ORGANIZATIONAL CAUSES AND CONTROL OF PROJECT SCOPE CREEP IN PAKISTAN'S HYDROPOWER PROJECTS

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ABSTRACT

Hydropower projects are backbone of Pakistan's electrical power sector and irrigation system. Being cost and time intensive, these projects become more difficult and expansive due to cost and associated schedule escalations. The envisaged benefits of projects are also considerably compromised. Scope Creep is a well documented problem that contributes in cost escalation of large projects. The study investigates applicability of identified causes of project scope creep in Pakistan's hydropower project implementation and possibilities of reduction or control of these causes. The study finds that scope creep is seriously affecting hydropower project implementation and can be controlled significantly through organizational efforts. The results of the study can be utilized to improve project scope creep and implement hydropower projects more efficiently and effectively.

Keywords: Scope Creep, Hydropower, Project Scope, Cost Escalation.

INTRODUCTION

Hydropower is vital for sustainable solution to electrical power shortage / demand in Pakistan. Large potential, economic generation of electricity, water reservoir benefits, long life and environment friendly nature of hydropower technology makes it an appropriate choice for Pakistan. Several new hydropower projects are planned for construction. Hydropower potential in Pakistan is more than 100,000 MW. The present hydropower installed capacity in Pakistan is only 6,902 MW. However, hydropower project implementation is a persistent problem area. Hydropower projects are cost intensive to implement. Cost and schedule overruns make them more expansive and laborious to

construct. Sizeable reduction in cost escalation can avoid wastage of resources and ensure envisaged benefits in future projects. Project Scope Creep is a known cause of cost and schedule overruns globally but causes of project scope creep and its effect on Pakistan's hydropower projects have not been investigated. The purpose of the study is to evaluate the role of "Project Scope Creep" in "Pakistan's Hydropower Project Implementation". Probing the possibilities and extent of its control for achieving better results is also intended. The outcome of the study is considered critical as the Country prepares for undertaking several hydropower projects including Mega Projects i.e. Bunji Hydropower Project (7100 MW), Diamir-Bhasha Dam (4500 MW), Dasu Hydropower Project (4320 MW) etc.

LITERATURE REVIEW

Most of the conducted research "clubs" scope creep among factors contributing to project cost escalation. Literature focusing scope creep as a major cause of cost escalation and its origin is limited.

Scope Change Vs. Scope Creep

A scope change is deliberate action of project manager, government, client etc. to change, include or eliminate a feature of the project as per circumstances. Cost and schedule are adjusted in scope change decision. Scope creep refers to a situation where scope to construct a project grows outside the originally defined scope. Cost and schedule are not timely adjusted in case of scope creep as it is not planned or anticipated. Project scope creep is "the tendency of a project to extend beyond its initial boundaries". Change of scope is official, scope creep is unofficial till identified (Hussain, 2012 ; Farok & Garcia, 2016).

Role of Scope Creep

Hydropower projects and nuclear reactors have the greatest amount and frequency of cost overruns in electrical power infrastructure projects (Sovacool, Gilbert & Nugent, 2014). Project Scope Creep is a major and in some cases, the leading cause of cost increase in large projects (Mirza, Pourzolfaghar & Shahnazari, 2013; KPMG-PMI, 2012; Hussain, 2012). Scope creep introduces unexpected tasks in the project scope and complicates the project implementation. Research on project scope has not been much emphasized despite its criticality (Mirza et al., 2013). Cost performance is most important project success indicator. Poor cost performance of construction projects has persisted for decades (Rehman, Memon & Karim, 2013). Changes in scope (inclusive of Scope Creep) can be most important and have most impact on cost overruns in public sector construction projects (Apolot, Alinaitwe & Tindiwensi, 2012). Some scope creep is inevitable, but large scope creep is detrimental for the project (Sylvester, Rani & Shaikh, 2011). The prevention of scope creep is very much unpleasant for project manager. Once project manager accepts scope creep from one client, he is setting precedent for the rest (Farok & Garcia, 2016). Sometimes people have hidden agendas for wanting the scope to

intentionally increase. Some causes of scope creep are related to business scope creep, and others are part of technical scope creep (Kerzner, 2014).

Major Causes of Project Scope Creep in Projects

The generic classification of factors influencing hydropower project cost and schedule can be made as poor cost estimation, erroneous implementation, change of scope and prevalent circumstances. Inaccurate estimates are a manifestation of "Institutional Weakness" even if prepared by others. (Merrow & Schroeder, 1991). A strong owner is characterized by certain capabilities termed as "owner project capabilities" such as strategic capabilities, commercial capabilities etc. (Winch & Leiringer, 2015). Lack of experience and preparedness by owner or appointed project teams restricts the effectiveness of controlling and monitoring (PwC, 2013).

The "inside viewers" among decision makers, engineers, economists etc. are too optimistic in respect of project cost, and envisaged benefits. The outside viewers explain problems of costs overrun and reduction in benefits as consequences of "inside view" which focuses on constituents of specific planned action and disregards the results of similar projects already completed. The tendency has been characterized as "psychological delusion and strategic misrepresentation" or "optimism bias and political deception". Further, the project managers or experts may sometimes incorporate large scope changes but ignore small changes of scope i.e. Scope Creep (Ansar, Flyvbjerg, Budzier & Lunn, 2014 ; Allaheim & Liu, 2009 ; Hussain, 2012). The biased and optimistic project managers are keen to obtain approvals and funding. They make an unrealistic assumption that the project will proceed smoothly from start to end (Ansar et al., 2014). Optimism bias is visible from delays in achievement of milestones. These delays form a recognizable trend (Eik-Andressen, Landmark & Johansen, 2015).

With reference to project implementation as a discipline, "scope definition" and "scope control" are important factors influencing project success. Majority of projects do not have a clear scope definition and proper control over scope (Mirza et al., 2013). Inadequacy of transparency and control of project changes blurs the actual situation for the owners and it is generally too late for remedial measures (PwC, 2013). It is extremely difficult to separate the factors of cost escalation and schedule delays as one results in the other. Monitoring and control is pivotal in Project Management (Olawale & Sun, 2015). Ineffective project change control results in the project being controlled by impulses and notions of stakeholders and team members (Millhollan, 2008).

Large projects are complex systems. Managers are inclined to avoid the repercussions of decision making under pressures of timeline. This leads to acceptance of lowest bids for momentary amelioration of pressures but reworks or additional works in the long run i.e. scope creep (Sharipo & Lorenz, 2000). Bidding is executed on incomplete information in large projects. The bidders submit bids based on incomplete information and under pressure of submitting the "lowest bid" for award of contract (Locatelli, 2015). The pressure on the contractors should be assessed while preparing cost estimates and capturing the scope (Bacon & Besant-Jones, 1998). Lowest bidding method was ranked

6.9 on a scale of 10 in a study of cost overrun factors in Pakistan's construction projects (Azhar, Farooqi & Ahmed, 2008).

In modern era, projects have to be constructed without causing harm to "stakeholders". The act of accommodating stakeholders' demands in return for their cooperation can result in project scope creep (Giezen, 2012). Hydropower development in Pakistan is not only a technical challenge. Several constituencies and communities have to be shifted, accommodated and supported. The economic justification should be inclusive of environmental impact (Siddiqi, Wascoat, James, Humair & Afridi, 2012). The stakeholders should be engaged early and at the time of capturing the scope to avoid scope changes at a later stage (Mirza et al., 2013).

"Engineering Design" is a prominent factor in cost and schedule performance of projects. Few projects have the specifications as described in original design. Design modifications, errors and lack of understanding affect the scope of the project during implementation (Chang, 2002). Mistakes in design can be the major cause of cost overrun in projects (Ansar et al., 2014). Most of the projects expand from planning stage to design stage and then execution stage (Bacon & Besant-Jones, 1998). Cost estimates have to be modified for majority of projects when detailed plans and specifications have been determined (Kaliba, Muya & Mumba, 2009).

Ambiguous terms and conditions of contracts affect the clarity of implementation and contribute towards scope creep. Growth of scope motivates the contractor for more profits and controlling the scope enables the owner to implement the project close to the budget and deadline (Winch & Leiringer, 2015). Disputes between parties i.e. owner, contractor and consultant can be a major cause in cost overrun of construction project (Apolot et al., 2012). The client can manage packages of project scope as project components but elements within packages are not easily visible to client. Contracting capabilities and contract management are crucial in such situations (Merrow & Schroeder, 1991). A study of delays in public utility projects found out that contractors blamed client and consultants whereas the client and consultants blamed the contractors (Al-Khalil & Al-Ghafly, 1999). Largest percentage of contract changes (43.45%) in road construction projects is due to project scope changes and changes due to scope omissions were also noticeable (18.16%). The contracts should be more flexible and policy makers should pay more attention to them (Verweij, Van-Meerkerk & Korthagen, 2014).

Human Resource Management (HRM) should be viewed as a core process in project-oriented environment. The perspective of research on HRM in project organizations should be of the individual employee as well as the organization (Huemenn, Keegan & Turner, 2007)

Direct cost of scope creep in Pakistan's hydropower projects after 2010

Review of official documents reveals sizeable amount and frequency attributed to project scope creep in Pakistan's hydropower projects. A summary is given in Table-1 below:

#	Name of Project (Capacity in MW)	Original Estimate	Revised Estimate*	Total Escalation	Due to Scope Creep	%age of scope creep in escalation
1	Duber Khwar HPP (130 MW)	9,754	14,103	4,350	2,721	62.6%
2	Jabban Rehab. Project (22 MW)	1,037.5	2,583	1,545.5	609	39.40%
3	Khan Khwar HPP (72 MW)	5,363	7,020	1,657	637	38.42%
4	Neelum-Jhelum HPP (969 MW)	273,000	500,500	227,500	141,000	61.97%

* Exchange rate i.e. USD to PKR adjusted to eliminate cost increase due to inflation

Table-1: Direct cost of scope creep in recently completed hydropower projects (Figures in Million PKR)

Apart from scope creep related causes, other significant factors also result in cost escalation and schedule slippage. These include cost and schedule underestimation, inflation, delay between design and start of the projects, change in government policy or laws, size of the project, lack of completeness and timeliness of project related information flow, first of a kind projects, natural disasters etc. (Apolot et al., 2012 ; Merrow & Schroeder, 1991; Allahaim & Liu, 2009 ; Winch & Leiringer, 2015).

RESEARCH METHODOLOGY

The statistics / calculations required to fulfill the objectives of the study can be described as:

$$SCI = (1.0 - F_1) + (1.0 - F_2) + (1.0 - F_3) + (1.0 - F_4) + \ldots\ldots + (1.0 - F_N) / N$$

Where SCI = Scope Creep Index

N = number of factors

$F_1, F_2, \ldots F_N$ = Impact of identified factors affecting project scope creep

i. Ranking of scope creep factors

ii. Calculation of Scope Creep Index (SCI) i.e.

$$SCI_{(i)} = \{1 - (F1 - Þ_1)\} + \{1 - (F2 - Þ_2)\} + \{1 - (F3 - Þ_3)\} + \ldots\ldots + \{1 - (F_N - Þ_N)\} / N$$

Where $SCI_{(i)}$ = Improved scope creep index

$Þ_1, Þ_2, Þ_3, Þ_N$ = Expected reduction / improvement in impact of identified scope creep factors

iii. Assessment of potential improvement in scope creep factors

iv. Calculation of Improved Scope Creep Index (SCI_i), i.e.

General Causes of Scope Creep

After extensive review of available research and official documents of hydropower projects recently completed or nearing completion, the following general causes of scope creep were identified for the research / data collection:

Sr.	Name of Factor	Abbreviation
1	Contract Management	CM
2	Design Performance	DP
3	Human Resource Management	HR
4	Lowest Bid Principle	LB
5	Monitoring & Control	MC
6	Organizational Project Management Knowledge and Initiative*	OP
7	Psychological Delusion & Strategic Misrepresentation	PD
8	Scope Definition	SD
9	Stakeholder Management	SM

* The aspect of Institutional Weakness not covered by the other selected factors

Table-2: General causes of scope creep in construction projects selected for data collection

Sampling Technique

The research has been based on "Purposive Sampling". The judgment of researcher has been used to engage the respondents who can provide best information. Table-3 below provides the summary of sampling technique:

Sr.	Terminology	Description
1	Element	Hydropower project / Commensurate qualified or experienced professional
2	Sampling design	Purposive
3	Sampling frame	Engineers, Finance & HR professionals
4	Measurement Procedure	Group briefing followed by distribution of questionnaire / Correspondence
5	Time	November 2016 to October 2017

Table-3: Summary of sampling technique

Survey Questionnaire

Major portion of survey questionnaire was designed to obtain responses on indicators corresponding to presence of a certain factor i.e. Contract management, monitoring & control etc. Each factor was included in form of a construct without mentioning the name. Likert scale offering five types of responses (Strongly agree, Agree, Do not know, Disagree, Strongly disagree) was used for data collection. A smaller second portion of questionnaire was included to assess the improvement in scope creep.

Measurement Procedure

Direct communication and correspondence was used to conduct test-retest. After test-retest procedure, data collection for research analysis and conclusions was conducted mainly through group briefings followed by administering the questionnaire as it was convenient for the researcher. Some responses were collected through correspondence. The research targeted around 100 responses. 70 responses were collected in total.

Reliability and Validity of Instrument

After test-retest data collection, the reliability of the instrument was satisfactory represented by Cronbach's Alpha of 0.8+ on SPSS. However, Factor Analysis, being mostly supportive, pointed towards ambiguity and misfit of some close ended statements or excessive inclusion of some attributes in the instrument which were eliminated. The reliability and validity was inspected again after collecting 70 responses. Final Cronbach Alpha was 0.849. Factor analysis was found satisfactory.

Limitations

i. Bias for one's own job area is a limitation. An engineer serving in Central Contract Cell (CCC) or a professional from HRM will give a biased opinion in response to "Contract Management" or "HR Issues" questions respectively. An attempt was made by the researcher to reduce this bias by not including the name of the variables being measured. Special attention was paid to this bias during briefing conducted before administering the questionnaire.

ii. Number of people falling in sampling frame throughout the country is not large. Soliciting a larger number of responses i.e. 100+ from qualified and experienced respondents could not be achieved. However, 70 responses are considered sufficient.

iii. A similar study was not carried out in past so no precedence about research methodology was available for comparison.

ANALYSIS & DISCUSSION

Ranking and Impact of Scope Creep Factors

The analysis was performed keeping in view the major research questions i.e. Ranking of applicable scope creep factors in hydropower projects, an assessment of scope creep factors' impact and potential improvement. Statistical methods, SPSS and interpolation were used to synthesize and tabulate data.

The applicability / impact of scope creep factors was obtained from data collected. The results have been shown in Table-4 below:

Sr.	Factor Name	Symbol	Mean Rating (Scale 1 to 5)	Ranking	Impact
1	Scope Definition	SD	3.805	1st	0.761
2	Contract Management	CM	3.793	2nd	0.759
3	Human Resource Management	HR	3.689	3rd	0.738
4	Lowest Bid Principle	LB	3.662	4th	0.734
5	Monitoring & Control	MC	3.586	5th	0.717
6	Organizational Project Mgt. Knowledge & Maturity	OP	3.439	6th	0.688
7	Psychological Delusion & Strategic Misrepresentation	PD	3.257	7th	0.651
8	Stakeholder Management	SM	3.257	8th	0.651
9	Design Performance	DP	3.200	9th	0.640

Table-4: Ranking & Impact of Scope Creep Factors on Basis of Mean Score

sds

Scope Creep Index (SCI)

Using the equation given in research methodology:

$$SCI = (1.0\text{-}SD) + (1.0\text{-}CM) + (1.0\text{-}HR) + (1.0\text{-}LB) + (1.0\text{-}MC) + (1.0\text{-}OP) + (1.0\text{-}PD) + (1.0\text{-}SM) + (1.0\text{-}DP) / 9 = 0.296$$

Assessment of Improvement in Scope Creep Factors

Assessment is based on values assigned to five improvement levels by the respondents. Table-5 and Figure-1 show the results in this respect.

Sr.	Name of Level	Mean Value (%)
1	Negligible	16.29
2	Fractional	29.43
3	Moderate	45.00
4	Significant	63.00
5	Drastic	78.57

Table-5: Values of Improvements Suggested at Five Different Levels

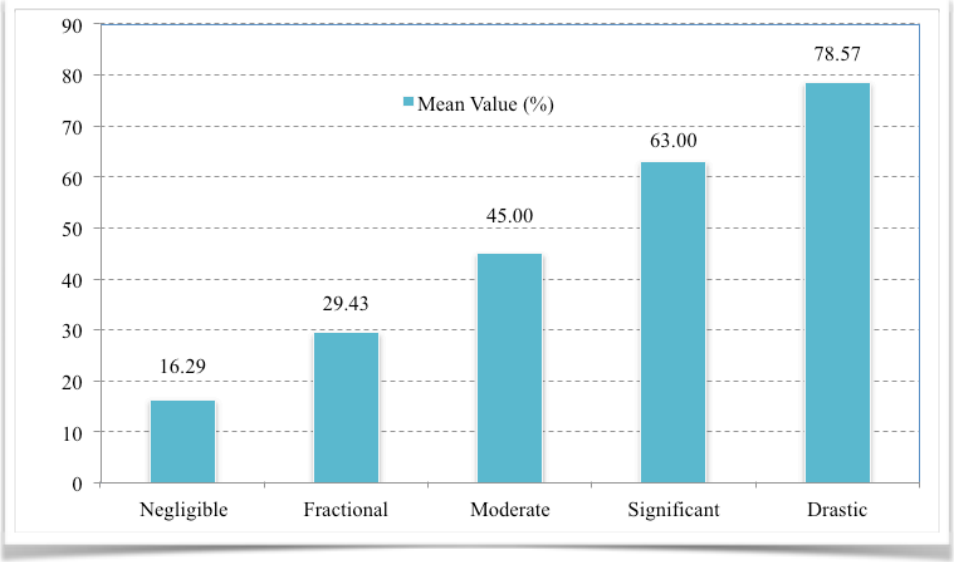

Figure-1 : Values of improvement suggested at five presented levels

The suggested level of improvement relative to impact of scope creep factors are shown in Table-6 below:

Sr.	Name of Factor	Symbol	Suggested Improvement (%)	Suggested Improvement Impact
1	Scope Definition	IMSD	49.68	0.378
2	Contract Management	IMCM	43.59	0.331
3	HR Issues	IMHR	49.68	0.367
4	Lowest Bid Principle	IMLB	42.80	0.314
5	Monitoring & Control	IMMC	45.18	0.324
6	Project Mgt. Knowledge & Maturity	IMOP	45.72	0.315
7	Psychological Delusion and Strategic Misrepresentation	IMPD	46.26	0.301
8	Stakeholder Management	IMSM	42.04	0.274
9	Design Performance	IMDP	44.07	0.282

Table 6: Worked-Out Values of Percentage Improvement suggested in Scope Creep Factors

Exact values at mean scores such as 3.26 or 3.80 etc. have been worked out using interpolation.

The impact of factors and suggested improvement has been shown graphically in Figure-2:

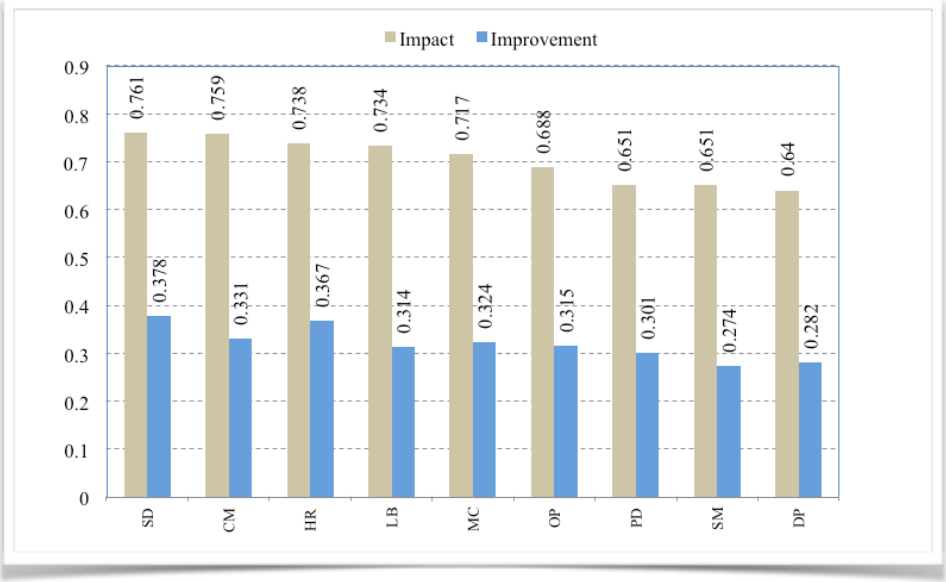

Figure-2 : The impact and suggested improvement in scope creep factors

Improved Scope Creep Index:

$$SCI_{(i)} = \{1.0-(SD-IMSD)\} + \{1.0-(CM-IMCM)\} + \{1.0-(HR-IMHR)\} + \{1.0-(LB-IMLB)\} + \{1.0-(MC-IMCM) + \{1.0-(IW-IMOP)\} + \{1.0-(PP-IMPD)\} + \{1.0-(SM-IMSM)\} + \{1.0-(DP-IMDP)\} / 9 = 0.616$$

DISCUSSION

Applicability of Scope Creep Causes in Pakistan's Hydropower Projects

All the general causes of project scope creep identified in literature review were found applicable to Pakistan's hydropower project implementation but their impact varies clearly. No factor was found low enough to be disregarded.

The ranking provides critical information. Contrary to the regions where project implementation is at a more efficient and effective level, the findings indicate lack of fundamental practices and problems in areas of basic importance.

The highest ranked scope creep factors are Scope Definition (SD), Contract Management (CM) and HR Issues (HR) whereas the areas of recent interest globally such as Stakeholder Management (SM), Psychological Delusion & Strategic Misrepresentation (PD) are at bottom of the list but are still important on basis of value attributed to them.

The study of recently completed hydropower projects of different size and project cost also revealed major scope omissions and additions, inability to exercise control over cost escalations due to variation orders and subsequent revisions of project costs. Findings of this study also reveal appointment of project personnel in disregard to their qualification and aptitude. Contractual issues ensue from poorly defined scope, inability of personnel in contract framing and performance monitoring.

However, Scope Definition (SD) is of critical importance. The highest rank of SD is due to its own importance and the contribution it can make to other factors. Accurate and precise SD reduces the chances of scope and cost escalation at later stages.

The study affirms that Lowest Bid Principle (LB) puts pressure on the contractors to submit an underpriced bid in order to increase their chances of winning the bid. It is also used to avoid the consequences of decision making by the employers or project owners. As a result the lowest bid principle encourages scope omissions and underestimation at the time of bid submission and escalating the scope by contractors to maximize their profits.

Monitoring & Control (MC) techniques were also suggested as insufficient or ineffective by the respondents. Loose monitoring and control results in quicker and bigger scope creep during execution period.

Organizational Project Management Knowledge (OP) which indicates initiation or adoption of project management practices and knowledge of the subject also requires major improvement.

In absence of basic project management practices, it is understandable that recently evolved concepts such as stakeholder management and psychological delusion were also ranked highly. The relative lower rank may also be a manifestation of lack of knowledge in this area.

As regards Design Performance (DP), hydropower projects do not undergo major design changes or modifications during construction as most of such changes are incorporated before start of physical construction. The role of WAPDA and project personnel is limited in this respect as well. This can be a reason of DP being at the bottom of the list.

Suggested Improvement in Scope Creep Factors

Suggested improvement in factors follows the trend of factor ranking in terms of impact with exception of Lowest Bid Principle (42.8%) with lower suggested improvement and Psychological Delusion with relatively high suggested improvement (46.26%). Lower suggested improvement in Lowest Bid Principle may be a result of wide spread acceptance of the principle or presumed absence of alternative. Higher suggested improvement in Psychological Delusion and Strategic Misrepresentation can be attributed to centralized nature of projectized organizations and lack of participative decision making. All suggested improvements show a reasonable response.

Scope Creep Index (SCI)

SCI was devised for this research to assess efficiency of scope creep control. The value of SCI based on prevalent situation (0.296) indicates a low efficiency of scope creep control which is backed by the relevance of all 09 factor of scope creep. Improving scope creep due to these factors can improve SCI as indicated by the “Improved SCI” (0.616) which indicates a potential improvement of 108%. This improvement can be achieved by the organizations. The extent of improvement can be interpreted in terms of finances by reducing the scope creep costs in accordance with the suggested improvement.

For example, direct cost of scope creep in case of Dubair Khwar hydropower project is 2721.3 Million PKR (Chapter 3). Proportionate to improvement in scope creep efficiency it is reduced to 1307.6 Million PKR i.e. a potential saving of 1413.7 Million PKR by organizational efforts and without incurring large amount of funds.

CONCLUSIONS

Project implementation policy for hydropower projects in Pakistan requires major reforms. Recent experiences in hydropower project construction and size of up-coming hydropower developments warrant efficient project implementation to avoid serious cost and schedule escalations. Project management practices at present are undeveloped, whimsical and not aligned with proven and tested project implementation practices / techniques. Projects are being planned and executed in a typical manner and no standards of project failure and success are being followed.

Scope Creep in Pakistan's hydropower projects is on a high side and contributing significantly to cost escalation. Major problems have been detected in areas of elementary importance such as Scope Definition, Contract Management, HR, Lowest Bid Principle, Monitoring & Control and Organizational knowledge and maturity. The areas of relatively advanced level (being given more importance globally) such as Psychological Delusion & Strategic Misrepresentation of people concerned, Stakeholder Management and Design Performance are also largely unattended.

Scope Creep in all areas should be reduced as the Country prepares for large hydropower projects in future e.g. Dasu (4320 MW), Diamir-Bhasha (4500 MW), Bunji (7100 MW) etc. The study may be useful for developing countries/ regions who intend to implement hydropower projects in addition to Pakistan.

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