Telematics and Informatics 32 (2015) 586–593

Contents lists available at ScienceDirect

Telematics and Informatics

journal homepage: www.elsevier.com/locate/tele

Information literacy and peer-to-peer infrastructures: An autopoietic perspective

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ARTICLE INFO

Article history:
Received 19 November 2014
Accepted 27 January 2015
Available online 12 February 2015

Keywords:
Collaboration
Commons
P2P
Distributed
Artificial Intelligence
Literacy

ABSTRACT

This article argues that an autopoietic perspective of human communities would allow to understand societies as self-organized systems and thus promote information literacy as a facilitator of social development. Peer-to-peer (P2P) social dynamics generate public information available worldwide in digital repositories, websites and bibliographic resources. However, processing such amount of data is not achievable by a single central-controlled system. We claim that distributed and heterogeneous networks of coordinated mechanisms, composed by both specialized human and artificial agents, are needed to improve information retrieval, knowledge inference and decision-making, but also to produce social value, goods and services. Handling these issues implies the collective construction of global semantic networks but also the active labor of knowledge producers and consumers. We conclude that information literacy is as much important as any technical implementation and, therefore, may lead to networks of Commons-oriented communities which would utilize P2P infrastructures.

1. Introduction

Complex adaptive systems (CAS) are built on interactions between interdependent agents which process energy, matter and information, that is, agents with both metabolic and cognitive processes. For example, a human being is developed on the interactions of different biological subsystems through cognitive (information processing) and metabolic (matter and energy processing) networks. Also, the emergent properties of societies are built on complex interactions between simple agents. However, in this case agents are not neurons or other sort of cells, but citizens that consume and produce matter, energy and information.

CAS evolution can be explained on a temporal axis with two fundamental dimensions (Heylighen, 1999). On the one side, there is a structural dimension exemplified by the transformation of communications, evolving from centralized societies with low connectivity between agents to distributed networks (view Fig. 1) with thousands of exchanges per second. On the other, there is a functional dimension; as it is pointed by Stewart (2000), the progress from hunter-gatherer societies to transnational communities with high levels of heterogeneity, complex division of labor and wide diversity of cultural trends. In case a CAS has achieved high structural decentralization and functional heterogeneity, and we project the aforementioned view to a social system, then we call this state of balance a peer-to-peer (P2P) paradigm.

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http://dx.doi.org/10.1016/j.tele.2015.01.001
0736-5853/

In such a paradigm, the participating agents can potentially be both consumers and producers of information. P2P dynamics generate public information available worldwide in digital repositories, websites and bibliographic resources. The growth of the contents in collaborative platforms, such as Wikipedia or the increase of publications in blogs and other social media, implies a huge amount of unstructured, ambiguous and multi-lingual information. These resources can be only partially processed by human agents who are part of the same linguistic communities. However, parsing, translating and processing such amount of data require complex software mechanisms and it is not achievable by a single central-controlled system. We arguably need distributed and heterogeneous networks of coordinated mechanisms composed by both specialized human and artificial agents in order to improve information retrieval, filtering, reasoning and decision-making. Distributed, because the more complex a system becomes, the more difficult is to manage everything from a central node. Heterogeneous, because a larger variety of skills and approaches implies more possible solutions to common problems, avoids redundancy of efforts and therefore increases productivity (Heylighen, 2002).

In these distributed and heterogeneous networks, agents have to handle technical issues such as information overload, unstructured data and non-interoperability, but also have to be able to produce new knowledge and value from existing resources. These aspects imply a reformulation of knowledge management and a chance for Artificial Intelligence techniques such as Knowledge Representation and Reasoning.

In this paper we review different proposals, pointing out to possible answers for these issues. In Section 2, we introduce the idea of a P2P paradigm within the CAS. In Section 3, we address the problem of information overload and discuss some solutions proposed by Francis Heylighen. We also review some computer-based solutions that can be implemented in order to provide data interoperability and allow knowledge inference from heterogeneous and distributed sources. In Section 4, we explain briefly the notion of social autopoiesis and develop the idea of information literacy from an autopoietic perspective. Next, in Section 5, we focus on the Commons-based peer production and the basis of a new collaborative economy enabled by the P2P infrastructures. Finally, we summarize our conclusions.

2. Building P2P infrastructures

A CAS can be described as a network of interrelated agents able to adapt to changes in the environment (Levin, 2002). Such a system can also be considered autopoietic if it generates the necessary components to preserve its autonomy as a discrete unit. These two concepts (CAS and autopoiesis) can be used to describe a social system: we might use the CAS concept if we assume that the system evolves dynamically and is built on networked interactions between social agents; we might use an autopoietic perspective if we consider that those components which are necessary to preserve social interaction (language, media, markets, law or technology) are produced by the system itself, that is, by the collaborative work of social agents.

In this section we shall focus on CAS. A more detailed explanation of the concept of social autopoiesis will be presented in Section 4.

The correlation of CAS performance and two independent attributes (heterogeneity and decentralization) has been analyzed with computational models (Gonzalez-Rodriguez and Hernandez-Carrion, 2014). The impact of those variables on social evolution has been tested with the simulation of artificial societies. According to that work, the adaptability of a system would be related to the way information is produced and propagated across the social agents. In other words, the more decentralized and heterogeneous the system is, the better would adapt to dynamic environments.

Hence, it seems that knowledge production within a social system would be increased with a higher degree of functional heterogeneity and structural decentralization. The former would allow for a greater diversity of available strategies, cultural values, identities and behaviors which will benefit the fitness of the system. The latter would utilize and propagate the diversity of available knowledge through P2P exchanges and the relevant infrastructures. For example, free thought leads to

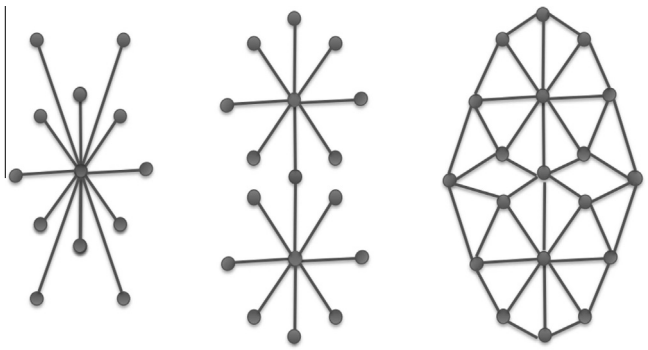

Fig. 1. Network topologies: Centralized, decentralized and distributed. In 1964, Baran proposed the third topology for the creation of ARPANET (Baran, 1964). The development of this network would eventually give way to the birth of the Internet. With a distributed topology, the network would be resistant to external attacks, eliminating any node with power filter.