

Opportunities and Challenges of Using Value Engineering in Iran's Dam Projects

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ABSTRACT

In the beginning of article situation of Iran's completed development projects and specially dam projects in order of constructing duration and cost has been discussed also basic concepts of value Engineering has been explained. Essential, potentials and purposes of studying value engineering in dam projects also challenges in this way that has been collected by questionnaire from ideas of high level managers and experts in dam structuring is a matter of discussion. The results shows us inappropriate situation of managing cost and time of constructing the projects that could be easily fixed by using the technique of value engineering, but unfortunately for many reasons such as flaws in Iran's law, slight politics of government, structure cultures of society, common ways of making dam project contracts, weakness in funds of clients, insufficient knowledge about value engineering and etc.

Key words: Value engineering, Dam projects, development projects, challenge.

INTRODUCTION

Every year a considerable amount of Iran's budget will invests in development particularly in water supplies on the other hand so many reasons like shortage in resources will expand the duration of project and this delay will cost a lot more than the considered budget. The mentioned reasons will divide in two categories internal and external problems. External problems are mainly caused by major financial problems and environmental reasons but internal problems generally have an obvious reason, the management thus a manager is in charge that has no ability to control the cost of the project and he can't organize the cost reduction with the special ways and techniques when it's needed. In major and unique development project like dam construction improvement in construction and cost control is an important deal and it's important to

consider the highest profit and quality from the designing part. For achieving this accomplishment, we can use value engineering. Special studies in value engineering field at schematic development of project design. Afterwards we should do the studies in details. But the major part of the studies because of unknown nature of underground particles in the construction zone of the dam that will be known in the progress of the construction should be done in this phase. By studying different phases of value engineering in proper time zones we can expect to obtain the goals of the project by using the lowest budget. It's also recommended to work on cultural bases of society to use value engineering and try to promote this field. It's necessary to work on legal obligations of the consulting and constructing to make the authorities and responsibilities of development projects to belief that in addition to using worthy designers and accurate calculations

there is also extra potential to reduce the cost of the project by using creative ways and innovation in designing and building.

It's notable that value engineering has been lawfully used in Iran's engineering society less than 15 years. This new management technique has introduced a new horizon in way that we look at development and industrial projects. in countries like Iran because of their shallow look at new ideas they go epidemic fast at first but they descend faster, it's always been a concern that technique and more important than that abilities of value engineering goes by this destiny so any unsuccessful try to Institutionalization and using properly of this method that is been using about 70 years the world and also has a lot of potential in Iran is not because of weakness of this method. It's caused by fear from encounter with new ideas. This article try's to shows opportunities and challenges in the way of using value engineering in the dam projects and also promote this technique in dam structuring industry of Iran.

Studying of development project in Iran with special look at dam projects

With respect to information and reports of supervision national development between 2005-2012 projects that wrote by Iran's management and planning organization in summer of 2014 it shows us that range of the completed projects of Iran in those years should be about 30.5%. This indicate that 2/3 commitment has not been done. According to this report estimation of the projects duration in 2012 is about 3.7 year but weighted average of completed projects duration in that year was 14.2 year. This tremendous difference between estimation and performance of construction is evidence that approved projects and programs are not coincident. Expanding duration of the projects will raise the cost of them won't satisfy the beneficiary , reduces the possibilities of using the expected potential, effects negatively on public, force us to restudy data and etc (Leasdals etal., 2013).

In order to understand the part and essential of the dam constructions between development projects and their importance in Iran's industry and also situation of constructing this projects, following

data that been chose from national development projects supervision will be presented :

- Ø The credit of mentioned projects in 2012 was 8980 millions of dollars that water recourses chapter with 3090 millions of dollars (about 34.4%) assigned the highest.
- Ø Between the completed projects 433 of them were related to department of energy that 389 of them supervised and 128 of them (about 33%) has completed (Leasdals etal., 2013).
- Ø From the completed projects of department of energy highest rate belonged to dam projects (29) with credit of 1663 millions of dollars.
- Ø Weighted average of performing completed projects duration was about 14.2 year that the longest one between program chapters belong to water recourses chapter with 16.7 year.
- Ø Weighted average of performing dam projects (29) was about 17.6 year that is one year more than average of water recourses chapter (Leasdals etal., 2013).

With respect to mentioned details and with glimpse at the chart that shows the performing of dam structuring projects between 2005-2012 it can be easily understood that this projects have a major share from development credit of Iran but unfortunately they have a unpleasant situation in performing. As you can see their completion time with average of 17.6 year is far behind their estimation time and universal standard. It also massively raises the cost of projects. These problems have a negative effect on Iran's crisis in controlling the water supplies and challenges in providing the water for people and industry. In the end its necessary to point that long durations of these projects and changing in climate makes the value engineering so important in this field.

Concepts of value engineering and its importance in dam projects

Value engineering is one of the newest methods in management that has its own special abilities that has been proved with so many reasons. After half a century from beginning of this method it's has a proper placement in development project

around the world and every day they will use it in so many projects. Value engineering is a sufficient way to recognize and cut off on necessary costs in the projects. This method with introducing new ways creativity, imagination and using proper experiences gives us excellent result in reducing the cost and time of the projects. In society of American value engineering (SAVE) opinion value engineering is a systematic method with special technique recognize the function of a product or service and improves the financial value of that function. So that product function with lowest cost and highest reliability. On the other hand we can say value engineering is an organized effort to analyze systems performance, equipment, services and facilities to improve them with lowest costs in the projects. This technique is useful in entire phases of projects but the highest rate of value engineering benefits is in the beginning of project, feasibility studies, conceptual and detail design.

In dam projects because of unknown nature of subsurface factors that will be known during the project, construction phase is so important in and should be considered seriously, because in studying and designing phase designers doesn't have a sufficient knowledge about the factors they have to consider high confidence data so value engineering is vital here. Also another case that recently uses value engineering is outsourcing and tendering. This is common around the world but sadly it hasn't used in Iran. This way particularly in dam projects that depends physical conditions of the projects and topography of the zone and also technical abilities of contractors and their financial wealth and using modern equipment and machinery are great potential and factors to constructing the project.

Necessity of doing value engineering studies in dam projects

Among so many that makes us to do value engineering studies in dam projects we can name this notable reasons:

- Ø Shortage of financial recourses and massive cost of dam projects
- Ø Complexity and difficulties in studying, designing and constructing the dam projects
- Ø Low accuracy in technical and financial studies of first phase of study

- Ø Establishing Weak connections between the experts that have be used in dam projects.
- Ø Lack of sufficient and primary information, unawareness about subsurface conditions and unknown nature of the zones climate.
- Ø Inappropriate behaviors and habits in steps of the construction
- Ø Long time gaps between steps of the construction and high possibility of changing climate of the area or discharge of the river's flood.
- Ø Necessity to accelerate the process of construction with respect to Iran's crisis in supplying the water for industry and agriculture.
- Ø Lack of proper management in cost, time, schedule, project control and risks, safety or weak performance.
- Ø Change in recourses and cost of the project
- Ø Continuous progresses in technologies and devices in dam projects
- Ø Changes client needs or increasing function of the dam because of its high potential.
- Ø Change in technical specifications of design because of identifying the unknown subsurface factors.
- Ø Pressures from in charge organizations and government institutions by notifications that makes them use value engineering.
- Ø Changes in social, political and financial circumstances of the country
- Ø Using creativity to promote the designs goals by increasing index of project value.

Potential of using value engineering in dam projects

Planning to improve value engineering in Iran's dam industries won't be successes without considering the potentials and helpful factors in this industry. There are lots of factors that could be mentioned that shows function of this technique in dam industry. Below factors on most important factors to use value engineering in dam projects:

- Ø Possibility to increase productivity of the design by interacting up and down streams plans (dam projects that they are in a rivers stream or a water channel has the ability to be improve in operation by multiple operation.
- Ø High capacity to reduce designing elements

by considering the effect of upstream structures (like reduction of the spillway structure dimension by reducing discharge inflow to the dam reservoir)

- Ø With a look at bright result in using value engineering in pioneer countries in dam projects and using their helpful experiences.
- Ø Inappropriate situation of dam projects in Iran in cost and duration perspective (dominant number of this projects will complete with more cost and time duration)
- Ø Existence of unnecessary costs, high safety factors designs, un useful structural and un structural component (like salt water reservoir of Gotvand dam)
- Ø Water crisis in Iran and low ability of government to control the water supplies.
- Ø Limitation of time to control border waters because of international organization ultimatum.
- Ø Revising the nature of subsurface particles in structuring progress that they are really important in the result.
- Ø Important effect of dam projects in improvement of agriculture industry and helping Iran's economic growth.
- Ø High number of young and experienced experts that can help development projects in Iran.

Goals of using value engineering in dam projects

There are so many discussions about value engineering goals that can be used in management of development projects. Such as reduction of primary, elimination of unnecessary costs, reducing time duration of the projects and etc. Result of this research shows us that unlike the most of projects that value engineering studies concentrates on reducing the costs in dam projects because of vast investment and important effect of this project on Iran's economic improving dam operation is the most important matter in studies. According to the result of this article convincing the Justifiability of the projects, decreasing time duration, combining performance, easing the construction, decreasing the operational volumes, elimination of unnecessary elements and decreasing environmental damages are the most factors of value engineering studies

in dam projects. Activities that are related to this achievement classified to three segments.

Operational segment

- Ø Improving the function of dam with locating a hydroelectric power plant or increasing capacity of that adequate to potential of the area.
- Ø Improving function of dam with adding tourism like wild parks, water parks, recreation center and etc. in the shore of dam lake
- Ø Improving function of dam with making some opportunity for local agriculture
- Ø Improving function of dam in places that dam is constructed for farmland irrigation by land consolidation to reduce costs of irrigation and drainage system.
- Ø Determine a pattern for culturing in order to optimize the usage from dam reservoir in different seasons of the year
- Ø Improving the environmental situation of area by establishing protected areas for aquatic animals.

Designing segment

- Ø Improving function of dam by combining performance of it with up and down streams
- Ø Improving performance of dam with adding some compartments like dyke and wind break in order to reduce water surface evaporation.
- Ø Improving performance of dam with reviewing of design and considering possible changes in weather and climate of the area between primary studies of the projects and completion phase because usually this is a long time and effects on designing parameters.

Improving performance of dam with reviewing of design and considering effects of upstream water plans on designing parameters like decreasing rate of maximum discharge and as a result decreasing the dimension of spillway structure (S. R. Parikh *et al.*, 2000).

- Ø studying possible options to divert the river stream for lowering operational cost
- Ø Studying possible options to making a diaphragm wall to reduce cost of the project.

- Ø Elimination of some unnecessary elements like cofferdam been consider dirt road with purpose of cost reduction.
- Ø Comparison between pavement and surfacing the road to the borrow pits and cost of carrying materials in this roads where has Ø Studying technical and economical for replacing roller compacted concrete (RCC) instead of asphalt concrete for cost

Table 1: Situations of development projects with national credits 2005-2012:

| Title/Ending year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---------------------|------|------|------|------|------|------|------|------|
| All projects | 1497 | 1509 | 2001 | 789 | 3283 | 4101 | 3556 | 2784 |
| Supervised projects | 1036 | 1142 | 1484 | 621 | 2121 | 3157 | 2507 | 2111 |
| Completed projects | 538 | 591 | 613 | 213 | 923 | 1192 | 1142 | 643 |

Table 2: Situations of dam projects with national credits 2005-2012:

| Budget (\$1000) | Duration (year) | Start year | Project name | Project code | Row |
|-----------------|-----------------|------------|-----------------------------|--------------|-----|
| 20609 | 18 | 1995 | Chegin dam | 40201002 | 1 |
| 22943 | 25 | 1988 | Sivand dam | 40201008 | 2 |
| 27407 | 23 | 1990 | Zirdan dam | 40201009 | 3 |
| 15264 | 22 | 1991 | Raeisali dam | 40201012 | 4 |
| 9219 | 20 | 1993 | Tabarak abad dam | 40201020 | 5 |
| 20069 | 18 | 1995 | Golabr dam | 40201030 | 6 |
| 12967 | 24 | 1989 | Yamchi dam | 40201031 | 7 |
| 5585 | 10 | 2003 | Sang siah dam | 40201046 | 8 |
| 31372 | 17 | 1996 | Dousti dam | 40201048 | 9 |
| 29354 | 23 | 1990 | Tang baragh dam | 40201050 | 10 |
| 5496 | 11 | 2002 | Khan abad dam | 40201073 | 11 |
| 13396 | 19 | 1994 | Nohom dam | 40201404 | 12 |
| 86868 | 17 | 1996 | Ostour dam | 4020154049 | 13 |
| 44500 | 19 | 1994 | Ghir dam | 4020158021 | 14 |
| 31744 | 17 | 1996 | Nesa dam | 4020159043 | 15 |
| 13103 | 15 | 1998 | Ordak dam | 4020160040 | 16 |
| 9918 | 9 | 2004 | Bar dam | 4020160128 | 17 |
| 24222 | 18 | 1995 | Shemil dam | 4020162079 | 18 |
| 3807 | 18 | 1995 | Baneh dam | 40201650 | 19 |
| 7505 | 18 | 1995 | Khorasan dam | 40201750 | 20 |
| 13834 | 12 | 2001 | Godar khosh dam | 40204015 | 21 |
| 16362 | 17 | 1996 | Daroungar dam | 40204056 | 22 |
| 5244 | 13 | 2000 | Shahid ghanbari dam | 4020455005 | 23 |
| 66875 | 19 | 1994 | Chah dam | 4020463016 | 24 |
| 1425 | 7 | 2006 | Golol dam | 4020479034 | 25 |
| 9026 | 14 | 1999 | Dahaneh rezeh dam | 4020480057 | 26 |
| 188761 | 29 | 1984 | Masjed soleyman power plant | 40601003 | 27 |
| 52499 | 18 | 1995 | Maroon power plant | 40601008 | 28 |
| 957592 | 19 | 1993 | Gotvand dam & power plant | 40601010 | 29 |

reduction.

- Ø Studying technical and economical for replacing geo textile with drainage materials in dam body in order to cost reduction.
- Ø Studying technical and economical for replacing fiber shotcrete with mesh and shotcrete for stabilizing surfaces of trenches and tunnels.
- Ø Refining temporary structures designs such as diversion tunnels with low safety factor and designing in cracked section method.

Construction segment

- Ø Merging the villages around the dam to reduce the cost of land ownership

Refine the designing and reduce safety factors by knowing subsurface factors during the progress of construction in order to cost reduction (R. S. Mahdi *et al.*, 2005).

- Ø Studying technical and economical details of tunnel boring by using TBM machine or using explosion method in order to cost reduction.
- Studying shipment of materials from borrowed mines to dam by TELEFERIC machine (R. S. Mahdi *et al.*, 2005).
- Ø Using modern technologies to improve time cost and quality parameters.

Challenges of using value engineering in dam projects

Rising of value engineering and necessity of using this method in high budget and complicated projects is approved nowadays but this technique makes Iranian managers work harder because of its dissident an out of line ways and methods. Mainly in important projects refuse to take risks and prefer to use a lot more money and that's because of they don't have sufficient information about their options and possibilities. Implementation of value engineering needs to have a proper interaction between organs of the projects but because of Iran's weak evaluation system that's incapable to appreciate competency or punishes debility so implementation of value engineering has been unsuccessful and faced oppositions. Generally reasons such disbelief, lack of knowledge, lack of motivation, refusing of the manager from using consulting and etc. are mentioned to be challenges in way of value engineering implementation.

Challenges arising from bylaw

Bylaw of value engineering in Iran have these flaws:

- Ø Absence of a responsible organization, incapability to send proper notifications to executive organizations and flaws in terms has caused insecurity in implementation of this technique.
- Ø Lack of transparency in performing the results of value engineering (consultant because of being unfamiliar with results refuses to take responsibility and on the other hand client because of being inexperienced cant process the data and take the possible risks).
- Ø Different bases of calculating time and cost reduction arising from value engineering and absence of a reference to determine the fees.

Challenges arising from contract

Common method to making dam project contracts is traditional method (Design-Bid-Build) which essence of this method deprives most of value engineering abilities because in this method client gives all of studying and designing responsibilities to consultant and the constructing responsibility goes to contactor with a supervisor. Supervisor usually is consultant. It's obvious that client wants to get rid of any kind of responsibility by giving all of responsibilities to others and not interfering into technical matters. On the other hand try's to lower the risks by using tested methods and previous experience because his responsibilities are only limited to accuracy of the design so this method in making contracts wont encourage him to use value engineering even there are so many research that shows consultants are aware of existence of subsurface elements but they prefer to rise the safety factors and ignore them so this behavior raises the cost of project a lot. On the other hand value engineering studies are in conflict with contractor benefits so contractor won't take responsibility for accuracy of the design and he only claims to do the constructing part right. There are some examples that opposition of the consultant discouraged the contractor to use value engineering in the project. In the end it's notable to say that using modern management techniques like value engineering helps Iran to pass traditional and inefficient methods and steps into brighter future.

Challenges of Client, Consultant and Contractor**Client**

- Ø Weak Communications between Governmental organizations to achieve a successful transact for the secondary function.
- Ø Unfavorable situation of culture in gathering villages around the dam in order to reduction of drainage and irrigation costs.
- Ø Incomprehension in usage, progress and purposes of value engineering also being unfamiliar institutes that use this method in their work.
- Ø Insufficient knowledge and expertise of the related institutes.
- Ø Limitation in human resources in related institutes and vast domain of knowledge and sciences that uses in dam projects.
- Ø Unreliability of collected in formations because of their nature or not having a trust worth reference.
- Ø Showing disrespectful behaviors to the value engineering consultant of project from contractor because of misunderstanding and lack of knowledge.
- Ø Being reluctant to hire value engineering consultants because time and budget and expert shortage.
- Ø Unsupportive senior manager of the client organizations and lack of compulsory laws for using this method.

Consultant

- Ø Lack of access to necessary design information about up and down streams to combine their performance and raise dam's function.
- Ø Lack of necessary potential in Iran's designing technologies so that makes the consultant use traditional ones.
- Ø Deviation from main steps of the project during value engineering progress because of weakness of research team leader or members.
- Ø Turning value engineering to design refining because of inappropriate leadership and useless workshop.
- Ø Exaggerating in expert technical studies and offering detailed designs instead of schematic designs.

Ø Not using experts in different parts of study with respect to vast branch of dam structuring field.

Ø Major domain of dam structuring field and different expertise makes research team members confused.

Ø Inattention to necessity on doing value engineering during the construction project because of unknown subsurface factors.

Time limitation during recognizing unknown subsurface factors and necessity of stopping the constructing progress (S. R. Parikh *et al.*, 2000).

Ø Wrong beliefs that indicate using value engineering is a proof for having flaws in main design and this questions adequacy of consultant.

Lack of desire to be pioneer and creative in designing, delay in doing value engineering studies, inexperienced and inefficient research team members, lack of motivation and encouragement in manager's plans, inattention to wasting country fund and etc (S. R. Parikh *et al.*, 2000).

Contractor

Ø Contractor only knows himself obligate to the consultant's design and won't enter to designing.

Inaccessibility of contractor to sufficient information and opposition of consultant against value engineering proposals (S. R. Parikh *et al.*, 2000).

Ø Conflict between proposals of value engineering and contractor profits.

Ø Wrong assumption of contractor that thinks performing value engineering plans will delay the completion of project.

Ø Dedication of a budget to value engineering studies with possibility of no useful result.

Ø Not using managers that have experience and specialty in the field.

Vacant position of value engineering in organizational structure, weakness of contractor employees in order to their experience, inattention to wasting country fund and etc (S. R. Parikh *et al.*, 2000).

CONCLUSION

- 1) A glimpse at progress of dam projects in Iran during past years shows us that situation of their constructor were so inappropriate and necessity of using modern technique of value engineering is pretty obvious. Average duration of constructing these projects than predicted time and universal average is multiple so not only this problem damages country economy but also massively effects on society.
- 2) Iran has been suffered from drought attacks and shortage of water supplies on the other hand because of political conditions there are major cut offs from controlling water supply budgets. Water supply projects have made a lot of chances for value engineer experts
- 3) Dam structure projects have a great potential to help country economy, produce clean energy, help tourism industry and etc. whit respect to massive cost of this projects its necessary to do studies for improving the function of the project.
- 4) Challenges in the way of the implementation of value engineering in dam projects in three segments of terms and conditions, contract and components of the project (client, consultant, contractors) have been discussed in details and the most important challenges have been identified.

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