Organizational Knowledge Generation: Lessons from Online Communities

Author Details

Fouad Zablith
Assistant Professor
Olayan School of Business
American University of Beirut
Beirut
Lebanon

Samer Faraj
Professor and Canada Research Chair
Desautels Faculty of Management
McGill University
Montreal, Quebec
Canada

Bijan Azad
Associate Professor
Olayan School of Business
American University of Beirut
Beirut
Lebanon

Corresponding author: Fouad Zablith
Corresponding Author's Email: fouad.zablith@aub.edu.lb

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Structured Abstract:

- **Purpose**: Knowledge capturing and sharing within an organization have been extensively studied in the literature. In this stream of work, an influential focus is on the process of encoding and managing knowledge to enable effective reuse within the organization. With the advancement of Internet and Web technologies, there is an increased interest in the study of knowledge flows in online communities. We highlight in this paper the fact that the boundaries between internal and external organizational knowledge are disappearing, mainly due to the extensive use of online-based platforms to support organizational operations. We believe that this will affect the activities of knowledge management in today's businesses. Our aim is to provide guidelines for organizations on how to bridge their internal and external knowledge using an integrated semantic approach.
- **Design/methodology/approach**: In this article we review two classes of approaches, those that target internal organizational knowledge, and those that target online knowledge flow processes. Then we identify the challenges involved in today's knowledge environments. To address those challenges, we propose a framework to bridge and integrate internal and external organizational knowledge. We map the activities handled in our framework to the existing knowledge management activities identified from the literature, and highlight how emerging technologies are used to support such activities along the knowledge management process. We apply our approach in the context of an organization's process that heavily depends on the appropriate alignment of internal and external knowledge. We focus on the use of emerging technologies that support collaboration and the generation of explicit and reusable semantics.
- **Findings**: Interaction points within organizations can be used to define the scope of knowledge exchanged. Following a methodology around our proposed framework, it is feasible to create conceptual connections around internal and external knowledge through explicit semantics. Such connections that are created to support online communities' knowledge exchange can be applied to internal organizational knowledge, and used as a bridge to external knowledge sources.
- **Originality/value**: The paper provides a roadmap for organizations on how to manage organizational knowledge processes in a coherent and collaborative semantic platform, with a view to what is available outside the boundaries of an organization.

Keywords: Collaboration; decision making; knowledge-based systems; knowledge mapping

Article Classification: Research paper

I. Introduction

Organizations are constantly generating knowledge in various forms. The perspective of the knowledge view of the firm is predicated on the ability of organizations to capture and reuse such knowledge in order to unlock innovation potentials (Nonaka and Takeuchi, 1995) and gain competitive advantage over other firms (Apostolou and Mentzas, 2003; Argote and Ingram, 2000; Dosi et al., 2008; Grant, 1996; Kogut and Zander, 1992). How best to manage an organization's knowledge has led researchers to explore the field from various angles ranging from theoretical frameworks (Nonaka, 1994) and models (March, 1991; Tsoukas, 2009), to systems and methodologies (Lee and Hong, 2002) that support business processes and product development. Today's Internet and Web technologies are evolving at a fast pace. The Web has been quickly moving from an environment where users were passive consumers of information, to more engaged entities that are actively collaborating and creating content. This trend has drawn the attention of many researchers to study the exchange of knowledge in online communities (Ardichvili et al., 2006; Awazu and Desouza, 2004; Faraj et al., 2011).

However, end-users are not the only actors in online communities. With the aim to reach out to their customers and other stakeholders, organizations are increasingly using online tools to support their daily operations. As McDermott (1999) states, "Organizations are becoming enmeshed in electronic networks." As a result, an organization's related knowledge is gradually becoming part of the online conversation. Consider as an example the car service industry. During the pre-Internet era, the knowledge barrier made it difficult for external firms to enter the industry segment. Today however, this industry is rapidly evolving toward openness where individuals are empowered to service their own cars. Car service firms have had to develop ways to provide self-help information and videos as well as sustain online communities of car aficionado. Such a radical change from knowledge as a source of competitive advantage that is to be protected as a valuable resource, to a model where knowledge becomes something that is freely flowing to and from a community of enthusiasts is a radical change affecting most firms. In short, knowledge is moving from being centralized and locked within the walls of organizations, to being decentralized and often created outside the control of organizations.

Brown and Duguid (1991) highlight the presence of knowledge that crosses the boundaries of the organization by involving parties that are external to the organization. With the increased use of online tools that are re-shaping the means of today's interactions, we see that the boundaries between internal organizational knowledge and online knowledge are disappearing. We argue that the weakening of boundaries will have a transformative effect on the flow of knowledge around an organization's processes. The research question that we aim to investigate is how can organizations integrate their internal knowledge with that available in online communities?

This paper is organized as follows. We begin by analyzing a group of approaches that focus on internal organizational knowledge, and another group of methods that investigate knowledge in online communities, coupled with the efforts employed in the area of Semantic Web (Berners-Lee et al., 2001) and Linked Data (Heath and Bizer, 2011) that are changing the way we represent information in online communities. We derive some of the lessons learned from online communities, and reflect it back to the generation of knowledge in the organization itself. We highlight that the direct involvement of the organization's elements (e.g. systems and people) in online environments is placing new challenges on the creation and maintenance of organizational knowledge. We then identify four challenges: knowledge elicitation, encoding, sharing and semantic consistency. Next the analysis is synthesized in a framework and methodology for creating organizational knowledge. The proposed methodology aims to handle the challenges identified. One of the core elements of this methodology is the adoption of a collaborative knowledge creation platform, with the ability to embed explicit semantics that can be easily consumed online. In conclusion we follow the design science (Markus et al., 2002) principles, and support the feasibility of our proposed methodology within the context of an organization's process that naturally involves a good orchestration of internal and external knowledge.

2. Theoretical framework

How best to develop and manage organizational knowledge has been investigated from a variety of perspectives. When it emerged, the knowledge management field was focusing on the knowledge created within the organization. Researchers have investigated aspects ranging from knowledge creation (Kogut and Zander, 1992; Nonaka, 1994), to its impact on the organization's performance and learning (Levine and Prietula, 2012; Song and Kolb, 2013). With the evolution of Web technologies and online platforms, studying knowledge exchange in online communities has generated increased interest (Chiu et al., 2006; Faraj et al., 2011; Wasko and Faraj, 2005). In this section we give an

overview of the works that target internal organizational knowledge, followed by other approaches that study knowledge flows in online communities. The goal of this joint analysis is to establish the compatibility between knowledge representation and flows between the organizational and online community settings. We rely on the existing approaches to propose a new framework that supports the generation of organizational knowledge aligned with external consumable knowledge.

2.1. Internal organizational knowledge

Managing organizational knowledge is important for firms to gain competitive advantage (Apostolou and Mentzas, 2003; Argote and Ingram, 2000; Dosi et al., 2008; Grant, 1996; Kogut and Zander, 1992), improve performance (Levine and Prietula, 2012; Song and Kolb, 2013) and innovate (Nonaka and Takeuchi, 1995). The metaphor of organizations as learning entities, while technically inaccurate for its teleological nature, has gained ground as a way to explain how knowledge is reshaped or increased due to organizational processes (Argote and Ingram, 2000; Chiu et al., 2006).

Knowledge is constantly created during the lifespan of an organization. In organizational learning, there is a continuous exchange of knowledge between individuals and groups within the organization (Alavi and Leidner, 2001). This learning process is supported by the management and accumulation of knowledge traded among the interacting elements (through for example dialogue (Tsoukas, 2009) and socialization (March, 1991; Nonaka, 1994)). March (1991) modeled two situations where the creation and exploitation of organizational knowledge occur: one is when individuals socialize to exchange and develop organizational knowledge; while another model is based on competition driven knowledge creation, where individuals and organizations compete for limited resources.

Nonaka (1994) proposed a framework that captures the process of knowledge creation. One of the major properties of this framework is the “spiral” effect. This notion reflects the amplification of knowledge when moved along the “ontological dimension,” from the individual, to the group and subsequently organizational levels and beyond. This spiral framework of knowledge creation highlights how tacit knowledge is exchanged through the socialization of individuals, while explicit knowledge is developed by combining knowledge entities such as documents. Furthermore, the framework captures the constant flow between tacit and explicit knowledge through externalization of tacit knowledge, and internalization of the explicit side. Recombining a firm’s capabilities also contributes to the creation of new knowledge (Kogut and Zander, 1992). Nonaka’s knowledge creation process, combined with the analysis of the culture within the organization, led to the creation of a model to derive organizational performance measures (Song and Kolb, 2013).

In addition to knowledge creation, the flow of knowledge in organizations has been studied from different perspectives. Shamsie and Mannor (2013) identified four different types of tacit knowledge that flow between individuals, groups and managers of an organization: “discrete productive knowledge” used by individuals to fulfill specific tasks; “linked productive knowledge” related to achieve collaborative tasks in groups; “discrete administrative knowledge” that individual managers need to better manage their employees; and “linked administrative knowledge” that reflects the knowledge between managers and their subordinates. The authors analyzed sports team to derive findings that can be applied in business contexts.

Enabling the flow of knowledge within organizations can be challenging. Davenport and Prusak (2000) highlighted three reasons that can hamper knowledge exchange in a firm. First, organizations may lack the means for identifying who knows what. Second, knowledge is not usually equally distributed within the organization. While this is normal, the authors argued that a strong asymmetry of knowledge can lead the knowledge holders and consumers to never meet. This is mainly due to problems in distribution systems. Third, individuals in firms tend to consume knowledge from people who are close to them, rather than from the people who may know. The authors referred to this as the “localness of knowledge”. They point out that the lack of (1) information about external sources of knowledge, and (2) the means to reach external reliable knowledge, push people to be content with what is close to them. Knowledge-mapping tools have been proposed to map knowledge to people (Driessen et al., 2007). In their framework (Driessen et al., 2007), the authors connect people who can be part of groups and involved in activities, to knowledge items that are referenced by concepts. While the focus of their work is to enable organizations to identify and evaluate knowledge mapping tools that fit their purpose, people, their interactions, and connections to conceptual knowledge form the core elements of their framework (Driessen et al., 2007). Most knowledge mapping tools contain concept extraction functionalities. Those can be done manually for example when applied within a project and a group context (Berg and Popescu, 2005; Nakata et al., 1998), or supported by tools to extract and learn concepts to form ontologies (a set of interrelated conceptual representation of a domain (Gruber, 1993)).

2.2. External organizational knowledge

We refer to external organizational knowledge as the knowledge that lies beyond the boundaries of a firm. Before the boom of electronic networks, organizations used to be the main source of knowledge and clear boundaries demarcated what knowledge was accessible to organizational members.

The advancements of Internet and Web technologies are facilitating and improving online collaboration. Today, it is easy to bring people together around specific subjects of interest. Almost every person is equipped with the means to enable online collaboration using for example social media platforms, or other tools like MediaWiki (www.mediawiki.org), Web forums, and mailing lists, to name a few. Online collaboration allows the flow of knowledge among individuals in a dynamic way without the physical and traditional organizational structure constraints (Faraj et al., 2011). These virtual forms of organizations have become the focus of increased research interest. Initial interest around the "mystery" of why individuals share their time and valuable expertise freely with strangers has morphed into more focused attention as to how online communities function. Factors such as the identity, social capital, and learning motives have been identified (Chiu et al., 2006; DeSanctis et al., 2003; Kudaravalli and Faraj, 2008; Ma and Agarwal, 2007). Indeed, there has been a reframing away from narrow economic or motivational factors to a growing understanding of online knowledge as a public good to be treated as such by community members (Wasko et al., 2009). Thus, research around knowledge in online communities is enabling us to reflect and apply new thinking as to the treatment of knowledge within organizations (Awazu and Desouza, 2004; Faraj et al., 2011).

An exploration of why people share knowledge in online communities compared to within organizations can shed new light on some long accepted knowledge management practices. In traditional organizations, people tend to help each other, expecting reciprocal behavior from their colleagues when needed. One image is a role based expectation: one helps others out of a defined expectation associated with the role, e.g., a manager is expected to help a struggling subordinate. More informally, an appropriate behavior is to provide help as a way to create ties and a "you owe me" bank of favors to be called on at a later time. This is not the same in online communities. It is found that there is some correlation between reciprocity and the quantity of knowledge shared online, but not with its quality (Chiu et al., 2006). However as Chiu et al. (2006) discuss, it is unclear whether such results can be generalized to all types of virtual groups. This is especially true given that other findings show that people tend to make knowledge available to the community for free, without anything in return from community members (Wasko and Faraj, 2005). According to Wasko and Faraj (2005), lawyers belonging to an immigration law community are motivated to share knowledge online only partially in order to improve their reputation, but also because "it is what one does." By virtue of being part of the online community and because the development of legal expertise requires elaboration, comparison and reflection, senior lawyers engage with their more junior colleagues, irrespective of the medium. In other communities, culture and the environment in which individuals are working can also have an impact on sharing knowledge online (Ardichvili et al., 2006).

As mentioned previously, internal knowledge transfer can be challenging. However Argote and Ingram (2000) argue that transferring knowledge within the organization is more effective and easier than transferring it externally. This is based on the assumption that people interacting in a firm share more similarities than with people outside the organization. However, it is possible that trends toward increased inter-organizational collaboration may be changing this state of affairs. Organizations are acknowledging the fact that they cannot rely purely on their internally brewed knowledge to achieve their activities and are embracing external sources of knowledge and expertise (Anand et al., 2002). Feller et al. (2013) tested the extent to which the Nonaka and Takeuchi (1995) knowledge creation framework was operating in dyadic research and development partnerships. Using data from 109 partnerships, they found that the failure to support one of the four knowledge conversion processes (socialization, externalization, combination and internalization) led to the emergence of difficulties in sustaining these R & D collaborations. Indeed, these results operated over and above the impact of traditional measures of alliance health such as equity investment, knowledge similarity, or knowledge complementarity. The authors highlighted that this may be due to the way the combined knowledge is structured and contextualized.

In spite of widespread hype about their usefulness, the role of new technologies, such as Web 2.0 tools in facilitating knowledge transfer is not yet well established. For example organizations are relying on Wikis to create knowledge around specific communities (Stvilia et al., 2008; Yates et al., 2010). Such Wikis not only enable knowledge sharing, but also improve and reshape existing knowledge (Yates et al., 2010). Mailing lists are also used to enable a threaded interaction across disparate collaborative communities (Kuk, 2006). Online forums are also knowledge sharing enablers (Kanuka and Anderson, 1998). In addition to these tools, newer social media platforms are alleged to offer organizations the advantage of getting participants more intimately engaged (Kaplan and Haenlein, 2010). These environments are claimed to facilitate the elicitation of participant knowledge based on constant interactions and visible social ties. As a result, social media becomes unavoidable for firms as their products, services, leaders, stores or even staff people can be mentioned or critiqued in the social media sphere. Further, additional information about product

reuse, socioeconomic trends or even competitors can be highly valuable and affords new learning and responses for the focal organization.

Another area of research is reshaping the exchange of information in online communities. During the last decade, the Web has been moving from a space of links across documents, to meaningful links at the data level. The Semantic Web (Berners-Lee et al., 2001) and Linked Data (Heath and Bizer, 2011) movements have been pushing the availability of structured knowledge at a large scale. This is another wealthy and freely accessible source of knowledge that firms can contribute to, and easily consume. More and more organizations are releasing public knowledge with semantics that are embedded at the data level. To name a few, governments like the US (http://data.gov) and the UK (http://data.gov.uk), references such as DBpedia (Auer et al., 2007) and DBLP Linked Data (Bizer and Cyganiak, 2006), universities and education providers (d' Aquin, 2012; Zablith et al., 2015), and many others are releasing public information in this format. The way knowledge is created at a linked Web scale follows well defined procedures (Heath and Bizer, 2011), with specified vocabularies that can be extended in order to make the exchange of knowledge semantically coherent. While the Semantic Web is opening the road for a meaningful exchange of information on the Web, it is also acknowledged to offer solutions to problems related to information exchange within an organization (Daconta et al., 2003). From this analysis of the literature, we see that there is a substantial amount of research that investigates internal organizational knowledge on one side, and external organizational knowledge on the other. However it is becoming clearer that the current knowledge economy, and the environment in which we are operating, are prompting organizations to be actively engaged and connected to the knowledge flowing in online communities. In other words, the boundaries between internal and external organizational knowledge are disappearing. One particular area of research that can help organizations overcome the fusion of its internal and external knowledge is the Semantic Web. However we observe that there is a need for a roadmap to guide organizations in facing the fusion of their knowledge sources with what is available outside their boundaries.

3. Challenges of organizational knowledge in today's environment

In global environments, managing knowledge faces various challenges (Denizhan Kalkan, 2008). Given that organizations have continuously been seeking better ways to manage their knowledge, much of the solutions currently present in organizations are optimized to internal needs and processes. With time, knowledge flows are built on, and support, a firm's daily operations. These processes are often coupled with the formation of communities of practice based on task demands or expertise. As a result, knowledge exchange channels become hardwired around the regular interactions between the organization's stakeholders. For example, it is normal to expect minutes of meetings to be circulated to the involved parties in the form of reports or emails. Regular meetings are held among specific groups, around which specialized knowledge gets locked. With time, exchanged knowledge gets accumulated deep into organizations' sources, making it hard to find, share and reuse, especially in online environments where most of the interaction is moving. So the question is how can organizations enhance their ability to capture their internal knowledge and bridge with the online knowledge environment? We believe that this complex undertaking involves the following main challenges.

Knowledge generation and elicitation: The daily operations of an organization often comprise interactions among the various parties in the firm. Such interactions (e.g. face-to-face meetings (Davenport and Prusak, 2000)) result in a substantial amount of knowledge generation. This knowledge, which tends to spread across different human subjects, should be constantly captured. This activity is also referred to as externalization (Nonaka, 1994). There are various traditional techniques to elicit knowledge from individuals. This includes for example interviews, focus groups, surveys or others (Cooke, 1994). While this task is a major bottleneck in building internal organizational knowledge when most interactions are offline, it is easier to achieve in online communities, where interaction naturally relies on computer or mobile mediated platforms around which knowledge is exchanged. Such platforms are constantly capturing knowledge in various formats such as text, images, and others. The challenge here is to constantly identify interaction points happening around the organization, and we propose to match such interactions to appropriate tools that proved to be successful in online communities in inducing and facilitating knowledge sharing of the involved individuals.

Knowledge encoding and storing: Another challenge is related to the means used to capture organizational knowledge. Knowledge is usually created in different contexts, using different approaches and formats. This will result in broken or disconnected blocks of knowledge. Encoding can be done for example in the form of text documents, Extensible Markup Language (XML) (Bray et al., 1998), or more recently in Resource Description Framework (RDF) (Lassila and Swick, 1999) and Microformats (Khare and Çelik, 2006). To fully exploit the potentials of created knowledge, it should be encoded in a way that all involved parties can consume, extend and share it. The complexity here is not only related to individuals, but also to platforms and applications that are used by external organizations.

For example, if a knowledge system is capturing knowledge in a firm, such knowledge should be created in a format that can be understood not only by the firm, but also by other collaborative organizations and online communities.

Knowledge sharing and connecting: With changes in environment dynamics and globalization, organizations should create knowledge with sharing in mind. The increase in competition is pushing firms to collaborate in order to achieve various tasks along their business processes (Feller et al., 2013). Hence, another objective of today's organizations is to make their knowledge available to external parties. If done properly, this will generate good returns for the organization not only out of better collaboration with other firms, but also from reducing other costs in their supply chain. One example mentioned earlier is related to the ability of consumers to get answers to their inquiries personally, without the assistance of traditional knowledge holders. This is a natural evolution of the fact that organizations are becoming enmeshed in electronic networks (McDermott, 1999). This dynamic nature of knowledge exchange raises further challenges like how to protect sensitive knowledge from reaching competitors? In other words this flags the need for organizations to regulate what to share, and have some kind of control mechanism over their shared knowledge.

Semantic consistency for effective reuse: Shared knowledge is continuously moving within and outside an organization. This constant flow may lead to situations where knowledge becomes "decontextualized", especially when knowledge is encoded using different approaches and formats. This will result in broken or disconnected blocks of information. In other words, a block of knowledge that fits the purpose in one context can be obsolete in others. While the issue of context is easier to manage inside the organization where people share common background knowledge and similarities (Argote and Ingram, 2000), it is much harder to handle outside the boundaries of the firm. When the organization opens up its knowledge to the external world, we believe that appropriately handling the semantic consistency of knowledge is one of the most challenging tasks that, if handled properly, can enhance the flow of knowledge around organizations. We believe that this challenge can be alleviated by the research evolving around the area of Semantic Web and Linked Data, which aim to inject semantics at the data levels. This allows the alignment of the meaning of knowledge using standards that are increasingly used in online communities. In this area of research there is a push towards creating vocabularies, also referred to as ontologies for domain representation (Gruber, 1993), which when commonly used by more than one entity can ensure a preservation of context and meanings during information exchange. The use of common ontologies by information publishers is increasing, especially when consensus is reached with major players such as Google, Yahoo! and Bing who control a big portion of information exchange online in the case of the schema.org vocabulary (www.schema.org).

The aforementioned challenges have always existed in building knowledge systems. However, today the perspective is somewhat different. One important factor that is affecting this field of research is the evolution of the web from a space of users and organizations who are passive information consumers, to a space where online communities are actively engaged in the process of creation and consumption of knowledge. We believe that the development of today's knowledge systems should follow a methodology that takes care of the core aims of organizational knowledge systems, while embracing findings and lessons from the growing online communities.

4. Proposed approach

In this part of the paper we present our observations from online communities, which lead to a methodology for creating knowledge suitable for inter and intra-organization environments.

4.1. Knowledge flow between internal and external sources

We propose in Figure 1 a framework that reflects the move between internal and external organizational knowledge. Organizational knowledge is often *generated* when various parties interact in diverse forms such as meetings (Davenport and Prusak, 2000), and more informally through socialization (March, 1991; Nonaka, 1994). This socialization aspect is reflected in the ontological dimension of Nonaka's framework (Nonaka, 1994), where knowledge moves from the individual, to the group, organization and inter-organization levels. Interactions enable the involved entities to contribute their knowledge with the purpose of fulfilling specific goals. Knowledge contribution will often support the generation of new ideas, resulting in the advancement of specific objectives as well as unlocking innovation (Dosi et al., 2008; Nonaka and Takeuchi, 1995). However, the means of interactions are constantly changing. Traditional interactions are being complemented, and often replaced by, computer mediated tools that enable easier collaboration among the organizational stakeholders. Such tools are not used purely to decrease organizational costs, but also to seek further knowledge that lies beyond the scope of the organization. Hence interactions are increasingly occurring at a thin boundary between the organization and online communities.

While knowledge revolves around the interaction points in an organization, there is constant movement between the knowledge sources available internally and externally. Within the organization, interactions result in *storing* knowledge in internal knowledge sources for future use. This enables the possibility of *reusing* this knowledge in subsequent interaction points. An example in this context is bringing a sales report to a meeting to support future marketing strategies. With the increase of the availability and ease of access of external knowledge in online communities, firms are *reusing* external knowledge to fulfill specific tasks. This knowledge is combined with other internal knowledge, and

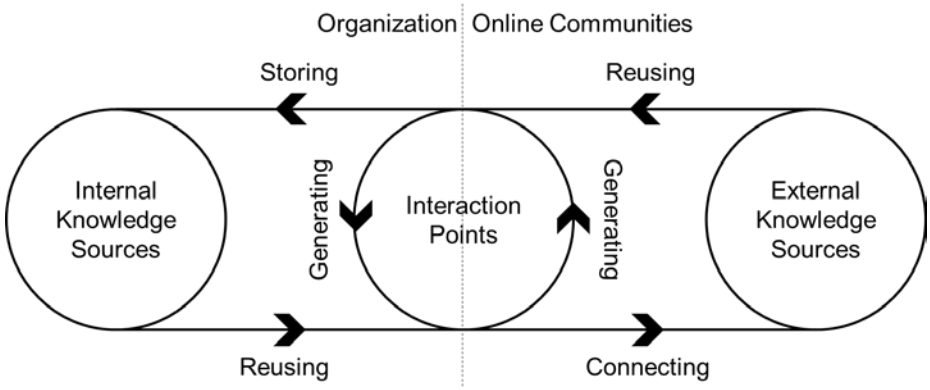

Figure 1. Framework of knowledge flow between the organization and online communities.

blocks of such knowledge become part of the internal knowledge source. External knowledge however does not only flow towards the organization; organizations often tend to increase the value of their knowledge by *connecting* their knowledge to external sources.

While the core activities of managing organizational knowledge are well defined in the literature, the technologies around them are constantly evolving. We highlight in Figure 2 the list of knowledge management activities identified in the literature (Holsapple and Joshi, 2002), mapped to the activities depicted in our framework, with a selection of technologies supporting them. The dashed lines aggregate two groups of technologies; one is the Linked Data technologies, and the others that are developed to support online communities. One particular observation is the wide variety of tools available today that support online communities, which indirectly contribute to knowledge generation with increased sophistication. While a diversity of technologies are still widely used in organizational contexts, knowledge management practitioners are forced to keep an eye on new emerging technologies that support online communities. This is due to the fact that most of the interaction is happening today through for example social media and online tools that connect individuals and organizations alike, where most of the knowledge is being generated.

4.2. Creating organizational knowledge that extends to online communities

We propose a methodology to handle knowledge creation in an organization that can be better connected to online environments. Our contribution at this level is to provide a roadmap that includes the various options around the proposed framework for managing knowledge in the midst of the increase of online knowledge. This methodology highlights proposed steps that organizations can use to support their knowledge creation process.

Interaction points. What brings people together in online communities is the motivation to share expertize around a specific topic of interest (Wasko and Faraj, 2005). Similarly, in organizations people interact (or socialize (Nonaka, 1994)) to achieve specific goals. This goal driven behavior is also studied in the context of multi-agent systems in the area of Artificial Intelligence (Dieng et al., 1994). Interactions can revolve for example around product design and development, or planning and customer support. While interactions are constantly happening in organizations via meetings, group discussions and other forms, the knowledge created often goes unnoticed. Interactions are naturally driven by the internal needs of the organization, making the collaboration relevant to a specific set of people, isolated from other stakeholders. Detecting interaction points can potentially enable identifying where knowledge is created in an organization.

The main elements of interactions include the actors, objects of interest, and interaction goal. When interaction points are identified, future references of the involved actors, objects and interaction goals are made possible. Additionally, devising the appropriate means for capturing knowledge is made easier. Individuals are the main knowledge holders in every organization. They are the core drivers of interactions to solve organizational related matters. Identifying *who* is involved in the interaction point is key for knowledge creation. This is important for various reasons. First, individuals own the know-how of things. Second, even though there is an increase in the automation of

knowledge exchange, involved actors are the ones who control the knowledge flow in organizations; i.e. *storing* knowledge internally, *reusing* internal and external knowledge, and *connecting* knowledge to external sources. Third, knowing who is involved allows a better assessment of the tools to use in collecting and generating knowledge. In addition to identifying actors, the related objects should be highlighted. Most interactions in firms are usually held around objects of interest. The objects form the material element of interaction. A substantial amount of knowledge

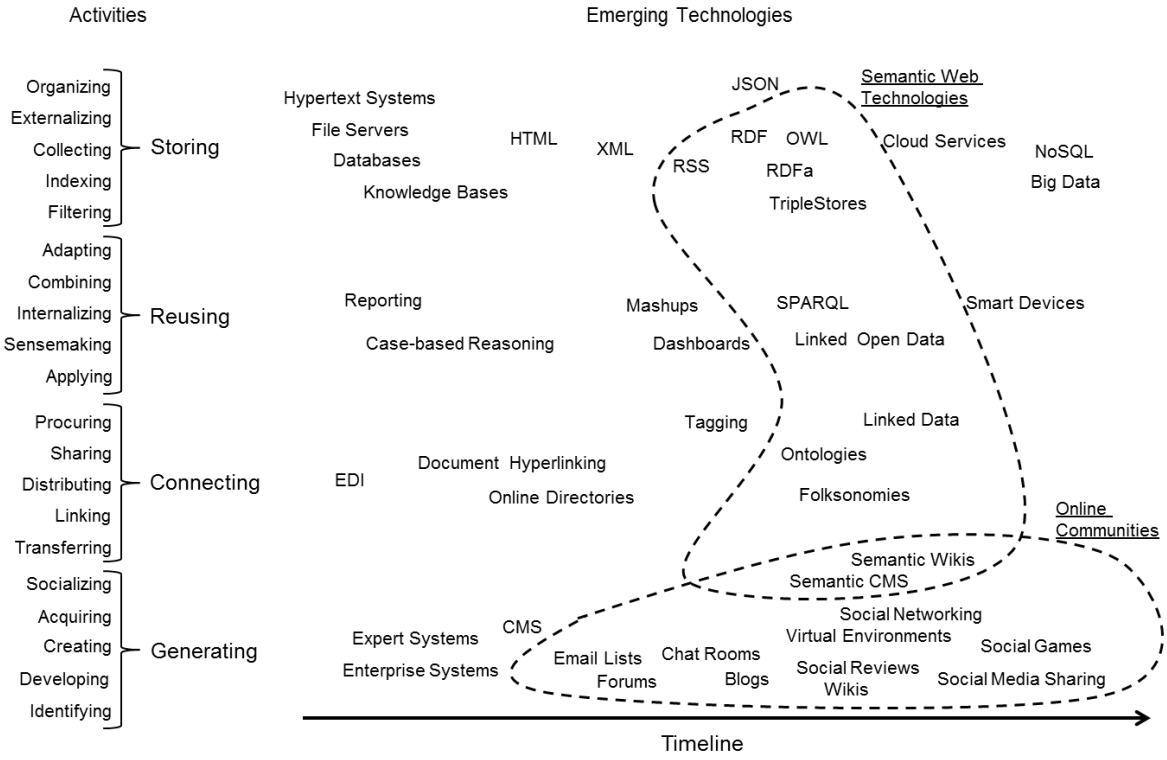

Figure 2. Knowledge and information management activities identified in the literature mapped to our framework with a selection of supporting technologies.

exchanged in organizations is product or service related. Knowing what actors are interacting about can clarify the scope of knowledge generation and consumption. The third element to consider is the interaction. For example a discussion around solving a product related problem, is different from developing new product ideas. While in the first case the interaction extends to reusing knowledge related to the product in focus, the latter might require seeking and combining new ideas that can be external to the organization. Another goal could be for example to disseminate and market organizational activities. In such cases organizations might involve external people and entities to reach out to a large audience. In these situations, the more the knowledge flows outside the organization to external parties, the greater the dissemination impact. Defined goals serve as a way to monitor the interaction progress. When fulfilled, interactions can be closed. In the other cases, goals can highlight the need for further actors to be brought to the interaction.

Internal knowledge sources. In order to fulfill the goal of interactions, the next step is to locate the required internal resources. While the involved actors can be the same, a different interaction goal naturally requires different prerequisites. Resources can be made out of knowledge repositories, people or groups of people. For example employees from the product development department might be invited to a weekly sales meeting to discuss the feasibility of modifying a product based on customers' requests. Product documentation (example of a knowledge repository) can be referenced to resolve a product related problem. With time, knowledge gets accumulated in different repositories and formats. This makes the process of identifying required knowledge more challenging and dependent on the knowledge holders. Hence an interoperable way of capturing internal knowledge is required, as discussed later in the paper.

External knowledge sources. In some cases, internal knowledge sources are not enough to accomplish the aims of an interaction; seeking external sources of knowledge might be required. For example, an organization would seek alliances with another organization with the aim to bring new knowledge and know-how that is expensive to rebuild from scratch. Reusing external knowledge and the possibility to connect to it can boost the value of organizational knowledge bases. External knowledge is also getting easier to locate and access with the increased sophistication of

Web and knowledge technologies. For instance Wikipedia (http://www.wikipedia.org) is a great example where an encyclopedia was built based on a collaborative effort. While this knowledge base is easily accessible and search-able from any connected device, it came to the attention that the contained knowledge can be made even further exploitable. This gave the birth to another platform, DBpedia, which made the connections across Wikipedia entities explicit and consumable (Auer et al., 2007). The ability to bring in external knowledge can contribute to the improvement and enrichment of interactions within an organization.

Knowledge manipulation around the framework elements: storing, reusing and connecting. Storing knowledge is also referred to in the literature as the externalization process, which Nonaka (1994) defines as the move from tacit to explicit knowledge. As knowledge is stored to mainly enable future reuse in probably different contexts that could involve different entities and organizations, firms should take special care of two aspects: the first is at the encoding means, and the second is related to the portability of semantics. The process of storing knowledge is highly dependent on the tools employed by the organization. Such tools direct the means of encoding the knowledge. Depending on the context, it should be made clear to the actors involved how knowledge is encoded. The encoding methods and semantics involved are used to align interactions between parties. Customers for example who would like to file a complaint should do so through a specific form on a firms' Website. This way, knowledge can be captured with the required fields, and information along with the semantics is channeled to the right person automatically. In this example, knowledge can be encoded in different ways. For instance the request can be translated into text and sent by email to the support department. This unstructured representation is beneficial for a short-term problem solving, but without further processing, it will provide limited future knowledge reuse. Another encoding way can be done in structured formats using databases or XML for an easier future reuse. However the limitation at this level is the rigid schema and tree-structure levels posed by such representation languages, making it hard to extend and change. Graph-based representations such as Resource Description Frameworks (RDF) have been introduced to overcome such problems. With today's Web technologies, organizations can benefit from tools that foster collaboration, and at the same time encode knowledge in the appropriate formats.

Reusing and connecting knowledge internally or externally that spans across an organization's boundary requires an effort from the parties involved. Traditionally organizations have worked on connecting their knowledge sources through custom made translators, to map and align various sources. However the maintenance of such alignments in an environment when knowledge sources are constantly on the rise is very expensive. The surge of knowledge in online communities is not making this task easier. The tools used by the actors to input and store the information can be decoupled from the semantics involved. In other words semantics can be added at the encoding level or at a later stage when transformation of existing knowledge can be performed. Take for example social media platforms, where people enjoy the experience of sharing personal information. While users have been putting more or less the same type of information on Facebook (http://www.facebook.com) for example, the way knowledge is represented semantically has increased in sophistication. One relevant outcome is Facebook's graph based representation of information, which enables better knowledge connections and more expressive search queries ("Facebook Introducing Graph Search," 2013). Another example in this line of advancements is Google's Knowledge Graph (http://www.google.com/insidesearch/features/search/knowledge.html), which delivers relevant results based on the semantics of entities searched. While the used knowledge is basically the same, the addition of a semantic layer has given it more value and better usability. The described semantics can only succeed when there is a mutual agreement on the vocabulary used by the involved actors. Vocabularies, also referred to as ontologies, act as glue when knowledge is exchanged beyond the boundaries of one organization. For example "Schema.org," the vocabulary generated by the current search engine leaders Google, Yahoo! and Bing, is increasingly used when publishing information online (Mika and Potter, 2012). When such a common vocabulary is used, an organization can benefit from making search engines "understand" for example their product information, making it easier to cross connect online knowledge across various systems. The increasingly important role that vocabularies and ontologies are playing in knowledge representation and exchange should be met by an equally important effort from the organization side. There is an ongoing effort to manage the available vocabularies in the Linked Data and open Linked Data (Schaible et al., 2013). Instead of creating new vocabularies, it is much more beneficial for an organization to identify existing relevant vocabularies to their context, and adopt them to model the knowledge for internal and external reuse and processing.

When generating knowledge, organizations should keep an eye on what is available externally, and connect to it whenever appropriate. Such connections should not be created randomly, but they should be done strategically in a way that brings value back to the organization's knowledge base. Consider for example a restaurant that publishes its menu on a Website. Compare the value of the menu when it is isolated on the restaurant's Website, to the value of the same menu when it is connected to the Facebook graph mentioned earlier. The Facebook graph would allow the possibility for people to interact with the menu through comments for example, creating more visibility and channels to the restaurant's products. This is similar to Google's PageRank algorithm (Page et al., 1999), where content alone is

not enough to place your Website at the top of relevant search results. Your relevancy is related to how your Website is linked to others, and how others link to you. The way connections are created can be different. We identify two major ways to achieve this purpose. The first is to keep the existing internal knowledge structures in the organization and only add connections to the external parties; the second is to choose to be part of the platform of the external host. Each option has advantages and disadvantages. The first method will give the organization more control over its knowledge, such as customer information that is very valuable to a firm, and usually not given away. However, complementing such information with activities on social media platforms will give an edge to the organization; firms can simply connect their customer information to their customers' relevant online social presence, and pull this knowledge back for the organization to use. However, the disadvantage here can be due to the amount of control and restriction that the external knowledge holder enforces. In the second option, where a firm chooses to be part of the external knowledge host, it might have a continuous access to the knowledge needed. However it might be giving away vital information to external organizations. Often a mix of these two options can provide a balance in terms of knowledge connections. The Linked Data and linked open data are playing an increasingly important role in knowledge connections at a web scale. One of the linked data principles is to create online unique reference identifiers (URIs) to online objects. Such URIs serve as an anchor referencing online resources. For example "The Godfather" movie is uniquely referenced as "http://dbpedia.org/resource/The_Godfather" in the DBpedia Linked Data source. If a DVD rental company connects its internal title records to DBpedia's, it will be able to fetch all the related movie's details that are present in DBpedia (e.g. cast, awards, etc), and reuse them in its internal systems. With all the advancements happening in online environments, organizations today have various options to connect their knowledge infrastructure to external components.

5. Applying the proposed approach in the context of an organization

Following our proposed approach and framework, we assess the feasibility of this methodology on a process that involves a service undergoing changes proposed and analyzed by various entities within an organization. In this section we first describe the use-case and scenario used. We then discuss the proposed methodology applied in this context.

5.1 Scenario description

Managing higher education services is a knowledge intensive exercise. Similar to other business contexts, globalization is putting more pressure on universities to align their deliverables to external requirements and demand. This fact, coupled with complex organizational settings, present for us an opportunity to apply our proposed methodology.

In this use-case, we analyze interactions around service changes and improvements in a higher education organization. The different organizational entities interact to improve and refine their service and degree offerings, where a good orchestration of internal and external knowledge is needed. The organization is governed by an administrative body, and formed of three departments. Each department is led by a chairperson whose role is to orchestrate decision and recommendations from the top committees down to faculty track members and vice versa. Similar to most higher education institutions, service components (i.e. courses) are often interconnected through prerequisite requirements and common concepts. Hence a change in one module can affect other modules and the delivery of the whole program. For a successful change to occur, an appropriate coordination of knowledge among the involved stakeholders in the service has to be in place.

We examine in this scenario the knowledge involved in the work of the committee (formed of 13 faculty members) in charge of the periodic program review process. The review committee task is challenging for various reasons. First, the fact that different components are delivered by different entities makes the task of coordination more challenging, especially when there is a high degree of overlap between the components delivered; second, information related to the service components are stored in various formats and repositories (e.g. textbook material, course syllabi, catalogues, teachers' notes, etc.), which will hamper the possibility of having an overview of the program based on a common knowledge platform; third, the knowledge available online relevant to the service is increasing at a fast pace, making it challenging for the organization to keep up with it. We apply our proposed methodology with the aim to create a knowledge platform that interconnects the internal knowledge, with a semantic layer that enables connections to external knowledge.

5.2. Methodology applied in the use-case

Interaction points. In this scenario, interactions mainly revolve around the review committee. At a high level, the interaction goal is to review the program according to three sub-goals: identify modules content overlap, sequencing of modules, and benchmarking against external program knowledge. Based on the internal organizational procedures, every inquiry, recommendation or decision taken by the committee will trigger a chain of sub-interactions at the track levels, and back to the committee through the track chairpersons. In other words the committee cannot properly achieve its goals without seeking knowledge from the right people in the organization. This will lead to the identification of the involved actors. Furthermore, the objects of interest are highlighted, and the actors are expected to bring knowledge related to the objects being investigated. In this context the objects are the relevant modules that are affected by the review process.

Internal knowledge sources. With the interaction points and goals highlighted, the next step is to check the sources of internal knowledge needed. Such sources are usually within the reach of the organization. In this context, most faculty members (or at least one faculty by module) will be needed to provide the relevant knowledge to fulfill the aforementioned goals. According to the first objective, knowledge is needed to identify how modules overlap in terms of concepts covered in the degree. For that, every department will need to call for the individuals involved in the module. This selection of individuals is key as they know where the knowledge resides in the organization. For example, in this case, faculty members have deep knowledge of the topics covered in their modules. They can also provide exact references to the internal sources and material needed. In addition to the knowledge provided at the module levels, broader knowledge is needed about the program. This can be provided by the program and curriculum designers. This knowledge is also needed to fulfill the sequencing of modules objective. While this knowledge is within reach, context alignment would be needed to bridge the different perspectives of the involved stakeholders.

External knowledge sources. In many cases internal organizational knowledge is not enough to fulfill the interaction goals. For example in the described context, benchmarking the service to external programs definitely requires the organization to go and seek knowledge from outsiders. This process can be eased if the internal stakeholders have good connections outside the boundaries of the firm, or even better, if external parties make such knowledge available in a consumable format online, enabling the creation of online communities around the subjects. In this context, the organization will be searching for topics that are emerging in the field, and the possibility to integrate such topics in the curriculum. Introducing a new topic to the curriculum can be challenging, mainly because of the lack of internal knowledge in the organization. Consider for example the case of offering a new course related to the emerging area of business analytics and big data. While the organization could have limited knowledge about the topic, a lot of material (e.g. business cases, interactive videos, etc.) and knowledge is available online. If such knowledge is connected to the organization's education program, the introduction of this new topic can be better justified when the value it brings to existing modules in the service is highlighted.

Knowledge manipulation: storing, reusing and connecting. Bringing the knowledge holders and sources together to align and share their bits of knowledge is a challenging task. Product information often resides in many repositories that follow different formats. For example universities tend to hold program information in the form of course catalogs, and often replicate it at the level of the departments' websites. While such catalogs are useful for high level descriptions, it is usually complemented with more granular information (e.g. courses' syllabi) to have more in-depth information for example about topical coverage and assessment procedures. We observe that the encoding of knowledge is done in isolation; each knowledge holder tends to share knowledge in disconnected platforms, often creating discrepancies, inconsistencies and less informed decisions. Based on the overview of the emerging technologies we presented in Figure 2, we put to the test a Semantic MediaWiki platform (Krotzsch et al., 2006) that lies at the intersection of tools that support online communities, while providing the goodness of semantic technologies for managing and processing knowledge. Through this platform we fulfilled the following requirements: (1) having a centralized platform that can be easily accessed from anywhere within and outside the organization; (2) embedding semantics at the data level to preserve the meaning when information is exchanged around different systems; and (3) provide an easy entry point for knowledge holders to create, update and curate relevant knowledge. Wikis are increasingly used to solve enterprise problems where collaboration is key (Ghidini et al., 2009; Hansch and Schnurr, 2009), and proved to be successful in moderating knowledge in online communities (Gunawardena et al., 2009). The platform we used in this use-case is accessible online[1], and includes predefined forms that we created to guide the user on how to enter information. Such forms will automatically generate semantics using predefined Semantic Web vocabularies to enable discussions (Berners-Lee et al., 2001). This enables reinforcing meanings and aligning bits of information coming from different sources. In this scenario, in order to better represent the service offerings, we enabled all parties to enter relevant information through forms that will cross connect information at the conceptual levels. Take for example when representing products, the corresponding components' information should appropriately connect for a holistic view of product information and features. In this context, each department was enabled to create

the various modules of the service through an online form[2]. Following the template, the knowledge holder will be able to encode knowledge with the appropriate structure. When new knowledge is created, the semantics will also be created accordingly using Semantic Web vocabularies. For example we use in this context the course related vocabulary (e.g. the CourseWare vocabulary (http://courseware.rkbexplorer.com)). For more generic product information, further vocabularies can be used such as the GoodRelations (Hepp, 2008) or schema.org (www.schema.org) ontologies. Such vocabularies make it possible to easily connect external sources to the organization's knowledge. For example, if an external university is using the same CourseWare vocabulary to represent its courses information, we can seamlessly reuse such knowledge back in this context, as external courses and their related entities are explicitly defined. This fulfills the third goal of the interaction to benchmark the university program to external programs. One particularly useful feature provided by the use of semantics, which was not possible to do using the existing systems, is the conceptual linking of entity related knowledge. Users will be automatically notified when existing concepts are available for reuse. This feature of internal reuse of knowledge enables the creation of an interlinked body of knowledge at the conceptual level. To illustrate an example of how such connections can be exploited, Figure 3 displays the linked concepts around a module. The added value of this view built on top of the knowledge graph is the ability to identify connections that spread across the service in a unified representation. Hence the impact of a decision to modify the coverage in one service component in the review process can be easier to detect. The program's core components have been represented by 2,684 interlinked concepts[3]. With the new knowledge structure in place, the organization can extend this knowledge graph in any direction. This extension is not only performed to internal knowledge components, but links can be created to external conceptual entities that bring value to the knowledge base. With the increase of the adoption of Linked Data in publishing information, we can expect to have more granular connections for example at the topic and concept levels. This will enable the committee to have a more detailed view of how the service can be enriched. It is worth to note that from this platform all the Linked Data can be extracted to be reused to develop more interactive and informative applications. This will play a major role in managing customers' expectations (i.e. students in this case), and decision making at the administrative level.

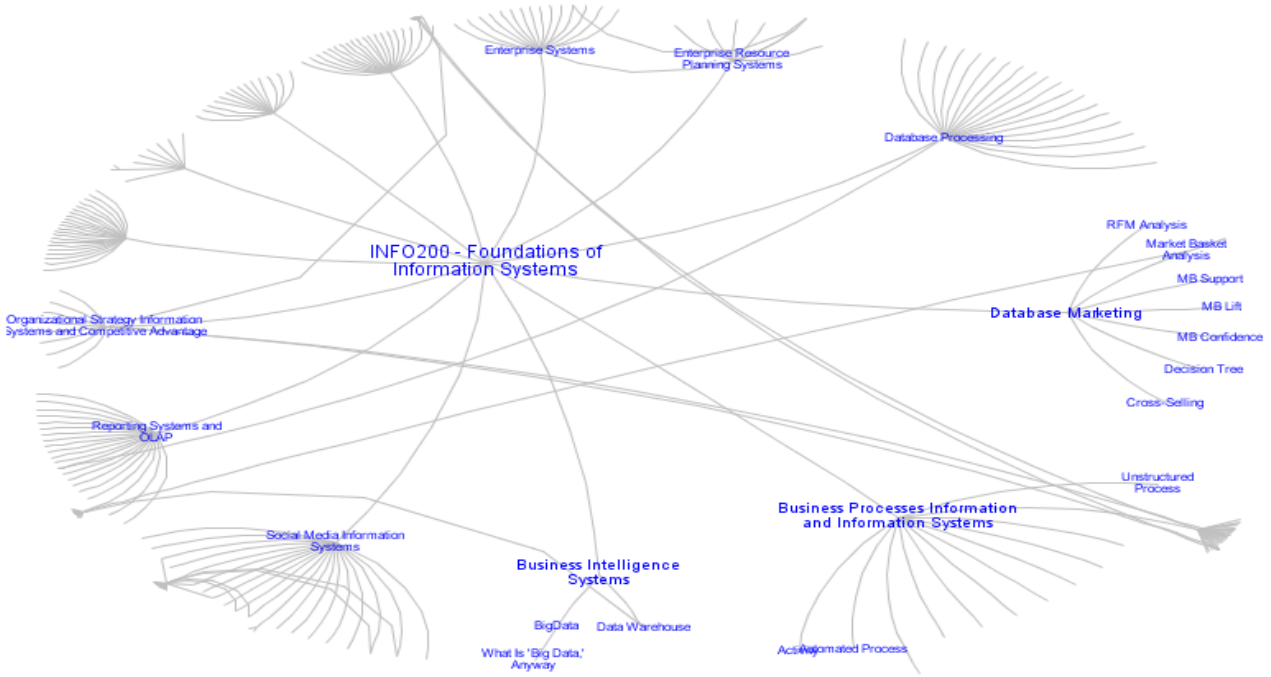

Figure 3. Conceptual dynamic visualization of the encoded knowledge around a module.

6. Future Research Directions

Online communities are providing new insights on how organizations succeed or fail in fulfilling certain objectives. With the increased sophistication of online tools, techniques for data capturing and representation are also evolving. We see potential research opportunities that can be pursued in various directions. We focus in this section on four trends that we believe are relevant to the field.

Business and data analytics. While today we are witnessing an increased interest in large scale data analysis coined as "Big Data", we see that Linked Data can turn even small data into big data insights. It is worth measuring how such small data, when semantically manipulated and visualized, can impact organizations in performing better analysis. One particular focus can be on artifacts that naturally contain deep links that require extensive cognitive efforts to elicit. This is highly relevant to the analysis of services that tend to be entangled through various levels of abstractions.

Artifacts and organizational (unusual) routines. A second potential research direction is to assess the impact of the creation of the body of knowledge on organizational routines. Organizational routines, which are the result of operational and behavioral patterns in a firm, can sometimes become unusual due to irregularities for example in the pattern frequency or communication (Rice and Cooper, 2010). This research path can investigate how a body of contextual knowledge can help in taming unusual routines. This can be done for example through tracing back the root causes of irregularities, and aim to realign the various entities involved in the routine by anchoring discussions in the linked body of knowledge.

Data portability in distributed information systems. A third path worth investigating is the role of Linked Data as a data mediator in distributed information systems. The benefits and value that Linked Data can provide to existing systems are not easy to highlight. Further research can help shed the light on why such semantics add value to the existing systems in a firm. This role can be evaluated from various perspectives. For example from an end-user's perspective, usability and level of acceptance can be measured when existing systems are enriched with relevant data. This can also be assessed from the decision maker's perspective through for examples the new views that are enabled by such a linked layer of knowledge.

Visualization and concept mapping vis-à-vis frames and boundary objects. We have reported a case of curriculum re-design. Curriculum re-design in academia is probably akin to strategy change in firms. Therefore, it may be worthwhile to explore the implications of our findings with additional data collection as follows. First, it may be useful to investigate the influence of visualization and concept mapping on how issues are framed and the outcomes of the framing process. Second, the underlying data can also be analyzed via a boundary object lens to better understand how groups sense make and negotiate around abstract but fundamental concepts such as a degree program curriculum and how these are represented/changed via boundary objects such as syllabi.

7. Conclusion

Knowledge is constantly created within the context of any organization's operations. Online communities are shifting a substantial part of organizational knowledge outside the internal channels of knowledge exchange. With time, the boundaries of internal and external organizational knowledge are disappearing. Hence organizations are more and more required to publish their knowledge in ways that can be connected to external environments. However the challenges involved add further considerations to the process of knowledge creation. We identified the need to handle knowledge elicitation, encoding, sharing and semantic consistency, to better exploit the knowledge from within and outside the organization.

We presented in this paper an approach that supports knowledge generation in organizations, with a methodology to connect published knowledge to online communities. The methodology is based on a proposed framework that reflects the flow of organizational knowledge. We mapped the flow activities to the existing knowledge management activities, coupled with their supporting emerging technologies that are increasing in sophistication. The methodology starts by identifying interaction points (e.g. meetings), where naturally most of the knowledge gets created. This is followed by defining the involved actors (e.g. employees) and related objects of discussion (e.g. products), coupled with a well-defined interaction goal. Subsequently, the related internal and external knowledge sources required to fulfill the interaction goal can be easily highlighted. The next step is to encode the identified knowledge in a format that supports knowledge transfer. We highlighted that the encoding process can be decoupled from the content. It is mainly related to modeling knowledge in formats that can enhance the usability by the organization's internal and external entities. The final step in the methodology is to connect the encoded knowledge to external sources. This step can be enhanced by embedding explicit semantics in content that adheres to the standards of the Semantic Web movement. The presence of semantics will ensure a seamless connection among internal and external knowledge sources. We also provided in this paper a use-case within the context of a higher education organization, following our proposed methodology. Part of this scenario included the adoption of a collaborative semantic wiki platform that enables knowledge holders to encode and share knowledge around their products, where semantics are automatically created and defined. The presence of this platform ultimately contributes to the availability of a shared space that connects internal knowledge elements (e.g. product related) of the organization to external sources (e.g. online material that can enrich product information).

This work has an impact at various levels in an organization. Decision making of the administrative body of a firm can now be based on more informed grounds; instead of dealing with isolated content silos that often include hidden connections, decision makers can now process a connected graph of knowledge that extends to external knowledge sources. Additionally, organizations can better represent product information and thus be able to better manage consumer expectations. Furthermore, publishing key knowledge for external consumption will increase interaction points with the consumers, and bring indirect returns to the organization in this online interconnected era. Another potential impact is on the collaboration aspect among organizations. Publishing knowledge in a format that any external firm can understand cannot be but beneficial for a profitable collaboration; this will help overcoming the traditional problems of data silos and semantic discrepancies.

Notes

[1] http://linked.aub.edu.lb/collab
[2] http://linked.aub.edu.lb/collab/index.php/Special:FormEdit/Course/New_Course_Title
[3] http://linked.aub.edu.lb/collab/index.php/Category:Learning_concepts

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