

JIMMA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
JIMMA INSTITUTE OF TECHNOLOGY
CIVIL ENGINEERING DEPARTMENT
CONSTRUCTION ENGINEERING AND MANAGEMENT STREAM
MASTER OF ENGINEERING

**EFFECTS OF PRODUCTIVITY AND OVERTIME IN BUILDING
CONSTRUCTION**

By
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ABSTRACT

Construction industry is one of the major sectors contributing for infrastructure development in Ethiopian government; main investor in developing countries allocates a considerable amount of budget. Hence, productivity improvement in this sector will undoubtedly generate lots of benefits for all stakeholders of the country.

The research title came from the problem statement that there is a need to enhance the construction management on productivity rate and overtime schedule.

The researcher found Productivity rate & Overtime in building construction, a serious and an interesting issue. Most of the employees (skilled and unskilled) produce less at a regular working time in order to compensate the time wasted with overtime. They abuse the concept of overtime and they are using it as a means of income which leads the contractor a lot of loss. Therefore reducing the frequency of overtime requires a strong management and monitoring system.

Productivity is a ratio of output per working hours. And overtime is work performed outside the ordinary hours listed in an award or agreement. Productivity and overtime have an inverse relationship. Overtime is usually paid at a higher rate. Overtime is often the best way to impress management (Client) and show contractors dedication to ensuring a project is delivered on time.

Through proper management and satisfactory productivity, in some instance, mandatory overtime is a necessity for a contractor to meet its financial and

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production goals. When this happens, there are pros and cons for the contractor and the employees, depending on the perspective the contractor have on the issue.

Most obvious advantage of overtime for employees is extra income meanwhile the contractor gets benefit of increased levels of productivity and gain more profit On the other hand overtime can cause burnout among staff which means more productivity but at a lesser rate of quality. This also comes at a higher expense to the contractor than the regular rate.

The main observations of this study work have been the fact that one of the common problems in the construction industry is delay. Results indicate that the main causes of delays are related to productivity and overtime

And these causes have an impact on the successful completion of projects at the time and cost contractually specified. The finding suggests that special attention to factors identified in this study will help the industry practitioners in minimizing overtime planning.

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Abbreviations/Acronyms

BaTCoDA =Building and Transport Construction and Design Authority

CPM =Critical Path Method

HRS= Hours

CHAPTER I
INTRODUCTION

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1.1 General

Construction projects are undergoing all over Ethiopia as part of the national development plan. Much of the country's budget (more than 35%) has been spent on the development of basic infrastructure facilities in rural and municipal areas including roads, waterworks and building projects. In spite of this increasing demand of the construction industry, most construction projects usually suffer with the problem of time delay.

One of the common problems in the construction industry is delay. Even though owners and contractors strive to avoid delays in construction and to minimize the time and costs associated with delays, they often find it difficult to control the circumstances causing delays. Delays occur in every construction projects though the magnitude varies considerably from project to project. Some projects are only a few days behind the schedule; some are delayed over a year. The complexity of projects, complicated schedules, poor production and land hair-splitting coordination all contribute to delay [1]. According to Robert Palles, 2002, delay and additional cost in construction projects are an inevitable consequence of the risk and uncertainty associated with the execution of any construction project, which is likely to be unique and prototypical in nature. [2]

From past experience, delays are endemic to construction projects in Ethiopia. The range of delays in percentage encountered in most of the projects is between 100% - 350% of the original contract time. The consequence of delay is increasing construction cost; time extension if

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caused by owner and liquidated damage if caused by the contractor. The other solution of delay is overtime.

Construction project refers to a high value, time bound, and special construction mission with predetermined performance objectives. The construction project objectives are stated in terms of project completion time, budgeted cost and stipulated quality specifications.

1.2 Background of the Problem

Construction projects are time bounded. Each project has predetermined duration with defined beginning and completion time. Therefore projects are pre-established in time, budget, and quality; to maintain these stipulated factors (issues) proper management is required. The project manager should have enough knowledge of modern construction hence s/he can easily forecast the possible obstacles that affect the progress of the project to be completed within the limited time maintaining the required quality. Construction projects may not go smoothly as planned due to uncertainties about events in the future. Delays, which are the major cause of claims, may occur due to poor productivity, unforeseen site condition; increase in scope of work and others [3].

The research focused mainly in Addis Ababa, building constructions in order to have adequate information from Head office and form practical projects. The case study mainly focused on Productivity loss that is experienced when a contractor is not accomplishing its anticipated

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achievable or planned rate of production and is best described as a contractor producing less than its planned output per work hour of input. Thus, the contractor is expending more effort per unit of production than originally planned. Productivity following the schedule plays a great role in time limited construction. Otherwise the contractor obliged to work overtime to compensate the time lost.

Literature says, “Delay is endemic to Ethiopia “[4]. Hence the main goal of the research is to assess productivity and overtime in building construction projects in Ethiopia. The research focuses on projects carried out in the last three years due to time constraints and to focus on current situation.

1.3 Objective of the study

This research tries to address the practice and challenges of productivity and overtime in building construction and recommend possible improvement of production and overtime planning practice.

This case study is undertaken with the following three specific objectives;

1. To explore production rate and overtime technique.
2. To identify the potential challenges of productivity and overtime planning.
3. To recommend on the possible improvement of the production rate and overtime planning practice in the Ethiopian construction industry.

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1.4 Scope and limitation of the study

The scope of this research project is limited to building construction projects in Addis Ababa. Productivity & overtime planning aspects are only of interest and no effort is made to correlate it with resource planning though it has significant contribution for a complete work in this area.

The study begins with review of the important aspect of productivity to minimize overtime planning. It then takes a survey study analysis to identify the practice and challenges of accurate productivity and overtime planning. It further tries to address what has to be done to improve this productivity and overtime planning practice in the industry.

CHAPTER II
RESEARCH METHODOLOGY

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2.1 General

WubishetJakele (2004), Citing Burns (2000) and Komar (1999) stated that a research is a systematic investigation to find answers to a problem; similarly, a research is also a process for collecting, analyzing and interpreting information to provide solution to questions [4]. In line with the definitions, this case study tries to address the following research questions.

- What are the causes of less production rate and overtime planning in building construction?
- What are the challenges of productivity and overtime planning?
- How to reduce the overtime?

For the purpose of this thesis, the research only focuses on the survey study for preliminary data collection.

2.2 Survey Study

The preliminary data for the survey study was collected through a literature review.

- Literature review is done to build a conceptual background on procedures and tools for productivity and overtime planning.

2.3 Analysis and Conclusions

Upon the identification of the real practices and challenges of productivity and overtime using analysis of the project sites and head office

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data, conclusion was forwarded together with recommendations as to how improve productivity in order to minimize the challenges of overtime.

CHAPTER III
LITERATURE REVIEW

Productivity and Overtime

3.1 Introduction

In construction all projects are constraint bound: a project needs to be finished within a given time period, below a specific budget, to a given quality and standard. Thus, for the project to be successful, it has to manage the constraints. The best way for construction managers to handle these constraints is to prepare a thorough plan for the execution of the project.

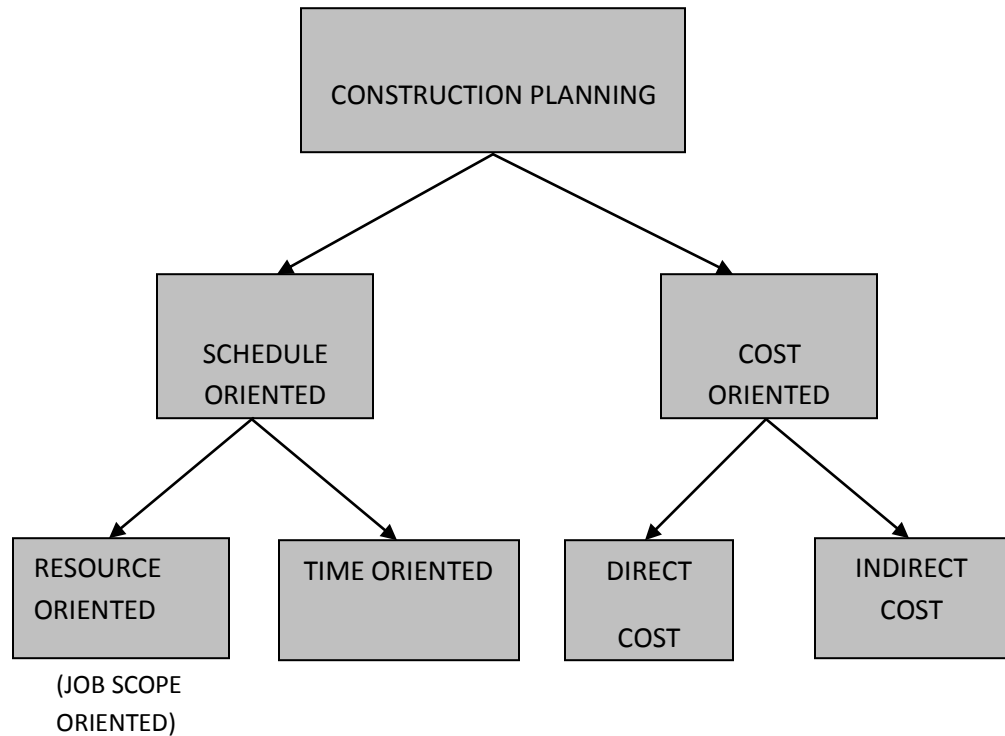
Planning aims at formulation of a time based plan of action for coordinating various activities and resources to achieve specified objectives. It is a fundamental and challenging activity in the management and execution of construction projects. It involves the choice of technology, the definition of work tasks, the identification of any interaction among the different work tasks and the estimation of the required resources, cost and duration for individual task[5].

Planning, in its broader perspective, involve advance thinking as to what is to be done, what are the activities, how it is to be done, when it is to be done, where it is to be done, what is needed to do it, who is to do it and how to ensure that it is done; all of this is channeled to generate and evaluate options for evolving an action plan aimed at achieving the specified goals [6]. The planning process involved in construction planning can broadly be divided in to planning time, planning resource and planning implementation. A good construction plan is the basis for developing the schedule and the budget for work. In developing a construction plan, it is

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common to adopt a primary emphasis on either schedule control or on cost control as illustrated in Fig 3.1.

FIGURE 3.1 Alternative importance of Construction Time Planning



3.2 Definition of productivity and Overtime

What is productivity in construction and how is it measured? Several authors have answered this question in the following manner.

“...productivity refers to quantities produced per employee hour of effort...”

and further is

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“...defined as the ratio of output to input [7] Productivity can be defined by any of the equations ...

$$\text{Productivity} = \text{Output} / \text{input}$$

$$= \text{Units} / \text{work-hours}$$

$$= (\text{Total output}) / (\text{Total work-hours})”$$

“Productivity is measured generally by the output per hour of input.”

“Productivity: relative measure of labor efficiency, either good or bad, when compared to an established base or norm as determined from an area of great experience [8].

Productivity changes may be either an increase or decrease in cost [9].”

“Productivity is defined as the craft hours necessary to produce a unit of finished product [10].”

When productivity rate decreased the result is a loss of money for a contractor. Therefore, challenging aspect of construction cost control is measuring and tracking work hours and production insufficient detail to allow analysis of the data in order to determine the root cause(s) of poor labor productivity, should it occur?

On the other hand Overtime is work performed outside the ordinary hours listed in an award or agreement [11]. Overtime is usually paid at a higher

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rate. Overtime is often the best way to impress management (Client) and show contractors dedication to ensuring a project is delivered on time.

Employees can be classified into categories based on the number of working hours

Table 3.1 Category of Employees based of working hours

| | |
|--------------|--------------|
| Under 30hrs | Part time |
| 30 – 40 hrs. | Under time |
| 40 – 45 hrs. | Full time |
| 45 - 50 | Extra time |
| 50 – 60 hrs. | Over time |
| 60 – 70 hrs. | Excess time |
| 60 – 80 hrs. | Extreme time |
| 80 + | Danger time |

Source Website (Internet)

Scheduled overtime is seldom found on competitively bid firm priced contracts. Most contractors are mindful of some of the deleterious effects of overtime on costs and productivity. However, particularly on large cost-reimbursable projects, scheduled overtime is sometimes ordered by owners or construction managers in an effort to accelerate completion make up for previous delays, complete an originally scheduled project, which has been increased in size and complexity, or compensate for

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shortages of skilled construction workers in the area. One of the worst but most common reasons is to use overtime premium pay to induce needed workers to leave other jobs and accept employment on the project on which the overtime is scheduled [12]. In Ethiopia the employees (skilled and unskilled labors) abuse the idea of overtime and use it as a source of extra income.

The deliberate or unintentional speeding up of a project may result in lengthy periods of mandatory overtime, the addition of second shifts, or the addition of more labor beyond the saturation point of the site or that can be effectively managed or coordinated, all of which may have distinct impacts on productivity.

There are no comprehensive documented studies made on labor productivity in Ethiopia. Studies made by the former BaTCoDA are meant to establish productivity standards only. There are no background studies, which pinpoint problem areas of productivity in the sector.

Simple arithmetic shows that premium pay for double time or time and one-half makes overtime work much more expensive [12]. However, proponents of overtime often overlook the other cons associated with overtime which may be more significant than premium pay. Premiums affects only overtime hours, but continuing scheduled overtime affects costs of all hours. All available research findings indicate a serious reverse ratio between the amount and duration of scheduled overtime and the

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labor productivity achieved during both regular and overtime hours. All of studies showed that continuing scheduled overtime has a strong negative effect on productivity which increases in magnitude proportionate to the amount and duration of overtime.

In Ethiopia, the most frequent causes of overtime are the under listed three parties.

Client: - Most of the time the owners has a limited or no awareness about the building they are paying for and they wouldn't be able to, manage their representatives and participate on any decisions. Therefore it will be difficult for a client to understand and solve delays, productivity, overtime and other related issues.

Consultant:-incomplete design and/or redesign, poor supervision, change order and late decisions, are some of the problems come across in construction. The formula used for contract duration is old fashioned and it doesn't consider latest technology and other factors. For example one of a governmental consulting firm, they use this formula for every project contract.

Project Duration= $\sqrt[3]{(\text{Engineering estimation}/1,000,000.00 * 240 \text{ calendar days})}$

Contractor: - from the research, almost all delay claims are raised by contractors fault. The main causes are

- Communication gap between head quarter and the project (site),

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- Material shortage at site, including nonpayment to suppliers causing the stoppage of material delivery to site
- improper labor assignment, and
- Incapability of contractor's site management to organize site activities like scheduling and monitoring.
- In most projects, the labors produce less than the expected quantity at regular working time in order to compensate the loss by working through overtime (in night shift).

3.3 Basic concepts of Productivity and overtime planning

Many people who claim to be discussing productivity are actually looking at the more general issue of performance. While productivity is a fairly specific concept related to the ratio between output and input, performance is a term which includes almost any objective of competition and manufacturing excellence such as cost, flexibility, speed, dependability and quality. However, various performance objectives can have a large effect on the productivity in an operation:

- ✓ High-quality operations do not waste time or effort having to re-do things, nor are their internal customers inconvenienced by flawed service.
- ✓ Fast operations reduce the level of in-process inventory between micro operations, as well as reducing administrative overhead.

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- ✓ Dependable operations can be relied on to deliver exactly as planned. This eliminates wasteful disruption and allows the other micro operations to operate efficiently.
- ✓ Flexible operations adapt to changing circumstances quickly and without disrupting the rest of the operation. Flexible micro operations can also change over between tasks quickly and without wasting time and capacity.

Planning a project begins with the preparation of comprehensive statement of the objectives, usually determined by management directives .This objective usually include to complete the project;

- With the given time period
- Below the specific budget
- To a given quality and standard

Therefore in time planning completion date of construction should be set before the construction work begins together with the expected cost and the expected project out comes.

A degree of change and uncertainties is inherent in the construction, and it should be expected that a plan would change. It must therefore be able of being updated quickly and regularly if it is to remain a guide to the most efficient way of completing with the predetermined project completion time. The plan should therefore be as much as possible

- Simple, so that updating does not demand the feedback of large amount of data

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- Flexible, so that all alternative course of action can be considered.

Federal and state laws require most employers to pay overtime. The overtime premium is 50% of the employee's usual hourly wage. This means an employee who works overtime must be paid "time and a half" -- the employee's usual hourly wage plus the 50% overtime premium -- for every overtime hour worked [14].

These laws contain many exceptions, so not all employees are entitled to overtime. Employees who are eligible for overtime are called "nonexempt" employees, and those who are not eligible for overtime are called "exempt" employees.

Although the vast majority of employers must pay overtime, not all are required to. To figure out whether you must pay overtime, first determine whether you are covered by the federal Fair Labor Standards Act (FLSA), the federal wage and hour law that sets out the overtime rules. Even if your business is smaller, however, you must pay overtime if your employees work in what Congress calls "interstate commerce" -- that is, they conduct business between states. This includes more than you might think, including making phone calls to or from another state, sending mail out of state, or handling goods that have come from, or will go to, another state [15].

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3.4 Choice of Method of Construction Technology

Choice of appropriate technology and method of construction are ingredients in the success of the project. Choice of method of construction is one of the factors that affect project implementation plan. Method of construction technology depends on different considerations and varies from one project to the others [15]. In selecting among alternatives methods and technologies, the planner should think ahead in order to choose appropriate method of construction, which makes the project effective or reliable.

3.5 Relationship between productivity and overtime

Although it makes intuitive sense that labor productivity would decline as works become fatigued due to working overtime hours, and although that phenomenon has been borne out by studies, the relationship between overtime and productivity is more complex than a direct correlation. Additional variables come in to play, such as continuity and momentum. Productivity is also affected by companywide infrastructure issues, such as the difficulty of maintaining a supply chain when production is ramped into overdrive. The decision to schedule overtime hours should take into account whether there will be enough added productivity to justify increased payroll expense [16].

Some researchers and managers see performance objectives, especially quality, as a part of the concept of productivity, while they instead should see them as factors affecting productivity. It is believed in this research

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that the confusion surrounding productivity will be even more complicated with a too broad view of productivity. If productivity measures should include all types of performance objectives, they are in grave danger of becoming so complex that their usefulness as meaningful measures of improvement becomes questionable.

Overtime hours can have beneficial effects on worker productivity when scheduling additional hours enables to take advantage of economies of scale. The longer the shift, the smaller the percentage of time spends at these additional tasks relative to the total amount of work that must be done.

Workers who work regular overtime hours are prone to be tired, with good reason. The construction crew's productivity declined as they began working overtime, and continued declining as overtime hours increased. The more consecutive weeks they work overtime, they will be less productive [17].

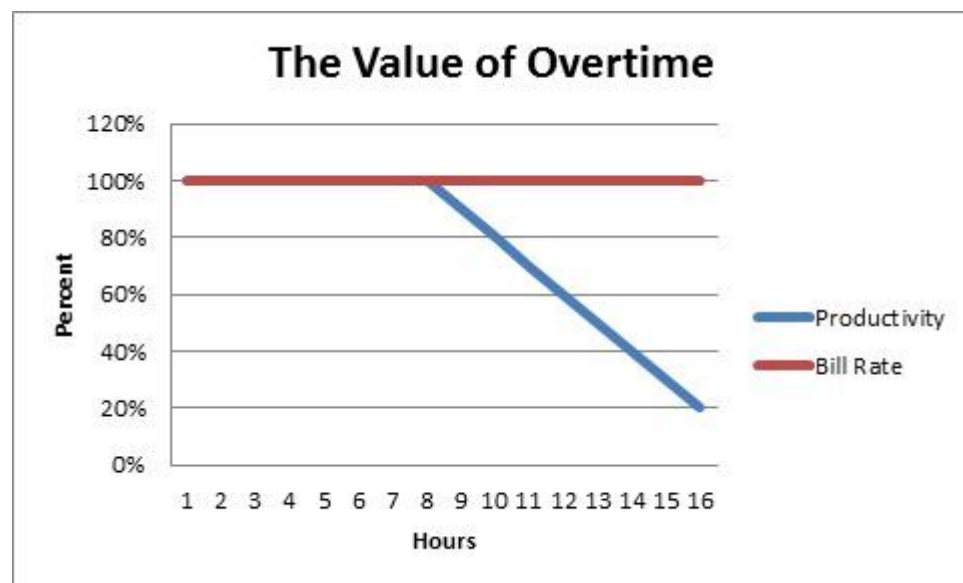
The quality of the employee's work isn't the only variable affecting this productivity when s/he works overtime hours. When a company tries to get more done in less time, it must implement the range of strategies to achieve this objective. For example, all of the necessary materials must be available, or workers earning overtime wages will simply be standing around waiting to supplies to arrive. In order to schedule overtime to have

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any beneficial effect on productivity, a company's other systems must also be functioning smoothly.

There is a direct relationship between motivation and productivity, and an inverse relationship between motivation and number hours that an employee works, once that number exceeds 10 to 20 percent above a typical work week [18]. A research shows that employees who are not motivated have low productivity rates, regardless of the number of hours that they work. The research advises that the best way to maintain employee motivation when schedule demands call for long hours is to create an environment where employees work extra by choice rather than by compulsion [19].

Figure 3.2 the Value of Overtime



The reasons have been found to account for declining productivity resulting from scheduled overtime:

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- 1) **Project duration method.** Different consulting firms use different methods to calculation for a given project duration. This will definitely affects the occurrence of overtime.
- 2) **Behavior and tradition of labor.** Specifically in Ethiopia, the productivity of labor varies from place to place, their culture, language and life style must be considered while preparation of contract duration and scheduling. Even in some towns like Bale during harvest season it's impossible to find unskilled labor.
- 3) **Work Pace Inertia.** Industrial engineers have found that worker expend energy at an established pace determined by long periods of adaptation. Hence, when the hours of work increase, there is a tendency to adjust the pace to accomplish about the same amount of work in an extended workday or workweek as was accomplished before the extension [20].
- 4) **Absenteeism.** Bureau of Labor Statistics Bulletin 917 stated: "But, whatever the reason, one fact stands out clearly in the survey: the longer the hours, the more schedule work time loss through absenteeism." [21]
- 5) **Accidents.** The productivity-killing effects of accidents are widely acknowledged. The BLS Bulletin stated: "injuries also increase as hours increased, not only in absolute numbers, but also in rate of incidence [22].
- 6) **Fatigue.** In work such as construction which is not machine-paced and which requires sustained physical effort as well as mental alertness,

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Physical and mental fatigue obviously reduced productivity during all hours worked.

- 7) **Morale and Attitude.** Fatigue causes deterioration in morale and positive attitude. In addition, continuing expensive overtime can quickly result in an attitude that “Cost means nothing to the customer, so why should we workers worry about efficiency?” Deteriorating morale and attitude coupled with fatigue increases friction among the workers, grievances against management, and jurisdictional disputes with other trades.
- 8) **Turnover.** Frequent turnover of workers is expensive and disruptive. Regardless of the skills of the new workers, a considerable amount of time is needed to train them to the specific needs of the project and orient them to what they will be doing and how it integrates with the work being done by others on the job. Turnover can be expected at an ever accelerating rate as overtime schedules continue because of fatigue, poor morale and attitude, and lack of economic need to continue working [23].
- 9) **Job Shopping.** In an area where one or more large projects have scheduled overtime, workers seem to spend more effort finding the project highest premiums than in getting the work accomplished. If other construction employers feel induced to schedule overtime to keep their share of the area work force, a daily “auction” for available manpower is likely to occur. The effects on productivity are obvious [24].
- 10) **Supervision Problems.** Because of their greater responsibilities, supervisory employees are likely to feel the fatiguing and demoralizing

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effects of prolonged overtime schedules even more than production workers. Loss of key supervisor's part way through a construction job can have highly detrimental effects, but such loss can be expected on a job with prolonged overtime due to illness or resignations because of overwork. Pressures resulting from scheduled overtime also cause supervisors to become careless, to make errors in judgment and to become irrational thus adversely affecting their relations with workers and others [25]. Obviously, the alternative of not having experienced supervisors present during all overtime hours worked can have even more serious consequences.

- 11) **Stacking of Trades.** Scheduled overtime almost always distorts the orderly sequence of the original schedule. This inevitably results in space conflicts and undesirable mixing of employees of different crews and different contractors [26].
- 12) **Pressure for More Overtime.** It is common for jobs with scheduled overtime to have worker pressure for more overtime and slowdowns among workers receiving less overtime pay than others. Competition to get larger paychecks seems to become a greater motivator than pride of participating in a successful project [27].

3.6 Scheduling and Monitoring

3.6.1 Introduction

The scheduling of work element is the most important step in planning because it is a basis for allocating resources, estimating costs, and

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identifying performance or productivity and also shows the timing for work elements and denote when specific events and milestones takes place [28]. While monitoring helps quantify the attainment of the schedule whether the performance or productivity is implemented as planned, the resources are deployed on time or modification of the schedule is required and the schedule is updating regularly [29].

Definition

Scheduling is

- Putting the plan on calendar basis or addition of time dimension to the planning process.
- It is a timetable of work that outlines the projects work program

Monitoring is

- An inspection that ensures that proposed construction is consistent with the funds that are being requested from the contractor.
- It also verifies that work completed is consistent with Plans and Specification.

3.6.2 Benefits of construction scheduling and monitoring

Realistic construction scheduling has the following benefits:

- It fulfills the time objectives.
- It simplifies the project plan.
- It optimizes the resources employed.

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- It can also serve as evidence in case of construction claims
- It helps for controlling of progress.
- It helps for the implementers as a guideline for project execution

This changes focus as one goes along the life cycle of project. Scheduling can be serve different purposes in different stages of the construction projects;

At pre-construction stage: Scheduling the pre-construction stage is important to provide the owner with the necessary information to Plan and Coordinate.

Knowing the exact dates when all the key events are going to occur is critical to the overall success of the project. Construction projects participants, owners, contractors, consultants, regulatory agencies, and financial institutions, all of are interested in when they will be involved in the project and for how long. These answers can be provided only through the use of schedule [30].

At construction stage: Project schedule are not only useful during the pre-construction stage, they are essential to the successful coordination of the day-to-day activities of the projects, Material deliveries and the utilization of equipment and people

During construction at the job site, a frequent use of the CPM schedule is to record the actual activities at the size from day- to-day basis. The schedule is clearly visible to all the trades. The project manager can

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graphically record progress. This can often be done with different markers and symbols. This practice cannot only record issues for the day; it can help anticipate problems that may occur in future. This information may also prove essential to the successful negotiation of future change order or delay claim [31].

Post-construction stage: As project completion the ultimate users of the facility becomes more involved in for construction process. In many projects the owner begins to occupy the facility while construction is still occurring. This called partial occupancy, and if this condition occurs, it must be closely scheduled, requiring weekly meeting to coordinate the construction work with the tenant improvement work necessary to allow company. Therefore scheduling is involved at all stages of construction [32].

Monitoring focuses on the measurement of the following aspects of intervention.

- ❖ On quantity and quality of the implementation activities (output: what do we do? How do we manage our activities?)
- ❖ On processes inherent to a project or program. (Outcomes: What were the effects/changes that occurred as a result of your intervention?)

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- ❖ On processes external to an intervention. (Impact: which broader, long-term effects were triggered by the implemented activities in combination with other environmental factors?)

3.6.3 Factors affecting construction scheduling and monitoring

The scheduling of a project plan has to take into consideration many variables like time, resources, and financial constraints. It is better to consider the following factors, when developing the schedule of a project work;

- **Time**-The availability of time is a limiting factor in project. There are factors which have to be considered during scheduling of working time:

The schedule must account for holidays, bad weather and the non-working periods. In Ethiopia, culture and religious holidays must be put into consideration while schedule is preparing.

Most of the projects carry time constraints so that a schedule must meet the project time constraints, in such a way that project duration is not exceeded.

- **Manpower**- The non-availability of suitable labor is the main factor, which affects the successful execution of projects. Therefore, it is very essential to consider the working hours, overtime and other incentive while deciding the manpower schedule.

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Most employees are paid general holiday pay for these days whether they work or not

Table 3.2 General Holidays

| No of days | General holiday | Date |
|------------|----------------------------------|--------------|
| 1 | Ethiopian New Year | September 11 |
| 2 | Id Al Adaha | September 23 |
| 3 | Finding of the true cross | September 28 |
| 4 | Birthday of the Prophet Mohammad | December 23 |
| 5 | Ethiopian Christmas | January 7 |
| 6 | Ethiopian Epiphany | January 20 |
| 7 | Victory of Adawa | March 02 |
| 8 | Ethiopian Good Friday | April 29 |
| 9 | Ethiopian Easter | May 01 |
| 10 | International Labor day | May 01 |
| 11 | Patriots Victory Day | May 05 |
| 12 | Dawn Fall of the Derege | May 28 |
| 13 | Id Al Fatar (Ramadan) | July 16 |
| 14 | Other religious holidays | |

Source: - Ethiopian Calendar

- **Materials**-No project can ever be started without materials. However, construction material might not be obtained at the required time, especially local materials. Therefore the schedule may have to be based on availability of such constraints.

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- **Machinery**-The availability of machinery is normally a limiting factor. For example, in an activity involving excavation, the schedule may specify a requirement of two dozers, but one may actually be available. This makes the schedule not to meet the required targets. The aim of machinery and equipment scheduling should be to find out the minimum duration schedule in which the employment of equipment and machinery is systematically and uniformly distributed based on its availability.
- **Capital**-is the core of all project activities.

3.7 Importance of having a good measure for construction productivity in Ethiopia

The results of the head office data survey indicate that all parties involved in the construction activities uses time planning. But the extent and use of time planning varies from parties to parties.

Clients

Clients use time planning at pre-construction stage to know the scope of the work and determine the completion time for the project. The client use time planning to set the completion time for the project. This plan doesn't consider the complex nature of construction activities, productivity rate and necessity of overtime. On the other hand almost all clients have no understanding about the construction methodology in order to manage

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their building and to involve logically before the delay occurs. Therefore they will be facing to Additional cost.

Clients are one of the most important bodies which influence the productivity of the project site by changing their requirement; the project scope. This action causes change and additional design to be produced causing temporary shortage of design information to the contractor unless prior design revision and engineering control is done in before the execution of works. Studies made in other countries shows that percentage of change orders is directly proportional to loss of productivity [33]. Other time clients may limit the project completion time but providing design changes in such a case the contractor may be forced to use overtime works which has also similar effect in reducing productivity [34].

Consultants

All consultants use time planning at the pre-construction stage for the purpose of tendering. They use time planning to determine the completion time of the project that can be used for evaluating and awarding of tenders. The time set for the project should reflect the complex nature of the construction project such as complexity, location, and weather condition, etc. In most cases the consultants provide incomplete design and unrealistic project duration without preliminary study. The contractor will suffer to complete the project on time even if the production rate riches

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the standard and doubles up the crew, in a while the case becomes complicated to handle by both parties, consultant and contractor.

These are among the most important parties affecting the overall productivity of the construction site. It is known that design information in the form of drawings and specifications are one of the most important inputs of the construction process. Unless the engineering information is appropriately scheduled and controlled like other resources it will cause loss of productive time of workers.

The survey indicates that timeliness and clarity of decisions and acceptance by the consultant is low which demands the client for a different project delivery system. The client can reduce the problem related to this by using design and build system whereby early integration between the contractor and the consultant be facilitated.

Contractors

In Ethiopian 75% of the contractors use time planning and monitoring at all stages of construction (pre-construction, construction and post-construction stages) and 25% use only at construction stage. During the pre-construction stage they use it for tendering purpose and at the construction stage to prepare a work program.

At early time of construction stage, the contractor lacks proper management and monitoring of the project. Afterwards the contractor refuses to accept additional cost caused by overtime at a critical time of

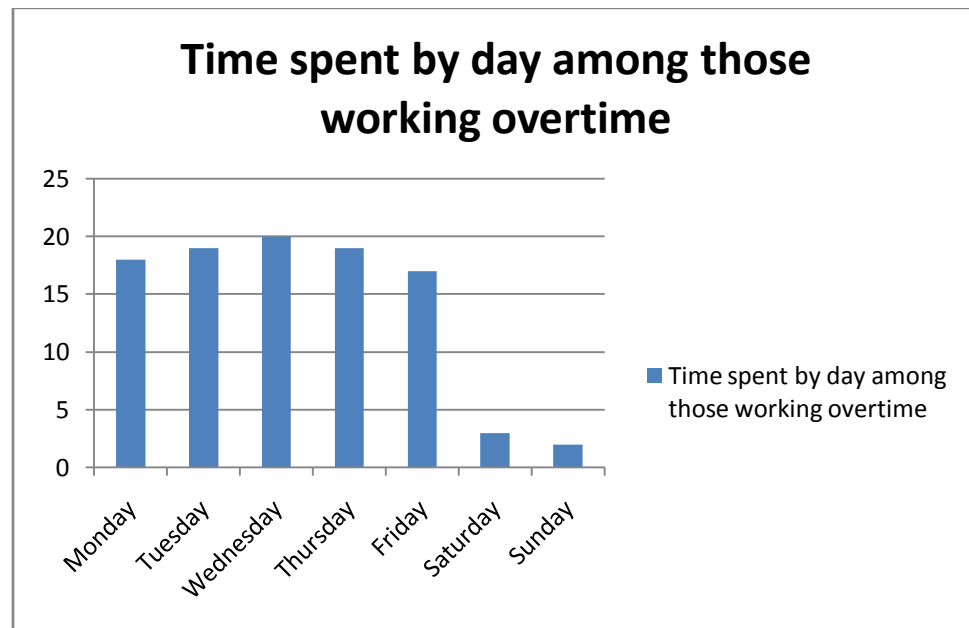
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the construction stage. Contractor might reduce overtime by hiring temporary workers, but they might not save any money in the long run and the productivity does not completely compensate the time wasted at the beginning of the project so over time activity will become mandatory.

Headquarters also affect the productivity of the site as they are the providers of most resources to the construction project. Poor scheduling and communication between the project office and the head quarter contribute a lot besides cash flow problems in causing disruption of projects temporarily.

The survey indicates that the companies' effort in providing good project organization, resources and general support is adequate. Slightly more work is done on Wednesdays than other days.

Figure 3.3 Time Spent by Day among Those Working Overtime



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In developing countries like Ethiopia, it might be very difficult to minimize delays and eliminate overtime work when construction industries are necessary and growing fast. Delay is inevitable because of several seasons but in order to avoid this they should take in to consideration consequence of overtime during the planning stage otherwise it significantly affects the economic development of the country and the users' benefit that will be obtained if it has been completed on time.

For continual assessment and improvement of labor productivity at any managerial level, it is advisable to establish bench marks for the purpose of comparisons [35].

Benchmarking is defined as “a systematic and continuous measurement process; a process of continuously measuring and comparing an organization business process against business leaders anywhere in the world to gain information which will help the organization to improve its performance” (Koskela, Osman & Abdel-Razek, Madigan, and Olomolaiye) [cited by 42]. Benchmarking can be internal, external, classic, traditional, process, performance, functional, strategic or a combination. The idea behind each is the same; to identify measure, compare, perform gap analysis, adapt and implement new ideas [36].

The study found that no standard was used for management though all projects need productivity standards for the purpose of scheduling. The productivity standard that was used in the schedule was not transferred down to the crews. Of course, the standards that were used in the schedule were estimates collected from somewhere and should not be considered as realistic physical targets [37].

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Unless specifically identified on the agreement between an employee & employer, the under listed law precisely stated (govern) rate for overtime payment.

National laws on labor, social security and related human rights

Labor Proclamation No.42/1993.

(NegaritGazeta, 20 January 1993, Vol. 52, No. 27, pp. 268-328.

PART IV. HOURS OF WORK, WEEKLY REST AND PUBLIC HOLIDAYS

CHAPTER I. HOURS OF WORK

Division 2. Overtime

Section 66.**General.** (1) Work done in excess of the normal daily hours of work fixed in accordance with the provisions of this Proclamation shall be deemed to be overtime.

(2) Work done within the limits referred to in sections 61, 63 and 64 shall not be deemed to be overtime.

(3) Overtime shall be worked only in cases expressly provided for under section 67 and on the express instructions of the employer.

(4) The instructions given under subsection (3) of this section and the actual overtime worked by each worker shall be recorded by the employer.

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Section 67. **Circumstances in which overtime work is permissible.** (1) A worker may not be compelled to work overtime; however, overtime may be worked whenever the employer cannot be expected to resort to other measures and only where there is:

- (a) accident, actual or threatened;
- (b) force majeure;
- (c) urgent work;
- (d) Substitution of absent workers assigned on work that runs continuously without interruption.

(2) Notwithstanding the provisions of subsection (1) of this section, overtime work of an individual worker due to urgent work shall not exceed two hours in a day or 20 hours in a month or 100 hours in a year.

Section 68. **Overtime payment.** (1) In addition to his wage, a worker who works overtime shall be entitled to the following payments:

- (a) in the case of work done between six o'clock (6 a.m.) in the morning and ten o'clock (10 p.m.) in the evening, at the rate of one and one-quarter ($1 \frac{1}{4}$) multiplied by the ordinary hourly rate;
- (b) In the case of night time work between ten o'clock in the evening (10 p.m.) and six o'clock in the morning (6 a.m.) at the rate of one and one-half ($1 \frac{1}{2}$) multiplied by the ordinary hourly rate.

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- (c) in the case of work done on a weekly rest day, at the rate of two (2) multiplied by the ordinary hourly rate;
- (d) In the case of work done on public holiday, at the rate of two and one-half (2 1/2) multiplied by the ordinary hourly rate.

(2) Payment for overtime work shall be effected on the day fixed for wage pay day.

3.8 Better solution to improve the productivity and reduce overtime

Finally based on the analysis of the study, recommended possible areas of the activities that must be improved in the building construction industry are:-

- 1st. It is better to make a research on the existing productivity of resources and develop a nationwide up-to-date standard productivity rate.
- 2nd. When the client set time for completion of project, it is essential to take into consideration the complexity and degree of uncertainties of the project.
- 3rd. The parties who are involved in the construction industry has to make an appropriate feasibility study at pre-construction stage
- 4th. Construction firms who are in developing country like Ethiopia should be able to acquire relevant (professional) skills that will be necessary for improving the efficiency of time planning.

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- 5th. Since construction time planning requires a higher effort, it is better to give sufficient time for the preparation of time plan.
- 6th. Before assigning duration to the activities, it is very important to make preliminary assessment of resource availability to minimize resource constraint during the implementation phase
- 7th. Through proper management and monitoring any site challenges must be eliminated in order to increase productivity. And special attention must be given to motivate employees.
- 8th. From the starting of the project scheduled overtime should be set considered the projects complexity and provided duration.
- 9th. Clients can influence the productivity of their site by applying appropriate project procurement system so as to foster earlier integration between external bodies. For example by applying design and build method clients can integrate the effects of designers and contractors into one body hence reducing efforts required for communication.
- 10th. Consultants can contribute a lot in enhancing site productivity by applying the concepts of open systems theory and integration management.
- 11th. Contractors: Contractors shall try to install comprehensive project management information systems to their projects integrated with properly designed on site data collection system; especial

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emphasis should be given to materials and productivity management systems.

12th. Contractors and regulatory bodies shall establish current and engineered productivity standards that can be used for the purpose of internal management and regulatory work.

13th. Contractors shall understand the effect of tools and simple machines in improving productivity hence they give emphasis to introduce these to the domestic industry so as to be competitive as other countries.

14th. Contractors should not be discouraged in introducing measurement systems for certain performances seeing the immediate cost incurred. The implementation of it has high leverage in reducing costs related with labor inefficiencies.

15th. Contractors shall encourage their project leaders in introducing competitive values through their working environment.

CHAPTER V

CONCLUSION AND RECOMMENDATION

Productivity and Overtime

In this paper, the misperception surrounding the concept of productivity and its relation to other similar terms, overtime, has been explored. Several characteristics features of productivity have been presented that explains how productivity should be distinguished from the terms; profitability, performance, efficiency and effectiveness.

Unlike developed countries, the construction projects management in Ethiopia is traditional; there is no experience in measuring at least certain performances to reveal certain facts. From experience no project had installed labor productivity measurement for the purpose of management. The basis of human resource planning and schedule preparation was based on non-engineered standards developed at national level.

Unfortunately, it seems to be practically impossible to create an exact definition of productivity that is applicable and accepted within all areas of building construction industries. Nevertheless, it's vital that the basic features that characterize the term are understood in building constructions. Otherwise, the existing misinterpretations on the subject will continue to cause problems and declines in productivity.

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4.1 Conclusion

- A. There is no proper assessment of resources availability in the preparation of time plan.
- B. In estimation of activity duration, there is no up-to-date productivity standard for labor and equipment.
- C. Construction method management were not done in a scientific way as demands due to lack of trained manpower in construction methods in the projects ;and standards were used only for planning purposes at higher level; hence could not be used for controlling crew performances.
- D. Lack of assessment of degree of uncertainties in estimation of activity durations.
- E. There is a problem of taking immediate corrective actions when deviation occurs and problem of progress report at regular interval
- F. Most of the time, the time set for completion of project is unrealistic.
- G. The application of updating of plan is not properly done.
- H. In Ethiopia, while preparing schedule for a project, it do not take mandatory overtime into consideration at pre construction stage.

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4.2 Recommendation

- All of the parties concerned with planning and scheduling construction projects including owners, construction managers, architects, engineers and contractors, should be fully aware of the magnitude of the extra hours caused by scheduling overtime and that productivity losses will affect work during normal hours as well as during overtime hours. All must recognize that the supposed benefits to be gained from scheduled overtime, such as accelerating completion or making up from previous delays, are unlikely to be realized and too costly to attempt.
- Initial completion schedules should be realistic and take into account the availability of skilled manpower and potential delays from weather, strikes, licensing delays, interference by environmental effects, etc. Completion schedules should allow sufficient flexibility to absorb unexpected but unavoidable delays. Design the work to be completed and the construction started early enough that the customer's need for a completion date will be taken care of without artificial acceleration.
- Change orders of a size or number which will delay completion should be avoided unless the completion date can be extended to permit performance of both the changed work and the original work without resorting to overtime. No changes should be contemplated or authorized without full consideration by all parties its effect on completion time.
- If the costs of scheduled overtime are to be paid by the customer under a cost-reimbursable contract or under cost-reimbursement

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provisions for changes or acceleration orders, the contractor should not be permitted to proceed with scheduled overtime without the previous written agreements with the customer. Prior to agreeing to the proposed overtime schedule, the contractor should thoroughly the inherent disadvantages, consult with contractor associations in the area for their opinions on what the effects of scheduled overtime will be, and make sure that no other alternatives are available.

- Contractors on firm-priced contracts must be fully compensated for loss of productivity as well as for overtime premiums and additional supervisory and administrative costs resulting from working on overtime schedules if required by the customer to perform changed or accelerated work which necessitates scheduled overtime.
- An effort should be made to negotiate and utilize variable shift work clauses to perform much of the work which must be performed outside scheduled working hours with employees who are not employed during regular working hours. It should be recognized however, that productivity during shift periods is not likely to equal that during regularly scheduled work hours.
- Overtime should never be used to induce needed worker to leave other jobs and accept employment on the project on which the overtime is scheduled.

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