

Original Research

EVALUATION OF TIME OVERRUNS AND TIME MANAGEMENT TECHNIQUES IN ROAD CONSTRUCTION PROJECTS IN ERBIL CITY

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Abstract: Successful people utilize their time judiciously. The challenge of completing construction projects within the estimated time frame is the biggest concern among practitioners. In this research two aspects have been highlighted, first; the most significant factor of time overrun in construction projects performed by Erbil Municipality during road construction. The second aspect is the time management methods held by the project team. A random sampling technique was used to administer 126 questionnaires to professionals such as Project managers, Engineers, and contractors working on road construction projects for Erbil municipality. On the other hand, a case study has been conducted for 70 constructed projects during 2018-2022 for the evaluation of time management techniques in road construction projects by identifying the process of monitoring, software packages that are used for that, the progress of work, and investigating how progress records are kept in Erbil City municipality projects. The results revealed that the most significant factor for time overrun was the economic crisis which led to the failure to pay contractors' dues in a timely manner, followed by the unreasonable time frame for the completion of projects. Used techniques and software packages for time management were identified. It is revealed that there is no specific method for managing time. Multiple methods are used depending on the situation.

Keywords: Road construction industry; Delays; Disputes; Project management; Project success; Time management techniques; Time overrun.

1. Introduction

In the projects of the public sector, time overrun has become a global issue, especially in developing countries. Cost and time overruns exceed more than 100% of the estimated cost and time [1]. The completion of projects on time becomes a business for every stakeholder working in the construction industry. Clients are the most affected stakeholders by time overruns because their plan usage and initial budget might be affected upon the completion of their project [2].

The objectives of time management are to prepare the schedules and control the time, and the networks. The Project Management Institute (PMI) had a great effort in clarifying the required processes in project time management. The processes of time management include all the necessary inputs, tools and techniques, outputs, and activities involved [3]. The concept of project time management is a system that helps one to use one's time to achieve what one wants. It is a set of skills, tools and practices, and principles, [4]. There are 7-time management processes, which include: planning

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schedule management, defining activities, sequencing activities, estimating activity resources, estimating activity durations, developing schedules, and controlling the schedules [3]. Sahito and Vaisanen [5], defined time management as a process to manage time depending on some requirements of different assignments and activities ensuring organizational success, and maximizing benefits by saving, utilizing, and not wasting energy or time. Successful project management ensures the completion of the project within budget, on time, and within project specifications. It is the process of recording and controlling time spent by staff on the project [6]. Time performance is considered one of the key measures of project success [7].

The road construction industry in Erbil Governorate, the capital of the Kurdistan Region of Iraq is growing widely. Road construction projects are facing several issues and challenges. Time overrun is considered one of the major ones. Therefore, it is important to have a process of time management for a construction project. The significance of this study is to investigate the main time overrun factors in road construction projects in Erbil Municipality. And to determine how time is managed. So that the managerial staff can get a clear understanding of time management techniques and controlling time in such projects to improve the time management process and try to adopt a specific updated system for time management. This study tried to fill the gap by examining the processes of time management techniques in road construction projects in Erbil City.

2. Literature Review

According to the Chartered Institute of Buildings (CIOB), there are eight types of principal tools for time management: a flow

chart, a bar chart, a line of balance, a time chainage diagram, a minute of meetings, correspondence, a partial and fully linked networks, [8]. The site records have lots of information relating to progress, finance, and quality. These progress records are providing details of the used resource, disruption or delay if any, what happened, and when it happened. These records are very important during the time management process because they are providing a means of monitoring and controlling the project and have a big role in resolving construction conflicts and disputes [9].

Aftab et al. [10], in their research, identified the most effective software package and time management technique. They ranked the most effective package that is used in Malaysia. They found that the critical path is the most common and effective method of time management. And the most commonly used and effective software package is Microsoft Project.

Al-Momani [11], investigated contributors to delays in 130 public building projects in Jordan. He found that the main seven main causes of construction delays are; late deliveries, delays related to the designer user changes, site conditions, weather, increases in quantity, and economic conditions. `

Odeh and Battaineh [12], investigated the construction delays in Jourdan. In their research, they revealed that there is an agreement between the contractors and consultants about the most important causes of delays which are; improper planning, slow decision-making, labor productivity, owner interference, inadequate contractor experience, incompetence of subcontractors, and financing, and payments.

Frimpong et al. [13], in their paper, investigated delays and cost overruns. They identified the relative importance of 26 significant causes of

delays in Ghana groundwater construction projects. The result of the study revealed the main contributors to cost overruns and delays are: poor technical performance, material procurement, monthly payment difficulties from agencies, poor contractor management, and escalation of material prices.

Koushki et al. [14], identified the main causes of time and cost overrun in Kuwait construction projects. They stated that the main factors affecting time overrun are owners' financial constraints, owners' lack of experience, and change orders.

Faridi and El-Sayegh [15], investigated delays in United Arab Emirates construction projects. They found that half of the construction projects are delayed and not completed on time. They found that the main significant causes of construction delays are inadequate early planning, process, and approval of drawings.

Sambasivan and Soon [16], investigated the important causes of delays in Malaysia's construction industry. They found that the top 5 causes of delay are: inadequate client finance and payments for completed work, contractor's improper planning, contractor's poor site management, problems with subcontractors, and inadequate contractor experience. Also, they revealed 6 main effects of delay which are: cost overrun, time overrun, disputes, litigation, arbitration, and total abandonment.

Kaliba et al. [17], conducted a study about delays in road construction projects. In their conclusion, they stated that there is 13 top affecting factors of delay in Zambia. The most significant are the delayed payments, financial difficulties and processes on the part of clients and contractors, modification of contracts, national economic problems, materials

procurement, drawings changes, staffing problems, etc.

Mahamid et al. [18], conducted a study in the West Bank of Palestine. They identified and ranked the delay causes of road construction projects. Both the contractor and consultants agreed that the two main causes of the delay are the segmentation of the West Bank and limited movement between areas and, the political situation. Aftab et al. [10], identified that the major factors contributing to time overrun in the Malaysian construction industry are: contractors' cash flow and financial difficulties, owner financial difficulties poor site management and supervision, incompetent subcontractors, and shortage of workers.

Aziz and Abdel Hakam [19], conducted a study in 2016 and investigated the causes of time overruns in 16 different countries all over the world. They found that the causes of time overruns are varies from 7 to 113 depending on the location of the country. Othman et al. [20], identified the major time overrun factors faced by contractors, clients, and consultants, the main causes of time overrun are financial resource management, Contract administration, and project management, contractor's site management, design, and documentation, and ineffective project planning and scheduling.

Al Saadi et al. [21], identified various factors causing time overruns in construction projects in Oman. These causes were grouped into five phases; planning, design, construction, finishing, and miscellaneous.

Mohammed Laissy [22], ranked the top five important time overrun factors among 34 identified factors in Saudi Arabia's public construction projects. The study revealed that poor labor productivity, improper planning, lack of contractor experience, additional work, and,

rework are the main important factors for time overruns. While, poor contract management, improper planning, rework, changes in material types, and poor resources are the most frequent factors. The result of the study revealed that improper planning, bid award for the lowest price, poor labor productivity, lack of contractor experience, and additional work are the most severe factors that affect time overruns. Salunkhe and Patil [23], summarized the external and internal factors that influence the construction process and outlines the effect of delay in large construction projects. They revealed that the main causes are: inadequate mobilization of the contractors, slow progress of civil work, delay in land acquisition, tender cancellation, delay in forest clearance, delay in equipment erection, changes in the scope of work, escalation in cost, fund constraints, law and order problem, and delay equipment supply. Ibrahim et al. [24], studied the causes and types of delays, the allocation of responsibilities, and the consequences of delayed construction projects in Nigeria. Their results indicate that the causes of delay are due to the weaknesses and faults of both the contractor and owner. The study revealed that public holiday is the least that can cause delays at the early stage of construction. While delays in honoring payment certificates are the first to cause delays.

3. Data Collection

In this study, a structured questionnaire survey was used for time overruns and time management techniques as a quantitative mode of research. Based on the literature, in addition to face-to-face interviews conducted by the author during site visits, and discussions with management experienced construction team.

Stratified random sampling was adopted for this study. According to Kothari [25], this method of

sampling is used where the population embraces several distinct categories, the frame can be organized by these categories into separate "strata." Each stratum is then sampled as an independent sub-population, out of which individual elements are randomly selected. The selection of respondents from each stratum was based on simple random sampling. In assessing construction risk the research targeted project managers, consultants, and contractors as the sample units

The following are the objectives of this study:

1. Evaluating a preidentified list of time overrun factors that have an impact on time management in road construction projects.
2. Adopting a case study for (70) road construction projects that have been constructed in Erbil City during 2018-2022 to evaluate the practice of time management techniques in these projects.

4. Procedure and Methodology

A questionnaire has been prepared and designed by the researcher for time overrun factors based on a literature review conducted to cover previous studies on the causes of time overruns in construction projects. The verified factors are likely to influence the time management of any construction project. Depending on the literature review and the author's interviews with 8 project managers experienced in road construction projects. An extensive checklist was elicited for time overrun.

During the first round, the respondents had to express their experience in the road construction industry to rate a list of (38) factors for time overruns. These factors are classified into four groups; Consultant related, Owner related,

Contractor-related, Other related(external). As shown in Table 1.

35	bad weather conditions
36	accidents
37	curfew
38	crisis

Table 1. Time overrun factors

owner related	
1	change orders
2	insufficient coordination among client, consultant, and constructor
3	change in project scope
4	improper construction methods
5	poor site management
6	delays in payment
7	finance disputes
8	poor supervision
9	insufficient communication between parties
10	poor financial control on site
11	unreasonable project time frame
12	poor contract management
13	additional work
consultant related	
14	incomplete drawings provided by the consultant
15	change in design
16	inaccurate estimates
17	underestimation of the costs of projects
18	underestimation of the complexity of projects
19	delay in instructions from consultants
contractor related	
20	material allocation
21	plant allocation
22	labor allocation
23	cost management
24	improper planning and Schedule control
25	improper coordination
26	improper techniques
27	subcontractor related factors
28	mistakes during construction
29	lack of communication
30	underestimation of time for completion of projects
31	lack of program of works
32	rework
other factors (external)	
33	fluctuation of prices
34	unforeseen conditions

The respondents expressed both the likelihood and severity of these factors on a base of a four-point Likert scale from 1 to 4, these numerical values are assigned to the respondents' rating to evaluate the importance of each factor later. The data has been analyzed by using a significant index method. This method can be described as the function of both likelihood of occurrence and the level of impact of a factor on the time overrun of a project.

Using likelihood and impact in the qualitative method is a very effective way of communicating the distribution of the probability of risk results [26].

Data collection was carried out among project managers, consultants, and contractors involved in road construction projects. 150 questionnaires were distributed. Only 126 of them returned as shown in the respondent's profiles in Table 2.

Table 2. Respondent's profile

Working years	Project manager	Consultant	Contractor
1-5	3	4	6
6-10	7	10	9
11-15	10	12	12
16-20	8	12	8
>20	7	9	9
Total	35	47	44

Data were analyzed statistically with the statistical software package SPSS.

Three types of indices were used for the data processing as follows: -

(F.I.) Frequency index: to express the frequency of occurrences of time overrun factors by using

the following formula which was adopted from Mohammed A. J. [27]:

$$F.I = \frac{\sum W}{A*N} \quad (1)$$

Where:

W = weight assigned to each response (ranges from 1 to 4), N = the number of responses.

The values assigned to the respondents' ratings are:

1 =rarely

2 = sometimes

3 = often

4= always

(S.I.) Severity index: to express the severity of the overrun factors by using the following formula which was adopted from Mohammed A. J. [27]:

$$S.I. = \frac{\sum W}{A*N} \quad (2)$$

Where:

W = weight assigned to each response (ranges from 1 to 4), N = the number of responses.

The values assigned to the respondents' ratings are:

1 =little

2 = moderate

3 =great

4 = extreme

The importance index (IMP.I.) of each cause is calculated as a function of both frequency and severity which was adopted from Mohammed A. J. [27]:

$$IMP.I. = F.I. \times S.I. \quad (3)$$

The data of responses were analyzed to calculate the values of (F.I.), (S.I.), and (IMP.I.) to rank each time overrun factor. Determining rankings make it possible to cross-compare the importance of time overrun factors perceived by the respondents to get the weightage average for ranking the effects.

For the second round, 70 projects that have been constructed during 2018-2022 by Erbil municipality were examined as a case study. Data collected from Erbil Municipality Engineers for examining the practice of time management techniques used on road construction projects, a questionnaire survey has been adopted to identify the methods used for monitoring the progress of work that needs to be done and to investigate how the progress records are kept during the progress of work. The respondents who were responsible for constructing these projects were asked to specify the method related to statistical information regarding the following information:

- The time management techniques.
- The techniques of time control.
- The method of keeping progress reports.
- The method of identifying the planned activity.
- The application of logic to planned activities.
- The method of establishing the planned sequence of work.

5. Results and Discussion

Table 3 shows the frequency (F.I.), severity (S.I.), and importance (IMP.I.) Indices for cost overrun factors.

The results in Table 3 show that the most important time management factors are; economic crisis (other related) rank1

unreasonable project time frame (owner related) rank2, delays in payment (owner related) rank3, underestimation of time for completion of projects (contractor related) rank4, improper planning and schedule control (contractor related) rank5, fluctuation of prices (other related) rank6, additional work (owner related) rank7, inaccurate estimates (consultant related) rank8, change orders (owner-related) rank9, and underestimation of the costs of projects (consultant related) rank10, respectively.

fluctuation of prices (other related) rank2, economic crisis (other related) rank3, underestimation of time for completion of projects (contractor related) rank4, unreasonable project time frame (owner related) rank5, inaccurate estimates (consultant related) rank6, improper planning and schedule control (contractor related) rank7, poor financial control on-site (owner related) rank8, additional work (owner related) rank9, change orders (owner related) rank10, respectively.

The most frequent factors for time management are delays in payment (owner related) rank1,

Table 3. F.I., S.I., and IMPI. I. for time overrun factors

	Owner related						Contractor related						
	F.I.	Rank	S.I.	Rank	IMP.I.	Rank	F.I.	Rank	S.I.	Rank	IMP.I.	Rank	
1	2.511	10	2.738	9	6.899	9	20	2.360	12	2.750	8	6.514	13
2	2.083	22	2.404	17	5.007	28	21	2.357	13	2.678	12	6.312	15
3	2.154	19	2.392	18	5.152	27	22	2.345	14	2.678	12	6.279	16
4	1.833	32	2.345	20	4.298	34	23	2.333	15	2.535	16	5.914	19
5	2.309	17	2.857	5	6.596	12	24	2.642	7	2.857	5	7.548	5
6	3.297	1	2.714	10	8.948	3	25	2.011	24	2.297	22	4.619	31
7	1.857	30	2.142	26	3.977	35	26	2.285	18	2.654	13	6.064	17
8	2.142	20	2.595	15	5.558	21	27	2.321	16	2.535	16	5.883	20
9	1.964	27	2.238	23	4.395	33	28	1.940	29	2.690	11	5.218	25
10	2.595	8	2.309	21	5.991	18	29	1.988	26	2.357	19	4.685	29
11	2.666	5	3.404	1	9.075	2	30	2.773	4	2.738	9	7.592	4
12	2.047	25	2.607	14	5.336	24	31	2.380	11	2.797	7	6.656	11
13	2.523	9	2.869	4	7.238	7	32	1.690	33	2.607	14	4.405	32
	Consultant related						Other related						
	F.I.	Rank	S.I.	Rank	IMP.I.	Rank	F.I.	Rank	S.I.	Rank	IMP.I.	Rank	
14	1.928	29	2.678	12	5.163	26	33	3.166	2	2.333	20	7.386	6
15	1.857	30	2.880	5	5.348	23	34	2.119	21	2.952	3	6.491	14
16	2.654	6	2.714	10	7.230	8	35	1.571	34	2.178	24	3.421	37
17	2.369	12	2.845	6	6.740	10	36	1.273	35	2.154	25	2.742	38
18	1.845	31	2.535	16	4.677	30	37	1.154	36	3.309	2	3.818	36
19	2.035	23	2.690	11	5.474	22	38	2.892	3	3.309	2	9.569	1

The most severe time management factors are unreasonable project time frame (owner related) rank1, curfew and economic crisis (other related) rank2, unforeseen conditions (other related) rank3 additional work (owner related) rank4, change in design (Consultant related), poor site management, (owner related), and

improper planning and schedule control (consultant related) rank5, underestimation of the costs of projects (consultant related) rank 6, lack of program of works (contractor related) rank7, material allocation (contractor related) rank8, change orders (owner related) and underestimation of time for completion of

projects (contractor related) rank9, and inaccurate estimates (consultant related) and delays in payment (owner related) rank10, respectively.

In the construction industry, there are many effective software packages for scheduling and management that are used for time management. It shows the types of software packages that are mostly applied in road construction projects. Fig.1 shows that Microsoft Excel is the most used software by the respondents for controlling time in road construction projects with a rate of 76%. This software is easy to operate where the progress is obtained directly. While Microsoft Project ranked as the second software applied by respondents with a rate of 14% and the third most commonly used is Primavera Project with a rate of 10%. On the other hand, the CA Super project and Pert master, Deltek Open Plan, Project Commander, and Asta Power Project are never used in construction time management. Most of the respondents admitted that they are not familiar with them.

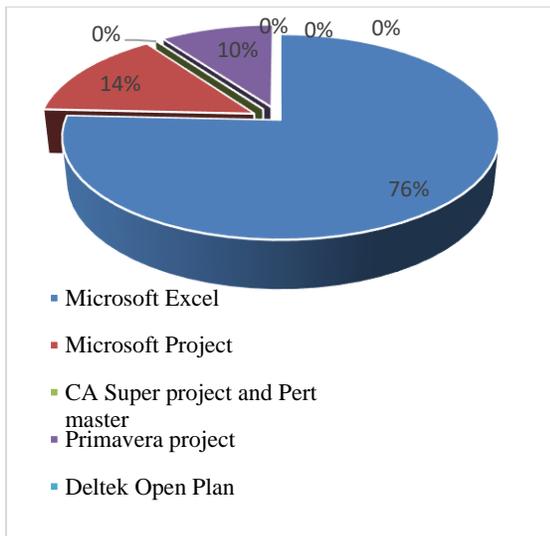


Figure 1. The time management techniques

Fig.2 shows the ranking of the techniques used for time control based on the respondents' experience in road construction projects.

The respondents ranked the bar chart as the most commonly used method with a rate of 44.29%. The flow chart was ranked in second place with a rate of 38.57%. While the critical path method ranked in third place with a rate of 12.86%. The line of balance method is rarely used. While, other methods such as PERT, Milestone, etc. are never practiced. It is noticeable that the old methods are used in controlling projects. And most of the respondents are not familiar with the new methods of controlling.

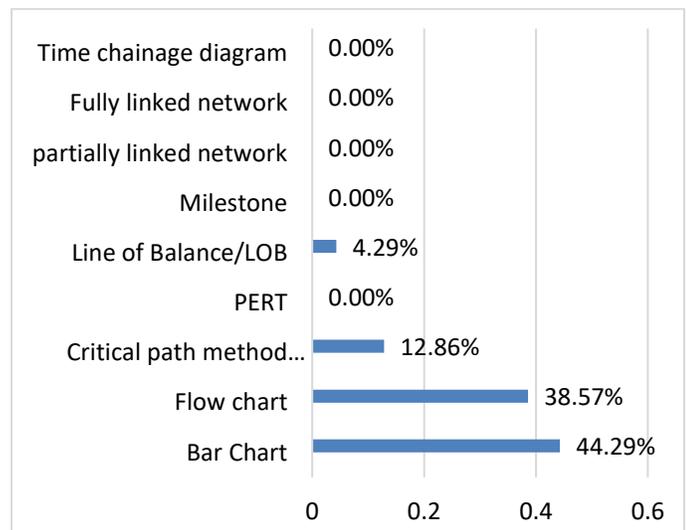


Figure 2. Techniques of time control

Fig.3 shows the results of the methods of keeping progress records.

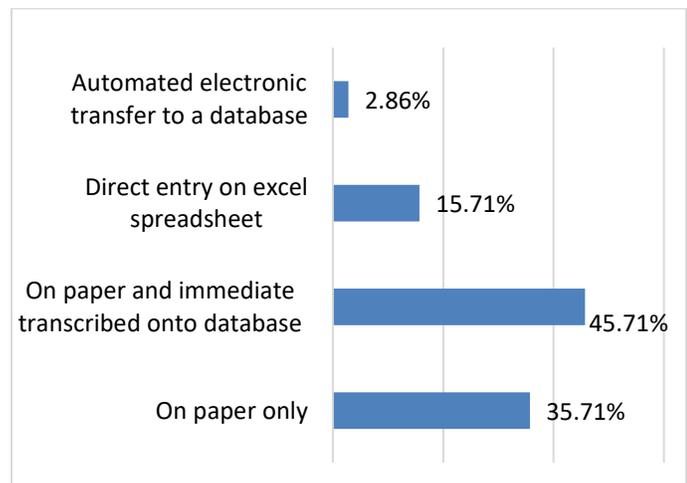


Figure 3. The method of keeping progress reports

According to the results, 45.71% of records are on paper and then transferred to the database. 35.71% are on paper only. 15.71% of responders used direct entry on an Excel spreadsheet. On the other hand, only 2.86% of responders used automated electronic entry to a database. The respondents announced that they are using multiple methods for recording depending on the type, the volume, and the importance of the project.

Fig.4 shows the methods of application logic for planned activities

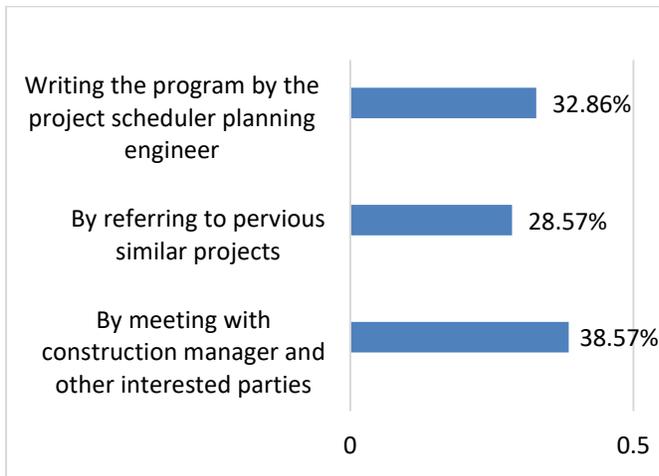


Figure 4. Application logic for planned activities

About 38.57% of respondents apply logic to planned activity during a meeting with the construction manager. 32.86% of them by writing the program by the project scheduler planning engineer. While 28.57% by referring to previous similar projects. During the discussion with project managers, they stated that the method is depending on the type of work and the volume of work.

Fig.5 shows the results of the method of identifying the planned activity. About 38.57% of respondents estimate by reference to previous similar projects. 30% of the estimated reasonable time adding a contingency. While 21.43% calculate by references to resources and

productivity. On the other hand, 10% of respondents estimate a reasonable time. It is noticeable that multiple methods are used in identifying the planned activity.

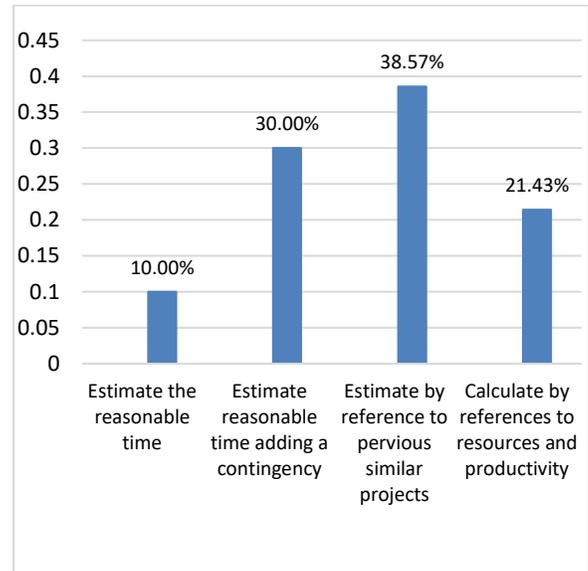


Figure 5. The method of identifying the planned activity

Fig.6 shows the results of the method of establishing the planned sequence work.

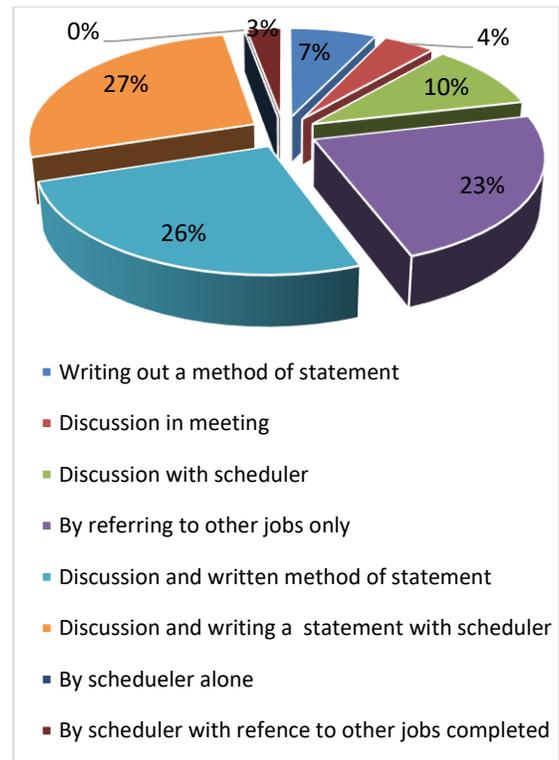


Figure 6. The method of establishing the planned sequence of work

Having a discussion and writing a statement with the scheduler is the most used method for the establishment of the planned activity with a rate of 27%. Discussion and written method of statement ranked as the second used method with a rate of 26%. While referring to other jobs only ranked third with a rate of 23%. Schedulers alone never take such decisions.

6. Conclusion

The most significant factors of time overrun are economic crisis, unreasonable project time frame, payment delays, and underestimation of time for completion. Owner-related factors come in first place followed by external factors that are beyond the control but owner-related factors could be controlled. Thus, special attention is needed to minimize the effect of these factors. The results show that multiple methods are used for the time management process. The most common method of controlling time was the Bar Chart Method with a rate of 44.29% and the Flow Chart Method with a rate of 38.57%. The respondent recorded that Microsoft Excel is mostly used followed by Microsoft Project, but Primavera is rarely used. The duration of planned activity is identified mostly by referring to similar projects and sometimes by estimating the real-time with adding time for a contingency. The sequence planned is set as a result of a discussion and written method statement with the project manager. The project manager has a high percentage of responsibility for drafting a planning method statement and project planning meetings. Other times the program is written by the project scheduler planning engineer. and the sequence of work is established by a discussion

with a scheduler or by referring to other jobs only. From the findings, the majority of progress reports are recorded on paper and immediately transcribed into the database. But sometimes they are kept on paper only. It is recommended to have a specific time management system based on the importance and type of the project.

Abbreviations

CIOB	Chartered Institute of Buildings
PMI	Project management institute

Conflict of interest

The authors confirm that publishing this article will not cause a conflict of interest.

Author Contribution Statement

This paper is individual work. The author conceived the presented idea, developed the theory, performed the computations, verified the analytical methods, and supervised the findings of this work.

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