the same construction. Such an example shows that company overheads and the cost of materials dropped giving the contractor the possibility to reduce his prices and further intrinsically pursue a cost leadership strategy giving him a competitive advantage over other contractors.

The effect of planning and resource leveling on UAE contractors

Controlling the organizational micro environment to suit the current financial crisis is a key point in achieving success. Such control can be planned for using proper planning strategies on projects which can be summarized in proper implementation of resource leveling strategies.

The basis of an agreement has been achieved, that planning does have an impact on performance, profitability and competitiveness, which tend to set the organizational strategies.

6.2- Case study two

The effect of resource leveling on project planning

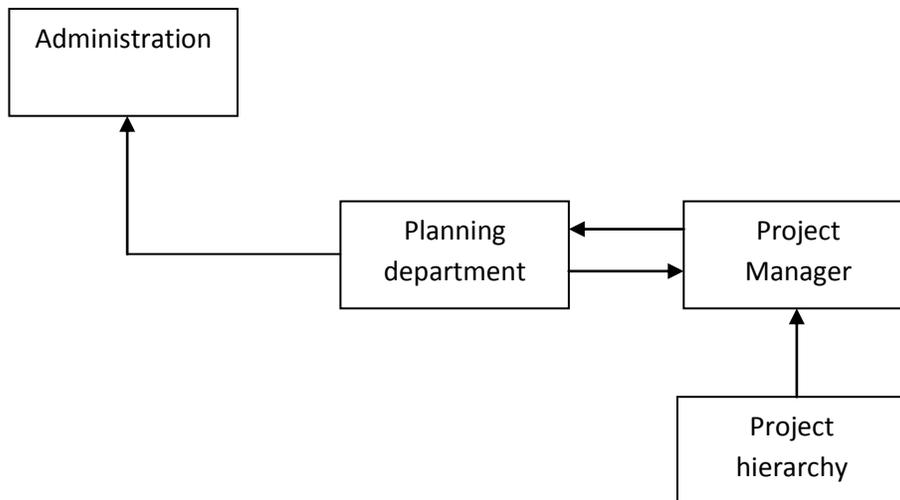
In this case study the advantage of maintaining human capital is the company's main concern, i.e. human retention, is the core of used planning methods. It is noticed that resource planning was implemented with an aim to level human resources rather than materials. It is seen that the planning procedure was done in a two tiers. The first tier is done in the head office by the planning department where financial and project plans are combined to achieve human resource requirements of projects and assign those resources based on a time constrained planning method. This approach has been adapted due to the company being public in nature and its need to hand over projects on time.

As noticed a minimum slack first priority rule has been used as the basis to plan activities and assign human resources. The second tier is implemented at the project level which constitutes of leveling material resources taking all project activities into consideration. Based on a unified leveling strategy the project manager uses the minimum slack first priority rule to level needed material resources. An update of those plans is communicated with the planning department to maintain a realistic plan. Looking at the structure of the planning department it is seen that the material leveling process is only implemented by each project manager individually and updated by him leading the project plan to the following drawbacks:

- The project manager is too busy to plan all activities
- Small items are not considered in the leveling process assuming they are not significant
- The purchase department might not be able to properly forecast project costs due to unclear requirements
- Data loss through improper communication due to various paradigms

The effect of planning and resource leveling on UAE contractors

Looking at the departmental structure of the organization it is found that the current communication hierarchy led to mentioned drawbacks. The following graph illustrates the information flow hierarchy (see figure 17):

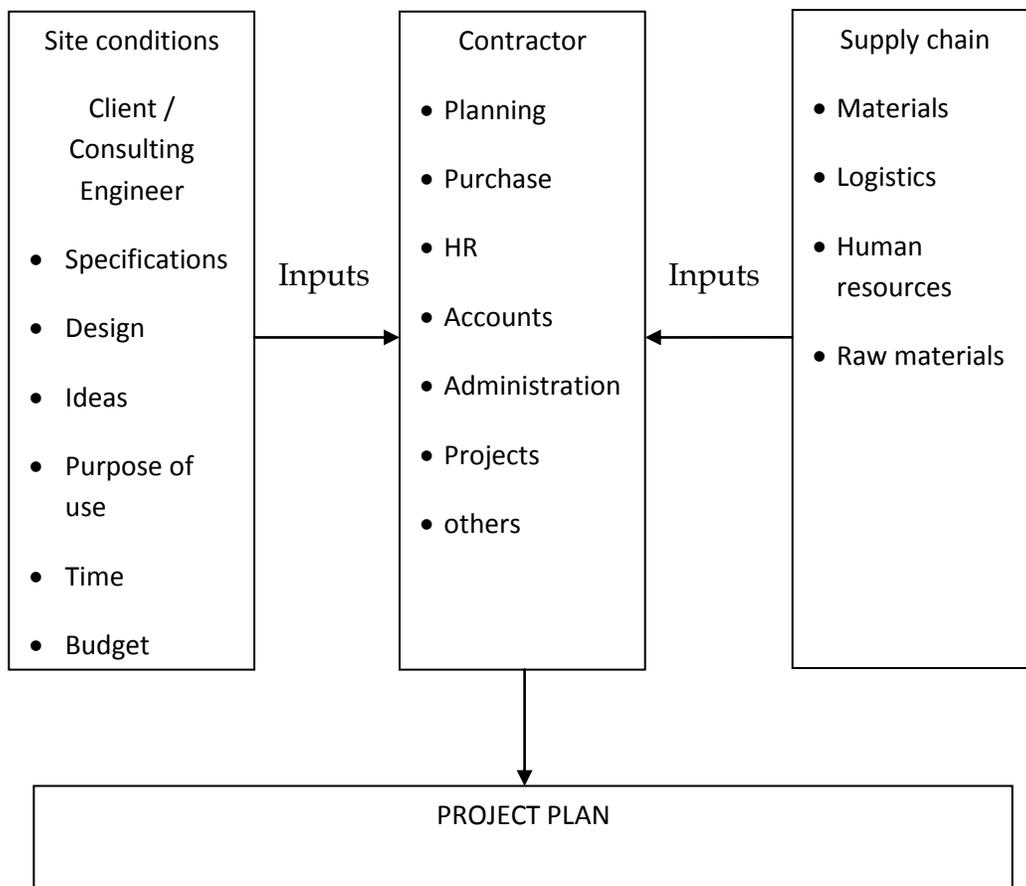


(Figure 17: information flow hierarchy)

Although required advantage of human retention is achieved the incurred cost due to none leveling materials is derived from obliging the company to acquire materials based on priority. Consequently this forces buying decisions to be made in small quantities resulting in bearing additional material prices and a cut down in profits. Looking into planning challenges a consensus has been achieved that lengthy payment term is considered one of the most affecting factors to a project plan. As mentioned in the case study the company cash flow depends on projects inflows therefore if a project payment is delayed the company would be obliged to delay payment to the projects staff. This situation contradicts with the company's goal of human retention and human development therefore the planning department would immediately reallocate human resources expediting works in other work fronts to cover any cash deficit. Also the mentioned shift would induce additional costs of logistics to transfer people from one project to another. A further identified challenge

The effect of planning and resource leveling on UAE contractors

is trust and control. As noticed an indirect relationship between trust and control has been identified during the construction boom. This relationship lowers morale and increases opportunism. Under the current financial crisis the situation changed putting all parties under stringent control. A further challenge is supply chain management and inheritance of site conditions. The herein identified challenges seem to be related in practice since both are considered at the organization macro level and affect the project plan. The following graph explains the same (see figure 18):



(Figure 18: Macro affect on project plan)

Identifying planning effect on organizational performance, profitability and competitiveness

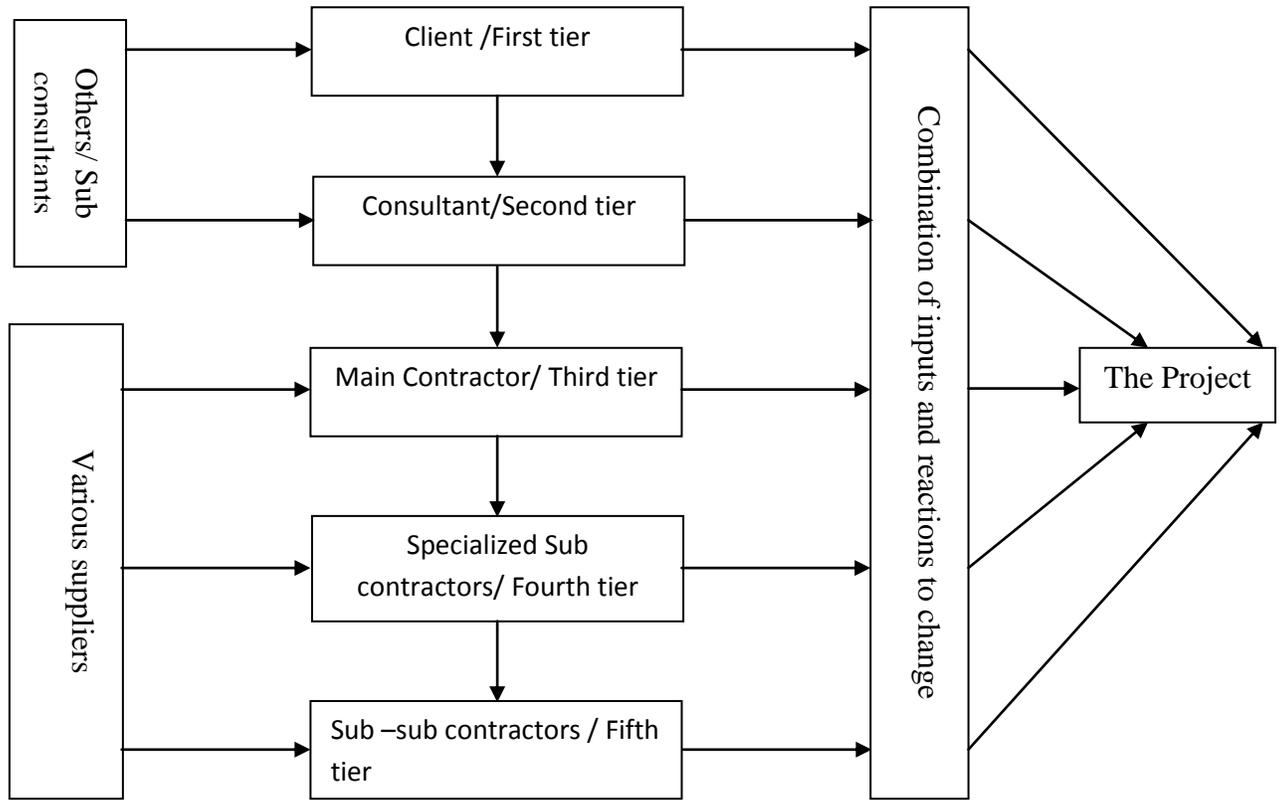
The interviewee utterly agrees that planning a project does enhance overall performance, competitiveness and profitability. Taking the company financial abilities due to being publicly held gave the organization the ability to compete where others could not. Considering Porters (1985) generic strategies it is seen that the organization has set its strategic target to be market segmented and focus as its competitive strategy. Taking the CFO's statement 'No project is hard to finance or execute' support the position of their strategy. Combining such financial ability, clear strategy and planning results in a very strong organization. Due to a centralized human resource leveling strategy and an individualized material control strategy drawbacks mentioned in the earlier section were realized, but not affecting competitiveness as opposed to other aspects like performance and profitability. For example, in such a large working environment a laborer being idle for a day or two due to shortage of an unplanned material requirement could not be noticed at all or maybe will by the end of the project. Such idle time could have been used in benefit of the project hence the organization. The instance may be small in its entirety but the repetition of such an action in various projects will result in losses of performance and profitability.

Human capital planning and the possessed financial ability are the main enablers resulting in international expansion of the organization to other markets. Pursuing the same competitive strategy in new markets can be seen only as a long-term plan that the company has since the financial crisis is not local but global. Currently retaining human capital at the same level of remuneration would be considered impractical unless similar profit margins are assured. Combining macro opportunities is added value that the company has practiced to enhance their profits and maintain their client base. Such an arrangement was not found to be done by any other contractor which is considered to be tempting to clients and advantageous to them.

6.3- Case study three

The effect of resource leveling on project planning

In this case the contractor understudy is considered to be of higher specialization which places him lower on the project hierarchy. The following figure explains the herein understudy project hierarchy and information flow: (see figure 19)



(Figure 19: Project hierarchy and information flow)

Looking at above figure it is noticed that inheritance of site conditions and planning have an indirect relationship i.e. the contractor ability to plan a project and maintain a realistic plan seem to enhance if ranked at the highest level of the project hierarchy where changes are made by him rather than followed by him.

Looking at the selected project plan (see appendix VI) it clearly shows that resource leveling was not entertained. All activities were planned to fit into the master work program which has been prepared by the main contractor. Any additions or omissions

The effect of planning and resource leveling on UAE contractors

to scope of work must be entertained into the work program with an aim to achieve the same within the original project period if possible. Changes to program usually flow starting from the client, as shown in figure 17, till reaching desired contractor, where change initiators will increase the more we move towards the bottom of the hierarchy.

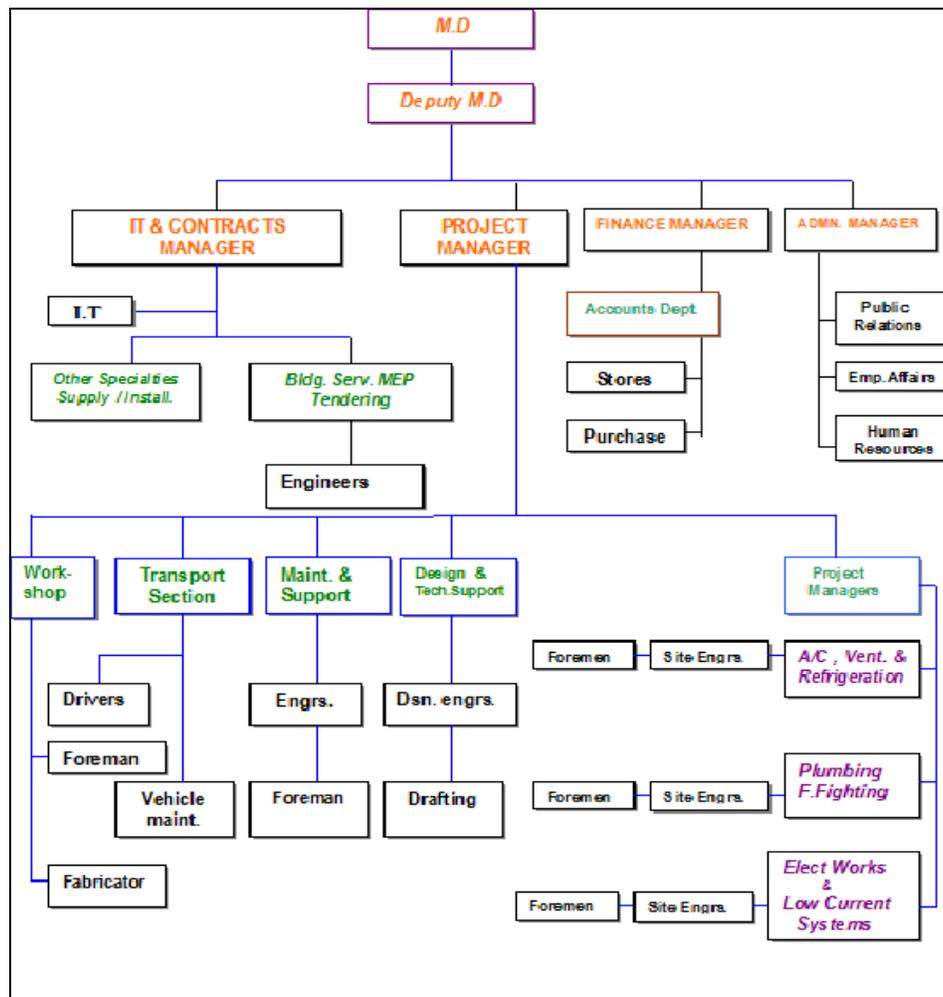
As seen from followed method an improvisatory approach based on experience is the base of project needs and expectations. Given the company macro environment affect on projects, it enforces continuous change disabling the contractor from placing any planning systems to control such a volatile environment. Considering heuristic resource leveling based on a minimum slack first priority rule as the most suitable approach to construction being a subcontractor is rather about strategic planning and the management of change.

Observations on current strategies due to the financial crisis could not be made due to the fact that no changes were noticed in the used planning method.

Identifying planning effect on organizational performance, profitability and competitiveness

It was noticed that the general manager agrees with the fact that planning is considered important to enhance overall organizational performance, profitability and competitiveness but looking at the opportunity cost related to each one of those the required organizational structure may not be feasible considering project value and scope of work. It is expected due to strong inheritance that daily updates and alterations to plans have to be made and followed to maintain a realistic plan. The following graph illustrates the organizational structure (see figure 20):

The effect of planning and resource leveling on UAE contractors



(Figure 20: Organizational structure)

As noticed a planning department does not exist in its entirety. It is embedded within the projects and finance departments. As attributed to feasibility reasons mentioned the management of change is considered to be here in the costliest. As (Betts and Ofori, 1992) state ‘ management of change, coping with changes in the environment and making adjustments to its strategy, diversifying as necessary, modifying operations, altering its method of employment of manpower, updating its approach to managers, changing its organizational structure and making constant adjustments to its financial and pricing policies ’ is how to manage a contracting company. Taking this into consideration supports the fact that establishing a new organizational structure to suite those needs will not be in favor of the organization at this level of

The effect of planning and resource leveling on UAE contractors

turnover. Looking at the situation it is noticed that the company management style is rather improvisatory. Based on the affect attributed to inheriting site conditions being a fourth tier contractor made the organization in need to base its decisions on personal experience of the general manager (Long term decisions) and project managers (short term decisions). Such improvisatory approach might lead to the following drawbacks:

- Over or under allocation of resources
- The student syndrome
- On spot purchase of materials to execute activities ahead of plan
- Demoralize workforce
- Establish a non healthy project environment and changing working hours
- Increase risk margins within pricing to avoid unforeseen delays
- Lower competitiveness

Since no proper resource planning tool is identified the management aimed at maintaining a shortage in human resources and implement a shifting strategy to avoid execution delays based on rules of thumb. Hence the management aimed at securing geographically neighboring projects to lower logistics costs (shifting costs). The selected method is known to be criticized by loss of performance due to resistance to change. Although the scope of work is similar, the working environment will change from one project to another.

As for associated advantages, maintaining resources at this level aided the organization during the current financial crisis through enabling them to reduce their turn over without a need to layoff any of their employees resulting in higher morale and enthusiasm.

6.4- Discussion:

In an attempt to categorize analyzed data a brief comparison will be made between companies A, B and C that shows the response to investigated issues.

Effect of resource leveling on project planning:

Company (A) has through its organizational structure proven that resource leveling is being implemented with heavy emphasis towards harvesting advantages related to such practice. The establishment of in house software to tackle resource allocation, leveling and control is interpreted through management commitment to a clear control system that reflects the organizational policy in terms of implementing an aggressive strategy. Company (B) did not fully share the same idea towards resource leveling in which they tailored the system to deal with human resources given that the financial structure of the organization is much stronger making them rely on human retention rather than using time and effort on controlling materials controllable by individual project managers. Implementing such an amended approach enhanced the company's profitability. Given its delicate formation of being public the management sought profit maximization which they have achieved during the boom. Company (C) due to its position on the construction hierarchy the issue of resource leveling was of less concern in comparison to managing change and coping with day to day work fulfilling main contractors and client's requirements.

Identify barriers to resource leveling:

Identified barriers among companies (A) and (B) are considered identical:

- Lengthy payment terms
- Inheritance of site conditions
- Supply chain management

In addition company (B) has identified a further challenge which is trust and control. Given the organizational structure built in companies (A) and (B) it is noticed that

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due to the financial ability of company (B) less interest has been placed in tracking material prices and the issue of leveling these materials due to the fact that construction is repetitive in nature and materials can be used on various projects. As for company (A) cash flow management was of higher importance since they do not have the same privilege. Company (C) deals as well with the same issue but managing change and dominance of the management based approach is an added barrier to the consented list of barriers. This occurred due to the organizational position on the construction hierarchy and the effect of the organizational macro environment and nature of work that pressures company (C) to being a follower rather than an initiator.

How to overcome these barriers:

All three organizations agreed that proper flow of information within department and transparency in client contractor relationship would enhance the contractor's ability to overcome such issues and generate a healthy project environment that achieves set goals and objectives.

Company (A) further stated that the establishment of specialized departments to serve various work packages in terms of planning would ensure a proper information flow between the departments controlling the organizational micro environment.

Resource leveling advantages:

Company (A):

- Lower involvement of top management
- Reduction of errors
- Increase in people morale
- Reduction in problems such as payroll
- Implementation of just in time inventory policy
- Enhancing overall organizational profitability and competitiveness
- Obtain higher experiences at lower remuneration rates

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- New entrants bring in new ideas enhancing competitiveness.

As for company (B) the intended advantage is to retain the human capital which they have clearly achieved through the series of expansions implemented to maintain such worthy capital. Company (C) leveling advantages were not clearly identified due to the fact that company (B) had neither the financial ability nor the needed organizational structure to implement such a method. On the contrary the company has expanded serving projects and fulfilling targets but inefficiently.

Shift in project type due to the current financial crisis:

In response to the shift on project level due to the current financial crisis it is seen that medium scale organizations like company (C) has faced less trouble in adjusting its departments and working strategies. Companies of higher specialization have a different financial model than main contractors. Specialized contractors or subcontractors aim at quoting and implementing projects which are already awarded to a main contractor by his client. This scenario was applicable during the construction boom. Due to the current financial crisis has driven main contractors to establish their own specialized departments to gain additional profits and enhance competitiveness driving in return specialists to use their accumulative experience in finding new solutions to save costs. In general company (C) shift in project type caused a change in the financial model making their project rather budget constrained i.e. resource constrained. As for company (A) the established structure to deal with organizational aspects demands achieving a minimum scale of projects that ensures work load to all employees. The departmental specialization enhanced organizational performance but placed more pressure on the company financials. Due to shortage in funds because of the financial turmoil projects initiated towards the end of the construction boom lost the importance of the time constrain, due to investments macro environment resulting in a change in feasibility studies, and gained on resource constrained i.e. budget constrained consequently obliging such structures to be minimized or even collapse.

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Therefore company (A) chose to reduce its structure and aim at smaller scale projects to adapt to the change in market and project situation. Company (B) faced similar hardships to company (A) but given the financial ability of company (B) a series of expansions were made enabling them to continuo adapted focus strategy in new markets.

Identify planning effect on organizational performance and competitiveness:

Comparing various responses from selected companies it is seen that company (A) has taken an immediate decision to change its competitive strategy to suit the current financial crisis. The change came from the belief that cost leadership will dominate the market given that previously achieved profit margins are no longer achievable. The management provided a further indication that leveling resources enhanced the overall organizational performance through the enhancement of profits. For example' due to proper implementation of resource leveling management involvement in day to day activities was no longer needed giving them more time to concentrate on long term strategies enhancing the organizational opportunities hence profits. Company (B) stated that due to the organizational setup of strong financials, experienced work force and known reputation of owners they were able to compete in the local market pursuing a focus strategy. Looking at the projects executed by company (B) it is noticeable that all executed projects are considered iconic locally and internationally. As for company (C) they based their competitive strength on past experience enabling them to learn using a trial and error approach. Considering the rate of error it is noticed that company (C) have maintained an experienced work force able to take decisions when needed. Though this is possible yet the use of available resources is still insufficient and might lead to time and cost overruns.

Management opinion on planning importance:

All three company's general managers have agreed that planning is considered an essential corner stone to any project and to the organization as a whole.

Chapter 7

Conclusion

This chapter is considered this dissertation end in which it summarizes research outcomes and suggest further areas of study for future topics

7- Conclusion

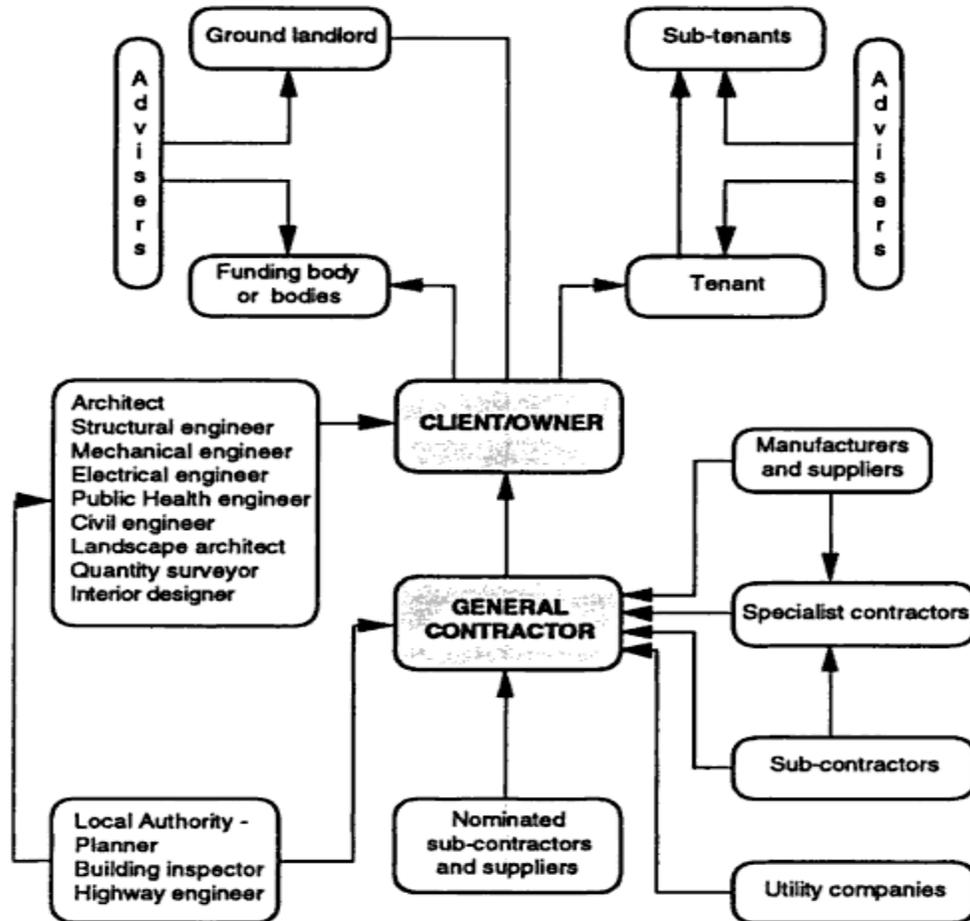
The aim of this research comprises of emphasizing the importance of planning resources, indentifying the most effective planning techniques used during the financial crisis in addition to indentifying and tackling planning challenges for the UAE construction market. It begun with a thorough review of related literature such as resource planning, resource leveling, planning challenges, time constrained project scheduling, resource constrained project scheduling and competitive strategies followed by a case study research to illustrate a more clear idea about related issues and form basis for future researchers.

Despite the large number of studies carried out on the topic of resource planning and different resource planning schemes. It seems that only a few have directly dealt with the UAE local market and was able to gather information based on actual procedures followed within companies. It is noticed that based on gathered information this could form a reliable method to be followed by organizations in setting structures and assessing best practice methods in addition to enhancing reactions to macro and micro project environments.

A total of three case studies have been used based on United Arab Emirates- Dubai construction companies to achieve the project objectives and answer the research questions. As a result the case studies revealed that resource management plays a vital role in setting an organizations competitive strategy which enhances its profitability and competitiveness. They further identified the current used leveling methods and what organizational structures are needed to successfully execute such a strategy. However, it was noticed that a heuristically based approach on minimum slack first priority rule is again identified to be the best leveling technique used as stated by Meredith and Mantel, 2003.

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One of the findings indicates that the lower we get on the construction hierarchy planning seem to diminish. The following graph the relationship in any construction project: (see figure 21)



(Figure 21: involved parties in a construction project)

(Flanagan, 1993)

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Therefore future studies can be implemented in the area of finding best practices for subcontractors project planning and what would be a useful contractual agreement that can force such a work procedure.

Finally, the research aims and objectives have been fulfilled through literature and case studies used. Literature has provided an answer to the first objective and the case studies answered balance research questions.

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Appendix I

Appendix II

Appendix III