4 SUMMIT VIENNA 2015
IS IS

Extended Abstract

Primary and Secondary Experience as a Foundations of Adaptive Information Systems

Sergej Lugović [1,*], Ivan Dunđer [2] and Marko Horvat [1]

[1] Polytechnic of Zagreb / Vrbik 8, 10000 Zagreb, Croatia
[2] Department of Information and Communication Sciences, Faculty of Humanities and Social Sciences, University of Zagreb / Ivana Lučića 3, 10000 Zagreb, Croatia

E-Mails: slugovic@tvz.hr (S.L.); ivandunder@gmail.com (I. D.); mhorvat1@tvz.hr (M.H.)

* Author to whom correspondence should be addressed; Tel: +385-91-465-81-99, Fax +385-1-5603-999

Accepted:

Keywords: adaptive information systems, science 2.0, information behaviour, socio-technical systems, open innovation

Introduction

Humanity evidences major social, technological, economic and cultural transformations producing a new kind of society: network society [1]. Such an environment is described as turbulent, and is more complex, with higher uncertainty and with more interdependence. In such contextual turbulent environment, technocratic bureaucracies, with its mechanical authoritarian control structure of the organisational form, cannot absorb or reduce such environmental turbulence. The absorption and reduction are necessary, opening the way to a viable human future [2].

Information systems can be understood as the "extension of meaning engagement practice through mediating and organising social interactions" [3]. Empirical evidence of such a proposition can be found in a recent massive-scale experiment on Facebook users in which the emotional state of the user changed accordingly to the amount of positive or negative content in their news feed placed without their acknowledgment [4]. Besides emotions, patterns of the information system use can configure cognition and behaviour of a user in the process of accomplishing work-related tasks [5].

If an information system consists of social, technological and informational components, which are not separate but interrelated [6], and the social component of such a system changes according to

patterns of behaviour, whereas there is an inherent inseparability between the technical and the social [7], can we search for causality between those patterns and adaptiveness of the information technology?

Human and material agencies are shared building blocks of routines and technologies, but by being isolated, neither of them (human or material agencies) are important. Namely, what is essential is the moment when they become imbricated, i.e. interlocked in a particular sequence, and as a whole they produce, sustain, or change routines and technologies [8]. To observe this phenomenon and to find an answer to the aforementioned question, the particular sequence of the relationship between human and material agencies, the inherent inseparability between the technical and the social, and the complexity of real situations should be examined, rather than analysing separate aspects [9].

Science 2.0 as a socio-technical system

In a recent proposal for development of science based on socio-technical progress, the term Science 2.0 emerged as a new phenomenon of interrelated socio-technical interactions, claiming that socio-technical systems are best studied at scale, in the real world, by rigorous observation, carefully chosen interventions and ambitious data collections [10]. In such an environment, which is fruitful for critiquing, suggesting, sharing ideas and data, communication is the heart of science, the most powerful tool ever invented for correcting errors, building on colleagues' work and fashioning new knowledge [11].

To understand technology in society, we have to treat it as an action system, where its subfunctions could be performed by humans or technical objects (human or material agencies) acting as subsystems. This allows us to transform the abstract action system into a socio-technical system by conceiving an object for every suitable acting function and by integrating them into the human acting or working relations [9]. Software to be run on such a socio-technical system must be able to sense, interpret and respond [12] to patterns of system behaviour that emerge according to internal system properties or reflections to the environment.

Secondary experience research

The aim of this research is to investigate and eventually enable the exchange and (re)use of scientific papers created on the universities in the Danube region with their wider external environment including public, private and non-governmental organisations. Scientists working at the universities publish scientific papers and get the papers' reflection according to the usage of the outside environment including public, private and non-governmental organisations. The main research question is, can we build an artefact in form of an information system that supports such an exchange and reflection?

In a critical review of the literature related to university governance of knowledge transfer, institutionalisation of linkage between universities and industry is defined as a new phenomenon, underlying various forms of knowledge transfer activities, ranging from collaborative research projects involving universities and companies (e.g. research contracts), intellectual property rights and spin-offs, labour and student mobility, consultancy etc., as well as "soft" forms of knowledge transfer, such as attendance at conferences and creation of electronic networks. Universities' governance of knowledge transfer applies only to research contracts, intellectual property rights and spin-offs, but

most university knowledge is transferred via traditional channels such as personnel exchanges, publishing, consulting and conferences. However, these types of knowledge transfer activities have not been institutionalised and little attention has been paid to their management and governance [13]. We believe that an intervention into this area by designing an adaptive information system could extend the capabilities of human and material agencies.

As a starting point for the conceptualisation of our research, we use primary and secondary experience proposed by John Dewey. The primary experience is the one with "minimum of incidental reflection", while secondary experience is described as "what is experienced in consequence of continued and regulated reflective inquiry... experienced only because of the intervention of systematic thinking". Dewey contrasted two different kinds of experience, primary and secondary, proposing that objects in secondary experience "get the meaning contained in a whole system of related objects; they are rendered continuous with the rest of nature and take on the import of the things they are now seen to be continuous with" [14].

In our view, the primary object in designing an information system is the one in which the observed object is excluded from the context with other objects, while secondary objects are those objects which are observed as a part of the higher-level system, consisting of the object itself and its relationships and behaviour in interaction with other related objects. Such a higher-level system includes an information system itself, but also its users and their information behaviour observed as a whole.

To design such an information system, we have to understand the information behaviour in socio-technical systems consisting of technologies that support the interaction between scientists, organisations they are working for, and published papers. The environment consists of public, private and non-governmental organisations. Those three sectors together with the academic actors create a Quad Model [15] or Quadruple Helix [16] creating a framework for EU Digital Agenda for Europe in which government, industry, academia and civil participants work together [17].

To do so we have to extend our research not only to the design of the information system, but also towards the information behaviour research in such a socio-technical system.

We have to research what type of information resource (e.g. abstract, full paper etc.), and what type of media (e.g. scientific journal, conference proceedings, web pages etc.), are being utilised, but also what are the patterns of information seeking behaviour in the process of accessing information resources. Those three research variables (type of information resources, type of communication channels and information seeking patterns) will provide us with insight into the phenomena of impact and usage of already published scientific papers by their environment (public, private and NGO). Such an insight is essential for the design of such an artefact, i.e. information system.

Another research inquiry is the area of interaction, or precisely speaking, what are the motivation drivers and factors that influence the interaction between scientists and their environment. If we understand the motivation drivers and factors that influence interaction, we can implement them into the design of an information system.

But we cannot know the effect of such functions in the information system, unless we incorporate them and put them into use.

Theoretical background of research

Main theoretical background of this research is in the Activity theory [18], describing the three-way relationship between a person (the subject), an object, to which an activity is directed, and the tools or instruments used in the activity. A further theoretical extension is in different models of information behaviour [19], which will provide us with the framework for collecting data about the usage of already published scientific papers existing in the area of interaction between universities, public, private and NGO organisations.

In our research we will use the Documents of Action concept [20], which gives us an analytical framework to analyse usage, interaction and co-operations around already published scientific papers. Another theoretical concept used in this research is Evolutionary Learning [21], suggesting that sustainability requires collaboration among governments, businesses and civil society. A clear distinction was made between growth, development and evolution, where growth is the increase in size or quantity, development is an amelioration of conditions or quality, and evolution is a tendency towards greater structural complexity and organisational simplicity, more efficient modes of operation and greater dynamic harmony.

Another theoretical contribution to this research is based on knowledge sharing communities [22] and communities of action [23] providing us with detailed frameworks for an information system functionality that supports both, social and technical, aspects of information behaviour. Also different social cybernetic concepts about self-organisation, self-reference, self-steering, autocatalysis and cross-catalysis and autopoiesis [24] will be used in researching feedback between the information system and its users. This proposed research also contributes to the discipline of information system design science [25-27] and contributes to the extended definition of the information system, seen as an artefact which consists of information, social and technical elements, creating a whole which is greater than the sum of its parts [6].

Conclusion

We evidence a trend of blurring the line between technological and social in information system research, moving the focus from deterministic to more casual logic in their design. Main aim of our research is to search for feedback from users' socio-cognitive behaviour that could be used as a signal that triggers information system adaption. One of the theoretical fields we are currently exploring is information behaviour, which results in patterns of that behaviour. As the dynamic of patterns is observable by a machine, we believe that there is a possibility to use this signal to automatically (or semi-automatically) trigger restructuring of the information system, to generate new functions to support existing and create new information system goals.

We perceive an information system as a system consisting of informational, social and technological components acting as a whole, and that is aligned with findings from related theoretical and empirical studies presented in this paper. Those components interact between each other and such an interaction, which is not only deterministic but casual, could provide fundaments for adaptive information systems which evolve along their usage. Researching interaction around scientific papers by universities, public, private and non-governmental organisations could provide us with valuable information on where and how to intervene in such a system.

Building an artefact in form of an information system for the purpose of the research could provide us with empirical insights which of the interventions and interactions give optimal results in terms of information system performance.

For example, if we knew what types of documents have the most impact on the environment and trigger the cognitive, communicative and co-operation processes [28] (with public, private, non-governmental organisations), we could further design amplification towards this area of the system which could then produce change in dynamics of information behaviour and related patterns. New patterns will open up new areas of research interests, which then again could be amplified or attenuated. In that way we could design feedback loops in the information system which could enable deterministic but also casual properties.

References and Notes

1. Castells, M. *The rise of the network society: The information age: Economy, society, and culture*, 2nd ed.; Volume 1; John Wiley & Sons: Hoboken (NJ), USA, 2011; p. 17.
2. Trist, E.L.; *The evolution of socio-technical systems*; Quality of Working Life Centre: Toronto, Canada; 1981; p. 39.
3. Aakhus, M.; Agerfalk, P.J.; Lyytinen, K.; Te'eni, D. Symbolic Action Research in Information Systems: Introduction to the Special Issue. *MIS Quarterly* **2014**, *38(4)*, 1187-1200.
4. Kramer, A.D.; Guillory, J.E.; Hancock, J.T. Experimental evidence of massive-scale emotional contagion through social networks. *Proceedings of the National Academy of Sciences of the United States of America* **2014**, *111(24)*, 8788–8790.
5. Ortiz de Guinea, A.; Webster, J. An Investigation of Information Systems Use Patterns: Technological Events as Triggers, the Effect of Time, and Consequences for Performance. *MIS Quarterly* **2013**, *37(4)*, 1165-1188.
6. Lee, A.S.; Thomas, M.A.; Baskerville, R.L. Going back to basics in design: From the IT artifact to the IS artifact. *Proceedings of the Nineteenth Americas Conference on Information Systems* **2013**, 1757-1763.
7. Orlikowski, W.J.; Scott, S.V. Sociomateriality: challenging the separation of technology, work and organization. *The academy of management annals* **2008**, *2(1)*, 433-474.
8. Leonardi, P.M. When flexible routines meet flexible technologies: Affordance, constraint, and the imbrication of human and material agencies. *MIS Quarterly* **2011**, *35(1)*, 147-167.
9. Ropohl, G. Philosophy of Socio-Technical Systems. *Techné: Research in Philosophy and Technology* **1999**, *4(3)*, 186-194.
10. Shneiderman, B. Computer science. Science 2.0. *Science* **2008**, *319(5868)*, 1349-1350.
11. Waldrop, M.M. Science 2.0. *Scientific American* **2008**, *298(5)*, 68-73.
12. Stock, G. Metaman: The merging of humans and machines into a global superorganism. New York: Simon and Schuster, recited from; Hofkirchner, W. (2007). A critical social systems view of the internet. *Philosophy of the Social Sciences* **1993**, *37(4)*, 471-500.
13. Geuna, A., Muscio, A. The governance of university knowledge transfer: A critical review of the literature. *Minerva* **2009**, *47(1)*, 93-114.
14. Dewey, J. *Experience and Nature*, George Allen & Unwin, Ltd: London, UK, 1929.

15. Wilson III, E. J. How to Make a Region Innovative. *strategy+ business* **2012**, *66*, available at: http://www.strategy-business.com/article/12103?pg=all
16. Carayannis, E.G; Campbell, D.F.J. "Mode 3" and "Quadruple Helix": toward a 21st century fractal innovation ecosystem. *International Journal of Technology Management* **2009**, *46(3/4)*, 201-234.
17. EU. Open Innovation 2.0, available at: http://ec.europa.eu/digital-agenda/en/open-innovation-20
18. Wilson, T.D. (Ed.). *Theory in information behaviour research*, Chapter 1-Activity theory, Eiconics Ltd: Sheffield, UK, 2013.
19. Wilson, T. D. Models in information behaviour research. Journal of documentation **1999**, *55(3)*, 249-270.
20. Zacklad, M. Documents for action (Dofa): infrastructures for Distributed collective Practices. *Actes du workshop "Distributed Collective Practice: Building new Directions for Infrastructural Studies CSCW"* **2004**, p. 6.
21. Laszlo, K.C.; Laszlo, A. Fostering a sustainable learning society through knowledge-based development. *Systems Research and Behavioral Science* **2007**, *24(5)*, 493-503.
22. Nousala, S.; Miles, A.; Kilpatrick, B.; Hall, W.P. Building knowledge sharing communities using team expertise access maps (TEAM). *Proceedings of the KMAP05 Knowledge Management in Asia Pacific* **2005,** p. 30.
23. Zacklad, M. Communities of action: a cognitive and social approach to the design of CSCW systems. *Proceedings of the 2003 international ACM SIGGROUP conference on supporting group work* **2003**, 190-197.
24. Geyer, F. The challenge of Sociocybernetics. "Challenges to Sociological Knowledge", Session 04: "Challenges from Other Disciplines", 13th World Congress of Sociology, 1994, available at: http://www.critcrim.org/redfeather/chaos/006challenges.html
25. Hevner, A.R.; March, S.T.; Park, J.; Ram, S. Design science in information systems research. *MIS Quarterly* **2004**, *28(1)*, 75-105.
26. March, S.T.; Smith, G.F. Design and natural science research on information technology. *Decision support systems* **1995**, *15(4)*, 251-266.
27. Järvinen, P. Action research is similar to design science. *Quality & Quantity* **2007**, *41(1)*, 37-54.
28. Hofkirchner, W. How to Achieve a Unified Theory of Information. TripleC: Communication, Capitalism & Critique. *Open Access Journal for a Global Sustainable Information Society* **2009**, *7(2)*, 357-368.