Public Interfaces as the Result of Social Systems Structural Coupling

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ABSTRACT. Social systems are autopoietic (self-creating) systems which produce all their internal processes by them selves. When autopoietic systems interact with environmental (possibly alopoietic) systems the process of structural coupling takes place and there are possibilities that language will emerge. We analyze different public interfaces like wiki systems, forums, weblogs, social networks, tagging etc. to show how such interfaces can be seen as the result of structural coupling of social systems. We conclude that to facilitate citizen participation in on-line processes one needs to facilitate autopoiesis through various mechanisms. In the end we present the ŦAOPĪS system that we implemented which aims on solving the described issues.

Key Words. public interface, social system, structural coupling, autopoiesis

1 Introduction

Autopoietic theory is one of the contemporary complexity theories, dealing with complex, non-linear and especially living systems (Schatten, 2008). Autopoiesis a pseudo Greek word coined from *αυτό* (auto) for self and *ποίησις* (poiesis) for creation, production or forming was first coined by the Chilean biologists Humberto Maturana and Francisco Varela (1973) to label the type of phenomenon which they had identified as the definitive characteristic of living systems (Whitaker, 2001).

Using the metaphor of autopoiesis a whole theory of social systems based on communication was developed later by Niklas Luhmann (1984). He introduced the concept of autopoiesis to formal organization theory basing his reasoning on a special subset of communication: decisions that, following Luhmann, are the essence of organization (Luhmann, 2003).

Autopoietic systems produce all of their internal processes by them selves, as opposed to alopoietic systems that produce something else then them selves. Such systems create a distinction between self and environment and use different techniques to establish and maintain their boundaries. "*The organismic autopoietic system is conceived as originating (or self-originating) as a recursive enactment of material events, by which recursion, a structure is constituted which conserves itself (or fails to do so) in interaction with other such systems and with the nonliving environment. The autopoietic system has the capacity (indeed the requirement) to preserve itself, not (like a rock) by remaining the same, but by (like an organism) changing. That which changes while the autopoietic system maintains itself, is called by Maturana and Varela the system's* ***structure****, while that which the system maintains is called its* ***organization***" (Guddemi, 2000).

When an autopoietic system interacts with other systems from their environment they perform a process known as structural coupling. "*The result of structural coupling is an autonomous and strictly bounded system, that has nevertheless been shaped extensively by its*

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interactions with its environment over time, just as the environment has been shaped by its interactions with the system" (Quick, 2003).

A special case of structural coupling is that between two autopoietic systems. When two autopoietic systems interact they use their structure to influence the others structure. This mutual influence often yields semantics that we commonly call language. While such language is obvious when considering living (biological) systems, when observing social systems the definition is less evident. Such language when following Maturana is the "coordination of coordination of behavior" that allows social systems to interact with each other.

In the following we will argue that the process of structural coupling between social systems in cyberspace yields public interfaces commonly known under terms like web 2.0, social web as well as social semantic web or web 3.0. That the participation of citizens in such interfaces is a function of the degree to which autopoiesis is facilitated by information technology shall also be shown. Automated acquiring of public opinion is possible if the autopoiesis of social systems is acknowledged in such technology, which is why we present the ᴛAOPĪS system that aims on providing suitable mechanisms.

2 Public Interfaces

In the last few years we were witnesses to a great deal of new web technology that facilitates user participation. Various systems like discussion forums, wiki systems, social networks, social tagging, podcasting, content feeds, weblogs etc. were introduced and are in heavy use. Such systems are of particular interest to government and democracy since they in a way reflect the public opinion of citizens.

When taken into an autopoietic perspective the public is a social system that is autopoietic in terms of self-producing its social processes that yield culture, opinions, social expectations etc. Such autopoietic systems reproduce their components (social people) and structurally couple to their environment (physical world, cyberspace, media, other social systems etc.). In particular, when structurally coupling to modern information technology, like the previously outlined ones, social systems provide a pattern of behavior that can be measured and analyzed (Schatten, 2008).

Autopoietic theory allows us to use a strong metaphor: social systems can in a way be seen as living beings that adapt to their environment preserving their internal organization (Žugaj, 1996). This allows us to observe social systems behavior by measuring and analyzing their immediate environment in a metaphoric way comparing them for instance to animals that create their nests, leave trails and show certain behavior in special situations. The measurement of such behavioral characteristics is often referred to as biometrics or behaviometrics in the context of living beings.

It must be stated here, that the only thing that can be measured are the effects of an autopoietic system to their environment. In order to measure the internal organization of an autopoietic system, one would have to become part of it (a component in the terminology of autopoietic theory) which would inevitably influence the observers objectivity.

From this reasoning we can conclude that the "trails" or effects of social systems to modern web technology can be measured in terms of content left by components of the system and influenced by its internal processes. The content accumulated by such systems contains semantics that can be interpreted as public opinion. The possibilities of analyzing such semantics are strongly influenced by the very technology used and especially by the degree to which input mechanisms are structured. This degree, in a way, sets the rules of structural coupling.

There are two forces that have to be taken into account: (1) the degree of structure of input mechanisms and (2) the degree of ease of use. While the former introduces easier analysis, the

letter facilitates structural coupling. These two forces may seem reciprocal, but as shall be shown, they don't ought to be. In the following a few most popular modern web applications will be analyzed from this perspective.

Discussion Forums A forum is a network application that allows its users multimedia based communication (mostly through text, images, and simple animations) that is organized into subjects and subforums. A forum is hierarchically organized in a way that every user can participate in the communication process by answering previous messages. The communication process of such a system can be thought of as a general tree structure in which nodes are messages and arcs are the essential connections between message and answer. Forums are a very widespread technology with a lot of implementations like *PHPbb* and *vBuletin* to name the most popular. Lots of communities functioning almost completely through this kind of technology. Weblogs or simply blogs are very similar to this kind of technology, which is why we wont elaborate it further. Forums have in terms of our perspective a low degree of structure imposed by their input mechanisms. The only metainformation that is attached to content are the author, the subject and eventually a simple context like subforum or subject thread. On the other hand their ease of use if very high which is a major factor that influences their popularity. Methods that can be used to extract structured content (the actual result of structural coupling) are advanced and closely bound to web mining as shown in (Dringus and Ellis, 2005) and (Spangler et al., 2006). In order to enhance the degree of structure, without diminishing their ease of use, mechanisms like polls, social tagging as well as social network analysis can be introduced.

Wiki Systems The concept of a wiki system operates in the following way: every user or visitor of a wiki service on the Web can change articles and information that he encounters, add new articles and/or information and argue about the existing ones. Wikis became a widespread technology with typical implementations like *WikiMedia* to name the most prominent one, which is the engine of *Wikipedia* the free Internet encyclopedia. Wiki systems have a higher degree of structure introduced by their input mechanisms then discussion forums, but their ease of use is still high. The structure is most evident due to the relationships between articles. Still methods to extract structured content include web mining since most articles are written in natural language, but context analysis through the interconnections can be applied as well (Mehler, 2008). To enhance the degree of structure various ideas from the semantic web initiative (Berners-Lee et al., 2001) can be used like structured tags, link annotations, querying facilities, formal language support etc. It should be mentioned that such mechanisms reduce the ease of use, and should be implemented with care.

Social Networking Applications for social networking allow their users to virtually create social networks of their friends, colleagues, co-workers etc. One can browse others friend lists and profiles, play virtual games, get in touch with long lost friends etc. Some of the most famous social applications like *Facebook* or *MySpace* allows one to engage a lot of different activities with her friends like games, projects, petitions, causes, exchange images, videos, journals etc. Social networking applications have a high degree of structure in terms of connections between people, but a low degree in terms of content. Their ease of use is high due to millions of users world wide. To extract content of interest one could use social network analysis for information regarding the social structure, but for content again advanced web mining techniques have to be used. To provide more structured input mechanisms that wouldn't decrease the ease of use various technologies could be used like social tagging, group management, network management etc.

Social Bookmarking Social bookmarking and social tagging technologies allow their users to organize content they encounter on the web or on site through tags and/or bookmarks. One of the most prominent social bookmarking and web search engine application *del.icio.us* allows users to tag any page on the World Wide Web with custom defined keywords. The search results are impressive having the simplicity of the algorithm that constitutes the application in mind as opposed to complex algorithms used by traditional search engines. Such applications have a high degree of structure regarding their input mechanisms since they allow users to directly input keywords for chosen content. One could see the provided metainformation as user-preprocessed content. Ease of use is dependent on implementation medium to high. The extraction of structured content is allmost direct in such systems, but limited to simple keywords. To enhance the degree of structure one could use built-in ontologies or simple taxonomies, as well as additional autocompletion mechanisms.

Podcasting Podcasting services are another interesting web technology that allows its users to broadcast their own video, audio, image and presentation materials. Services like *YouTube*, *Slideshare* and others became extremely popular and are often compatible with other technologies mentioned previously. Such systems have a low degree of structure since input is multimedia, whilst ease of use is high. The extraction of structured content is extremely hard to conduct introducing methods like pattern recognition, advanced audio/video processing algorithms, neural networks etc. To facilitate the input of structured content (and likewise its extraction) social tagging can be used, and especially image tagging (allready provided by few such services).

3 Discussion

The previous analysis showed that most modern web technologies are easy to use, but are limited in terms of possibilities for extracting structured content. From an autopoietic theory perspective we could state that such systems facilitate autopoiesis due to the fact that communication and interaction are a major factor for the maintaining of social system's autopoiesis. The actual content gathered during the systems normal functioning can be viewed as the result of the social systems, which surrounds such applications, structural coupling. The social system coordinates its behavior according to the given possibilities of the environmental system (in this case a web application). Thus, the only way for the social system to leave effects on web applications are the provided input mechanisms. The greater the ease of use of such input mechanisms, the greater the effects the social system will achieve on the environmental system.

This observation gives us a valuable insight that we can take advantage of when designing input mechanisms to web application. If input mechanisms are structured in a way that the effects of structural coupling can be processed by the web application in order to yield structured content then we would be able to measure, track and analyze the social systems behavior. This implies mechanisms for acquiring instant public opinion, facilitating public participation as well as fostering e-democracy. On the other hand one has to bear in mind that such mechanisms need to remain easy to use in order to acquire valuable effects of structural coupling. This is why we propose to hide advanced technology (like semantic techniques, formal languages, ontologies, web mining, pattern recognition etc.) inside a web application system and provide intuitive input mechanisms.

Having such a reasoning in mind we developed the ᴛAOPĪS system that aims on providing a platform for self-organizing communities. For such communities suitable tools like semantic wiki systems, forums, blogs, ranking mechanisms, content filtering, tagging, social network analysis etc. are provided. The advanced technologies are hidden in the background of the

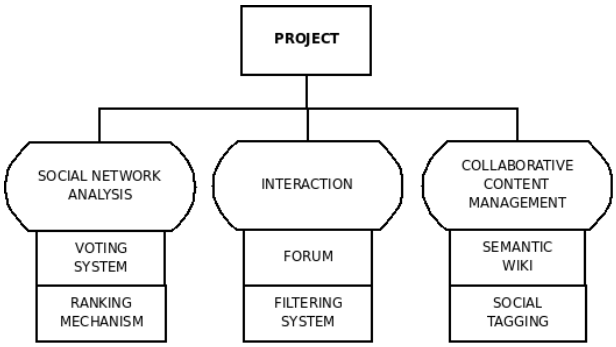

Figure 1: ΤΑΟΡΙS System's Architecture (Maleković and Schatten, 2008)

system in order to remain the initial ease of use, while various input mechanisms are provided that allow an emergent generation of structured content through the coupling social system.

Figure 1 shows an outline of the ΤΑΟΡΙS system's architecture. The system basically allows any user to create an arbitrary number of projects which in turn other users can join or register a project of their own. Any project consists of three interconnected parts, namely a social network analysis part, an interaction part, as well as a collaborative content management part. The part concerning social network analysis comprises of a voting system that allows project members to vote for each other as well as a ranking mechanism that analizes the voting data and maps each project member to her/his respective rank. In particular a modified PageRank algorithm is used to analize the voting data as well as to calculate member's ranks. The member with the highest rank is pronounced project leader which is a dynamic role that can change depending on voting data. Thus a dynamic hierarchy is constructed on every project resambling a dynamic fishnet structure (Schatten and Žugaj, 2007). The interactive part is represented through an multimedial discussion forum as well as an self organizing filtering system. The discussion forum suports threaded discussion, binding to mailing lists as well as inclusion of multimedia files like images, animations and video files. The filtering system basically allows any user to be a forum moderator by filtering messages and other content she/he encounters. Other users can use a moderation of another user or be the moderator for their selves. A list of most used moderators is also provided in order to yield the most popular moderators on any project. The collaborative content management part consists of a semantic wiki system based on a well established formalism called frame logic (Kifer et al., 1995) as well as of a social tagging system. Users by organizing their own content through attribute-value tags provide the reasoning engine with metadata which in turn allows other users to query the dynamically created knowledge base.

4 Conclusion

Public interfaces can be seen as as the result of social systems' structural coupling to information technology. Such public interfaces contain valuable information that can provide us with public opinion, social decisions and trends. In order to extract such structured content one needs to acknowledge the autopoiesis of social systems as well as the limitations of research methods. To facilitate autopoiesis, which in social systems is a matter of communication, public interfaces need to remain easy to use. On the other hand, such interfaces have to be provided with additional mechanisms that will facilitate the creation of structured content. The design of such input mechanisms is subject to our future research.

References

Berners-Lee, T., Hendler, J. and Lassila, O., 2001. *The Semantic Web.* Scientific American Magazine.

Dringus, L.P. and Ellis, T., 2005. *Using data mining as a strategy for assessing asynchronous discussion forums.* Computers & Education, Vol. 45, 141–160.

Guddemi, P., 2000. *Autopoiesis, Semeiosis, and Co-Coupling: A Relational Language for Describing Communication and Adaptation.* Cybernetics & Human Knowing, Vol. 7, 2-3, 127–145.

Kifer, M., Lausen, G. and Wu, J., 1995. *Logical Foundations of Object-Oriented and Frame-Based Languages.* Journal of the Association for Computing Machinery, Vol. 42, 741–843.

Luhmann, N., 1984. Soziale Systeme: Grundriß einer allgemeinen Theorie. Suhrkamp, Frankfurt, Germany.

Luhmann, N., 2003. *Organization.* In T. Bakken and T. Hernes (eds.) Autopoietic Organization Theory Drawing on Niklas Luhmann's Social Systems Perspective, Abstract, Liber, Copenhagen Business School Press, Oslo. 31–53.

Maleković, M. and Schatten, M., 2008. *Leadership in Team Based Knowledge Management - An Autopoietic Information System's Perspective.* In B. Aurer and M. Bača (eds.) 19th Central European Conference on Information and Intelligent Systems – CECIIS2008 Conference Proceedings. Faculty of Organization and Informatics, 47–52.

Maturana, H.R. and Varela, F.J., 1973. *Autopoiesis: The organization of the living.* In H.R. Maturana and F.J. Varela (eds.) Autopoiesis and cognition, Reidel, Boston. 59–138.

Mehler, A., 2008. *Structural similarities of complex networks: a computational model by example of wiki graphs.* Applied Artificial Intelligence, Vol. 22, 619–683.

Quick, T., 2003. *Autopoiesis.* `http://www.cs.ucl.ac.uk/staff/t.quick/autopoiesis.html`, (accessed: 01-04-2008).

Schatten, M., 2008. *Autopoietic Theory as a Framework for Biometrics.* Interdisciplinary Description of Complex Systems, Vol. 6, 2, 74–79.

Schatten, M. and Žugaj, M., 2007. *Organizing a Fishnet Structure.* In 29th International Conference Information Technology Interfaces Proceedings. Cavtat-Dubrovnik, Croatia, 81–86.

Spangler, W.S., Kreulen, J.T. and Newswanger, J.F., 2006. *Machines in the conversation: Detecting themes and trends in informal communication streams.* IBM Systems Journal, Vol. 45, 4, 785–799.

Žugaj, M., 1996. *Teorija kaosa i organizacija.* Zbornik radova Fakulteta organizacije i informatike, Vol. 21, 51–62.

Whitaker, R., 2001. *Tutorial 2: Concepts and Constructs.* `http://www.enolagaia.com/Tutorial2.html`, (accessed: 20-03-2008).