

## **Chapter 6: Modelling**

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This Chapter discusses the modelling mechanism and the gradual buildup of the model as per the philosophies discussed in the antecedent chapters. This Chapter also describes the fulfillment of the research objectives.

### 6.1 Building the Integrated Model

In addition to the antecedent discussions, this modelling chapter is dedicated to addressing the elicited areas of improvements challenging the efficiency and development of the design product through the PEDM cycle. As such, the model needs to address the critical issues presented in Table 5.4 in order to answer the research question. These critical issues are the particular issue owners & so they are termed Owners and the solutions from the inductive analyses are proposed to be the actual solution operators in the system & hence are termed Operators (refer the *bold+italicised* terms in Table 5.4).

#### 6.1.1 Owners & Operators

The Owner of a particular challenge is defined as the property of any particular activity, the lack of which has been identified to negatively (disdainfully) impact the PEDM Cycle that in turn directly/indirectly erodes the competitive advantage of the company.

The Operator of a particular solution is defined as a managerial tool that administers a particular solution to a particular Owner in order to overcome a specific challenge, thus making a positive (coveted) impact on the PEDM Cycle that in turn directly/indirectly sharpens the competitive advantage of the company.

In Table 5.4 of the preceding Chapter 5 all the identified Owners & the proposed Operators have been seen; it has been noted in Table 5.4 that there are eight or octo-operators (of solutions) to the twelve owners (of issues); a closer look at the operational meanings of each these Owners & Operators and the working constituents of the new model are as follows:

### **1: Objectivity in Technical Decisions**

Technical decision making needs to be based on facts, technical experience & company's benefit, rather than on any pre-conceived notions or personal interests; these decisions need to be verified to be Aesthetic: compliant to sound engineering/management practices, Functional: able to achieve the desired result/s, Buildable: is practically feasible, Economic: is potent to give the best quality result among all the other decision options within the budget yet is the cheapest among the similar other options. The Operator named Objectivity-Ensurer (O-E) shall ensure that these activities are automatically done before the decision can reach to the next level in the PEDM cycle.

### **2: Positivity of Uncertainty**

Every uncertain decision has a negative as well as a positive side; any uncertain decision needs to be taken after careful analysis of both the sides; just

like some measures are put to prevent or limit the negative side effects to ALARP, the decision needs to ensure that AHARP exploitations of the positive side effects have also been analysed, before accepting or rejecting any uncertain option in any decision. The Operator named Uncertainty-Positiviser (U-P) shall ensure that these activities are automatically done before the decision can reach to the next level in the PEDM cycle.

### **3: Interdisciplinary Design Optimization**

In jobs requiring multiple design disciplines (for e.g. Mechanical & Piping Engineering, Chemical/Process Engineering, Electrical & Instrumentation Engineering, etc.), after each discipline is ready with their preliminary output, they should jointly review their designs to know each other's specific design concerns and address that in their own designs as applicable; further they should periodically audit their own designs (at least once even in extremely urgent schedules) as well as each other's designs before issuing to Client, in order to ensure that the agreed objectives have been met; examples are HAZOP Studies, Mechanical Audits of Electrical designs (only on the Mechanical Engineering aspects), etc. The Operator named Interdisciplinary-Optimizer (I-O) shall ensure that these activities are automatically done before the design output can reach to the next level in the PEDM cycle.

### **4: Design Knowledge Management**

It is as vital for the company's designers to have the required design knowledge for the present design job as it is for the experiential design knowledge of the seniors to flow into the juniors and vice-versa for the company's future. The Operator named Transknowledge-Balancer (T-B) shall ensure that these

processes are automatically complied with in each of six phases, through transparent (well documented) Sequencing-Controlling-Monitoring before the design output can move on to the next phase in the PEDM cycle.

### **5: Effective Communication**

Keeping all stakeholders in the PEDM cycle well informed is a key to achieving the best design in the shortest time; technical disagreements shall be encouraged as that brings out diverse views to the same problem, however, conflicts shall have to be positively resolved by Shared Understanding & Treating Assertions as Facts; this has to be bi-directionally practiced in each phase of the PEDM cycle both internally (among the Design Engineers & the Design Managers) as well as externally (with the Clients) in order to ensure that the whole team is Integrated towards achieving the best possible design goal in the shortest possible time; also the higher management need to ensure that their all subordinates understand the company's vision, mission and the Company's strategies to achieve the goals. The Operator named Multi-integrative-Communicator (M-C) shall ensure that these processes are automatically complied with in each of six phases before the design output can move on to the next phase in the PEDM cycle.

### **6: Innovation**

Innovation is a key to business success and hence, neglecting or discouraging innovation, in whatever little way, can go a long way to sabotage the Company's future. Every innovative idea needs to be analysed closely and objectively by the immediate superior before being verified by another person; further, all the team members need to think of innovative ways on the design and

the whole process, right from the innovative idea popping in a member's head to the verifier, has to be recorded to enable future audits. The Operator named Innovation-Integrator (I-I) shall rigorously ensure that AHAPR innovation is being systematically practiced on each side (process side & product side) in each phase of the PEDM cycle.

### **7: Non-Value Adding Activities**

The timely identification and elimination of non-value adding activities to ALARP level is another important factor to achieve the highest returns from any process. Hence, Design Managers & Design Engineers shall need to identify & systematically remove valueless activities that waste time, money and energy. The term rework is defined here as any non-value adding activity that wastes time without giving any positive desired result, hence directly/indirectly causes some rework or some delayed other important work in the PEDM cycle. The Operator named Rework-Minimizer (R-M) shall ensure that the identification and removal is systematically done in each phase before a design product can reach to the next phase in the PEDM cycle.

### **8: Competencies**

The other meaning of competency is the right people with the right knowledge at the right place in the right time. It is vital to develop competencies of engineers as well as managers because only then the engineers shall have the right knowledge to apply at the right place at the right time and only then the managers shall be able to ensure that all the right resources i.e. engineers, design trainings, design software, etc. have been synchronized properly to achieve continuously developing competency levels. For example, if a manager does not

have the managerial competency to understand the company's future goal requirements, then he/she may not approve any costly but indispensable training of his/her subordinate in order to show more profit in the current financial year of the company. Further, the development shall have to be periodically monitored through a transparent & clearly defined performance appraisal system for each design project in order to reap the maximum benefits (competency alignment to technical requirements, specific learnings from specific mistakes/trainings on the project, positive identification & proportional reward for performers, positive identification & proportional penalties for non-performers, etc.) The Operator named Professional-Developer (P-D) shall ensure that these processes are automatically complied with in each of six phases before the design output can move on to the next phase in the PEDM cycle.

All the preceding eight operators act on both product & process sides in each phase of the PEDM cycle. The preceding discussions have clarified the working of the individual constituents that make up the model; following from there, the details on the integrated functioning of the whole model with all its constituents are described in the proceeding chapter.

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*(Section 6.1.2 follows in next page)*

### 6.1.2 Naming the New Model

The antecedent discussions have described the ingredients that make up the Integrated Piping Engineering Design Management Model. Before forging ahead further on the topic, the name of this New Model is meaningfully derived; '**D**'<sup>1</sup> is selected as the first constituent of the name, as it is the researcher's consecrated Deb's<sup>1</sup> model; the second constituent is '**Octo**'<sup>2</sup>, as the model is operated by eight/octo operators so it is octo-operated; the third constituent is '**Naut**'<sup>3</sup> as the octo-operated model navigates/nauticates throughout the entire piping engineering design management cycle or orbit; therefore, integrating these three constituents, the new model's name is derived as D's (Deb's) plus Octo (Octo-operated) plus Naut (Nauticator) equals to **Doctonaut**.

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1 = the study has been dedicated to God and Deb means God in the researcher's innate language or Mother-tongue Bengali, thereby, the first letter of Deb's, i.e. **D** is selected

2 = there are eight Operators or Octo-operators solving the challenges/issue-owners to catalyse the PEDM cycle towards business excellence as earlier described, thereby short form of Octo-operated, i.e. **Octo** is selected

3 = anything navigational is metonymious with Nautical and this new model with its octo-operators navigates throughout the entire PEDM cycle/orbit, thereby short form of Nauticator, i.e. **Naut** is selected

1 + 2 + 3 = Deb's Octo-operated Nauticator = **Doctonaut**

## 6.2 Checking Fulfillment of Research Questions & Research Objectives

The research objectives & questions have been always borne in the mind of the researcher throughout the entire research process, with special emphasis during the data collection and analyses stages of the research; as a result, each step has been deeply thought upon, profoundly analysed, rigorously verified and then used in the research (as discussed in the preceding sections). The following discussion corroborates whether the findings do indeed answer the research questions discussed in Section 3.5.

*1<sup>st</sup> Question: HOW Piping Engineering Design is being managed in oil & gas industry in India?*

*Answer:* As described in sub-section 5.2.1, it has been seen how the different PEDM activities start, flow and end, the types, why and when of the activities, the interaction subjects, pathways & causes, the quality management practices, etc.; thus the first objective has been gratified.

*2<sup>nd</sup> Question: WHAT are the areas of improvements in the existing practices/models and HOW those areas can be catered to through a Model of Piping Engineering Design Management?*

*Answer:* In sub-section 5.2.2, the identified areas of improvements challenging the development of the PEDM cycle have been seen and in sub-section 6.1.1 it has been discussed how those areas can be improved upon through the use of specially designed Operators. Further, it has also been seen in sub-section 5.2.2 that most of the challenges are observed to be similar to the issues found by other PEDM researchers through their independent researches worldwide as discussed earlier (Table 3.1) but a few (five) additional challenges (the ones identified as 'new' in Table 5.4) are found that are unique to the Indian context. The second

research question has required to identify the issues/challenges and also ingredients to make a model for catering to those issues. The issues have been identified and the modelling ingredients for catering to those issues have been developed (refer Table 5.4, Sections, 5.2.2 & 6.1.1); with the preceding described tools (Operators of Owners) and tackles (augmented knowledge) the ingredients/constituents of the new Model Doctonaut have been developed in accordance with the earlier discussed philosophies & rationales of research design; thus the second objective has bountifully gratified. For ligature continuum it may be marked here that while the ingredients have been workably described in the antecedent sections, the integrated working of Doctonaut has been described in the following chapter. In this context it is noted that one particular approach on the product side, that has been identified to be a sub-component of one issue/challenge in PEDM cycle (Design & Drawing Reviews in Multiple Stages: refer Table 3.1 point-3) in other industries, is not a sub-component of any challenge in this present research case since design & drawing reviews are observed to be reviewed in multiple stages in this particular company; as such this has not been included in the design definition of the Operator Interdisciplinary-Optimizer in sub-section 6.1.1.

In consideration of these facts, this present research has provided detailed answers to the research questions and has thus rhapsodically fulfilled/achieved the research objectives.

In this Chapter the workable ingredients for catering to all those identified issues, modelling tools & mechanism for gradually building up the new model and the fulfillment of the research objectives have been depicted. The proceeding Chapter describes the new model Doctonaut & its integrated working, and epitomizes the neoteric knowledge advancement through this research.