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

Fazel Ansari[1*], Madjid Fathi[1], Ulrich Seidenberg[2]
[1]Institute of Knowledge Based Systems & Knowledge Management
[2]Institute 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 approches

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)

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

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.

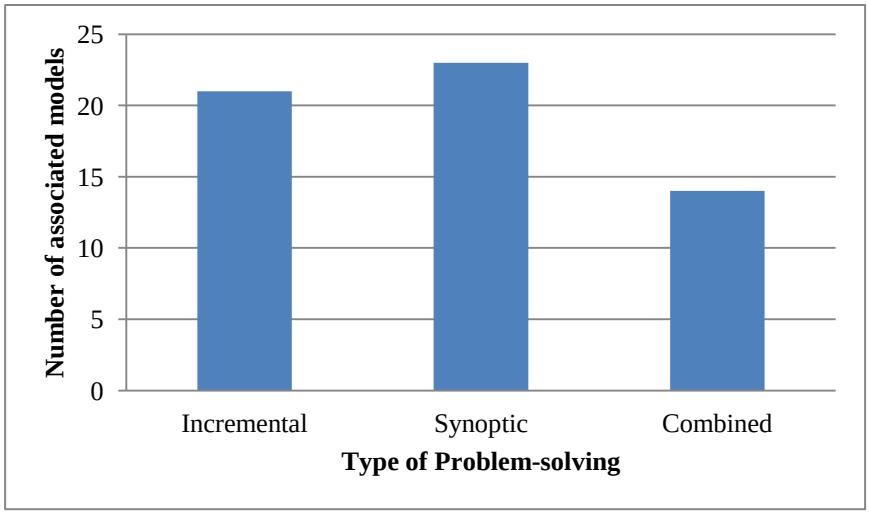

Figure 1. Type of problem-solving and the number of associated models corresponding to each expression (Literature review of 69 approaches to MCM)

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

Andrews, K. R. 1971. *The Concepts of Corporate Strategy.* s.l. : Dow Jones-Irwin, 1971.

Ansari, F., Fathi, M. and Seidenberg, U. 2011. Evolution of Intelligent Quality Management Process Based on Using Performance Quality Indicators. [ed.] Ronald Maier. *Professional Knowledge Management: From Knowledge to Action.* Bonn : Gesellschaft für Informatik, 2011, pp. 149-160.

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).

Ansari, F., Uhr, P. and Fathi, M. 2013. Textual Meta-analysis of Maintenance Management's Knowledge Assets. *International Journal of Services, Economics and Management (Accepted on 11.04.2013).* s.l. : Inderscience Enterprises Ltd., 2013.

Ansoff, H. I. 1991. Critique of Henry Mitzberg's The Design School: Reconsidering the basic premise of strategic management. *Strategic Management Journal.* s.l. : John Wiley & Sons, 1991, Vol. 12, pp. 449-461.

Ansoff, H. I. 1977. The state of practice in planning systems. *Sloan Management Review.* s.l. : Massachusetts Institute of Technology, 1977, Vol. XVIII, pp. 1-24.

Beck, N. 2001. *Kontinuität des Wandels:Inkrementale Änderungen einer Organisation.* Wiesbaden : Westdeutscher Verlag, 2001.

Becker, T. 2008. *Prozesse in Produktion und Supply Chain optimieren.* 2nd. Berlin/ Heidelberg : Springer, 2008.

Berens, W., Delfmann, W. and Schmitting, W. 2004. *Quantitative Planung.* 4th. Stuttgart : Schäffer-Poeschel Verlag, 2004.

Blohm, H., Beer, T., Seidenberg, U. and Silber, H. 2008. *Produktionswirtschaft.* 4th. Herne : NWB Verlag, 2008.

Braybrooke, D. and Lindblom, C. E. 1963. *A strategy of decision: policy evaluation as a social process.* New York : Free Press, 1963.

Bresser, R. K. F. 2010. *Strategische Managementtheorie.* Stuttgart : Kohlhammer, 2010.

Dror, Y. 1964. Muddling Through - "Science" or Inertia? *Public Administration Review.* s.l. : Blackwell Publishing - American Society for Public Administration, 1964, Vol. 24, pp. 153-157.

Evans, J. R. and Lindsay, W. M. 2011. *The Management and Control of Quality.* 8th. s.l. : South-Western,Cengage Learning, 2011.

Fredrickson, J. W. 1983. Strategic Process Research: Questions and Recommendations. *The Academy of Management Review.* s.l. : Academy of Management, 1983, Vol. 8, pp. 565-575.

Goffin, K. and Mitchell, R. 2010. *Innovation Management.* 2nd. New York : Palgrave Macmillan, 2010.

Imai, M. 2002. *Kaizen.* 2. Munich : Econ Ullstein List Verlag, 2002.

Johnson, G. 1988. Rethinking Incrementalism. *Strategic Management Journal.* s.l. : John Wiley & Sons, 1988, Vol. 9, pp. 75-91.

Käschel, J. and Teich, T. 2001. Reihenfolgeplanung in Produktionsnetzwerken. [ed.] B. Jahnke and F. Wall. *IT-gestützte betriebswirtschaftliche Entscheidungsprozesse.* Wiesbaden : Gabler Verlag, 2001, pp. 239-259.

Koen, B. V. 2002. *Discussion of the method:Conducting the Engineer's Approach to Problem Solving.* Oxford : Oxford University Press, 2002.

Koen, B. V. 1985. *Definition of the engineering method.* Washington : American Society for Education, 1985.

Leavitt, P., [ed.]. 2003. *Using Knowledge Management to Drive Innovation.* s.l. : American Productivity & Quality Center (APQC) , 2003.

Lindblom, C. E. 1959. The science of "muddling through". *Public Administration Review.* s.l. : American Society for Public Administration, 1959, Vol. XIX, pp. 79-88.

Lorange, P. 1980. *Corporate planning : An executive viewpoint.* New Jersey : Prentice Hall, 1980.

Methe, D. T., Wilson, D. and Perry, J. L. 2000. A Review of Research on Incremental Approaches to Strategy. [ed.] Jack Rabin, Gerald J. Miller and W. Bartley Hildreth. *Handbook of Strategic Management.* 2nd. New York : Marcel Dekker, Inc., 2000.

Miller, D. 2011. Some Hard Questions for Critical Rationalism. Coventry : University of Warwick, 2011.

Mintzberg, H. 1990. The Design School: Reconsidering the Basic Premises of Strategic Management. *Strategic Management Journal.* s.l. : John Wiley & Sons, 1990, Vol. 11, pp. 171-195.

Nicholas, J. 2011. *Lean Production for Competitive Advantage: A Comprehensive Guide to Lean Methodologies and Management Practices.* New York : CRC Press, 2011.

Nicolai, C. 2010. Konzepte für den organisatorischen Wandel. *WISU - Das Wirtschaftsstudium.* Dusseldorf : Lange Verlag GmbH & Co. KG, 2010, Vol. 39.

Pfeifer, T. 2002. *Quality Management: Strategies, Methods and Techniques.* s.l. : Carl Hanser Verlag, 2002.

Picot, A. and Lange, B. 1978. *Strategische Planung: synoptisch oder Inkremental?* Hannover : Leibniz Universität Hannover, 1978.

Popper, K. R. 2003. *Das Elend des Historizismus (The Poverty of Historicism).* 7th. Tübingen : s.n., 2003.

Quinn, J. B. 1980. *Strategies for change: logical incrementalism.* s.l. : Richard D. Irwin, 1980.

Schmelzer, H. J. and Sesselmann, W. 2010. Geschäftsprozessmanagement in der Praxis. 7. Munich : Hanser Verlag, 2010.

Seidenberg, U. 2012. *Ausprägungen und Einsatzbedingungen inkrementaler Managementansätze.* Siegen : University of Siegen, 2012.

Simon, H. A. 1997 (1957:1st). *Administrative Behavior.* 4th. s.l. : Free Press, 1997 (1957:1st).

Smith, Karl A. 2002. Teamwork and Project Management. s.l. : McGraw-Hill, 2002.

Steiner, G. A. 1979. *Strategic Planning.* New York : Free Press, 1979.

Stevenson, W. J. 2012. *Operations Management: Theory and Practice.* 11th. New York : McGraw-Hill Irwin, 2012.

Toft, G. S. 2000. Synoptic (One Best Way) Approaches of Strategic Management. [ed.] Jack Rabin, Gerald J. Miller and W. Bartley Hildreth. *Handbook of Strategic Management.* 2nd. New York : Marcel Dekker, Inc., 2000.