Chapter 2.46
Autopoietic Approach for Information System Development

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INTRODUCTION

In the last decade a new generation of information systems (IS), such as enterprise resource planning, Web-based information systems and knowledge management support systems, have emerged in response to ever-changing organizational needs. As these systems are socio-technical phenomena in which social and technical factors interweave the ways in which people work, the issue of "how to integrate the work activity and social context of users into the IS which is being designed" becomes one of the principal problems of IS development (Bai et al., 1999). Therefore, the need for new information system design theories is recognized. According to Walls et al. (1992), an "IS design theory" must have two aspects—one dealing with the description of the system and one dealing with the prescription, that is, the process of developing of the system. The prescription aspect includes a description of procedures and guidelines for system development. In addition, these two aspects have to be grounded on theories from natural or social sciences, that is, kernel theories. Therefore, the development of new IS design theories requires a closer look at the system theories that go beyond the traditional system theory that is based, among other things, on Cartesian dualism, that is, mind/body or cognition/action, and on a model of cognition as the processing of representational information (Mingers, 2001). One of the candidate theories is the theory of autopoiesis, which can be best viewed as a system-grounded way of thinking with biological foundations, together with its extension into social domain.

THEORY OF AUTOPOIESIS

In order to conceive of living systems in terms of the processes that realized them, rather in terms of their relationships with an environment, Maturana and Varela (1980) coined the word autopoiesis

(autos = self, poienin = creation, production) to denote the central feature of their organization, which is "autonomy". The meaning of this word coveys the very nature of living systems as systems that maintain their identity through their own operations of continuous self-renewal. Moreover, these systems could only be characterized with reference to themselves and whatever takes place in them, takes place as necessarily and constitutively determined in relation to themselves, that is, self-referentiality.

One of the key concepts of autopoiesis is the distinction between organization and structure. On one hand, organization is the capability of a system to re-produce its identity by referring constantly to itself, through the alternate re-production of its components together with the component-producing processes, that is, the capability of a recursive self-reproduction. On the other hand, structure is the realization of a system's organization through the presence and interplay of its components in a specific realization space. While organization is necessary to establish system unity and identity, structure is necessary because different spaces of its actualization impose different constraints on systems' components (Maturana & Varela, 1980). By rough analogy, an algorithm for solving certain problem can be viewed as a description of the system's organization, whereas the corresponding computer program can be viewed as the realization of this organization (structure) in a certain space (programming language).

Autopoietic Systems

An autopoietic system is defined by Maturana and Varela as

"a network of processes of production, transformation and destruction of components. These components constitute the system as a distinct unity in the space of its actualization and they continuously regenerate and realize, through their interactions and transformations, the network of processes that produce them." (Maturana & Varela, 1980, p. 135)

Among the distinct characteristics of the autopoietic systems, the most relevant ones are:

- The simultaneous openness and closure. Autopoietic systems are open with respect to structural interaction with the environment, that is, structural openness, which is unavoidable consequence of the fact that system elements must satisfy the particular requirements of the physical domain in which they occur, while they are closed with respect to their own organization, that is, organizational closure. The recognition of the simultaneous openness and closure of autopoietic systems is in opposition to the tradition for which a system is one or the other but not both. This interpretation is possible only because of the clear distinction between organization and structure (Bednarz, 1988).
- Structural determination. The state transition a system undergoes in response to environmental perturbations is entirely determined by its structure at that time. Moreover, a system specifies which environmental perturbations may trigger which structural changes. In other words, the environmental perturbations could trigger the system's structural changes but can never determine or direct these changes. Moreover, a system specifies which environmental perturbations may trigger which structural changes. Over time, through ongoing interactions with the environment, an autopoietic system will experience what Maturana and Varela (1992) describe as a structural drift, or a gradual change to their structure. The nature of this change is determined by previous system's history of structural changes, that is, its ontogeny.