Combining Synoptic and Incremental Approaches for Improving Problem-Solving in Maintenance Planning, Monitoring and Controlling

Fazel Ansari1*, Madjid Fathi1, Ulrich Seidenberg2
1Institute of Knowledge Based Systems & Knowledge Management
2Institute of Production & Logistics Management
University of Siegen, D-57076 Siegen, Germany
{fazel.ansari@, fathi@informatik., seidenberg@bwl.wiwi.}uni-siegen.de

1 Introduction

Planning, monitoring and controlling are equally important to manage business processes. Those are associated with efficient use of physical resources and personnel, continuous performance improvement of practitioners and processes, and sustaining organizational goals. In this paper, we have primarily focused on the nature and fundamental characteristics of problem-solving as the key to bridge and compensate the gaps of planning, monitoring and controlling across business processes. In addition, we foresight the needs to develop combined approaches that simultaneously consider rational and coherent aspects of decision-making, and develop the problem-solving within incremental procedures. This especially applied and proved in the field of maintenance cost management.

2 Problem-solving approaches

Literature of strategic planning and management deal with two major schools of thought (i.e. general approaches) for strategy formulation and process modeling entitled Synoptic formalism (Rationalism) and Incrementalism. The former is based on “principles of rational decision-making and assume that purpose and integration are essential for a firm’s long term success” (Fredrickson, 1983). In contrast, the latter takes into account how organizations really make strategic decisions (Fredrickson, 1983). Toft defined “synoptic formalism as a wide range of problem-solving approaches that can be characterized as being ideal, rational, sequential and comprehensive” (Toft, 2000). This school of thought is originated by (Andrews, 1971), (Ansoff, 1977), (Steiner, 1979), and (Lorange, 1980). They discussed long-range planning and traditional strategic planning (Toft, 2000). Moreover, Methe et al. argued that strategic problems are too complex and ever changing, therefore, the strategic decision-making cannot be accomplished in a rational and straightforward manner, and it is coherently incremental and adaptive (Methe, et al., 2000). This school of thought is known as Incrementalism. Furthermore, incremental approaches break through the barriers of synoptic formalism by stating that the latter is not applicable in some cases and therefore cannot be used and even should not try to be used in such cases (and trying it regardless is not rational) (Seidenberg, 2012).

The well-known incremental approaches are “bounded rationality” (Simon, 1997 (1957:1st)), “muddling through” (Lindblom, 1959), “disjointed incrementalism” (Braybrooke, et al., 1963), “logical incrementalism” (Quinn, 1980), “Kaizen” (Imai, 2002), and “piecemeal engineering” (Popper, 2003). The terms “incremental approach” or “continuous improvement” - (Nicholas, 2011) – are addressed in the management literature, especially in contributions or partial overlapping to the thematic areas such as organizational change (Beck, 2001), (Nicolai, 2010), optimization of business process (Becker, 2008), (Schmelzer, et al., 2010), corporate planning, account planning (Picot, et al., 1978), (Bresser, 2010), product innovation (especially the discussion of radical and incremental methods to innovation management) (Beck, 2001), (Leavitt, 2003), (Becker, 2008), (Goffin, et al., 2010), (Nicholas, 2011), and quality management (Pfeifer, 2002), (Evans, et al., 2011).

Besides, synoptic models are to maximize the organizational goals which are defined in economic or financial terms, based on a rational and comprehensive procedure (Methe, et al., 2000). Incremental
models are to decentralize the selection of alternatives through adapting to environmental changes. Therefore “organization is constrained to multiple goals composed of an admixture of economic, political and social considerations” (Methe et al., 2000).

Table 1. Major features for the selection of synoptic and incremental approaches – Translated by the authors from (Seidenberg, 2012)

<table>
<thead>
<tr>
<th></th>
<th>Synoptic approach</th>
<th>Incremental approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underlying principle of cybernetics/Control</td>
<td>Open loop</td>
<td>Closed loop</td>
</tr>
<tr>
<td>Involved management phases</td>
<td>Planning and Decision-making</td>
<td>All, especially including monitoring</td>
</tr>
<tr>
<td>Type of complexity reduction</td>
<td>Trivialization of source of problems by structuring</td>
<td>Tentativeness by the solution of the problem</td>
</tr>
<tr>
<td>Type of problem shifting</td>
<td>Degenerative</td>
<td>Progressive</td>
</tr>
<tr>
<td>Cause of the phenomenon, to solve the &quot;wrong&quot; problem</td>
<td>Unsuitable modeling, especially by highly reduced complexity</td>
<td>Unsuitable problem selection /prioritization</td>
</tr>
<tr>
<td>Time sequence of the problem-solving process</td>
<td>Defined initial and defined end (Project)</td>
<td>Without a defined end (ongoing task)</td>
</tr>
<tr>
<td>Status of problem-solving</td>
<td>Definitively (Elimination of the problem)</td>
<td>Tentatively (Dealing with or handling the problem)</td>
</tr>
<tr>
<td>Required level of quality of problem-solving</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Possibility of wrong decision</td>
<td>In the basic model of decision theory is not provided</td>
<td>Considered in this approach</td>
</tr>
<tr>
<td>Direction of evaluation of problem-solving</td>
<td>Forward (based on the goal) What is left to do?</td>
<td>Backward (based on previous state/literal review) What has been reached?</td>
</tr>
<tr>
<td>Benchmark to assess the problem-solving</td>
<td>Absolute, based on optimum</td>
<td>Relative, Comparative</td>
</tr>
</tbody>
</table>

Synoptic and incremental approaches have been examined, criticized and/or comparatively studied by numerous authors of (strategic) management particularly Lindblom (Lindblom, 1959), Dror (Dror, 1964), Picot and Lange (Picot, et al., 1978), Fredrickson (Fredrickson, 1983), Johnson (Johnson, 1988), Mintzberg (Mintzberg, 1990), Ansoff (Ansoff, 1991), Toft (Toft, 2000), Methe et al. (Methe, et al., 2000), Miller (Miller, 2011), and Seidenberg (Seidenberg, 2012). Hard critiques and debates can be detected concerning “Incrementalism” and/or “Rationalism” (Synoptic formalism). An example is the phenomenon of “strategic drift” when the “incrementally adjusted strategic change and environmental change, particularly market changes, moved apart” (Johnson, 1988). This phenomenon roots in the characteristics of incremental approaches especially mean-end relationship (i.e. prioritization of the alternatives to goals), and concept of choice (i.e. selection of the approximate choice rather than the best choice, or the one that most closely approximates the desired end). Seidenberg also reviewed and compared four incremental models “disjointed incrementalism”, “logical incrementalism”, “piecemeal engineering” and “Kaizen” (Seidenberg, 2012). He concluded that these models differ in several ways, so one cannot speak about one single kind of “Incrementalism” (Seidenberg, 2012).

In the past 45 years synoptic and incremental models have been evolving and discussing in both theory and practice. However, which one is “the best way of problem-solving”? Fredrickson suggested “not only organizations that employ both synoptic and incremental approaches, but the strategic process may be synoptic on some characteristics (e.g. the process is proactively initiated), and simultaneously incremental on others (e.g. strategic decision is not the result of conscious choice)” (Fredrickson, 1983). This hypothesis was reconsidered through an empirical investigation by Methe et al (Methe, et al., 2000). They pointed out the question of selecting either incremental or synoptic is not exact, and it
should be reformulated to “when and how” the two approaches could be used (Methe, et al., 2000). Thus the question of selecting "one best way" to solve problems (either synoptic or incremental) is the wrong one. Instead, coexistence and combination of the two basic approaches to strategic management is recommended (Fredrickson, 1983), (Toft, 2000), (Methe, et al., 2000), (Bresser, 2010) and (Seidenberg, 2012). Table 1 presents our findings based on the literature study and Needs Analysis regarding the major features of synoptic and incremental approaches to problem-solving (decision-making) activities. It provides recommendations to decide “when and how” synoptic and incremental approaches can be used.

In terms of problem discovery and solving, Heuristic models encompasses principles of synoptic/incremental approaches, but concentrates more on providing hypotheses and guidelines (Käschel, et al., 2001), (Berens, et al., 2004), (Blohm, et al., 2008). Heuristic models are usually speculative formulation serving as a guideline in problem discovery and solving, and not guaranteeing the best way (Käschel, et al., 2001), (Smith, 2002), (Koen, 2002), (Blohm, et al., 2008). Heuristic models are used to guide, discover and solve problems in the entire process of problem-solving or decision-making (Smith, 2002), (Koen, 2002). Koen's definition of the engineering method is stressed the importance of heuristic modeling in the sense that “… the engineering method is the use of heuristics to cause the best change in a poorly understood situation within the available resources” (Smith, 2002), (Koen, 2002), (Koen, 1985). Examples of heuristic models are rules of thumb for proposing hypothetical structures for planning, monitoring and controlling which are strengthened in some cases by providing mathematical formulations. In the context of Operation Management, heuristic approaches are compared with Meta-Heuristic or approximation/optimization algorithms (Blohm, et al., 2008). Meta-heuristic approaches provide general patterns for universally problem-solving whereas situationally like heuristics (Blohm, et al., 2008), (Stevenson, 2012). Meta-heuristic models are used basically to find approximate solution(s) especially for solving the sophisticated and complex problems (Käschel, et al., 2001), (Blohm, et al., 2008). Examples are using evolutionary algorithms (e.g. Genetic algorithms) or Local Search (Käschel, et al., 2001), (Berens, et al., 2004), (Blohm, et al., 2008). However, the boarder for identifying which heuristic or meta-heuristic method is synoptic or incremental is too indecipherable. For example the synoptic approach like Branch-and-Bound can be interpreted in a shortened version as heuristic, and the genetic algorithm as a meta-heuristic approach, in contrast, is incremental (Blohm, et al., 2008). Therefore one can not classify those models in two fully separated categories. The advantages and drawbacks of synoptic/incremental models and their boarder of similarity to heuristic and meta-heuristic approaches, indicate the potential for coexistence of these approaches. Such a combination can lead to synergistic effects in problem-solving activities associated with the business processes.

3 Conclusion and Outlook

In order to concretely analyze utilization of problem-solving approaches in research and development and reveal the current situation, we have analyzed the literature of Maintenance Cost Management (MCM). Figure 1 shows the pattern for using different type of problem-solving detected through literature study of more than 69 problem-solving approaches detected in the field of MCM. It shows that the number of synoptic models is higher than incremental ones. However, the difference between the number of synoptic and incremental models is insubstantial and insignificant. The promising result is the indication of a large difference between the number of combined and uncombined (incremental plus synoptic) models.
As discussed earlier incremental models consider “errors” in decision-making and use feedback/feed-forward loop to compensate errors and learn for future decisions. In contrast, synoptic models presuppose comprehensive information for decision-making and therefore are based on open control chains. The incremental approaches/models also suffer lack of knowledge about the optimal step size as well as the optimum for the appropriate frequency of changes in the status quo. Therefore, the combination can lead to synergistic effects in problem-solving activities associated with MCM. Based on such a lack, an innovative approach is to employ combined principle models that promote bridging the gap of "Planning-Monitoring-Controlling". In this way, a promising future research topic is to specifically analyze Heuristic and Meta-heuristic characteristics of problem-solving in comparison with the findings of Table 1. Thereby the incremental principles for continuous learning and improvement are used together with comprehensive modeling of the decision-making. Especially the combined approach can be developed based on the deployment and integration of knowledge assets, either as explicit or implicit sources which are derived or used within the controlling process. This may lead to reinforce the dynamic of knowledge assets, and support sustainable incremental changes to achieve desired organizational goals. Therefore, the process of controlling will be merged with learning and foster discovering improvement potentials for (re)design and (re)formulating of strategies. The practical evidences and implications for development of such approaches, especially in the domain of MCM are presented in our previous works such as (Ansari, et al., 2011), (Ansari, et al., 2012), and (Ansari, et al., 2013).

References


Ansari, F., Fathi, M. and Seidenberg, U. 2012. Integration of Knowledge Management in Preventive Maintenance Cost Controlling Using Performance Quality Indicators. Chicago : CG-Publisher, 2012b. (Received Graduate Scholar Award).


