Construction Practice of Small Hydropower Projects in Nepal

[1]Er.Kiran Chiluwal, [2] Anjay Kumar Mishra,
[1]Project Manager, [2]Assistant Professor
Nepal Engineering College - Centre for Postgraduate Studies, Nepal

Abstract: Large number of hydropower projects is under construction and it is essential to document the construction practice of hydropower projects. Construction professional always focus on time, cost, safety and quality. The objective of the research is to assess construction management practice of small hydropower projects in Nepal. Out of thirty eight small hydropower projects twenty seven projects were considered for the study based on Cochran sample size for construction practice. Questionnaire survey, KII and case study of two projects was conducted for data collection.

Critical path method was popular for planning the project. Weekly meetings were preferred by client, consultant and contractor for monitoring of the project progress. The overall findings of 62.86 percent of parties involved in the project used to coordinate their current schedule with master schedule. 80 percent of client, consultant and contractor had the association of cost schedule with estimated time schedule. More than 74 percent of client, consultant and contractor did not use any software for planning, monitoring and controlling of cost of project. Furthermore, the safety factors were moderately used in construction project. Also, 40 percent of meetings were conducted weekly for the safety issues and there were less number of trainings for the safety. Improvement in construction practice is required for ensuring the safety and timely completion of project within estimated budget.

Keyword: Time, Cost and Safety Management Practice, Small Hydropower

INTRODUCTION

More than 90% budget of the HP projects is expensed in construction phase. It is the main part of the project life cycle. Most of the hydropower projects in Nepal have not been completed on time and within the estimated cost. Time and cost overrun in hydropower projects are very common problems. Among all these bad scenario of hydropower development of Nepal, few of the small hydropower projects developed by the private sectors are constructed within time frame as well as within the estimated cost.

A good construction practice of any construction project refers that it is free from defects, right things at right time and the continuous improvement of the project. It is measured with the time, cost, quality and safety of the project. The productivity as well as the satisfaction yield in quality aspect project is also the major part of construction. The profitability of any organization depends with the performance of construction.

The research to endorse the construction practice of the hydropower construction and its effect on the project to set the benchmark for the construction related issues. Due to availability of very little research in the area, the research is highly demanded. It is significant to provide information for local experts, decision makers and those foreign experts approaching in the region to work for Hydropower development.

1.1Research Objectives

The overall objective of the study is to assess the construction practice of the small hydropower runoff river (RoR) type projects in Nepal developed by Independent Power Producers (IPP'S) and the specific objectives are to assess the time, cost and safety management practice.

LITERARURE REVIEW

2.1Performance Measurement

Performance measurement received substantial attention from researchers and the construction industry over the past two decades, thus awareness of the importance use of appropriate performance measures and its role in supporting the application of lean construction concepts (Sarahan. 2002). However, very few companies systematically measure their performance in a holistic way. Moreover, the existing systems tend to focus more on product and less on process and design. The construction Industry performance is affected by national economies (Navon, 2005). This can lead to the sub-optimal quality of the performance measurement system, the misjudging of relative performance, and to complacency and the denying of appropriate rewards to the deserving. Previous studies have revealed that performance measurements can be measured in terms of financial and non-financial measures, or the combination of both (Glasgow Caledonian University, Glasgow G4 OBA, UK). When measurements are being implemented, contractors, consultants and the management team's performances are blamed as the major reasons for the failure of a particular project. The other project stakeholders, such as client, suppliers, trade contractors and the community at large, are neglected (Takim and Akintoye, 2002).

The construction industry has a great impact on the economy of all countries (Assaf,Al-Khalil, and Al-Hazmi, 1995). Performance measures are applied at different levels: industry, firm, project and activity. Productivity is an important industry level measure while concepts such as efficiency are applied typically at the firm level. In projects, especially construction projects, sustainability measures related to environmental, economic and social sustainability are applied increasingly. Resource uses including waste management is the input component of the productivity formula and also influences primarily environmental and economic sustainability.

The importance of performance assessment in construction is to eliminate higher costs and to eliminate any delay as well as value engineering. Therefore, there is need for identifying the key measures of performance that are used commonly in the field of construction and that construction organizations need to develop systems and process to measure in order to satisfy a wide variety of clients (Bhatti, 2013)

2.2 Performance Measurement of Hydropower Construction

Ofori (2001) posits that the absence of measurable targets in the development programs to guide and assess, at intervals, the success of their implementation is a possible reason for lack of progress and the persistence of problems in the construction industry. The continuous monitoring of the performance helps the construction industry to improve and sustain the industry. So, the sustainability in the area is very important for the long run. More importantly, the goal could be better achieved if the approach takes into consideration the very peculiar nature of the industry as outlined by Hillebrandt (1984): (i) the nature of the final product, (ii) the structure of the industry and the organization of the construction process, (iii) the determinant of demand, (iv) method of price determination.

Beatham et al (2004) notes five problems with this approach in relation to construction companies:

1. They focus on post-event lagging key performance outcomes at a very high level that offered little opportunity to change and were not used by businesses to influence managerial decisions.
2. The key performance indicators were not aligned to the strategy or business objectives of construction companies.
3. They were designed for cross industry benchmarking purposes, but due to a lack of certainty in the data, problems with different procurement routes and lack of validation of results, this level of benchmarking is not thought to be viable.
4. The key performance indicators do not provide a holistic, company-wide representation of the business.
5. They are not incorporated into a Performance Measurement system (PMS).

It is the position of this research that the objective of better improvement in the performance of construction industry would be better achieved if the industry is rightly divided into its major component parts that is clients, contracting firms, consultants, suppliers, publics and other stakeholders.

The performance in the hydropower construction depends on various factors. The success factor for the good performance depends on the Project Manager's Competence, Top Management Support, Monitoring and Feedback by Project Participants, Interaction among project participants and Owners' Competence. Furthermore, the failure factors for the performance are Conflict among the Project participants, Hostile socio economic and climate condition, PM's Ignorance and Lack of Knowledge, Faulty Project Conceptualization, Project specific factors and Aggressive competition during tendering (Jha & layer, 2006).

2.3Measurement of Project Performance

Internationally, the traditional (financial) performance management systems were criticized because they are based on lagging indicators that are not sufficient; they give information about the past and they are not helpful to introduce information about causes, areas, and responsibility in case the project succeeded or failed to support decision making and direct future performance (Kaplan and Norton, 1992). Performance measurement was defined as: ''the process of quantifying effectiveness and efficiency of actions.''(Neely et. al., 1995). The research proposed many tools which employ leading non-financial indicators such as quality, time, productivity, etc. that can lead the performance and not just know it (Bititei and Nudurupati, 2002). Indicators were defined as: "numerical information used to quantify the input, output and performance dimensions of processes, products, programs, projects, services and the overall outcomes of an organization" (NIST,2004). Then, the concept of key performance indicators (KPIs) is rose which is "a measure of performance of an activity critical to organizational and project success" (KPI, 2009). A set of performance indicators have been presented for performance measurement in construction; they are: time, cost, quality, client satisfaction, client changes, business performance and health & safety. The performance measurement helped in performance monitoring and setting priorities through defining fields that need attention. In addition it enhances enthusiasm, improves communication, and activates accountability (Waggoner et. al., 1999).

Cheung et al (2004) stated that New South Wales Public Works Department in Australia launched a Project Performance Evaluation (PPE) framework, which covers a wide range of performance parameters. PPE parameters are communication, time, cost, quality, safety, claims and issues resolution, environment, contract relations. The main purpose of PPE is to extend project performance measures to cover soft parameters, such as communication and dispute resolution. In UK, a project performance measurement tool referred to as the Key Performance Indicators (KPIs) was developed by the KPI working group under the UK Construction Industry Best Practice Program to include time, cost, quality, client satisfaction, change orders, business performance, health and safety. The three major steps in implementing KPIs are as follows: Decide what to measure, Collect data and Calculate the KPIs. However, both the PPE and KPIs are valuable tools for measuring project performance over a period of time. Anyway, it is obtained from previous study that both methods PPE and KPIs can be used for measuring performance as the indicators are similar in both methods. In this study KPIs method will be used to measure performance. (Iyer and Jha, 2005) stated that measuring the performance of any construction project is very complex process because modern construction projects are generally multidisciplinary in nature and they involve participation of designers, contractors, sub-contractors, specialists, construction managers, and consultants. With the increasing size of the project, number of participants in the project also increases. The objectives or goals of all participants need not be same in a given project. Hence to measure performance of a project without specifying the participant and without specifying the criteria for judging the performance holds no meaning. Past researchers have employed different criteria such as compliance to schedule, cost and quality to judge the project performance.

Lehtonen (2001) proposed new framework for measuring construction logistics by using two dimensions in order to improve productivity. The first dimension (use of measures) contains two kinds of measures. One of these kinds is called improvement measures which help construction industry to find out the problems with current practices. These measures are mainly used during development projects. Another kind is called monitoring measures which are used for continuous monitoring of operations. This dimension of the frame work is the focus of measures. It clarifies at which organizational level measures can be used. There should be information available at the company and project level, as well as at the specific supplier or subcontractor level. (Samson and Lema, 2002) proposed performance measurement system. The system comprises of construction business perspective including innovation and learning, processes, project, stakeholders, and financial perspective. The indicators developed from perspectives are categorized into three main groups which are drivers' indicators, process indicators and results indicators. The key to the success or failure of the measurement system are leadership commitment; employees' involvement & empowerment; and information coordination & management. (Shenetal, 2005) presented a method for measuring the environmental performance of construction activities committed by a contractor through calculating the contractor, is environmental performances score (EPS). The level of EPS serves as a simple indicator for measuring and communicating the level of a contractor is environmental performance.

2.4Key Performance Indicators

KPI is a type of performance measurement that helps to understand how the organization or department is performing. A good KPI should act as a compass, helping you and your teams understand whether you're taking the right path toward your strategic goals (Jackson, 2015). KPIs, both financial and non-financial, are critical element of effective communication of a company´s progress towards its goals (Cronin, 2007). KPIs have to be linked to all partial goals within the strategy map. It is essential to assign the required strategic value which will have expressing power about the level of organization performance (Iveta, 2012). Key performance indicators in construction are related with safety performance, quality performance, cost performance, delivery performance and the performance of employees and workers. Key performance indicators help to find the deviation of planned budget and schedule. Also, it helps to find the missed milestone and cost variance of the project.

Cheung et al (2004) remarked seven main key indicators for performance which are: time, cost, quality, client satisfaction, business performance, safety and health. Navon (2005) stated that a number of research efforts to fully automate project performance control of various project performance indicators have been carried out in recent years. These are also briefly described together with the concept of measuring indirect parameters and converting the mean to the sought indicators. These are (1) labor and earth moving productivity based on measuring the location of workers or earth moving equipment at regular time intervals; (2) progress based on the above data; (3) a comprehensive control of construction materials starting by monitoring orders and purchasing up to the movement of the materials on site.

Pheng and Chuan (2006) stated that project performance can be determined by two common sets of indicators. The first set is related to the owner, users, stakeholders and the general public which are groups of people who will look at project performance from the macro viewpoint. The second are the developer, a non-operator, and the contractor which are groups of people who will look at project performance from the micro viewpoint. Jin et al (2006) studied the relationship-based factors that affect performance of general building projects in China. Thirteen performance metrics are used to measure the success level of construction projects. These factors are categorized into four groups namely cost, schedule, quality and relationship performance. It is recommended that foreign firms that have entered or are going to enter the Chinese construction industry should learn how to build cooperative and harmonious relationships with Chinese partners and finally achieve satisfactory project performance by paying sufficient attention to the above-mentioned factors.

Ugwu and Haupt (2007) developed and validated key performance indicators (KPI) for sustainability appraisal using South Africa as a case study. It has used four main levels in a questionnaire to identify the relative importance of KPI. The main indicators were: economy, environment, society, resource utilization, health and safety and project management and administration. Luuetal (2007) provided nine key

performance indicators (KPIs) which can be applied to measure project management performance PMP and evaluate potential contractors as well as their capacity by requesting these indices.
Indicators for measuring performance building construction companies in Kingdom of Saudi Arabia

No.	Author and Year	Country	Performance Indicators	
1	Jastaniah (1997)	Saudi Arabia	1. Client satisfaction	6. Closeness to budget
			2. Planning period	7. Profitability
			3. Staff experience	8. Payment
			4. Communication	9. Claims
			5. Safety	
2	Egan (1998)	UK	1. Predictability - time	5. Profitability
			2. Construction cost	6. Safety
			3. Construction time	7. Defects
			4. Productivity	8. Client satisfaction
	Department of the Environment, Transport, and the Regions (DETR), 2000Department of the Environment, Transport, and the Regions (DETR) (2000		1. Time	5. Client changes
			2. Cost	6. Business performance
			3. Quality	7. Health and safety
			4. Client satisfaction	
	Wong (2004)		1. Staff experience	5. Contractor experience
			2. Resources	6. Time
			3. Site management	7. Cost
			4. Safety	8. Quality
	Constructing Excellence		1. Client Satisfaction	7. Profitability
			2. Defects	8. Productivity

	(2005, 2006, 2009) and Roberts and Latorre (2009)		3. Predictability cost, time	9. Safety
			4. Construction cost, time	10. Social indicators
			5. Variance cost, time	11. Environment
			6. Contractor satisfaction	
3	Pillai et al. (2002)	India	1. Benefit	5. Production
			2. Risk	6. Cost effectiveness
			3. Project status	7. Customer commitment
			4. Decision effectiveness	9. Project mgmt.
4	Cheung et al. (2004)	China	1. People	5. Safety
			2. Cost	6. Client satisfaction
			3. Time	7. Communication
			4. Quality	8. Environment
5	Rankin et al. (2008) and Canadian Construction Innovation Council (CCIC) (2007	Canada	1. Cost	5. Scope
			2. Time	6. Innovation
			3. Quality	7. Sustainability
			4. Safety	8. Client Satisfaction
6	Luu et al. (2008)	Vietnam	1. Construction cost	5. Team performance
			2. Construction time	6. Change management
			3. Customer satisfaction	7. Material mgmt.
			4. Quality management	8. Safety
7	Skibniewski and Ghosh (2009)	USA	1. Construction cost	4. Defects
			2. Construction time	5. Client

				satisfaction
			3. Predictability cost and time	
	Construction Industry Institute (CII) (2011)		1. Cost	4. Accident
			2. Schedule	5. Rework
			3. Changes	6. Productivity
8	Toor and Ogunlana (2010)	Thailand	1. On time	6. Safety
			2. Under budget	7. Defects
			3. Specifications	8. Stakeholders
			4. Efficiently	9. Disputes
			5. Effectiveness	

Source: (modified from Ibrahim et al., 2012)

METHODOLOGY

Research Approach

Qualitative as well as quantitative research approach has been used since the collected data were analyzed and presented with proportions and means according to the nature of the data. Depending upon the nature of the result, the perceived performance affecting factors were categorized where necessary.

3.1Study Area

Small hydropower projects either already constructed or in under construction phase are selected for the study because in comparison to the medium and large project, smaller project have fewer constrains and are easy and fast for the study, design and construction. Though every project is unique in nature, smaller projects have less issue, small scale of hindering factors and confined volume of construction parameters. Government and foreign investors have no interested in small scale projects, so it will be the project developed by the private developers. The project developed by the private developer has also been chosen because the history of the hydropower construction has shown that the cost of hydropower project developed by private developer is lesser than Government and other foreign investors.

3.2Study Population and Sample Selection

In this study, the population means all small hydropower projects which are in commercial operation phase and in the final stage of construction all over the Nepal. More than 38 small hydropower projects are in commercial operation (DoED, 2017) and more than 15 small hydropower projects are in final stage of construction (DoED).

3.3Sample Size

All the project parties Client, Consultant and Contractors were interviewed on objectives of this thesis.

1. Client
2. Consultant
3. Contractors of the project like Civil contractor, Hydro mechanical contractor, Electromechanical contractor and Transmission line contractor
4. Experts working on similar type project construction have also been interviewed to find the construction practice of project and local people who are closely monitoring the activities of the project.

3.4Method of Data Collection

Primary data were required for the fulfillment of the purpose of this research. It has been collected by field visit and interview of the personnel related to the project. Questionnaire has been developed in such a way that include participant from clients, consultants, contractors. The opinion of the experts has been taken as key informant interview with the project manager; finance head and site engineer of selected projects to find out the practical problem associated with the construction practice. Also, the opinion of people who were directly involved in project activities was taken by the focused group discussion to evaluate the impact of project in society and the impact on construction practice by the social issues.

3.6.1 Primary Data

Key Informant Interview (KII)

For the validity and reliability of the questionnaire, key informant interview were taken with the expert of hydropower sector. The KII was based on the snowball sampling. This interview was taken by meeting the expert of related field. Five experts were chosen for the KII and all of them had experience of more than ten years in the hydropower sector.

Questionnaire Survey

After the validity of the questionnaire, the questionnaires were distributed to the respondent of client, consultant and contractor. Forty percent of the questionnaires were distributed by visiting to their offices and sixty percent of the questionnaires were sent by the email. Most of the respondents have positive response regarding the questionnaire.

3.5Data Analysis

After collection of primary and secondary data, questionnaire and interviews these data were analyzed systematically.

RESULTS AND DISCUSSION

4.1The Construction Practice and Performance

The construction practice in terms of time, cost and safety of selected small hydropower projects were analyzed and performance of two hydropower projects in terms of cost performance index and schedule performance index were also analyzed.

4.1.1 The Time Management Practice

The representative of client, consultant and contractor were interviewed by questionnaire for the time management practice of hydropower construction. Table 4.1shows the method of project planning and scheduling.

Table 4-1Usage of planning method

Method	Client (%)	Consultant (%)	Contractor (%)
Bar chart	17.64	20.00	66.67
Critical path	23.52	60.00	16.67
S-Curve	52.94	13.33	8.33

Table 4-1shows that Bar chart method is most important planning and scheduling method for contractors because bar chart method can facilitate time performance control for each schedule activity through project implementation. However, Critical Path Method (CPM) is the most important one for consultants because CPM can be used to determine critical activities of project. This will assist consultants to evaluate overall time performance and to identify the effectiveness of critical path on completion date of project. S-curve method is mostly used by client because it can compare actual time and estimated time at any stage through project implementation. However, it is difficult to control time performance for each scheduled activity and it is difficult to obtain critical path affecting overall time performance of project.

Monitoring, updating and controlling of project progress are one of the most important factors for the performance of hydropower project. Table 4.2 shows the status of monitoring, updating and controlling of project progress.

Table 4-2Frequency of meeting type of project team

Period	Client (%)	Consultant (%)	Contractor (%)
Daily	11.77	13.33	25.00
Weekly	70.59	46.67	50.00
Monthly	17.67	40.00	25.00

Table 4-2 shows that clients, consultants and contractors often have weekly meetings for discussion. Weekly meeting assist them for monitoring, updating and controlling the progress through project implementation. In addition, they can solve problems, evaluate current performance, and improve future works. Respondents are rarely meets daily or monthly. Daily meeting are required in the case of sensitive and very important works. Navon (2005) stated that a controlling and updating is an important element to identify factors affecting construction project performance.

The practice of coordination of project schedule with master schedule is basically done monthly basis. Details have been presented in the table 4-3.

Table 4-3Coordination frequency of current schedule with master schedule

Period	Client (%)	Consultant (%)	Contractor (%)
Daily	5.88	6.67	8.33
Weekly	52.94	46.67	41.67
Monthly	41.18	46.67	50.00

Table 4-3 shows that most of owners and consultants coordinate current schedule with master schedule of the project weekly. This weekly coordination can assist them to evaluate time performance of project comparing with base schedule. However, most of contractors coordinate current schedule with master schedule of the project monthly. In fact, contractors should do that weekly in order to have continuous monitoring, controlling and updating of time performance of project. Generally, monitoring and updating the progress depends up on project duration, type of works and degree of project complexity. Reichelt and Okuwoga (1998) identified that the time performance problem is related to poor time control and updating. Lyneis (1999) obtained that project schedule must be controlled by the dynamic feedback process. Those processes include their work cycle, feedback loops and effects between work phases.

If there is any delay in construction or to avoid the delay in construction, generally the sub-contractor and supplier are advised to submit their detail a month earlier so that it can be adjusted with master schedule. The practice of submission of detail activities from sub-contractor and supplier are presented in table 4-4.

Table 4-4 Frequency of coordination with sub-contractors and supplier schedule

Period	Client (%)	Consultant (%)	Contractor (%)
Daily	5.88	13.33	16.67
Weekly	47.06	26.67	41.67
Monthly	41.18	46.67	41.67
Never	5.88	13.33	0.00

Table 4-4 shows that most owners coordinate with sub-contractors and supplier schedule monthly or weekly. This depends up on the need of coordination and controlling processes. However, most consultants coordinate with sub-contractors and supplier schedule monthly. Most contractors coordinate with sub-contractors and supplier schedule weekly and monthly. This coordination depends mainly on project nature, type of work and duration of supplying and implementation. Thomas (2006) remarked that the selection of suitable suppliers for the provision of various construction materials is one of the most important aspects in ensuring success performance of construction projects. Errasti (2007) stated that sub contractors in the construction industry are subject to tremendous pressures in terms of time, service and cost. Subcontractors have responded to these challenges in a number of ways, foremost amongst these has been by working more closely with their suppliers. In the construction industry, sub-contractors need to improve their performance in terms of quality, service and cost.

Furthermore, for planning and scheduling of project progress, the most used software is MS project. Details of the respondent have been presented in table 4-5.

Table 4-5Usage of each software for planning and scheduling

Software	Client (%)	Consultant (%)	Contractor (%)
Primavera	23.53	20.00	8.33
MS Project	58.82	53.33	75.00
Excel sheet	17.65	26.67	16.67

Table 4-5 shows that Microsoft project is the most important, famous and easy program used by owners, consultants and contractors for planning and scheduling. This program enables them to schedule, monitor, update and control many criteria of project such as time, cost and resources. It is observed that Primavera program is an advanced and a complex program compared with Microsoft project. Construction organizations in the hydropower sector in Nepal are not familiar with Primavera to be used or applied. However, Excel program has a limitation in usage for planning and scheduling.

Chan and Kumaraswamy (2002) remarked that construction programs with advanced available of software can help to accelerate the performance. Goh (2005) remarked that information technology management leads to performance improvement in the construction industries. For instance, in Singapore 2003, general administration, design, project management, planning, scheduling, site management were enhanced by using of IT. In addition, there were more advantages as quick working, good quality of work and fast access of information.

4.1.2 The Cost Management Practice

Cost management or cost control is one of the key factors to enhance the construction performance of hydropower project. If cost schedule and time schedule are associated to each other, outcome of project will be high. The details of association of cost schedule and time schedule have been presented in table 4-6.

Table 4-6Presence of cost schedule associated with the estimated time schedule

Description	Client (%)	Consultant (%)	Contractor (%)
Yes	76.47	80.00	83.33
No	23.53	20.00	16.67

Table 4-6 shows that construction organizations often use cost schedule associated with the estimated time schedule. This association assists organizations to evaluate performance of cost and time together at any stage through project implementation. That will assist construction organizations to know if project is ahead or behind of schedule and if it is over or under estimated cost. Reichelt and Lyneis (1999) obtained that time schedule and budget performance are controlled by the dynamic feedback process. Those processes include the rework cycle, feedback loops creating changes in productivity and quality, and effects between work phases.

Moreover, the concept of earned value analysis is also the most important part for the controlling the cost. Table 4-7 shows the context of actual value and earned value analysis to control the cost of the project.

Table 4-7Applying the actual value and earned value concept in controlling cost

Description	Client (%)	Consultant (%)	Contractor (%)
Yes	41.18	40.00	58.33
No	58.82	60.00	41.67

Table 4-7 shows that most of the contractors apply the actual value and earned value concept in controlling cost for the project. The client and consultant should also apply this concept. Earned value concept provides a system for evaluating the performance of the project through integrating cost, schedule, and work. This will assist for evaluation cost and time performance of projects. For example, at any stage of project, if earned value is more than actual value, the cost performance will be good. Vandevoorde (2006) stated that Earned value project management is a well-known management system that integrates cost; schedule and technical performance. It allows the calculation of cost and schedule variances and performance indices and forecasts of project cost and schedule duration. The earned value method provides early indications of project performance to highlight the need for eventual corrective action.

Cost control in the project is one of the challenging parts of the project. There need to have a cost control engineer for the control of the cost. The practice of hiring cost engineer is shown in table 4-8.

Table 4-8Having cost engineer who is only responsible for dealing with cost control

Description	Client (%)	Consultant (%)	Contractor (%)
Yes	29.41	46.67	41.67
No	70.59	53.33	58.33

Table 4-8 shows that most of owners, consultants and contractors do not have a cost engineer who is only responsible for dealing with cost control. This is because most construction firms in the Nepal are small size nature. Hence, their needs to cost engineer is much lower than large companies. Chan and Kumaraswamy (1996) stated that poor site management and low speed of decision making involving all project teams affecting cost performance control of project. Reichelt and Lyneis (1999) obtained that project cost performance can be controlled by the dynamic feedback process. Those processes include the rework cycle, feedback loops creating changes in productivity and quality, and effects between work phases.

There are many other expenses rather than direct expenses in the construction project. The practice of right and authority for line managers to manage the actual expenses are presented in table 4-9.

Table 4-9 Giving right and authority for line manager to manage the actual expenses

Description	Client (%)	Consultant (%)	Contractor (%)
Yes	52.94	26.67	33.33
No	47.06	73.33	66.67

Table 4-9 shows that most owners give right and authority for line managers to manage the actual expenses. However, most of consultants and contractors do not give right and authority for line managers to manage the actual expenses. Giving right and authority for line managers to manage the actual expenses depends mainly on the nature and size of works. Chan and Kumaraswamy (2002) remarked that effective communication and fast information transfer between managers and participants help to accelerate the building construction process and performance.

The application of software for the controlling of the cost is not used widely in the construction project. The details of application of software for the controlling of the cost are presented in table 4-10.

Table 4-10 Applying any software to plan, monitor and control cost

Description	Client (%)	Consultant (%)	Contractor (%)
Yes	23.53	13.33	50.00
No	58.82	86.67	50.00

Table 4-10 shows that most contractors use software program in order to facilitate planning, monitoring and controlling cost. However, the client and consultants do not use software. The most programs used in construction organization in order to control and monitor cost are: Excel and Ms-project. Most organizations are familiar with these software programs because they are easy to be used and have different facilities and functions to control the cost. Goh (2005) remarked that information technology management leads to performance improvement in the construction industries. For instance, in Singapore 2003, general administration, design, project management, cost control, site management was enhanced by using of IT.In addition, there were more advantages as quick working and good quality of work.

4.1.3 The safety management practice

Safety is major part of any construction. In Nepal, the practice of safety has not been done satisfactory. The respondent from many projects has moderately implemented the safety in their projects. The result of project safety implemented in the construction project is presented in table 4-11.

Table 4-11Implementation frequency of safety factors

Safety	Client (%)	Consultant (%)	Contractor (%)
Not at all	11.77	13.33	8.33
Moderately	70.59	60.00	66.67
Extensively	17.65	26.67	25.00

Table 4-11 shows that in most cases, an overall project safety factors has been moderately implemented in construction organizations. This is because of absence of safety control or its application through project implementation stage. In hydropower construction, there are many contractors do not care with applying health and safety factors during construction of projects. In addition, consultants do not have sufficient control or continuous supervision for safety application. All of that will lead to occurrence of accidents and problems in construction projects. Cheung et al. (2004) remarked that safety factor affects strongly on performance of projects. Ugwu and Haupt (2007) stated that safety factors are significant for consultants and contractors because it affects strongly the safety performance of construction projects.

Performance of the construction is directly related to the safety matter of the project site. So, regular meeting with the parties regarding the safety is one of the most important parts for the enhancement of construction performance. Detail is presented in table 4-12.

Table 4-12Meeting frequency for safety issues

Meeting	Client (%)	Consultant (%)	Contractor (%)
Daily	5.88	0.00	8.33
Weekly	47.06	40.00	50.00
Monthly	35.30	33.33	33.33
Never	11.77	26.67	8.33

Table 4-12 shows that most of owners and consultants organize the meeting for safety issue monthly. However, most of contractors organize the meeting for safety issue daily. This is because contractors are more interested with operational factors which require frequent and continuous meeting for safety issues. Otherwise contractors, owners and consultants are more familiar with clients and technical factors. Cheung et. al.(2004) and Ugwu and Haupt (2007) obtained that safety issues are significant and important for improvement of construction projects performance.

Moreover, safety training in project site is also the important aspects of project construction. Regular safety training helps to enhance the efficiency of the workers and employees. The practice of safety training is shown in table 4-13.

Table 4-13Safety training number

Training	Client (%)	Consultant (%)	Contractor (%)
None	41.18	13.33	16.67
One	35.30	33.33	66.67
Two	17.65	46.67	8.33
More than two	5.90	6.67	8.33

Table 4-13 shows that most of owners and consultants and do not have any formal safety training. However, most of contractors have formal safety training one time per month. Generally, in hydropower sector, it is observed that most of construction organizations do not have formal safety training. This will lead to absence of safety application and will contribute to occurrence of many accidents and problems in the site. Construction projects in Nepal are recommended to have formal safety training in order to improve performance of construction projects. Cheung et al (2004) remarked that safety factors affect strongly on performance of construction projects. Not only in hydropower but also in Road projects of Kathmandu Valley the implementation of safety was not found satisfactorily(Mishra and Shrestha,2017).

Before the construction starts, planning regarding the safety is most. Every workers and employers cannot be addressed in all the events of safety but the leaders like foreman and site managers have to take the safety related classes and issues. The result of pre-task planning for safety conducted by contractor foreman or site managers are listed in table 4-14.

Table 4-14Frequency of pre-task planning for safety conducted by contractor foreman or other site manager

Planning	Client (%)	Consultant (%)	Contractor (%)
Not at all	29.41	46.67	25.00
Moderately	70.59	53.33	75.00

Table 4-14 shows that in most cases, pre-task planning for safety was moderately conducted by contractor foremen or other site managers. This is because of absence of safety planning and control through project implementation stage. There are many contractors do not care with planning health and safety issues during construction of projects. This will lead to occurrence of accidents and problems in construction projects. Ugwu and Haupt (2007) stated that safety planning is significant for contractors because it affects strongly the safety performance of construction projects.

CONCLUSION AND RECOMMENDATION

5.1Conclusions

Client, consultants and contractor have used S-curve, critical path and bar chart for the planning and scheduling the project. Every week monitoring, updating and controlling of the project progress were most effective aspect of the project. The coordination of scheduling at different milestone of project was satisfactorily conducted. MS project were used for planning and scheduling of the project. Moreover, the cost management in construction project is very important for the performance and profitability. All the parties involved in the project had association of cost schedule with estimated time schedule. The concept of actual value and earned value did not apply for the control of cost. No software was used for planning, monitoring and cost control of the projects. Furthermore, in most cases, an overall project safety factors had been moderately implemented in construction organizations. This is because of absence of safety control or its application through project implementation stage. There are many contractors who do not give care with applying health and safety factors during construction of projects. In addition, consultants do not have sufficient control or continuous supervision for safety application. All of that will lead to occurrence of accidents and problems in construction projects.

5.2Recommendations

It is recommended that the construction methodology used for the construction of hydropower projects in Nepal is not satisfactory. The client, consultant and contractor should follow the specific methodology for the construction of hydropower projects. Moreover, planning and scheduling of the project should be proper and the use of software for the planning and scheduling should be specific.

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