Chapter 54
Innovating Practices in Managing Engineering Design Projects

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ABSTRACT

We can address innovation from different perspectives. In engineering practices we can look to changes resulting from attempts to discover ways of overcoming difficulties. How can we manage these innovative practices in engineering design projects? Furthering our perspective we use an actor-network way to look at change processes as chains of translations between heterogeneous actors that are enrolled in changes and where patterns of action are inscribed in durable manners. In an actor-network, the chains of inscriptions are stronger if the number of aligned actors is bigger, and this is the case of engineering projects where the cost of change builds up with time. Through the use of some stylized situations, the authors construct a Perturbation Index to obtain numeric values to assess the dynamics of innovations in engineering practices. The aim is that the application of this index to real situations could lead to meaningful descriptions of such innovation processes. Managing innovation in engineering design projects has to do with the management of project scope. The proposal extends scope management from its definition and planning phases through the control of changes along the execution.

1. INTRODUCTION

Most references to innovation relate to the development of new products, mainly from the product side characteristics. In this chapter we do not address innovation in these terms, but as practice changes an engineer creatively adopts during engineering design projects.

We adopt Actor-Network Theory (ANT) including the recent developments that go under the denomination of Modes of Existence (Latour, 2013), as a way to understand the change processes along

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the chain of inscriptions we call translations: "So the phenomenon we are tackling is not inscription per se, but the cascade of ever simplified inscriptions that allow harder facts to be produced at greater cost", Latour (1990), see section 2 of this chapter. The chains of inscriptions are stronger if the number of aligned actors is bigger, and this is exactly the case of a project where the cost of change builds up with the evolving of time (PMBOK, 2008).

We have in mind the management of project scope from its definition and planning through the control of changes and execution. We do it inspired by the Earned Value Management framework and new extensions. These extensions stress the relevance of "time" in projects and add to cost and time performance indicators a schedule performance index. We designed a "perturbation regime index" to account for translation effort. Then we analyze stylized changes "of regime" and conclude that some changes, more than others, can lead to innovative results. This means we gain a wider view about scope, and scope management, being able to observe and challenge good practices changes, something we repute crucial in engineering design (innovative) projects, where requirements and goals permanently drift.

In engineering processes adherence to good practices is positive for replication of things and to assure efficiency, but it can drastically limit innovation. In his day-to-day practice an engineer always has opportunities to innovate, but this always mean challenging good practices and stabilized routines. Good practices sometimes crystallize losing their edge and hampering innovation opportunities. Innovation in engineering design is not only about the design of new products. We address this dilemma by pointing to a way to challenge innovation in engineering design projects, questioning how engineers commit themselves with innovative practices. Can we mobilize people on their search for innovation? Can we manage the adoption of innovative practices? Is there any possible compromise between good practices and project (design-projects) goals? Can we manage the degree of perturbation in project translations in an advantageous way? To propose a way of research on the answering to these questions is the goal of this chapter.

Project Management standards cover different issues on project management within a roll of *situated* contexts. Maybe it is difficult to generalize but engineering design and technological innovation (R&D) are topics not specifically addressed in the project management different bodies of knowledge. In fact, the uncertainty about the outcomes implies the scope to be dynamic (Pons, 2008) and scope management to be influenced and fertilized by different techniques.

The view of scope as the result of a Work Breakdown Structure (WBS) with its hierarchical formalism may convene impressions of a neat way to go about the scope management of a project. But as all project managers are well aware, these impressions are illusory except for trivial cases. Engineering design is normally characterized by complex interrelated activities and large uncertainties on different aspects, for example about which solution path should be taken, availability of resources, and more. In these circumstances the full scope of a project cannot be anticipated beforehand (Pons and Raine, 2005). When dealing with engineering design projects a main problem is related with evolving uncertainty (Sonnemans et al, 2003). Uncertainty at the formulation level, *what* is the problem and which is the problem, with all the necessary negotiations with key stakeholders in order to formulate the problem well – *problem setting* (Schön, 1983). Uncertainty at the resource level, how can we grab and convince some crucial resources to be part of our project – *enroll and mobilize actors*. And uncertainty at the execution level, how can we estimate efforts to do things that were never done before, and how can we cope with such an amount of different solicitations and demands (strategic nature, operational type, product portfolio)? (Pich et al, 2002). Even from the side of product development, Ford and Chris Coulston (2008), recog-

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