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A Review of Large-Scale Hydropower Project in Public Sector of Pakistan

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Abstract: ***Client organization inadequate project planning before awarding the contract and insufficient monitoring and control system among the parties involved create severe problems. Ultimately, large-scale projects go beyond the expected cost and time control limits. This paper discusses the major issues involved with a large-scale Hydropower Project in Pakistan Public Sector environment. The latest approved Baseline Plan of project was reviewed and analyzed using Variance Analysis and Trend Analysis techniques in Primavera project management software to assess the efforts made of the parties involved. It was found that Project is 202% Cost overrun and 25% time delays from original contract award. After analysis of baseline plan and quantification of various variance issues in impacted activities, the questionnaire survey was conducted to identify the impact of causative factors. There were almost 17 most significant causative factors identified among 60 identified factors and responsibilities are assigned accordingly. At the end recommendations are made for strategic decisions as lessons learned during project evaluation.***

Keywords: Scheduling Practices, Delay Analysis, Causes of Delays, Project management practices in Hydropower

I. INTRODUCTION AND BACKGROUND OF STUDY

In large scale projects where time is considered as money, management of time plays a key role for the successful execution of project [1]. The stakeholders of the project and project sponsoring agencies like to know the actual status of the project regarding project progress. It is a crucial demand for the development of project planning and scheduling processes better in order to control the project as well as to identify the reasons of project delays and cost overruns for strategic decisions earlier. It has been learnt in most of the private as well as public sector projects that the contractor excusable claims are increased at a level which changes the original contract between the parties involved. Most of the projects exceed time limits due to heavy excusable claims occurred during the execution of project. For this purpose, there is a need to make a quantifiable mechanism to search for the current status of the project regarding the actual progress in works and to monitor it.

The knowledge of project management practices in Pakistan public sector is being increased to manage the projects professionally. However these are far away from private business environment. It is normally argued that in public sector, it is difficult to implement the world common project management practices in local environment due to complexity and lack of monitoring efforts for the projects especially in hydropower related. The conventional approach for the project monitoring and control cannot cope with the complexity issues inherent in the planning and execution phase.

To review the level of these practices in Pakistan public sector environment, the case of hydropower projects has been analyzed. The general research methodology used in selected problem area is case study project evaluation of a large scale (Installed Capacity: 969 MW; Execution Cost: Rs. 274.882 Billion Pak- rupees) hydropower project under construction stage. This project is planned and awarded at international standards namely FIDIC based standards (International Federation of Consulting Engineers). According to FIDIC contract clauses the three responsible parties generally called as: The Client or Owner of the Project as 'The Employer' ; The Consultants as ' The Engineer' and General contractor as ' The Contractor'.

For the methodology in our case, data has been collected from project site offices and inserted in a software platform (Primavera). The data has been analyzed and identified some core issues that have been addressed in the upcoming sections.

The upcoming sections of the study will explore the baseline of research under consideration. In the literature review section, it is tried to explore briefly about scheduling practices to cope the different issues involved with a project and significant factors to address these identified issues.

III. LITERATURE REVIEW

The most important phase of project life cycle after planning is execution and implementation phase which requires organization efforts and demand project controlling process which aid to complete the project successfully. The researchers and practitioners have been agreed that the efforts made at project planning stage have much significance for the success of project. Project life cycle explains not only the organizational efforts but also the controlling of all necessary resources needed for project execution. The organizational efforts are low at project conceptualization stage and increases slowly, maximum at execution phase and then decreases to termination phase [2].

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Researchers explained about the importance of planning that projects should be completed within a given time period, within allocated budget, according to technical specifications as scope definition, quality ensured in project works and according to client needs and expectations. After planning stage, the next step is project scheduling to break down the all works at timeline [3]. Callahan, et al. [3] argued the importance of project scheduling for the parties involved in project execution and claimed that project scheduling for contractor and sub-contractors working at project used as a valuable and informational tool for arranging required Wok force, equipment's, funds and any other resources. Finally client used it for timely arrangement of funds and other resources needed at project to avoid any disturbance that affects project completion caused by the owner side. Richman [4] described the importance of project monitoring and control that Project reviews should be conducted during project execution at any desired date as required to know the progress of the project. Because Projects are planned to achieve the defined objectives but there is also need to monitor and Control the performance of the project as planned to take corrective actions [4]. Kwak and Ibbs [5] statistically compares Project Status with planned and determine the results in the form of variances.

Project schedule management had been most commonly research interest of the scholars to find the correlation with successful project execution. Globerson and Zwikael [6] identify that project schedule management is highly correlated with successful execution of any project.

According to PMI [7], A good Project schedule management has much significance to avoid time overruns as well as cost and avoiding any disputes among the parties involved.

Mubarak [8] explained the objectives of schedule management, good scheduling practices at project planning stage. Researchers define project scheduling that it is the identification of project timing, sequence of interrelated activities and operations of project that combines together to give overall completion of project. Project planning gives the answers of what is going to be done in project? Once all the project related data is collected as planned and shown on CPM network logic and all the activities time estimations performed then CPM calculations are run to generate the schedule.

When Project planning activities finishes and scheduling function starts, then first CPM computation is run which gives the total project duration. Comparison can be made between desired and calculated project durations. Project schedule is considered as a valuable project control tool for monitoring and control the progress of projects to provide timely information for effective decision making according to pre -plans [9]. Yang and Kao [9] elaborated that delays in a project creates serious problems to complete the project in a expected time frame. According to Kikwasi [10] delays in a project creates hurdles to complete the project. To minimize the effects of these delays, analysis of contractual approved schedule is necessary for the purpose of allocating financial responsibilities among the parties involved[11]. According to Trauner Jr [11] , for allocating financial responsibilities; Delays are categorized into Excusable, Non- Excusable, Critical, Non- Critical and Concurrent Delays. Excusable delays are further divided into compensable and non-compensable delays.

The techniques developed for analyzing project delays are known as "delay analysis methodologies (DAM)". Braimah [12] and Ibbs and Nguyen [13] described that appropriate selection of delay analysis methodologies according to the purpose of their application during project schedule delay analysis are: as-planned versus as-built, impacted as-planned, collapsed as-built, window analysis and Time impact analysis. The selection of these techniques depends upon complexity of project, time available and the purpose of schedule analysis. As such as appropriate selection of schedule analysis technique concerns, the schedule reviewer or analyzer should clearly understand the purpose of schedule analysis [14].

Trauner Jr [11] explained about concept of float while analyzing project plan and described that the concept of float was introduced when the concept of critical path method was introduced. The float is a amount of time when an activity can be delayed without delaying the entire project from due date of completion. As the project schedule calculation depends upon the critical path which is longest path in the activities network and so float acts as contingency reserve between different activities which are not critical in the project plan but these can be critical later when any other non-critical activities will not complete within specified time frame and impacts on other on-going activities to be critical. Ibbs and Nguyen [13] further elaborated that when all the float will be used up between activities then chances of extending project completion time will be more. The strategies should be develop to save some float for any unexpected problems occurred in future[13].

In the light of these concepts, projects are managed either by early finish dates or by late finish dates of activities. When project is going as planned or have minor delays then focus should be on early finish times calculated to keep the project on track. The focus should be on late finish dates forecasted based on expected project completion time when project progress is going beyond the control and many activities float is being used up. When any consideration will not be taken on the management of float reserve for future unexpected problems, then at one time most of the activities will show late finish times before than early finish times and as a result negative float will appear instead of positive or zero value. When this situation happens in a network and most of the activities show maximum negative float value, then focus of all efforts to be on reducing these negative float values appeared in the network which caused the delays in a project. These negative float values can be minimized by reducing original estimated durations for each activity and this can be possible only by applying more resources on the early completion of that activity. It

is concluded that by managing each activity float through appropriate resources overall project can be managed in a better way provided that schedule data is properly managed and inserted to schedule management software. For timely corrective measures, schedule baseline plan should be updated and communicated on monthly basis in which daily targets should be cleared to each responsible party or person [15].

According to Ismael [16] time schedule is a contractual document between contractor and client which shows the project starts, end dates and important milestones dates of the project. It is also used to see the activities sequences, contractual work progress, to forecast the activities early start, early finish, late start and late finish dates of the project. The contractual time schedule can be classified into six types which are Tender Schedule, Master Time Schedule, Detailed Time Schedule, Baseline Time Schedule, Updated Time Schedule and revised Time Schedule. To find out the current status of the project at any desired date, project approved baseline time schedule should be regularly updated, so that updated time schedule can be compared with original approved baseline schedule. Variances in the activities are observed in the form of total float remaining and activities completion time is forecasted from original available float [9].

To identify the most significant causative factors of these variance issues, researchers conducted quantitative questionnaire type survey. The summary of their research findings is shown in the table 1.

TABLE I
SUMMARY OF PREVIOUS STUDIES ABOUT FACTORS OF TIME AND COST OVERRUN

S. No.	Researchers (Year)	Country Where Research Conducted	Causes of Delay Most Significant Factors identified during research
1	Halloum and Bajracharya [17]	Bangkok, Thailand	Lack of defined Scope of work
2	Motaleb and Kishk [18]	UAE	Design Change Orders
3	Shebob, et al. [19]	Libya	Delay in delivering project site to contractor
4	Ismail [20]	Iran	Delay in payments by client
5	Hafez and Elsaka [21]	Egypt	Controlling subcontractors by Contractor in the execution
8	Kagiri and Wainaina [22]	Kenya	Inadequate planning by employer before awarding the contract
9	Rahsid, et al. [23]	Pakistan	Delays in producing design document
10	Sambasivan and Soon [24]	Malaysia	Inadequate contractor's experience
11	M. Haseeb [25]	Pakistan	Sustained Cash Flow Problem by owner side

Project management practices in public sector projects, although have many similarities with private sector projects in terms of project management processes , tools, stages and principles but for controlling and managing projects in public sector involved many bodies for decision making and release of funds [26].

Pakistani Researchers further explained that, public sector projects should be managed in minimum possible cost due to their national importance for any country and need special efforts from decision makers but unfortunately they have slow response time due to bureaucratic culture. According to S.Mubin [27], public sector projects are those that financed, authorized and operated by federal, provisional, district or local governments while private projects are financed and operated by individuals. Public projects may be of any size but normally these are large and complex to handle due to their large scope of work than private concern. Pakistan planning commission has developed the guidelines for managing public sector projects at national level and researcher studied these guidelines also before analyzing the case study project.

The Planning Commission, Government of Pakistan developed proforma's which needs to submit by every client organization or ministry for approval of projects and release of funds accordingly called PC-1, PC-II, PC-III, PC-IV and PC-V document from conception stage to until completion of project[28].

From initial literature research, it has been seen that there is a gap between general world project management practices and public sector projects especially hydropower projects executed in Pakistan. Standard practices and procedures were over looked at each phase of project life cycle. Slow decision making processes and lack of seriousness among responsible stakeholders at organizational level and government bodies creates serious problems and ultimately projects did not executed in true way. For example at project conception stage, projects actual needs and priorities are not considered well, detailed feasibility analysis is not conducted for evaluating alternatives, detailed technical surveys are not performed well or if performed then accuracy of survey results is not ensured, poor scope definition at project planning stage, delays in projects awards, and poor consultants and contractors selection criteria are some major decision making issues which creates some serious problems during project execution stage and needs strategic decision making after their identification.

In this work, the main focus was on application of scheduling practices in large-scale hydropower projects because very little or no such type of practices had been found in previous studies except construction industry projects or other small scale projects. No such type of study has been found earlier in Pakistan public sector environment to know the different issues involved with hydropower projects and their failures.

This research is the identification of advanced scheduling practices to monitor and control the large-scale projects. The earlier studies focus was mostly on to develop the CPM schedule and use it only for personal checks from contractor side. In projects awarded at international terms where three parties (Contractor, Consultants and Client) are involved, contractor prepared mostly the CPM based schedule and shows its results to Consultants and Client for progress monitoring. In this research work, analysis of schedule has been performed to quantify the actual progress and different issues involved at project timeline if any 3rd party wants to audit the project performance up to status date (desired date of review).

Finally, quantification of significant factors responsible for project progress related issues are tested and explored in hydropower projects according to the country constraints. However these types of factors are identified in other construction projects in Pakistan or other part of world.

2.1 CASE STUDY PROJECT DETAILS

The ministry of water and power development authority (WAPDA) started number of hydropower projects to meet energy crises in the country, one of these projects is a project whose case is under consideration. The issues related to the project outlined are given in the table 2. It is evident that the activities have been delayed due to the issues found in the project outline.

TABLE II
HISTORY OF PROJECT MAJOR TIME LINES

Time Line (Years)	Important works and Decisions about Project Construction
1984 -87	Initial Feasibility & Design by WAPDA to construct 550 MW capacity project
1988	Original PC-1 (Rs.15 Billion) approved by ECNEC, However no construction works were undertaken.
1990	Initial Exploratory adits etc.
1996	Revised Feasibility Double Delivery
1997	A design completed for the construction of 969 MW Power Plant by foreign Consultants under a grant.
1998	Detailed design (Increased delivery)
2002	Revised PC-1 (Rs.84.502 Billion) approved by ECNEC on 28-02-2002 based on 2001 based price.
	Tenders were invited three times: • February 2005 (On suppliers credit) • November 2005 (On suppliers credit) • July 2006 (On Buyers credit), ECNEC approved on 10-02-2006
2005	Earthquake
2007	Award of Contract on 19th December 2007 to One foreign Contractor
2008	Project Original Cost and Time when awarded: Rs.90.90 Billion and 93 Months
2008	Appointment of Contractor and Works started at project site.
2010	Heavy flood due to heavy rains in the catchment's areas of river during July 2010 and Damage lot of Construction works at project site.
2012	Deployment of two Tunnel Boring Machines (TBMs) for acceleration of Tunnels work
2012	Revised PC-1 for 2nd time and cost increased up to Rs.274.882 Billion + 304 Days EOT against contractor Claims and Client Project acceleration requirements.

The decision of WAPDA for executing this project was to make separate company on temporary basis to ensure fast decision making but this practice had not been seen in earlier on any other public sector project. Researcher appreciated the efforts of Client organization to take this hard step in the year 2008. The company has Board of Directors (BOD) and the representative of the members BOD is managing director / CEO who is authorized and responsible for all decisions related to project execution.

III. DATA COLLECTION AND DESIGN OF RESEARCH METHODOLOGY

To achieve the objectives of the study, all the material and necessary information was collected from Client Organization project management office and site offices. For the concern of reviewing project plan, contractual approved baseline plan and current updated schedule was collected from contract documents and studied which is part of 2nd revised PC-1 document. After taking baseline plan from client project management office, monthly progress reports of Contractor and Engineer's reviewed progress reports were studied and consulted with Client and Engineer project management persons. Project sites has been visited for understanding the project and to collect schedule related data. The platform used for the schedule generated is primavera. The software can generate schedule based on data and information insight of project issues. As a part of research, scheduling task was also done. The research methodology adopted to produce research work has been shown figure 1. The performance assessment of project through trend analysis techniques at previous timeline up to status date was analyzed. After inserting the all required input data to software, each month progress updated schedule was compared with original approved baseline plan and various issues were quantified by using variance analysis techniques. The analysis of baseline plan progress status and quantification of various variance issues regarding project current status up to status date, the reasons of variance issues has been quantified using qualitative and quantitative analysis.

To know the perceptions of client officers, survey questionnaire was prepared and distributed among all management and site offices by hand to individuals as instructions given. The significant impact of causative factors was asked to rate on importance scale of 0 to 5 (0 means no significance or irrelevant factor, 1 for very low

significance, 2 for low , 3 for average, 4 for high and 5 for extreme significance). Sambasivan and Soon [24] used relative Importance index method in their research study to determine the relative importance of various factors causing delays and impacts on projects.

The same method has been used in the present study to know the least and highest significant factor from 60 identified factors related to project.

The Relative Importance Index (RII) is determined for each factor according to the following formula [24].

$$RII = \frac{\sum W}{A \cdot N} \quad (0 \leq RII \geq 1)$$

Where 'W' is the weight given to each factor, A is highest weight of scale for rating (i.e. 5 in this case) and N is the total number of respondents participated in the survey questionnaire. The value of RII ranged from zero to one (0 for No Significant or irrelevant factor to this project and value higher than zero means most important factor in this project which has highest impact on project cost and time overruns). For Statistical methods of construction delays, various analytical statistical methods have been reviewed for analysis of construction delay factors suggested by different scholars to recommend Relative Importance Index method (RII) for importance scale type research through survey questionnaire [29].

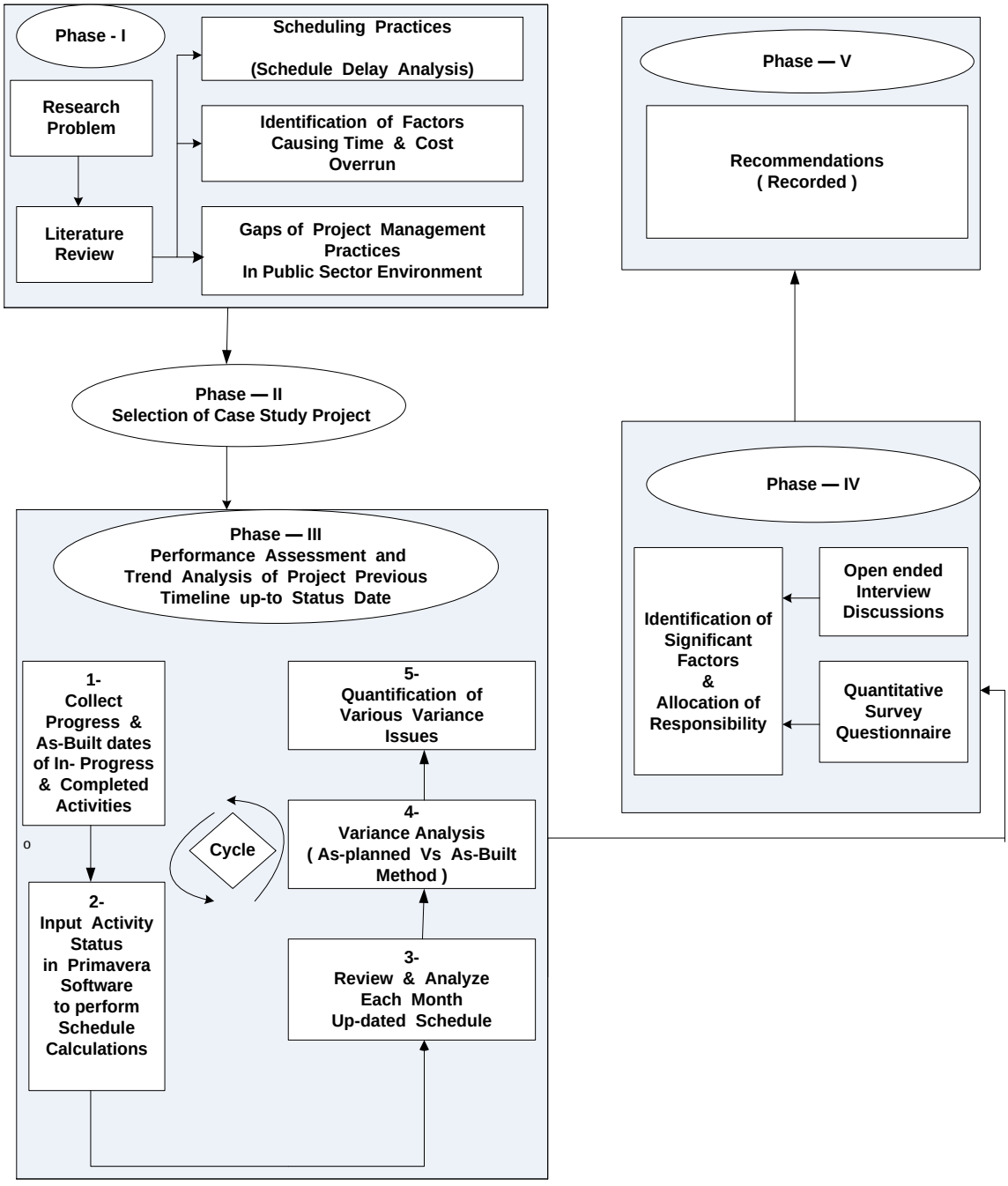

FIGURE I
Research Methodology Flow Chart

IV. RESULTS ANALYSIS AND DISCUSSIONS

As per contract signed between Contractor and Employer, the commencement date of works at project site was January 30, 2008 and contractor had to complete the project within 93 months from commencement date till October, 30 2015. Due to some issues occurred from client side for timely land acquisition and power supply shortage at project site which was client responsibility and also due to flood damages in 2010, contractor submitted the excusable claim for time extension and said that the completion of project within 93 months is beyond the control of contractor. Then by the approval of Employer and consultation of Engineer, 304 day's time extension was given to contractor which was the final updated time duration by incorporating contractor claims and impacted Employer variation orders issued for change in scope of works up to status date at the time of awarding 304 days compensated Extension of Time (EOT). Employer enforced the contractor for adopting appropriate project acceleration technique to complete the project before due date. The contractor deployed two new tunnel boring machines (TBMs) to accelerate the civil works at project site after approval of Client Organization and Engineer. The sample of Baseline Plan updated schedule has been shown in figure 2. The schedule plan comprises on 801 major activities whose status information was coded to software and analysis performed on the basis of software generated results. The progress line shows the variance in the activities.

The progress of the project is analyzed at project timeline according to the methodology explained to know the efforts made by all the three parties involved. The project physical progress rate is shown in the figure 3.

Activity ID	Activity Description	Orig Dur	Total Float	% Comp	Baseline % Comp	Variance 1 Early Start	Variance 1 Early Finish	Variance 1 Late Start	Variance 1 Late Finish
0050	Taking-over turbine/generator Unit 1	0	0	0	0	0	0	0	0
0060	Taking-overturbine/generator Unit 2	0	0	0	0	0	0	0	0
0070	Taking-over turbine/generator Unit 3	0	0	0	0	0	0	0	0
0080	Taking-over turbine/generator Unit 4	0	0	0	0	0	0	0	0
0090	Whole of the works taking-over	0	0	0	0	0	0	0	0
0050A	Operation of 1st turbine	0	-353	0	0	-353	-353	0	0
0060A	Operation of 2nd turbine	0	-353	0	0	-353	-353	0	0
0070A	Operation of 3rd turbine	0	-353	0	0	-353	-353	0	0
0080A	Operation of 4th turbine	0	-390	0	0	-390	-390	0	0
0090A	New Whole of the works taking-over	0	-390	0	0	-390	-390	0	0
CONTRACT C1 CIVIL WORKS									
Prep. works									
Technical facilities									
C1-1120	Operation building & Equipment installation	311	-145	0	0	-208	-208	0	0
C1-1121	cofferdam removal	30	-145	0	0	-176	-176	0	0
C1-1138	closure of diversion tunnel	7	-145	0	0	-176	-176	0	0
C1-1221	reservoir filling	10	-145	0	0	-151	-151	0	0
Intake and desander									
Excavation									
C1-1220A10	Excavation for intake	520	-145	97	100	0	-270	0	-125

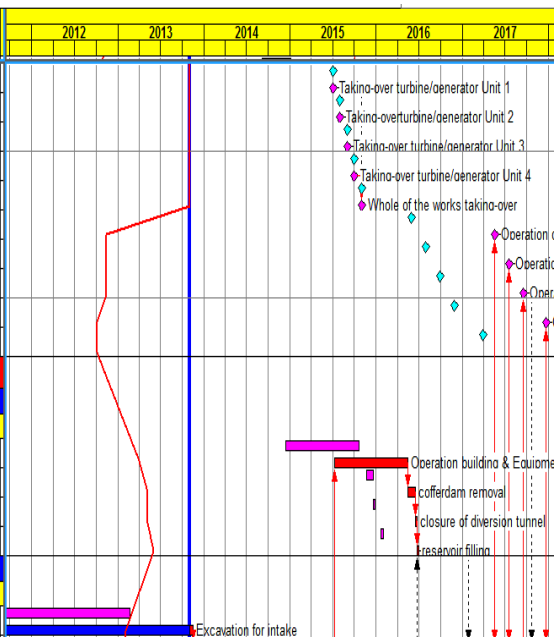

FIGURE II:
Sample of Primavera schedule Review

The figure 3 shows that the project physical progress rate is slow than expected rate of works completion due to variance issues in the project timeline. In the figure 4 (Progress updated timeline), percentage of issues involved with completed activities at project previous timeline has also been shown in order to assess the influence rate

In figure 4, the overall project progression and regression issues at timeline have been explained. It is observed that variance issues of activities planned start, finish and estimated activity duration increases in every month and maximum activities completed after delays which influence on current in-progress activities and future target milestones. If appropriate actions were taken in past timeline to keep the project on-track, then there would be minimum variance in current in-progress activities and control of project current variance to keep it at minimum. In figure 5, the variance gap of current in-progress activities has been shown up to the status month (August- 2013).

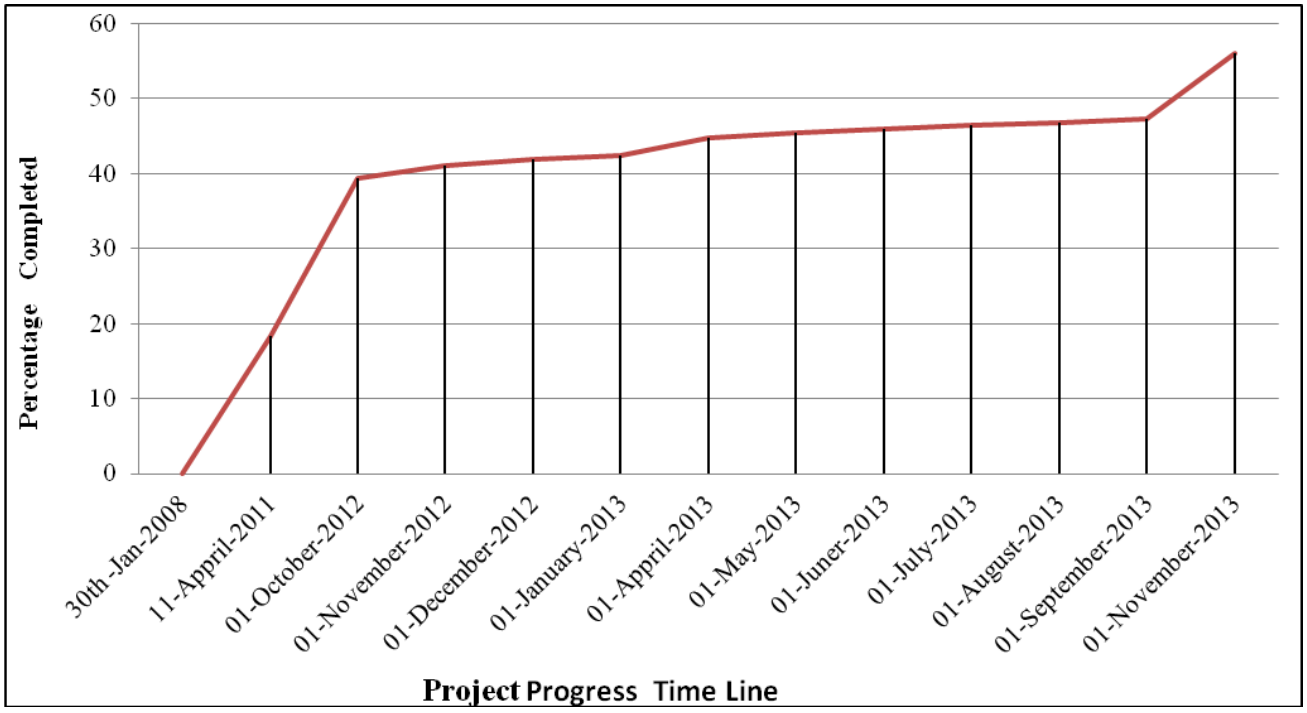

FIGURE III
Project Physical Progress Percent completion at Timeline

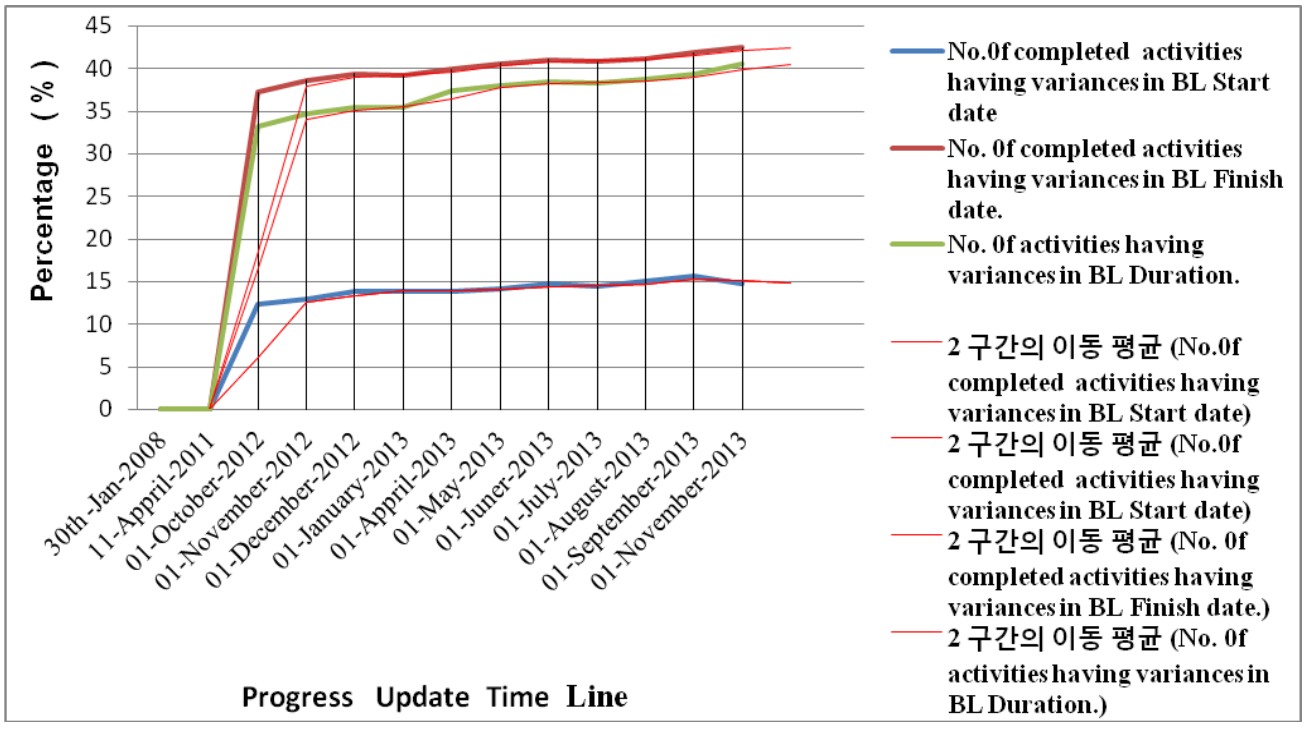

FIGURE IV
Percentage of Variance Issues in Completed activities

In figure 5 & 6, all the critical and in-progress activities status has been shown to identify the variance gap between expected activity percent complete and actual activity percent complete. This will help to identify the most critical activities in the project in order to take appropriate measures to achieve the target milestones. Trend lines in figure 6 are used to predict the progress rate of activities percent complete based on current resources and efforts input to project.

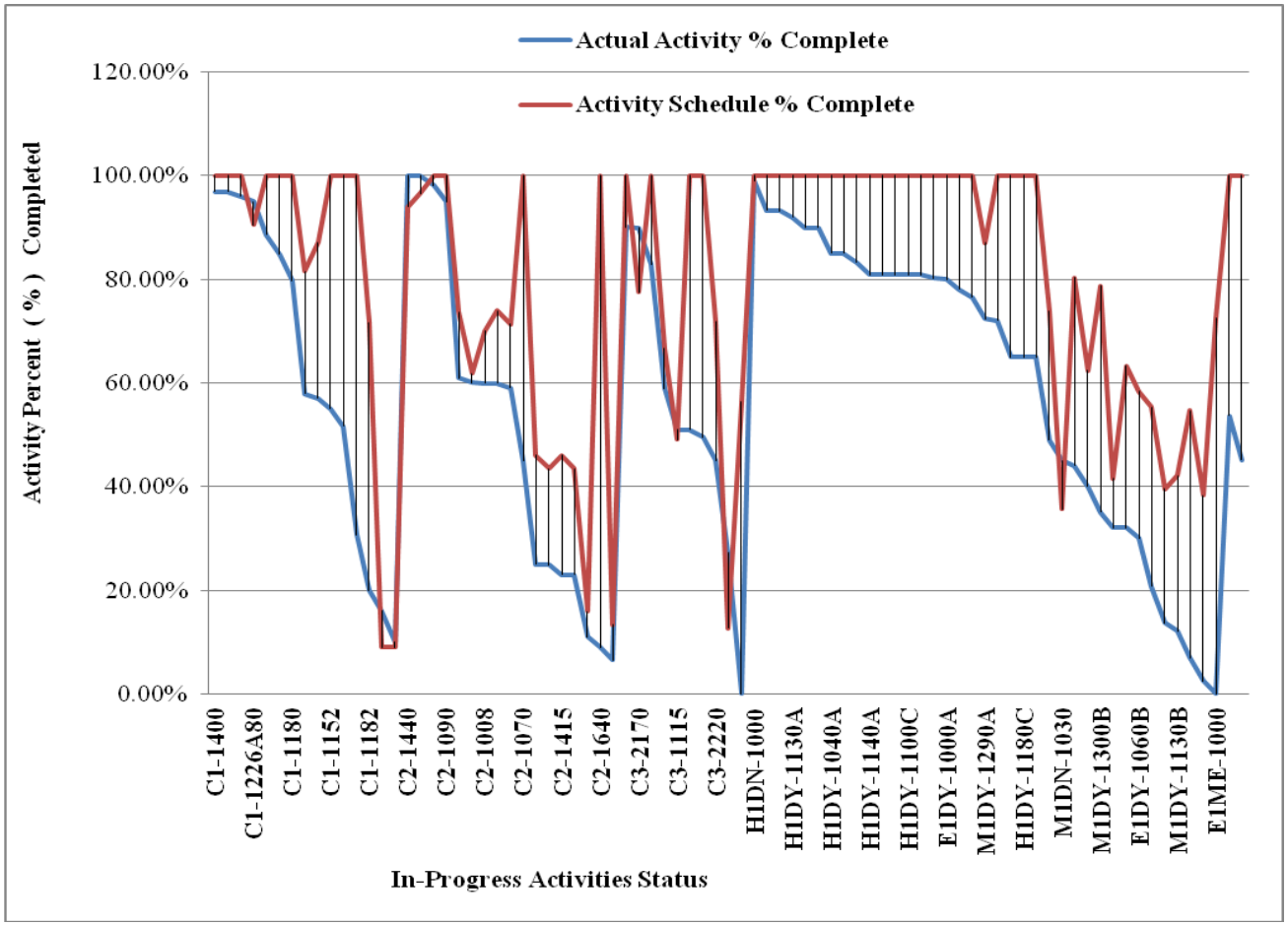

FIGURE V
Variance Status of (August-2013) In-Progress Activities

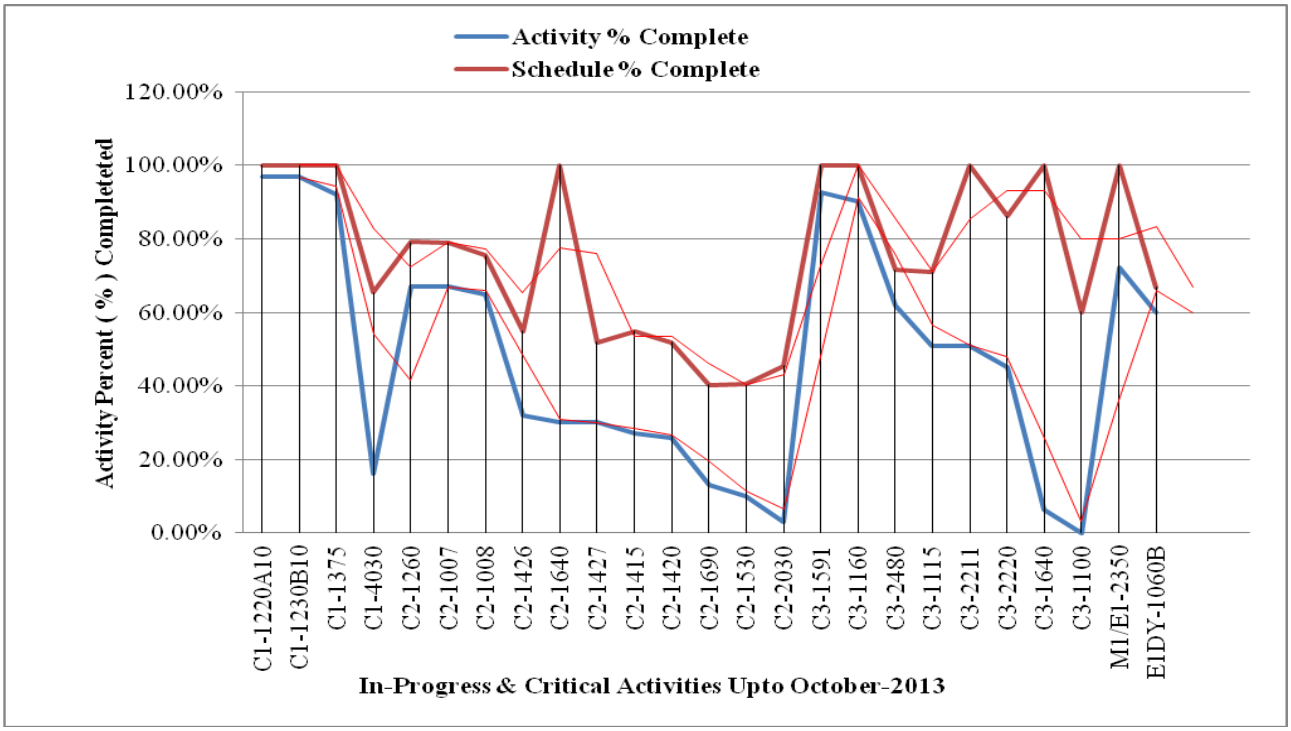

FIGURE VI
Variance Status of (October-2013) In-Progress Activities

In figure 7, the overall status of delays occurred at project timeline have been given to achieve 1st milestone that is operation and commissioning of 1st turbine unit.

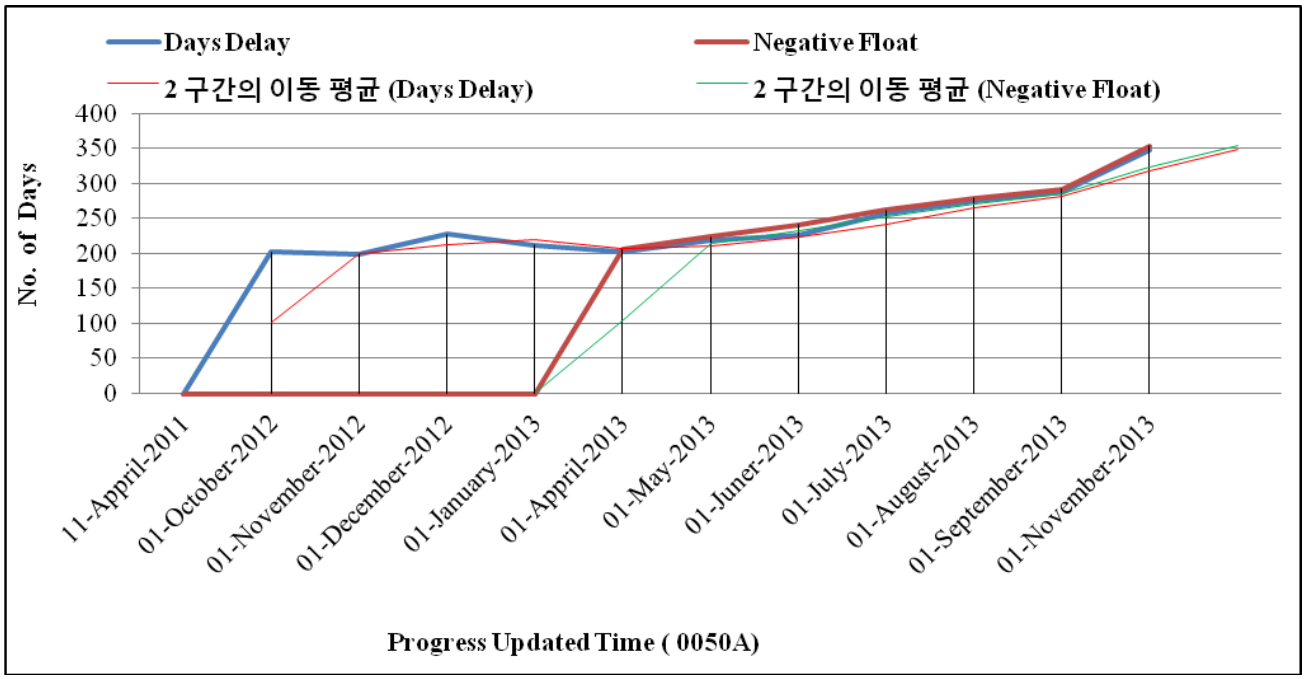

FIGURE VII
Status of Delays for Achieving 1st Milestone

The figure 8 shows the trend of overall delays occurred in the project timeline up to the status month (October-2013). It is evident that the efforts made at project are inappropriate to reduce the delays and to control the project within planned limits.

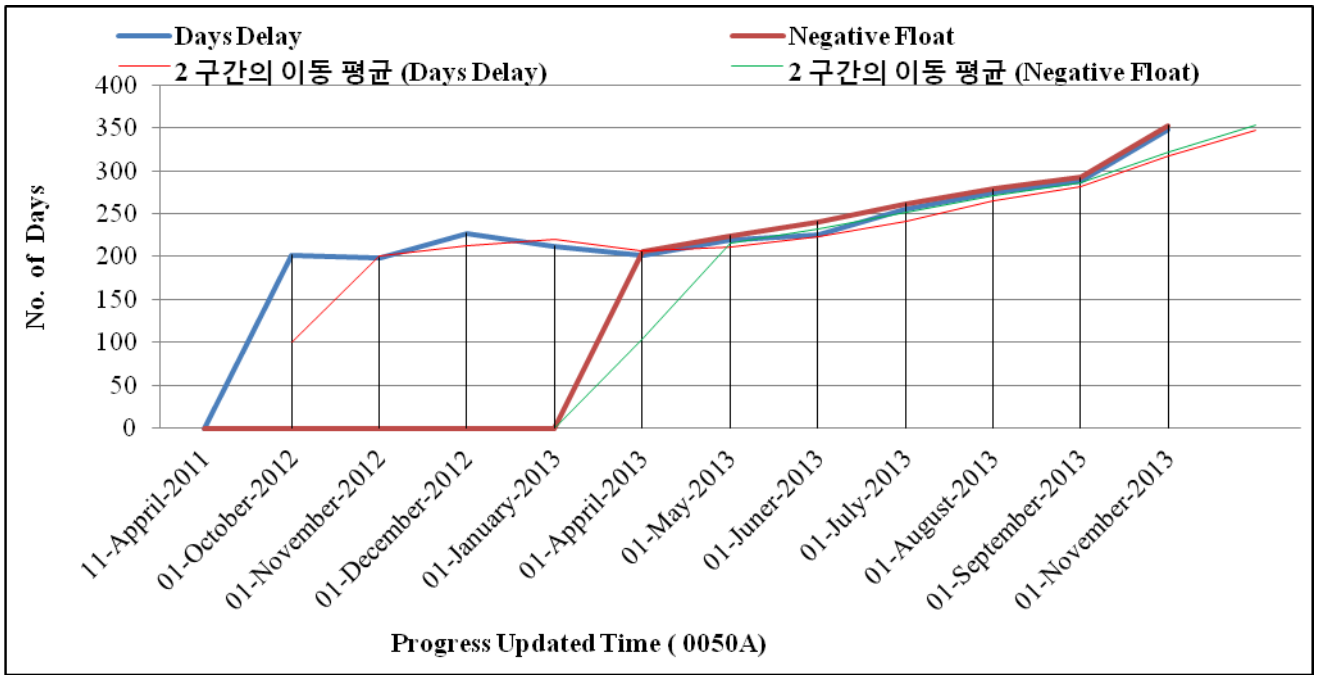

FIGURE VIII
Status of Delays for Hand over all works to Client

It is interesting to note that, the meeting was held on 18th July 2013 between the senior project management members of three parties to review possibility of project completion at the end of year 2015 as per desires of Client Organization. In Progress review meeting, The contractor signed the contract to ready the unit-1 for wet

testing and pre -commissioning till December 31, 2015 provided that every party will concentrate on their own tasks to achieve this goal. The efforts made for achieving new milestones called 'Best Effort Plan' to accelerate the project. This new milestone date instead of 30th May 2016 of unit-1 to be ready for the operation of 1st turbine is a major challenge for all the parties involved in project execution which can only be possible if all the parties consider their responsibilities carefully. The contractor needs to play major role for the implementation of best effort plan. It is seen from figure 7 that how the best effort plan can be implemented as project is already behind the target plan and is passing through delay issues. During review of software generated reports, it has been analyzed that maximum in-progress activities are critical and non-critical activities are moving towards critical path. Negative float has been observed in maximum activities which shows that activities shown in the schedule with negative float are behind the target schedule time. For the concern of different issues in the Project Baseline Plan, the current status of liabilities among the responsible parties has been analyzed from project related contract documents and interview discussions. It has been analyzed that client organization has slow decision making process to resolve the contractor excusable claims. The other major issues including Contractor demands for late clearance of IPC (Interim payment certificate) due amounts, Issuance of too much variation orders, late delivery of Construction and Engineering Drawings, Late delivery of land to contractor and Slow supply of appropriate resources by contractor to project according to scope of work needs have significant impact on project completion time. In addition to Project Baseline Plan evaluation as discussed earlier, researcher developed the questionnaire of 60 identified causative factors of time and cost overrun to know the perceptions of Client Organization about project delays and cost overrun issues. The results and analysis of questionnaire survey is shown in the table 1. The percentage of respondents score according to the scale provided from least significant to highest significant factor, average score gained by each factor, relative importance index (RII) to rank the given factor among all other factors and responsible group or party involved in the execution of project can be examined from table 3. The total 17 significant factors have been identified that influence the project and caused time delays as well as cost overrun.

Moreover, during field discussions with project management officers, communication issues are observed among the local and foreign employees due to language problem. The behavioral issues due to communication gap between foreign contractors and working staff, negative attitude of subcontractors with general contractor, interference of local population has also been seen which significantly affect the time, quality and cost. This has been established from the study that the project delay causes significant loss. A brief overview of previous and current study is explored here. This also raises some research questions (not scope of our study) that can be explored. Thus the visits, discussion with company senior management and a survey; following are some actions which need to be determined.

When the concept of 969 MW project execution was planned at site proposed against detailed design prepared by consultants in 1998, then why project works commencement was not ensured within minimum time. According to Rs.84.502 Billion revised cost approved in 2002 as compared to present cost Rs.274.882 billion is too much. This Cost difference can be saved if award of project was ensured during period 1998 to 2002 or near 2003. The problems and risks involved with project execution were also be minimized as compared to today scenario. Secondly ,when project commencement was not be possible up to the period 2008 due to poor cash flow problem needed for the project start up and lack of convincing international contractors and original consultants those prepared project design, then why the project was awarded without vetting from another consultants. Today Project delays and cost overruns were to be minimized if same consultant's appointment was ensured because they were charged heavy amount for preparing project design and taking of full responsibility. Thirdly, If Client Organization (WAPDA) knows that he is not capable for handling this type of special project own-self and appointment of original consultant's also cannot be possible, then why he is taking the risks of awarding the contract to contractor before appointment of new consultants and without design vetting. From project related literature survey , it is sorted out that the appointment of new consultants was ensured after 3.5 months later than awarding the contract to contractor. The Contract agreement was signed between contractor and employer at January 2008 and with new consultants at 15th may, 2008 for design review and engineering supervision of project. If new consultants were appointed some time before for previous design review and to help in negotiation with contractor, then probability of problems occurred due to new consultants appointment regarding design revised issues was to be minimized. After the award of contract, according to the plan given by contractor most of the works were not possible to start due to land acquisition issues by employer side which affected the project schedule. If employer was solved the land acquisition issues during the project awarding and tendering period before awarding the contract and handover the clear site to contractor, then blame of contractor for late delivery of project site for timely commencement of works was to be useless. Flood of 2010 during project implementation period greatly affected the project, it was due to lack of planning to take appropriate measures before coming raining and flood season. The decision of deploying Tunnel boring machines (TBMs) to accelerate the civil works was also late; if this decision was taken earlier then acceleration cost due to heavy investment on TBMs was to be recovered by completing the project earlier than present scenario.

TABLE III
TOP 17 SIGNIFICANT FACTORS AMONG 60 IDENTIFIED FACTORS

S. No.	Identified factors of Cost & Time Overrun relevant to the Case Study project	Percentage of Respondents Score(%) At Scale Provided					Mean	R I I	Rank	Responsible Group
		1	2	3	4	5	1 - 5	0 - 1	1 to 17	
1	Late Delivery of acquired project site to Contractor	12.5	12.5	33.5	16.7	25	3.5	0.7	6	Client
2	Employer Own Cash Flow Problem	4.2	8.3	8.3	16.7	37.5	3.5	0.7	7	Client
3	Too much Delays in awarding the project after Design Completion	4.2	8.3	16.7	41.7	20.8	3.42	0.68	8	Client
4	Delays in Payments to Contractor	12.5	12.5	33.5	16.7	25	3.29	0.66	12	Client
5	Issuance of Frequent Design Change Orders	4.2	4.2	20.8	12.5	58.3	3.17	0.63	13	Client
6	Issuance of too many Variation orders at construction stage	8.3	20.8	29.2	29.2	8.3	2.96	0.59	15	Client
7	Design Changes during Construction Phase	0	12.5	33.3	41.7	12.5	3.54	0.71	5	Engineer
8	Contractor own Financial Difficulties	8.3	12.5	12.5	25	37.5	3.58	0.72	4	Contractor
9	Controlling subcontractors & Suppliers in the Project execution phase	16.7	16.7	25	33.3	8.3	3	0.6	14	Contractor
10	Poor Project Planning & Scheduling practices	4.2	16.7	29.2	37.5	4.2	2.96	0.59	16	Contractor
11	Lowest bid wins system for awarding the contract	16.7	25	8.3	8.3	33.3	2.92	0.58	17	Contract
12	Acts of God like Earth Quake & Flood	0	8.3	20.8	25	45.8	4.08	0.82	1	External
13	Increased in unexpected Scope of Work	4.2	16.7	16.7	16.7	45.8	3.83	0.77	2	External
14	Bad Geological Conditions due to Poor Rock Quality which influenced Progress	4.2	12.5	20.8	37.5	25	3.67	0.73	3	External
15	Un-foreseeable technical difficulties & site conditions	8.3	0	54.2	16.7	20.8	3.42	0.68	9	External
16	Material Prices Fluctuation	8.3	20.8	25	16.7	39.2	3.38	0.68	10	External
17	Exchange Rate Fluctuations	20.8	8.3	20.8	16.7	33.3	3.33	0.67	11	External

Initially the project completion time was 93 months when it was awarded from January 30, 2008 to October 30, 2015. Later on, Project completion time extends to 304 days more against extension of time given to contractor. Finally management of funds by employer to ensure timely completion of project is most important factor for project delays due to poor cash flow issues. Employer should ensure sustained cash flows until the project is not completed.

As already explained that completion of project 5 months before the current targets is known as best effort plan that unit-1 should be ready at the end of year 2015 for commissioning and wet testing of first turbine. As explained in project progress status reviews that operation of first turbine (unit-1) is delaying 11.5 months (October-2013 status) from current targets, so this means 16.5 months difference will have to recover without delaying baseline plan to achieve the milestone of "Best Effort Plan" which seems to be impossible according to the current progress rate and efforts made.

V. CONCLUSIONS

The study of hydropower project scheduling and planning is a tedious task. It is evident that proper planning, governmental tight control and management of risks can cope with the uncertainties. Following conclusions have been drawn.

- The overall Project physical progress analyzed up to last status month is 56% at timeline (Figure 3) which is less than expected progress.
- The continuous increase of variance issues has been found in completed activities start, finish and baseline duration at timeline up to status month which have influenced on project present status. (Figure 4)
- A large variance gap has been found in current in-progress activities of last two months timeline. This large variance gap is due to previous timeline issues in completed activities that highly influenced current progress rate.(Figure 5 & 6)
- The schedule forecasted project completion time at project timeline up to status month depicts that there is a continuous increase of time delays. This continual increment of delays at each month of progress update was due to inappropriate corrective measures adopted by the project executing parties involved. (Figure 7 & 8)
- The contingency float reserve in baseline plan is continued to consume due to time delays in present in-progress activities and as a result negative float appears in most of the critical activities. (Figure 7 & 8)
- The key statistical reports generated during schedule analysis tells that various activities are working out of sequence which means that schedule progress according to baseline logic is not progressing.
- It is found that project is 202% cost overrun and 25% time delays from original contract award.
- Implementation of best effort plan seems to be impossible according to project current progress rate and efforts made at project previous timeline.
- The significant impact of identified causative factors was found during quantitative survey findings. There were almost 17 most significant factors identified from 60 major and minor factors selected. (Table 1)
- Responsibilities are allocated (Table 1) according to the groups assigned to each causative factor of time and cost overrun.
- In addition to 60 identified factors tested, the impact of following factors has also been analyzed during field interview discussions: (1) Language problem between foreigner and local staff, (2) poor quality issues due to cost of rework, (3) behavioural issue of foreign contractor staff with locals, (4) Negative attitude of subcontractors with general contractor and (5) interference of *local* population.

VI.RECOMMENDATIONS AND FUTURE WORK

Hydropower projects require long-term planning or strategic policies on realistic basis. If client organization completed the project formalities and awarded the project to contractor as per Planning Commission guidelines, then monitoring and control of project is the responsibility of client organization to complete it as planned and approved. If Projects delayed due to poor cash flow problems, then it is recommended client organization should seek timely management of funds by competent authorities. In case of lacking funds by competent authorities (Project Sponsoring or government bodies), then even projects should be completed by client organization own resources . Software based Knowledge Management Systems should be used at organizational level that can be retrieved easily whenever required for fast decision making. Following recommendations are made as long-term country visions for such projects which have been identified through case analysis.

1- To manage the sustained cash flow, the concept of marketing management should be introduced at organizational level to attract the investment potential.
2- Government should improve easy entrance barriers for international competitive bidding to attract quality contractors and consultants for mega projects.
3- For ongoing future projects, government should promote project management based company culture on temporary basis for the period of project execution in large-scale projects to ensure fast decision making practices.
4- Government projects planning agencies should promote research and development culture in every client organization to sort out the innovative solutions of problems involved at early planning phase.
5- Client organization should ensure completion of design before mobilizing the contractor on project site to avoid design related issues. Project design should be vetted by competent consultant engineers if design was prepared by another consultants.
6- Client organization should clearly define project scope at bid stage to avoid scope change issues at later stage or mid of the project.
7- Client organization should not award the project below Engineer's estimate to avoid poor quality issues and should seek contractor near Engineer's original estimate.
8- In case of foreigner contractor and consultant staff involved, Client organization should ensure appropriate security measures to avoid any mishap during project execution period.
9- Client Organization should solve land acquisition issues before mobilizing the contractor to avoid contractor demands for timely delivery of acquired land.

FUTURE RESEARCH DIRECTIONS

The directions for future research are given below that can be linked to research work produced in the present study by researcher.

- Review of project management practices can be carried out on other case study projects either in same organization or other organizations executed by different contractors awarded at international standards.
- Instead of taking one case study project, analysis of cost and time overrun factors can be carried out on

more than one large-scale projects in same organization or other organizations provided that availability of data is ensured and organization is motivated for carrying research.

- Development of software base knowledge management database system for client organization projects using advanced project and Programme management tools.

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