

CHAPTER-6

PROJECT EXECUTION MODEL

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6.1 OVERVIEW:-

Various steps involved in the development of the model are described in this chapter. Basis & assumptions, analyses & interpretation of data, conceptualisation & finalization of model and validation of model is discussed in this chapter.

6.2 BASIS & ASSUMPTION FOR MODEL:-

No published research is available for contract strategy or execution model in nuclear sector projects. The contract execution strategies/ models in construction sector other than the nuclear sector are the basis for development of new model in nuclear sector.

The following two basic assumptions are framed;

- a.** Schedule delay is key element and responsible for rise in project cost.
- b.** The model is applicable in nuclear sector projects executed by GOI institution.

6.3 ANALYSES FOR STRATEGIC FACTORS:-

The objectives of the study are to identify the factors contributing the formation of contract model for project execution of Indian nuclear sector. Questions are framed to ascertain the impact of these attributes individually on project parameters. Eight identified attributes which play a major role in formulation of project execution model are collected from the respondents for their views. The results are tabulated as :

Response on Strategic Factors from Project Authority:-Table No. -6.1

Response on Strategic Factors from Consultant: - Table No. -6.2

Response Strategic Factors from Contractor:-Table No. 6.3

Combined Response on Strategic Factors:- Table No. 6.4

**Table No.-6.1:- Response on Strategic Factors from Project Authority/
Owner**

Sr no.	Attribute	RII	Rank
1.	Professional management training shall be must for all engineers &staffs involved in project.	.880	1
2.	There is need to create the agency to carry out the awareness activities among the society to address the social issues .	.841	2
3.	Quality Assurance shall be kept as independence agency to meet the stringent safety requirement.	.832	3
4.	MIS (Management Information System) can play a great role for coordinating & controlling the project schedule.	.733	4
5.	Use of professional management tools &practices will help to meet project cost &schedule.	.728	5
6.	Research & development dept. shall be kept away during execution of project. They have to play role before project starting.	.702	6

Sr no.	Attribute	RII	Rank
7.	Involving a professional management agency (third party) to take care of project monitoring & control will help in project execution.	.631	7
8.	Involving an independent coordinating agency to take care of coordination, will help to meet the target cost & schedule.	.613	8

Table No.-6.2:- Response on Strategic Factors from Consultant

Sr no.	Attribute	RII	Rank
1.	Professional management training shall be must for all engineers &staffs involved in project.	.801	1
2.	There is need to create the agency to carry out the awareness activities among the society to address the social issues.	.790	2
3.	Use of professional management tools & practices (in house) will help to meet project cost & schedule in addition to MIS.	.789	3
4.	MIS (Management Information System) can play a great role for coordinating & controlling the project schedule.	.788	4
5.	Involving a professional management agency (third party) to take care of project monitoring &control will help in project execution.	.766	5
6.	Research & development dept. shall be kept away during execution of project. They have to play role before project starting.	.742	6

Sr no.	Attribute	RII	Rank
7.	Quality Assurance shall be kept as independence agency to meet the stringent safety requirement.	.706	7
8.	Involving an independent coordinating agency to take care of coordination, will help to meet the target cost & schedule.	.694	8

Table No. -6.3 -Response on Strategic Factors from Contractor

Sr no.	Attribute	RII	Rank
1.	MIS (Management Information System) can play a great role for coordinating & controlling the project schedule.	.781	1
2.	Use of professional management tools & practices (in house) will help to meet project cost & schedule in addition to MIS.	.769	2
3.	Professional management training shall be must for all engineers &staffs involved in project.	.769	3
4.	Involving a professional management agency (third party) to take care of project monitoring &control will help in project execution.	.766	4
5.	There is need to create the agency to carry out the awareness activities among the society to address the social issues .	.728	5
6.	Involving an independent coordinating agency to take care of coordination, will help to meet the target cost & schedule.	.710	6

Sr no.	Attribute	RII	Rank
7.	Research & development dept. shall be kept away during execution of project. They have to play role before project starting.	.690	7
8.	Quality Assurance shall be kept as independence agency to meet the stringent safety requirement.	.668	8

Table No.-6.4 : Combined Response on Strategic Factors

Sr no.	Attribute	RII	Rank
1.	Professional management training shall be must for all engineers &staffs involved in project.	.825	1
2.	There is need to create the agency to carry out the awareness activities among the society to address the social issues .	.795	2
3.	MIS (Management Information System) can play a great role for coordinating & controlling the project schedule.	.764	3
4.	Quality Assurance shall be kept as independence agency to meet the stringent safety requirement.	.748	4
5.	Use of professional management tools & practices (in house) will help to meet project cost & schedule in addition to MIS.	.739	5
6.	Research & development dept. shall be kept away during execution of project. They have to play role before project starting.	.712	6

Sr no.	Attribute	RII	Rank
7.	Involving a professional management agency (third party) to take care of project monitoring & control will help in project execution.	.711	7
8.	Involving an independent coordinating agency to take care of coordination, will help to meet the target cost & schedule.	.665	8

6.3.1 INTERPRETATION OF ANALYSES:

The comparative ranks for all three categories of respondents are summarized in table No.-6.5.

Table No. -6.5 : Rank Comparison for Strategic factors

Sr no.	Attribute	Over all Rank	Rank as a project owner	Rank as a consultant	Rank as a contractor
1	Professional management training shall be must for all engineers &staffs involved in project.	1	1	1	3
2	There is need to create the agency to carry out the awareness activities among the society to address the social issues .	2	2	2	5
3	MIS can play a great role for coordinating & controlling the project schedule.	3	4	4	1
4	Quality Assurance shall be kept as independence agency to meet the stringent safety requirement.	4	3	7	8
5	Use of professional management tools & practices (in house) will help to meet project cost & schedule in addition to MIS.	5	5	3	2

Sr no.	Attribute	Overall Rank	Rank as a project owner	Rank as a consultant	Rank as a contractor
6	Research & development dept. shall be kept away during execution of project. They have to play role before project starting.	6	6	6	7
7	Involving a professional management agency (third party) to take care of project monitoring & control will help in project execution.	7	7	5	4
8	Involving an independent coordinating agency to take care of coordination, will help to meet the target cost & schedule.	8	8	8	6

INTERPRETATION & DISCUSSION: All category respondents agree on some points and also disagree on the other points. Their responses are interpreted as:

- i. Overall responses from three respondents' categories show that the professional management training is essential for all engineers and staff. Professional working environment is one of effective tools to control the project schedule & cost. It helps self-discipline in working. In Department of Atomic Energy advanced training in

science & technology are provided but professional training in projects management is not provided in deep. The same is noticed by the respondents. Respondents as contractor have put it on rank three. Reason behind this might be, contactors have large numbers of workers/labourers manpower as compared to engineering staff, so he is not much concerned about this attribute.

- ii.** Respondents ranked the attribute, “need of existence of awareness agency” on second place. In present Indian scenario it is must. Example of this attribute is Kudankulam atomic power station agitation. The agitation was due to lack of awareness in the public about the projects. This is area where DAE has not realised in past. In present some awareness activities are in place in DAE institutions. But there is need for existence of an independent agency to carry out the social awareness activities in continuous manner. The right information at the right time shall be provided to all children, youngsters and adults. An interactive awareness program needs to be started targeting to all section of the citizens of India. Such awareness agency shall also do the task to coordinate the political & social parties and to make them understand.
- iii.** The attribute “MIS (Management Information System) can play a major role in coordinating & controlling the project schedule”, is ranked as third most important attributes. In present Information Technology era, MIS is one of the proven coordinating systems for big organization/mega project. MIS system is not only controls the project schedule and costs but also addresses other issues like conflict management, monitoring of personal activities etc. MIS is the back-bone of a project execution. Respondents as contractor ranked it at first place. Lack of coordination, monitoring & control is main reason of delay during construction stage of project. MIS are in practice in the project organisations in cut & pieces. There is need to design the MIS system suiting to the particular project organisation and implement it aggressively. It was noticed that lot of resistance came

from all section of management levels, especially from top management. Even though, it should be implemented in mandatory mode in different stages. For example in beginning material management, document management, project monitoring shall be included. In second stage tracking& reminder of information, attendance monitoring etc. shall be taken up. After that personal performance monitoring, authority, reward and punishment etc. can be implemented in MIS platform.

- iv. Only respondent as project authority has ranked an attribute “Quality Assurance shall be kept as independent agency to meet the stringent safety requirements” on third place. In nuclear project, QA is very stringent and only project authority is concerned. Safety at each stage, right from the design, analyses, construction, commission, operation & maintenance, is primary & essential requirement in nuclear projects.
- v. “Use of professional management tools & practices will help to meet project cost & schedule in addition to MIS” is ranked as fifth by respondents. Use of professional management tools like MS project, CPM, PERT, Primavera etc. help to control the project schedules. If these tools are integrated with MIS system, more control over schedule and cost can be achieved. MIS is being in practiced in many project organisations in private & government sectors partially. Effective use of MIS system needs to be evolved.
- vi. Attribute “Research & development shall be kept away during execution of project “is ranked sixth by the respondents. R&D shall be independent of project execution and shall be done before starting the project. R&D may affect the schedule if done parallel to project execution. R&D is essentially required in high technology filed like nuclear for advancement. This is also fact that R&D is one of attribute which increases the project schedule. In other words it can be said that the R&D shall be done in such a way that it should not hamper the

project schedule. It should be done before the project design & conceptualisation or at most before commencement of that activity.

- vii. Respondents are not in favour of adding independent management and coordinating agencies to control & monitor the projects. They have shown confidence in MIS. Improvement in-house system is always better than involvement of third party to achieve a task.

6.3.2 CONCLUSION OF INTERPRETATION: - The respondents have put stress on incorporation of Management Information Systems (MIS) and effective use of professional project management tools. They have accepted that professional training is essential for engineers and staff. The respondents also suggested to keep Quality Assurance (QA) as an independent agency. A separate agency also needs to be established to address the social & political issues which are one of the major causes of project delays in nuclear sector.

6.4 DEVELOPMENT OF MODEL:-

Important factors causing the delay in projects are come out from the ranked analyses of delay factors. Constraints and limitations in nuclear sector are also identified. The views on the attributes required to be included in formation of project execution model are also ranked for their importance.

The numbers of models are drawn to address the above factors as much as possible. Each model is tested for the attributes applicability. To get the optimum model, four ranked attributes related to delay, six ranked attributes related to strategic factors for model formation and four major constraints in Indian nuclear field are considered to develop the model. These models are developed based on the response received on strategic factors. These are summarised as below;

- i. Professional management training shall be must for all engineers & staffs involved in project.

- ii.** There is need to create the agency to carry out the awareness activities among the society to address the social issues.
- iii.** MIS (Management Information System) can play a great role for coordinating & controlling the project schedule.
- iv.** Quality Assurance shall be kept as independence agency to meet the stringent safety requirement.
- v.** Use of professional management tools & practices (in house) will help to meet project cost & schedule in addition to MIS.
- vi.** Research & development dept. shall be kept away during execution of project. They have to play role before project starting.

During the development of model the following attributed related to the delay factors are also addressed;

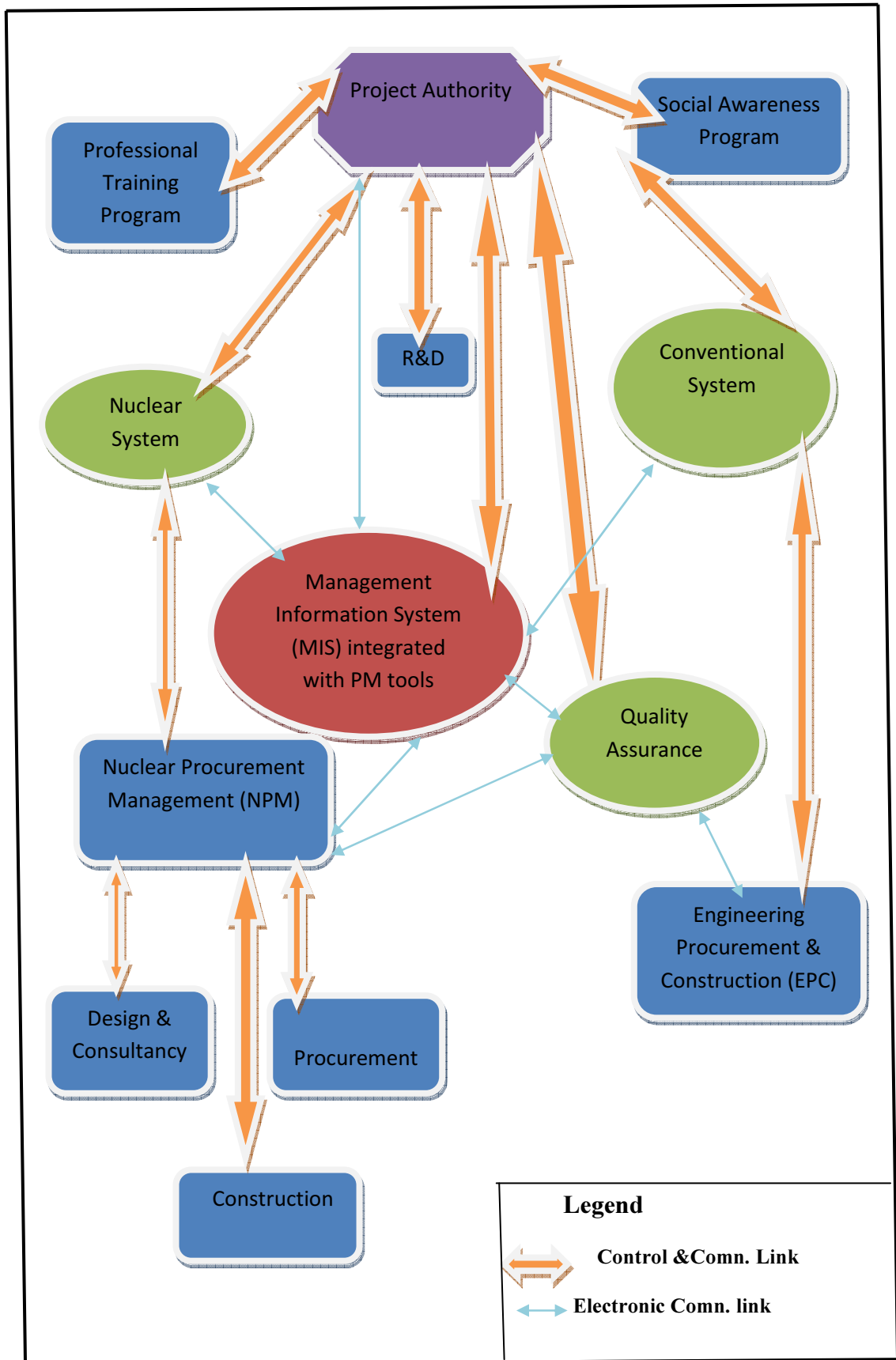
- i.** Delay due to poor / backward project planning & scheduling.
- ii.** Delay due to lack of communication among the involved agencies
- iii.** Delay due to poor site coordination with other agencies
- iv.** Delay due to external social & political factors.

The following points from Indian nuclear sector are taken into account;

- i.** None of Indian firm has full capability to execute project on turnkey basis.
- ii.** Keeping secrecy in Indian nuclear technology.
- iii.** Government of Indian is only project executing & operating authority.
- iv.** Stringent QA norms.

A project execution model confirming to above factors are drawn as figure No 6.1.

Figure No. 6.1 : Project Execution Model



6.4.1 DESCRIPTION OF PROJECT EXECUTION MODEL: The systems are divided into two parts, conventional system and nuclear system. Conventional system are those system where consultant, designers, suppliers, contractors are available in the market. The execution shall be carried in EPC (Engineering Procurement and Construction) mode. Architectural & civil design of buildings, construction of building, procurement of conventional system like air conditioning & ventilation system, steam boiler & water system, electricity generation & switchgear system etc. shall be covered under conventional systems.

On the other hand nuclear system where either vendors are no available or items can not to be sourced to outside vendor due to technology & secrecy constraints. The execution of these systems cannot be carried out in EPC or EPCM mode of execution. The execution needs to be done in house with help of outside selected, specialist & trusted vendors.

Management Information System (MIS) equipped with latest project management tools has major role in this model. This is kept in central position of model. This is the online project monitoring & control system which not only coordinate the various activities but also keep the project schedule and cost in control.

Quality Control (QA) is kept as an independent agency direct reporting of head of project in order to meet the stringent QA norms without influence.

R&D, awareness agency and professional training are kept outside the core project execution.

Management Information System (MIS) plays a major role in this model. The MIS shall be equipped with latest management tools. Online project planning & scheduling, monitoring, reporting and

coordination are the features of MIS. With help of MIS, effective coordination among the various stake holders as well as inside the project authority setup is possible. MIS not only monitors & controls the activities but also keep the schedule and cost within limit. First three delay attributes, delay due to poor planning, lack of communication and poor site coordination are addressed with help of implementation MIS and can control the delays. The uses of MIS and project management tools are also strongly recommended by respondents and this taken care in the model.

The professional management training to all engineers and staff must be provided as per respondents' recommendation. This programme is kept as an integral part of the model.

Implementation of social & political awareness with help of an awareness agency is recommended by respondents. In the model such agency is also kept separately to address the social awareness and handle the external social & political activities.

R&D agency is kept away from the main stream of execution of project. R&D should be carried out parallel without affecting the main project activities.

QA is very stringent in nuclear field. It is kept as independent agency directly reporting to project authority to avoid any influence or short cuts. This is one of main recommendation of respondents.

Since no Indian firm has project execution capability, the contract strategies are divided into two parts, conventional system and nuclear system. Conventional system needs to be executed by EPC mode and nuclear system shall be executed in house with help of trusted partners having special expertise. Responsibilities are lying with project authority. Since execution of nuclear part is in-house, the secrecy in technology is also maintained in this model.

Four ranked attributes related to delay and six ranked attributes related to strategic factor for model formation and four major constraints in Indian nuclear field are addressed in this model.

6.5 COST-BENEFIT FEASIBILITY ANALYSIS:-

Some new systems are introduced in the model. Implementations of these systems have some cost and these costs have to be recovered. The implementation cost shall be feasible.

The implementation cost of the systems "A" may be described as

$$A < (P * T + O * T)$$

Where P= Saving in project cost/year

O= Profit from early operation/year

T= Saving in number of years

Here P= £(m, n, i)

O= £(o, y)

m = saving in material cost

n = saving in construction cost

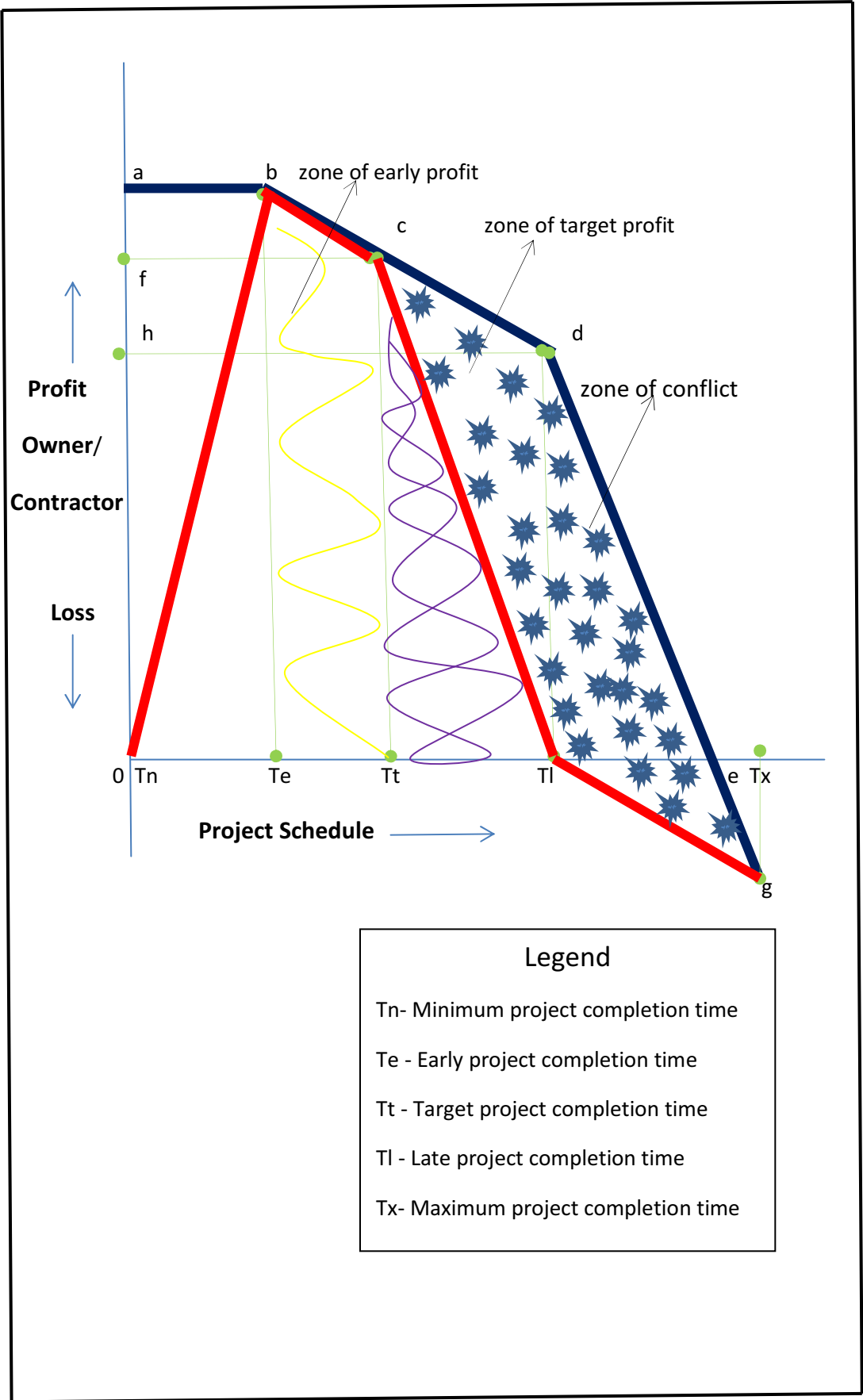
i = saving on interest on borrowed capital

o = operational profit

y = opportunity profit

The model is feasible if the above equation is satisfied. The shrinking/shifting zone of conflicts on application of this model can be graphically shown in Figure No.- 6.2.

Figure No. -6.2: Shrinking of Zone of Conflicts



The conflict zone and the reasons for this are identified and ranked during the research. The application of strategic factors also identified to address the cause of the conflicts. The model is based on the reduction or disappearance of the zone of conflict. Implementation of MIS system shall not allow to enter the project beyond “Tl” and also shorten zone of conflict. Effective use of MIS tries to pull the “Tl” towards “Tt” , which the optimum level of a project in contractor and owner prospective and implementation cost is also justifiable.

Ideally the zone of conflict should be vanished, but practically it can be shorten. The amount of shrinking is depends on the implementation and effective use of the MIS.

6.6 VALIDATION OF MODEL :

Empirical testing and hypothesis testing are adopted to validate the model. Under empirical testing seminar and personal interview approach are selected. Testing for significance is also done.

6.6.1 EMPIRICAL TESTING: Empirical research testing methods is employed for validation this model. The empirical observations or data are collected in order to answer the validity of the model. Under empirical research method, quantitative method, which is more appropriate when model/theory is well developed and for purpose of theory testing is used.

A seminar of project professional in nuclear field and five personal interviews of senior executives are conducted to validate the model.

Seminar: The complete model along with the delay factor has been presented in a seminar. Project professional working the nuclear field and having experience more than 5 years attended the seminar. 52 professional has responded their views about the model.

The eight attributes which are collected for development of model are selected along with three more relevant attributes also added to get the responses. Their responses are tabulated in table no 6.6.

Table No.-6.6 : Seminar Responses

Sr no.	Attributes	No. respondents fully agree for addressing it in the model	No. respondents not fully agree for addressing it in the model
1.	Professional management training shall be must for all engineers &staffs involved in project.	52	00
2.	There is need to create the agency to carry out the awareness activities among the society to address the social issues .	48	04
3.	MIS can play a great role for coordinating & controlling the project schedule.	52	00
4.	Quality Assurance shall be kept as independence agency to meet the stringent safety requirement.	45	07
5.	Use of professional management tools & practices (in house) will help to meet project cost & schedule in addition to MIS.	50	02

Sr no.	Attributes	No. respondents fully agree for addressing it in the model	No. respondents not fully agree for addressing it in the model
6.	Research & development dept. shall be kept away during execution of project. They have to play role before project starting.	51	01
7.	Involving a professional management agency (third party) to take care of project monitoring & control will help in project execution.	21	31
8.	Involving an independent coordinating agency to take care of coordination, will help to meet the target cost & schedule.	05	47
9.	This model is a practical model (can be implemented in field)	49	3
10	This model is new developed model (not a copy or modification of old model)	52	0
11	Implementation of this model in nuclear sector will be able to control the schedule	51	1

The frequency analysis is carried on SPSS. The results of SPSS are tabulated as Annexure-IV

It is very clear from above that the most of respondents are agreeing with first six attributes (sr. 1 to sr .6) those are fully addressed. Last two attributes are not fully addressed.

94% professionals agree that the model is a practical model and can be implemented for project execution in nuclear field. The originality of this model is also accepted by all respondents. 98% respondents agree that implementation of this model will be able to control the project delays. This is main objective of the study.

Interview: Five personal interviews are conducted with very senior executive in nuclear sector project area. The professional have more than 20 years of experience in the nuclear sector. The presentation on the research and developed model is made. Model is discussed in detail. The following questions are asked and their views are tabulated in Table No.-6.7.

Table No.-6.7: Interview Response

Sr no.	Questions	No. respondents fully agree for addressing it in the model	No. respondents not fully agree for addressing it in the model
1.	Is first six attributes are fully addressed in the model ?	5	0
2.	This model is a practical model (can be implemented in field)	4	1
3.	This model is new developed model (not a copy or modification of old model)	5	0
4.	Implementation of this model in nuclear sector will be able to control the schedule	5	0

Four out of five executives have agreed that the model is a practical model for implementation. All executives have confirmed that the implementation of this model is able to control the project schedule. On summary, the senior executives confirm the validity of the model.

6.6.2 TEST FOR SIGNIFICANCE :-

The statement “the proposed model is optimum & valid for implementation in Indian nuclear sector” is asked the respondents. The proposed model is presented in the seminar attended by the executives of Indian nuclear sector. The respondents who attended the seminar are asked to rate the statement in percentage of acceptance of statement. 27 executives are responded and 23 executives rated it above 50 %. Test of significance is presented in Annexure-VI.

The following approximations/ assumptions are made to analyse the sampling:

- a. Population is assumed to be normal. This satisfies the Normal distribution, the data should pass the Normality test.
- b. Population is finite. The population multiplier is used in test for significance.

CHECK FOR NORMALITY: The normality test of data was carried out with help of SPSS and represented in Annexure-V. The output of result is described as:

Kolmogorov-Smirnov ^a			Shapiro-Wilk		
Statistic	df	Sig.	Statistic	df	Sig.
.143	27	.169	.951	27	.233

The significance values are .169 from Kolmogorov- Smirnov and .233 from Shapiro-Wilk test of normality are both greater than 0.05 which imply that it is acceptable to assume that the distribution is normal (or bell-shaped).

HYPOTHESIS TESTING: Hypothesis testing for proportions is used to check the significance. 27 executives are responded and 23 executives rated it above 50 %.

The hypothesis for above 50% rating for the statement “the proposed model is optimum & valid model for implementation in Indian nuclear sector” considering the 5 % level of significance is formulated as:

Null hypothesis $H_0 : \mu_{H_0} = 50$

Alternate Hypothesis $H_a : \mu_{H_a} > 50$

$$z = \frac{(\rho - p)}{(\sqrt{p \cdot q/n})}$$

where z = test statistic
 ρ = sample proportion
 p = proportion success
 n = sample size

$$\begin{aligned} n &= 27 \\ p &= .5 \\ \rho &= 23/27 \\ z &= 3.656 \end{aligned}$$

The observed value of “z” is 3.656 which is in the rejection region since $R: z > 1.645$. and thus H_0 is rejected in favour of H_a at 5 % level of significance. The alternate hypothesis is acceptable. It can concluded that the statement “the proposed model is optimum & valid model for implementation in Indian nuclear sector” is acceptable.

The proposed model is optimum & valid model for implementation in Indian nuclear sector” confirms the validity of the model.

6.7 CONCLUSION ON PROJECT EXECUTION MODEL:

The confirmation of non-applicability of existing model in nuclear sector, development of new model based on respondents’ feedback and validation of model show that this model is a practical and valid model in nuclear field for execution of projects by GOI institution.