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Open Modeling For Designing Community Ecosystems

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OPEN MODELING FOR DESIGNING COMMUNITY ECOSYSTEMS

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Abstract

The paper proposes an open approach to modeling to cater for the emerging trend to complex adaptive systems. Such systems are seen as collections of people, programs, computers and other physical objects that must coexist and work towards a vision in a continually changing environment. The information system here is perceived as a network of physical, knowledge and other kinds of entities connected into a network that emerges as the environment evolves. The paper describes a community oriented approach to model such systems where each community is seen as a collection of such entities. The communities themselves are connected to create a system of systems or a community ecosystem where the communities collaborate to realize a continually emerging vision.

The paper describes an open modeling approach for such ecosystems to provide designers a systematic way to design community coordination. It first uses living systems and complexity as metaphors to design community structures that ensure collaboration persists over a long time. The modeling methods provide a flexible approach to show networks of community collaborating within their context. An open approach is to provide users with a flexible method to create community networks using semantics natural to the user and emphasizing perspectives to visualize the complex relationships within such systems.

Keywords: community, behavior, metaphors, complexity, social networks.

1 INTRODUCTION

The nature of systems is changing significantly with greater trends to more dynamically changing environments. There is more emphasis on communities as a unit of activity with greater focus on coordination between communities rather than predefined workflows. Community in this sense is a set of people with a common set of values. This can be a group of citizens, or a marketing team in a business enterprise, or a policy group. The term system of systems is now becoming more common as is cyber physical ecosystems (CPE) (Shin, 2010) or more conveniently Community Ecosystems (CE) to refer to systems of collaborating communities. The objective of such focus is to develop ways to support communities in a community ecosystem to collaborate towards a common vision.

Increasingly there are applications where work is being described in terms of community collaboration rather than highly structured business processes. This, for example, is the creation of a new service is more likely to proceed with collaboration between the marketing and production groups rather than a workflow collecting the requirements of a new service. Solving a problem in a supply chain often requires communities from different organizations to collaborate to resolve conflicting issues.

Associated with communities is greater emphasis on social networking in business (Pralahad and Krishnan, 2008, Cross, 2009). Social networking is not only supporting meetings but greater emphasis on aligning social structures to match the activity while encouraging the collaboration needed to create innovative solutions. A similar view is developed by McAfee (2006) who sees business networking supported by Web 2.0 as an emerging trend. This greater emphasis on social structures and emergence of social relationships to deal with environmental change calls for modeling methods to create community ecosystems.

This paper describes the need for models of community ecosystems, which are all evolving together to realize a vision in their combined environment. These models describe relationships between people, systems, organizations, and knowledge sources in a way that enables decisions to be made with the knowledge of the entire context. Increasingly the models must show relationships between objects and the way to coordinate them to facilitate the sharing and creation of new knowledge that is needed to maintain competitiveness in a continuously changing environment. Community coordination requires working towards a common vision while continually developing new directions to travel to that vision. One alternative is for communities to collaborate independently through continual emergence. The other is as suggested by Cohen (2010) to provide structure and assistance and is stressed in this paper.

There is a lack of methodologies that are perceived as natural by users to systematically describe the complex networking arrangements found in community ecosystems. This often leads to an adhoc development of systems and is symptomatic of the trend to an undisciplined approach to design noted by Parnas (2010) where users develop on an ad hoc basis one task at a time and then try to integrate the tasks into a working system. Design of CE requires an approach other than a top-down approach in modeling and designing systems. Jarke and others (2010) at a recent CAiSE conference similarly called for more context to be included in the design, the use of an architectural approach and greater emphasis on evolution and complexity.

The paper illustrates modeling methods that include both social and leadership as well as technology to supports the developments of CE. The methods are based on metaphors of complexity (Merali, 2006, Maquire, 2006) and living systems (Miller, 1978) to develop structures

that lead to sustainable operation and open systems and a more open approach is proposed to open modeling for community systems.

2 COMMUNITY ECOSYSTEMS

Communities as a term used in this paper take many forms. Communities are composed of people with common values. Examples include:

Loosely connected citizen or professional groups - Professional or citizens in local council areas that focus on limited goals. These often focus on local problems such as viewpoints in proposed local council plans,

Business Organizations - The communities here can be marketing, production, client management teams which must collaborate to achieve organizational goals. Azapagic (2003) stresses the need for such collaboration to ensure organizational sustainability. Examples here are strategic planning as for example described in Kodama (2005) or business networking often characterized by outsourcing arrangements.

Technology or Industrial Parks - These are environments where people share their knowledge both in their fields of expertise but also in the ways to put expertise together to create innovative products and commercialize them. Kamarulzaman (2008) describes ways such communities get value from collaboration.

Policy and Strategic Planning - Intercommunity collaboration is best exemplified by policy planning. Planning often includes a number of communities such as housing, energy needs, health delivery, maintaining a sustainable food supply and transport systems. For a business the communities may be products, client teams, groups managing distributed manufacturing processes, distribution chains and so on.

In practice communities often do not thrive as a society of connected communities but simply act as an individual community that operates independently using specific social software. Many local discussion systems focus either on a local problem or some global technical issue of interest to specialists but not to a global purpose. There is considerable distributed intelligence but it is no way combined to provide a community direction. The question then is how to bring them together. It requires both support collaboration within communities, and support of collaboration between communities.

Bringing communities together is often seen as the more challenging goal. It requires development of shared values and vocabularies (Garcia-Castro, 2010) to resolve transdisciplinary domain issues, which focus on ways to support cross-community integrated planning that takes into account different values and beliefs in resolving issues found in complex environments. Weik and Walter (2009), for example, define a system TIP (Transdisciplinary Integrated Planning) to enable decisions and plans across different knowledge communities, often called *transdisciplinary decision making* (Wiek, Walter, 2009). It is important to support communities by their social infrastructure, and by resources and technology to work towards these goals. The OCOPOMO project (http://fgwimz3.uni-koblenz.de:8081/ocopomo/) also addresses issues of collaboration in interdisciplinary collaboration in the European region.

3 SELECTING THE MODELING STRUCTURE FOR DESCRIBING COMMUNITY ECOSYSTEMS

Standard modeling techniques in most cases require users to describe their systems by prescribed concepts that often show little natural semantic correspondence to peoples perceptions. Expressing roles and people and objects as say UML objects does little to enable the creativity needed to emerge and respond to changing environments. It is creative in the way systems are represented but little to encourage creativity in creating the new structures.

Focusing on Architecture

Following the suggestion of Jarke (2010) and others to place more emphasis on architecture, the paper is based on the architecture shown in Figure 1. It shows loosely connected communities (Mintzberg, 2009) that collaborate to agree on common goals. At the same time these communities work within an environment of highly structured operational systems to access operational data to analyze the business environment and propose working solutions. These communities develop new knowledge by combining structured databases with tacit knowledge (Nonaka, 1994) in the community to identify new directions. In general, each community creates one or more models as its outcome and collaboration. The outcomes of communities are then monitored to determine and assistance needed to integrate the models to realize the common goal. The ICT support for the communities and the nervous system is provided through services provided through a workspace. The workspace can be mashed up to include access to operational data as well as Web 2.0 technologies to support discussion and creation and evaluation of model options.

Figure 1 again illustrates that CE concept, which provides a useful way to describe systems composed of people, equipment, software, databases, networks and so on all of which must be combined into a whole. The paper illustrates this by using an open modeling platform that allows modelers to define the concepts needed for their organization. The concepts are almost like genes that can be used to construct the DNA. For example, document structures, IT components can be combined with these concepts to provide a set of concepts needed to model CE environments. A CE system model can then be built virtually in freeform based on concepts derived from any models. In fact the concepts may be chosen to create the DNA to define the desired system behavior.

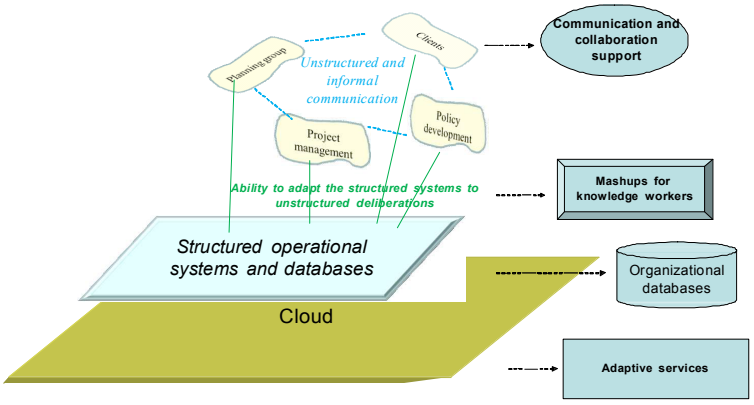

Figure 1. The Emerging Environment

What is needed in design are graphical depictions of the often-complex web of explicit objects, issues and gaps associated with key social software that brings together groups to share and evaluate ideas. It can include blogs, wikis, and other collaborative technologies to collect knowledge as it is created during social interactions.

The paper proposes a more open modeling approach where users can select concepts and bring them together in ways that allow users to see systems from different perspectives. This paper focuses on ways of modeling such systems. This should model the traits of systems.

Developing a architectural framework for community ecosystems

The approach used in the paper is to develop a modeling methodology based on metaphors. The guiding metaphor used here is that of living systems (Miller, 1978) combined with system and complexity theory. Living systems provides the metaphor that defines sustainable structures for a system of systems to survive. Based on the living systems metaphor the paper proposes the following kinds of communities. In using the metaphor to structure communities there is a balance to be achieved with ensuring that the community structure can self organize while not imposing a hierarchial set of controls. Briefly the communities are organized with emphasis on sustainability so there is one control community (the brain) that coordinates a number of knowledge communities that create the knowledge needed for the ecosystem to reach its vision. The knowledge communities create models in its domain of expertise. There are monitoring communities to monitor progress of the knowledge communities and assistant communities to provide assistance if there are problems either in the individual communities or in integrating the models of the different communities. The responsibilities of the communities are summarized in Table 1.

Community type	Responsibilities	Corresponding implementation
Knowledge community (Davenport, 2005)	Responds to perceived changes in the environment. They can be communities responsible for housing plans, water provision, food distribution and housing details. Each develops models as their outcome,	Support collaboration between team members and provide software to create models of its domain of interest to create new knowledge.
Coordination group	This may be an planning body that sets the vision and wider goals such as developing new housing estates with adequate traffic and water facilities. It determines the success factors. The group can include members of the knowledge communities to rach a common vision.	Develops a common vision through consultation with knowledge communities. Sets priorities (through consultation) Look at implications of outcomes on other activities Organizes ways to monitor outcomes and structure and notifies or selects assisting agents to improve operations. Provides guidelines and vision.

Ecosystem memory	Guideline and success factors to measure the progress of the communities..	A database of good practices.. Identify good modeling methods.
Assistance communities	Provide ways to resolve sectional differences. Monitors and compares against vision. The assistant communities are the assistance system that facilitates the collaboration between knowledge communities. The need for such assistance is outlined in Cohen (2010).	An advisory or assistant system. Software and processes that provide ways to resolve transdisciplinary issues. Possible addition of experts to knowledge communities. Search discussions to identify common interests.
The monitoring communities.	Provides ways to resolve l differences between knowledge communities Provides structure to assist community performance Rearrange responsibilities These monitors progress of individual communities and report any difficulties to the central planning. They also monitor the external environment. identifies external events or problems in the internal system	A monitoring system. Software agents. Monitors community activity including the degree of participation, level of activity, depth of participation, individual participation.

Table 1. Community traits

Define structuring for communities and ways for them to emerge. Define the concepts and relationships from many perspectives followed by their traits or behavior.

4 PROVIDING THE CONCEPTS TO DEFINE COMMUNITY RELATIONSHIPS

Concepts here are intended for users who want to see models that show objects that closely resemble the natural objects seen in their community from a perspective most appropriate for the problem. They further want to see them in ways that allow them to simply change relationships or see where they can in effect plug in new services to improve knowledge sharing within the community. This is where the open nature becomes important as users designing complex systems must have the freedom to change structures as communities emerge. Such changes can be from many perspectives, as for example need for new knowledge, reacting to an unexpected event or

simply improving knowledge flows. This calls for some flexibility in the way designers combine objects to create the collaborative systems. Beginning with collaboration (Hawryszkiewycz, 2005) the main concepts are:

Artifact, which is structure that refers to some explicit knowledge. It can for example be a database or it can be a document with attached comments.
Activity which defines the ways business is carried out,
Role that defines responsibilities within a system,
Participants are the people assigned to roles.

Other concepts include process, document, service component, computer infrastructure component, knowledge object. Ecosystem models can combine the concepts from to provide different kinds of perspectives. Designers can then create a variety of models including:

Social models, which focus on people's responsibilities and relationships
Knowledge model the defines the location and requirement for knowledge,
Activity model that defines how roles work together to create new artifacts,
Document model, which defines the structure of documents in the ecosystem
Process model that defines the steps followed in activities,
Infrastructure model that describes how technology is used to support activities.

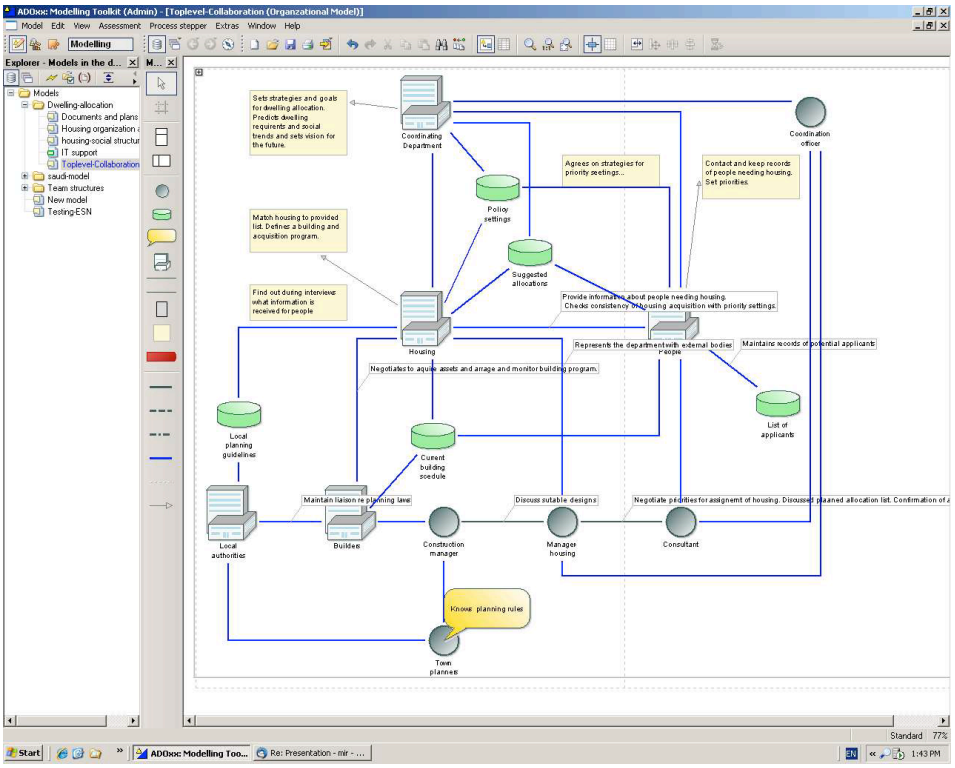

Figure 2. A Top level Organizational Model

The concepts can also be combined to answer questions like what does a system do and how does it do as raised in Cohen (2010). As an example, Figure 2 describes a generic community model to provide housing for housing applicants. The modelling method used here is implemented on the open modelling platform at the University of Vienna. The method known as MelCa allows models to be set up from different perspectives and maintains cross references between models as allowed by the open modelling platforms. New objects can be easily added to each perspective. The concepts for each perspective are shown in the center and can be easily selected and plugged into the model. On the left hand side is a menu that allows users to create models.

Figure 2 shows that we are creating a model of a 'community structure'. Here roles are shown as circles, organizational buildings as buildings, and artifacts as disk shapes. Other concepts are provided in models, which show the system from other perspectives. Figure 2 shows an organizational model called, 'top-level-organization' and other models showing different perspectives. This displayed model is the top level structure that focuses on an organization viewpoint. It provides a top level view of organizational relationships in a community ecosystem. Here there are two main communities that correspond to the knowledge communities, namely:

'People' who determine eligibility for housing. The model produced here is the applicant profile, and

'Housing' which acquires housing resources to hose the people.

'Builders" who provide the housing.

There is a coordinating department, which is community that defines the 'policy settings' and acts as the coordination group. This includes representatives from all the knowledge communities. These define the policy settings that include eligibility requirements of applicants and housing standard matched to the applicant profile. The model also shows the boundary roles between communities. The coordination officer is responsible for monitoring that the communities work towards those settings. The key role in the housing department is the 'Manager-housing' who negotiates with the construction manager and human relations consultant. This role also liaises with the coordination officer, whose main responsibility is to facilitate the negotiation need to build a common vision. The coordination also negotiates and monitors how the applicant list conforms to the policy settings.

Figure 2 in a way provides the 'what the system does'. It defines the responsibility of roles in each department and the coordination between them. The how it does it can be provided by a modeling methods that focuses on activities. An example is given in Figure 3, which is an activity model. It includes the concepts commonly found in describing collaboration.

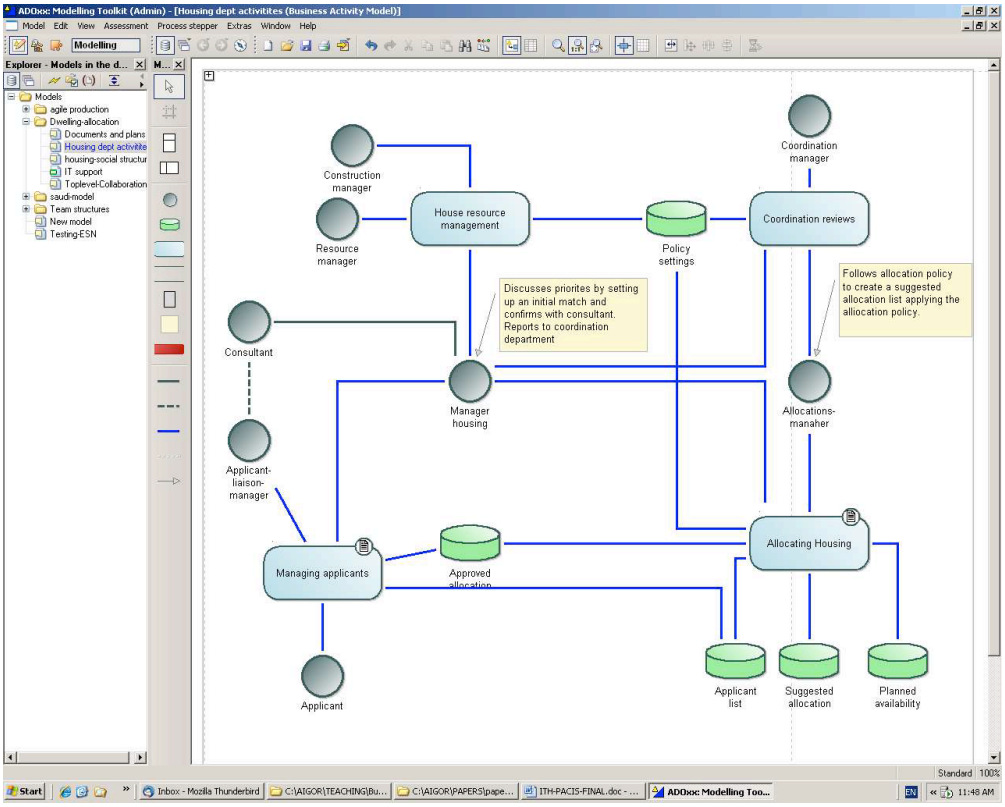

Figure 3. Activities within the housing community

The modeling methods described here are flexible in the sense that they both provide the flexibility in focusing on different perspectives. They also support evolution as they are graphical and easily changeable, allowing requirements specification to evolve as more knowledge is gained about the communities.

5 SUPPORTING COMMUNITY COLLABORATION

Community ecosystems need to define ways to remain sustainable and work towards a common but evolving vision. To do this they need to structure people responsibilities to supports message flows that facilitate community interaction while working towards an evolving vision and avoiding the onset of chaos which can result where information flows become uncontrolled. In the case of living systems, Miller (1978) proposes subsystems that exist within living systems and the way they exchange messages. A number of these subsystems concern information flows that can serve as guidelines for assigning responsibilities for information flows to roles in the system. The four kinds of communities defined earlier defined the structure. Table 1 described the responsibilities needed in the communities. The responsibilities are realized by the different community roles. These define ways in which complexity can be managed through responsibilities assigned to the roles. Figure 4 describes some such responsibilities in a generic sense.

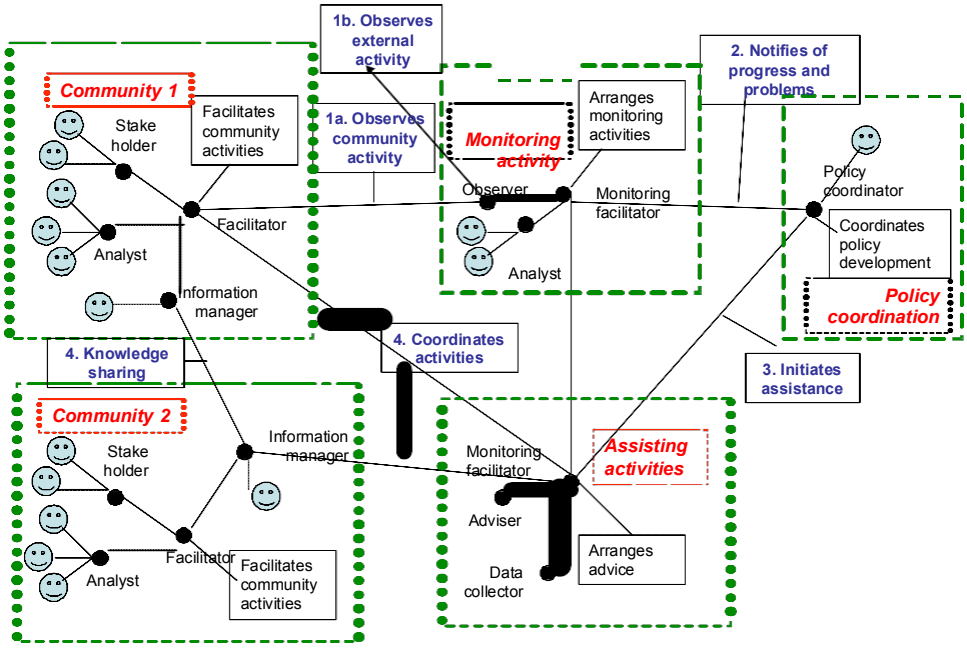

Figure 4. Structures for sustainability

The structure supports the complexity metaphor in that it allows communities to develop but at the same time provides the emergence and adaptability needed to adapt to a changing environment. Social structures then become important as they need to take responsibility for the expected behavior including facilitating emergence, knowledge sharing, and learning.

6 SUMMARY

This paper described the requirements of modeling methods for modeling community ecosystems. It outlined the need for greater emphasis on collaboration as well as developing community structures and behavior to ensure sustainability within evolving complex environments. It defined a structure for the community ecosystem where there is one community that acts as a coordinator of other communities that generate knowledge needed for the community to grow. It then outlined the need for an open approach to modeling where designers can construct models composed of concepts that represent their communities in natural forms and described one such open modeling approach.

References

Azapagic, A. "Systems Approach to Corporate Sustainability: A General Management Framework" Trans IChemI, Vol. 81, PartB, September 2003.

Cohen, B., Boxer, P. (2010): "Why Critical Systems Need Help to Evolve", Computer, May 2010, pp. 56-63.

Cross, R., Thomas, R.J. (2009): "Driving Results through Social Networks", Jossey-Bass, 2009.
Davenport, T. (2005): "Thinking for a Living" Harvard Business School Press.
Eccles, D.W., Groth, P.T. (2006): "Agent coordination and communication in socio-technological systems: Design and Measurement issues" Interacting with Computers 18, pp. 1170-1185.
Garcia-Castro, A., Labarga, A., Garcia, L., Giraldo, O., Montana, C., Bateman, J.A. (2010): "Semantic Web and Social Web heading towards Living Documents in the Life Sciences " Web Semantics: Science, Services and Agents on the World Wide Webb 8, pp. 155-162.
Hawryszkiewycz, I.T (2005): "A Metamodel for Modeling Collaborative Systems" Journal of Computer Information Systems, Vol. XLV, Number 3, Spring 2005, pp. 63-72.
Jarke, M., Loucopoulus, P., Lyytined, K., Mylopoulus, J., Robinson, W. (2010): "The Brave New World of Design Requirements: Four Key Principles" 22nd. International Conference on Advanced Systems Engineering, CAiSE 2010, Hammamet, Tunisia, pp.470-482.
Kamarulzaman, A.A., Norhashim, M. (2008): "Cluster-Based Policy Making: Assessing Performance and Sustaining Competitiveness" Review of Policy Research, Vol. 25, No.4, pp. 349-375.
Kodama, M. (2005): "New knowledge creation through leadership-based strategic community – a case of new product development in IT and multimedia business fields" Technovation 25, pp. 895-908. Elsevier Press
McAfee, A.P. (2006): "Enterprise 2.0: The Dawn of Emergent Collaboration" MIT Sloan Management Review, Spring 2006, pp. 21-28.
Maguire, S., McKelvey, B, Mirabeau, L., Oztas, N. (2006): "Complexity Science and Organizational Studies" in Clegg, S.R., Hardy, C., Lawrence, T.B., Nord, W.R. "The SAGE Handbook of ORGANIZATIONAL STUDIES, 2nd. Ed. SAGE Publications, London.
Miller, J. (1978): "Living Systems" Mc-Graw-Hill, New York.
Mintzberg, H. (2009): "Rebuilding Companies as Communities" Harvard Business Review, Vol. 84, No. 4, July-August, 2009, pp. 140-143.
Merali, Y., McKelvey, B. (2006): "Using Complexity Science to effect a paradigm shift in Information systems for the 21st. century" Journal of Information Technology 21, pp. 211-215.
Nonaka, I. "A Dynamic Theory of Organizational Knowledge Creation" *Organization Science*, Vol. 5, No. 1, February 1994, pp. 14-37.
Parnas D.L. (2010) :"Inside Risks: Risks of Undisciplined Development" Communications of the ACM, Vol. 53, No.10., October 2010, pp. 25-27.
Petzel, R., Archer, A-M., Fei, R. (2010): "Collaboration for Sustainability in a Networked World" Procedia Social and Behavioral Sciences 2, pp. 6507-6609.
Pisano, G.P., Verganti, R.: What Kind of Collaboration is Right for You. Harvard Business Review, Vol. 83, No. 8, December 2008, pp. 80-86. (2008)
Prahalad, C.K., Krishnan, M.S. (2008): The New Age of Innovation. McGraw-Hill. (2008)
Sheate, W.R., Partidario, M.R. (2010): "Strategic approaches and assessment techniques – Potential for knowledge brokerage towards sustainability" Environmental Impact Assessment Review 30, pp. 278-288.
Shin, D-H. (2010): "A Socio-technical framework for cyber-infrastructure design implication for Korean cyber-infrastructure vision" Technological Forecasting and Social Change 77, pp. 783-795.
Wiek, A., Walter, A.I. (2009): "A Transdisciplinary Approach for formalized integrated planning decision-making in complex systems" European Journal of Operations Research 197, pp. 360-370
OCOPOMO http://fgwimz3.uni-koblenz.de:8081/ocopomo/
Australian Government publication: "Tackling Wicked Problems: www.apsc.gov.au/publications07/wickedproblems.pdf