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Building ontologies for sustainable business through online networks

Abstract

Research in areas related to network management and business relationships indicates that strategic actions and decision-making in business networks are driven by how actors perceive and understand their environments. Often the complexities inherent in such environments compel managers to engage with diverse networks in order to make sense of the prevalent conditions. Firms dealing with sustainable development (SD) issues need to make sense of what it means in order to design and implement effective strategies. Digital technologies have powerful network effects and offer network-building tools like digitized platforms, which play critical roles as network intermediaries for knowledge development and diffusion. In doing so these platforms introduce new ways of understanding the core ideas behind sustainability and what they mean for sustainable business. We borrow the idea of ontology building for the creation of a Semantic Web from Information Systems (IS) Studies to identify sustainability related ontologies through a study of emerging online communities of a sustainability-oriented network. It aims to identify how ontology and Semantic Web rules can be used in a knowledge-based system to integrate information about sustainability that can help create network pictures for addressing sustainability challenges. This paper fills a gap in business network research that traditionally has not focused on the role of digital networks in creating network pictures.

Keywords: Sustainable, Business, Digital, Networks, Ontologies

Introduction

Global society is faced with issues such as climate change, inequality, resource scarcity, biodiversity loss, and food insecurity that in turn challenge the sustainability of business enterprises and their growth prospects (Shrivastava & Guimarães-Costa, 2017; Markard et al., 2012; Grin et al., 2010; Hart, 2010). The modern systems of production and consumption have become unsustainable, requiring new and improved techniques and processes, and this demands a change in how organisations operate (Shrivastava & Guimarães-Costa, 2017; Blok, et al., 2015). As changes take shape firms are engaging in diverse ways to address these complex challenges and identify innovation opportunities that this transition presents (Draper, 2013). The inherent interconnectedness and complexity of sustainability challenges make them impossible for individual firms to tackle, and researchers have recognized and explored networks that act as intermediaries for facilitating engagement on such issues in order to trigger systems innovation and trigger collective learning processes (Shrivastava et al., 2013; Loorbach et al., 2010; Boons & Roome, 2005; Svendsen & Laberge, 2005). This ongoing shift in thinking has, understandably, paved the way for new kinds of networks to emerge as firms identify challenges and spot opportunities for innovation, and collective learning.

The process of developing such sustainability networks could be viewed as a transition from traditional business network building to a kind of network building involving new actors and

institutions with few direct connections to core business activities. From this perspective, extrapolating from Schumpeter's notion of 'new combinations' (Hagedoorn, 1996), the processes of sustainability oriented network dynamics could be seen as an innovation. Omta (2002, 2004) has categorized processes of supply network dynamics as innovations as well. In practice most innovation processes influence all network partners. The processes of building sustainability networks involving actors beyond businesses to include governments, policy makers, researchers, educational institutions, civic organizations and others offer new ways of understanding and visualizing networks implying systems innovations (Van Bommel, 2011).

The IMP group has been at the forefront when it comes to understanding relationships and interactions within B2B networks and integrating contemporary agendas within its research focus. This transition context presents an opportunity to understand the new forms of relationships and interactions that are emerging, and building ontologies for sustainability oriented networks.

Values placed on relationships are specific to contexts and understanding of ongoing narratives of change (Lowe & Hwang, 2012; Nogueira, Araujo & Spring, 2010; Corsaro & Snehota, 2010). The contexts of systems transitions are complex involving new processes, strategies, and behaviours, giving rise to new narratives and ways of sensing, understanding, and visualizing the current realities, which in turn is making way for new interactions, alliances, and relationships. The complexity inherent in sustainability challenges requires new imaginations and creation of new pictures to prompt and encourage innovations opportunities for solving them. Therefore, these narratives and ways of understanding become interesting research themes for framing the interactions and imagining how the new alliances and relationships could take shape.

Digital technologies offer firms tools and opportunities for improving efficiencies, many of which have impacts on sustainability (Spring & Araujo, 2017). Extrapolating from this idea, digital technologies offer network-building tools for developing and exchanging knowledge, while evolving a collective understanding of what it means to be sustainable, thus paving the way for an efficient network building process. In doing this, these networks become important intermediaries for creating ontologies for sustainable business.

The idea of the Semantic Web is based on dissolving communication barriers on the Internet by creating a new system of data mark ups and online libraries or ontologies that will allow machines to communicate seamlessly. For solving complex sustainability problems, a shared understanding of concepts and ideas related to sustainability is vital for seamless communication across diverse networks. In this context, the idea of the Semantic Web is an interesting analogy for ontology building.

There is a significant interplay among the social interactions enabled by the design of the Web, and should be studied and understood as a phenomenon. However, it is important to remember that the Web is also something to be 'engineered' for future growth and capabilities and our interaction online during which we create, link, share, and consume information generates emergent behavioral patterns that often exhibit interesting properties requiring new ways of understanding (Hendler et al., 2008).

The aim of this paper is to identify ontologies by studying emerging online communities of sustainable business networks. We use the idea of ontologies as conceptualized for building the Semantic Web[1] whose objective is to organize webs of data into usable knowledge for use on the Web.

We first discuss the emerging networks for sustainability, and then look at the relevance of IMP research in sustainability transitions networks, followed by a detailed discussion on

[1] https://www.w3.org/2001/sw/SW-FAQ#WhatIsTheSW

ontologies and their relevance for building sustainability oriented networks, and finally method and discussions.

Emerging Networks for Sustainability

In order to reorient strategic practices that can address persistent environmental and social problems along with identifying new opportunities for growth, firms need to develop an understanding of what sustainability means from a societal perspective. Firms alone cannot drive sustainability taking into account economic, environmental and social aspects as they merely contribute to production and consumption patterns within society (Loorbach et al., 2010). The complexity and the persistent nature of issues related to sustainability require new conceptual models for addressing them. Such models should take into account the various relationships and networks that need to develop for tackling wider societal challenges. Building such relationships and networks would require an understanding of the ways in which sustainability issues are linked with one another.

There is acknowledgement that the understanding of sustainability challenges by firms is not global or holistic; it has remained limited to the industry, firm and operations levels (Shrivastava et al., 2013; Loorbach et al., 2010; Korhonen & Seager, 2008). This limited perspective pose challenges to how businesses are conceptualized and operated, and restricts their response to sustainability challenges. Holistic and systemic understanding of sustainability offer plenty of opportunities for innovations in products, services, production and logistics systems, and business models, with possibilities for co-creating value with diverse stakeholder networks (Boons & Lüdeke-Freund, 2013; Schaltegger et al., 2013; Shrivastava et al., 2013).

Relevance of IMP Research in Sustainability Transition Networks

Studies within the IMP-group has over the years integrated many contemporary agendas by drawing from other disciplines and theoretical frameworks in order to capture the complexity inherent in interactions and networks (Lowe & Hwang, 2012). Lowe & Hwang (2012) suggest that theoretical pluralism provides opportunities for critiques of dominant paradigms and ways of thinking, and thereby adds relevance to research. Paliwoda (2011) has discussed how IMP research is concerned with the longer-term perspective along with strategic issues integral to a dynamic and real world. An idea that has strong implications for firms, as strategies for sustainability have long-term perspectives and are rooted in real issues confronting us.

One area of network research engages with the network pictures metaphor that aims to capture a firm's position in its business settings within network formations (Geiger & Finch, 2010; Mouzas et al., 2008; Henneberg et al., 2006). It has been observed that one of the challenges faced by firms is the existence of possibilities that are not clearly evident but are distributed in the form of individual 'cognitive' pictures as perceived by managers within business networks (Ford et al., 2003; Henneberg et al., 2006). Mere collection of network pictures are not enough for forming networks within communities of practice, they result from extended interactions and exchange processes (Mouzas et al., 2008; Tsoukas, 2000). The emergence of a coherent network picture results from a series of attentive and diverse interactions, that transcend task specific knowledge of managers and such managers often take the lead in mobilizing other network actors within the business network for innovation activities that result in competitive advantage (Mouzas et al., 2008). Mouzas and Henneberg (2015) have argued that interactions between firms are based on shared understandings of the rules that guide actor behaviour and their subsequent impact. Such shared understandings of

rules can pertain to '*availability of exchange interfaces, trade practices and norms, or shared appreciations and values including explicit or implicit regulations and laws that govern business interactions*' (Mouzas & Henneberg, 2015).

Firms engaged with sustainability have understood the concept as a firm level issue and have pictured it in terms of regulatory concerns, competitive pressures, market potential through innovations, and a sense of corporate social and environmental responsibility (Shrivastava et al., 2013). Few managers think about sustainability as a systemic and interconnected issue and thus are unable to visualize the kind of networks that are required for addressing sustainability issues along with business objectives.

Sustainability-oriented networks present an opportunity for firms to build network pictures that could uncover the problems associated with dominant paradigms in business that limit sustainability transitions yet also open up ways to conceptualize a set of new networks and relationships that could help spot and act upon new opportunities for innovation that are able to address sustainability challenges. For instance, solving persistent sustainability problems such as climate change, inequality, biodiversity loss, or resource scarcity require radical structural changes both within as well as between firms and other institutions and agencies. Eco-efficiency strategies and incremental change, in fact, support current lock-in and lead to sub-optimal innovation pathways (Loorbach et al., 2010; Könnölä & Unruh, 2007; Korhonen & Seager, 2008). In contrast, Porter (2006) proposes, coevolutionary mechanisms that conceptualize firms as having symbiotic, and coevolving relationships with society and ecosystem, enabling both researchers as well as managers to engage with a systems perspective that highlight how firm level activities and societal outcomes interact. These kinds of coevolutionary mechanisms display emergent characteristics, implying enterprise that requires constant reconfiguration of networks and relationships, as institutional, technological, behavioural, ecological, economic, and other processes intertwine and reinforce each other (Loorbach et al., 2010). Transitions towards sustainability involve a number of systems innovations that radically alter relationships between firms, organizations, and individuals involved in the system that could be an economic sector, a societal domain or a region (Loorbach & Wijsman, 2013; Loorbach et al., 2010). Therefore, transition to sustainability imply systemic innovations that demand a process of collective learning in order to build knowledge about root causes, linkages and patterns, in order to formulate shared meanings and clarify common ground and differences in perspectives, needs and interests (Loorbach et al., 2010; Svendsen & Laberge, 2005).

In network literature, such radical change has been identified in the context of new technological paradigms that are also characterised by nonlinear and unpredictable change, accompanied by blurred market boundaries, and shifting and ambiguous market actors, with no evidence of any successful business models (Möller & Svahn, 2009). However, as described above, the emerging networks driven by sustainability transition involve a fundamentally different way of conceptualizing network formations and in order to do that there is a need to build ontologies of sustainability that captures the main characteristics of the domain.

Ontology in the Semantic Web

The sheer complexity, diversity and volume of data that is generated on the Internet is staggering and the efforts to categorize and organize it, is an ongoing project that is captured in discussions on the Semantic Web.

Berners-Lee, Hendler and Lassila (2001) described the Semantic Web as '*a highly interconnected network of data that could be easily accessed and understood by any desktop or handheld machine*'. While describing the Semantic Web, they also highlighted the role of

supporting technologies that would enable this to happen by creating a common language for representing data that can be understood by all software agents, and ontologies that translate information from disparate databases into common terms and offer rules that allow software agents to understand the rationale behind the information described in those terms. In order to achieve the goals of the Semantic Web, the most important task is to be able to define and describe the relations among data. Therefore, ontologies are key to the building of the Semantic Web. The idea of ontology building for semantic interpretation of disparate data presents a model for developing similar ontologies that are able to define and describe relationships between various concepts related to sustainability. The act of strategizing in decision-making processes involves choices about how to interact with, mobilize and influence other actors in the network through connected business relationships (Abrahamsen, et al., 2016; Gadde et al., 2003). A shared ontology for sustainability would enable firms to build relationships across diverse networks for identifying strategic actions for sustainability.

Mapping through Ontologies

In IMP research, pictures and maps are discussed extensively owing to their attractiveness for both researchers as well as practitioners as they offer simple representations of complex business settings and open up various dimensions of relationships within these networks (Geiger & Finch, 2010; Håkansson & Snehota, 1989). Research has focused on understanding a firm's network through historical developments as well as exploring individual managers' perceptions (Geiger & Finch, 2010). However, in order to enable the creation of pictures and maps where firm strategy is driven by the sustainability paradigm, the perspective needs to extend beyond interdependencies within business networks towards those between business and society (Shrivastava et al., 2013; Loorbach et al., 2010). In order to facilitate this shift it is important to become familiar with the concepts that drive sustainability transition networks and the vocabulary that is native to such networks.
It is within this context that developing ontology gains prominence as ontology consists of a vocabulary used in a given knowledge domain. This is enriched by some specification of the meaning or semantics of the terminology within the vocabulary and in this way, ontologies can potentially be used to bridge the gap between heterogeneous information systems, including those related to sustainability and firm activities (Borsato, 2014).

Building Ontologies for Sustainable Networks – Role of Policy Intermediaries

Sustainability transitions are characterized by transformation in socio-technical systems leading to shifts in relations between actor groups, infrastructures, and between technologies and contexts of application, and intermediary actors act as key catalysts for speeding up the transition process (Kivimaa et al., 2017; Hodson et al., 2013; Kivimaa, 2014). It is important to consider that in business networks, the strategic logic is temporal rather than spatial, as they are inherently dynamic. Assuming such logic means understanding and mapping territories, but this becomes a problem as these territories are constantly developing and evolving. From the perspective of the firm it becomes difficult to identify opportunities and even when opportunities are identified and acted upon, it is unable to predict how long such advantage is likely to last (Helfat & Peteraf, 2015; Teece, 2007). Under such circumstances the role of intermediaries become critical. As the Internet is transforming the production and use of knowledge in ways that are unique, it becomes an important tool for organizing networks within specific knowledge domains, thus presenting firms with opportunities to build diverse networks and also become part of emerging ones. The European Institute of Innovation and Technology (EIT), an independent European Body (EU) body proposes to

enable the ability to innovate by nurturing entrepreneurial talent and supporting new ideas that will provide solutions to societal challenges while creating growth and jobs. The EIT offers an important arena for both, researchers and practitioners aiming to study and understand the interdependencies between business and society, and the various collaborative approaches that are possible. In enabling this, such an arena also helps in creating ontologies for sustainable business networks.

Method

Given the growing importance of sustainability there are several networks that are emerging online. While this is a welcome development, an initial exploration of these platforms revealed that most of them appear to focus on specific areas, as far as business activity is concerned. For instance, circular economy is a well-represented area and does cover all aspects of sustainability but its focus on circularity takes away from a holistic understanding of sustainability as a process. The EIT in this sense with its focus on innovation communities comprising of business, education, and research helped us to conceptualize sustainability as a societal project that needs to explore all possible avenues and opportunities. Schot and Steinmueller's (2016) discussions on framing of innovation policy for transformative change influence our thinking in this sense. These discussions involve three kinds of framing of innovation, the first focuses on innovation for growth that taps the potential for science and technology in driving prosperity through systems of mass production and consumption, the second looks at the national innovation systems spurred by intense competition in global markets and the third framing involve questions about how innovation systems can address societal needs for sustainable and inclusive growth. The emergence of the third framing, in Schot and Steinmueller's view, does not replace the first two but instead all three compete for the imagination of policy makers and other societal stakeholders, including businesses. From this perspective, the EIT by stressing on innovation as a central driver manages to create a platform to facilitate such societal interactions for developing a socially constructed ontology of sustainability.

After identification of the research arena, we undertook a simple analysis of different texts available on the EIT site. We are using a data analysis tool developed by the Data Culture Project[2]. The objective is to build a list of key words and compare texts to try and extract stories out of them. We expect that this will help us understand links between the various concepts through words and ideas. The idea is to explore this ontology to help us not just map what exists but also what is possible.

Findings and Discussion

This part will be developed after completing the data analysis. However, initial results indicate that traditional firm structures will continue to function as usual but importance of dynamic networks that will merge into temporary bundles to solve issues and then disperse will grow and increasingly influence them. The very nature of these networks (firms, educational institutions and research organisations) is such that they will defy any formal organisational structure. An important reason why formal organisational structures will be inconvenient, not to mention expensive and illogical, is the ability of such temporary networks to pool knowledge residing in distant nodes into massive problem solving capabilities, with no requirement for any long-term centralized control. This presents

[2] https://databasic.io/en/culture/

enormous opportunities for learning about interconnected patterns in network interactions and self-organization.

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