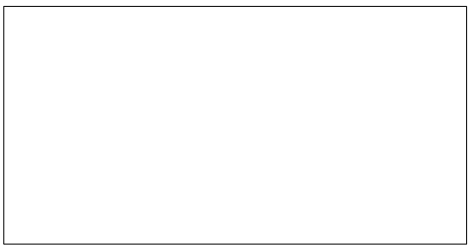

Toward a Knowledge Sharing-Aimed Virtual Enterprise

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Abstract. One of the requirements for a successful collaboration in Collaborative Networked Organizations (CNOs) is the sharing of knowledge resources between members. Knowledge sharing is a core competency for creating competitive advantage in Virtual Enterprises (VEs). Accordingly, the evaluation of the contribution of each VE member organization in sharing knowledge resources, as well as monitoring the distribution of these resources among the people is of great importance. For this purpose, a conceptual framework of a VE with the aim of knowledge sharing (henceforth, a knowledge sharing-aimed VE) is presented in this paper. In this framework, the conceptual structure of a cognitive system is designed to supervise the process of knowledge sharing among organizational staff in each VE organization, and thus to support decision-making by knowledge managers. The system collects log data of various organizational Knowledge Management Systems (KMSs) and then processes it using machine learning algorithms to identify the learning patterns and knowledge application in the organization to ensure employees access to distributed knowledge resources. In addition, by considering each organization member of VE as an individual user of an inter-organizational KMS, the same mechanism can be used at the cross-organizational level. Finally, it should be acknowledged that the implementation of this conceptual framework could play an essential role in improving the knowledge sharing and management process, which is the cornerstone of the organizations co-operation in a VE.

Keywords: Collaborative Networked Organization, Virtual Enterprise, Knowledge Sharing, Cognitive System, Log Data Mining

1 Introduction

Omnipresent knowledge management tools and technologies which enable online and offline communications between members propose more effective learning environments than traditional ones. Today's business complexity urges firms to sustain and manage their knowledge resources through inter-organizational collaboration [9]. Li et al. [20] enumerate enhancing knowledge use rate, reducing knowledge duplication, and managing risk as the benefits of a virtual knowledge alliance but when it comes to a knowledge sharing context (especially a virtual one), an important question arises:

How to evaluate each member's contribution (sharing behavior) in the whole network?

Individuals are not interested in sharing their know-how knowledge and expertise spontaneously [13]. Controlling knowledge sharing behavior is a complex challenge for knowledge managers and lots of knowledge sharing platforms face failure due to this issue [28]. At a higher level, the context in which various organizations form a knowledge-sharing platform are interacting, evaluation of each organizations knowledge sharing contribution and behavior becomes a critical inter-organizational concern. On the other hand, within organizations, understating learning experience and behavior is an essential issue for knowledge managers [29].

Narendra et al. [25] address the rise of conflict and the need for conflict management among firms in a VE. This kind of concern is also authentic fact in a knowledge sharing-aimed VE because the contribution of each partner in sharing valuable knowledge is vague. Therefore, applying a framework to evaluate each firm's contribution to sharing valuable knowledge is an essential.

So, in this research, we are looking for an answer to this important question: How can we improve the knowledge sharing process in a VE? So that ultimately, each collaborative network member has an effective partnership in this process and also knowledge sources within each of these organizations will be appropriately distributed.

Designing and proposing a conceptual framework of a cognitive system as a platform to collect and process different KMSs log data in a VE, in the first place, helps us identify learning behaviors within organizations and then monitor each firm's role in sharing valuable knowledge in the whole collaboration network, accordingly paving the way to move toward a knowledge sharing-aimed VE.

2 Literature Review

In today business environment, which is extremely inter-connected, businesses can ally together to form a VE to complement their competencies and/or share their resources collaboratively around the globe by the means of computer networks to seize new opportunities (or react to upcoming threats) in order to remain competitive [5, 14-17]. VEs are considered as the next organizational paradigm [30], and firms prefer to focus on their own core competencies more deeply and be a qualified node of value chain rather than focusing on other steps of a value chain out of their own capabilities [4]. A VE is a sociotechnical system in which geographically dispersed enterprises unite in a business alliance and with a specific aim to collaborate and share their resources in order to confiscate emerging opportunities and compete in the new complex business context [2, 5, 14, 16]. Virtual business alliances form typically with the aim of sharing and complementing either products/services or knowledge [20].

As businesses are becoming more knowledge-intensive, knowledge is considered as an important strategic resource. Therefore, sharing and creating knowledge in a VE is a desired outcome of collaborations [31], and contributes to a VE competence [21]. In an inter-organizational collaboration on knowledge sharing, different participants have access to external knowledge shared in the collaborative network and thus strengthening their knowledge as a strategic resource of the world today [1, 23].

As discussed before, firms are reluctant to share their knowledge in a networked collaboration and evaluation of each firm's efforts in sharing knowledge is an essential. Evaluating firms' knowledge sharing behavior merely by human cognition seems irrational. Cognitive systems are a kind of intellectual systems which can make or support complex decision makings with the help of data analytic techniques like machine learning techniques (known as artificial cognitive systems) [32] to improve human cognition and decision-making effectiveness [18].

This paper considers log data generated by various systems in a VE as an apt source to help humans get insights about each firm's contribution. Systems logs trace and collect all activities within a software system and are in the form of log files, databases or streams of data [24]. Their applications are optimizing and debugging system performance, detecting misdeeds and system intrusions, prediction and the most important to our study: Profiling user behaviors and reporting business analytics [26]. Applying data mining techniques on log data is called log data mining (or log mining) and it outperforms conventional log data analysis methods and even finds hidden ("below the radar") patterns [7].

There are various parts of KMSs contributing to constructing a knowledge sharing collaboration. In addition to Communities of Practice (COP) which are informal communities, Content Management Systems (CMSs), Learning Management Systems (LMSs), and Document Management Systems (DMSs) are among different modules of KMSs available to form an infrastructure for a knowledge sharing-aimed VE. A LMS is an e-learning system, which can support project-based instructions and collaborative learning [27]. Laudon & Laudon [19] define LMS as a consolidation of management, delivery, tracking, and learning effectiveness measurement of employee learning and training. While CMSs make more general structured and semi-structured knowledge available inside the enterprise, COP are cross-organizational informal communities for professionals to share specific best practices [19].

These systems log data are a precious and appropriate source [8, 22]. For instance, LMS log data can be used for analyzing learner performance, satisfaction [12], and engagement because it is on activity level, and scalable [11]. Park & Jo [27] conducted an analysis on LMSs log files and used activity theory [10, 33] as a framework to describe the results and drew some conclusions for improving learning with LMSs in the virtual education context. This claim is also supported in the virtual education context, utilizing data mining techniques on log data generated by Technology-Enhanced Learning (TEL) systems are far more effective [6] than using surveys and interviews for learning context and process analysis [3]. Empirical research related to the aim of this study is limited to the discussed researches to the best knowledge of authors.

The reviewed literature indicates that although the formation of a VE with the aim of sharing knowledge has attracted researchers' attention, no effort has done to effectively evaluate how each participant behaves in sharing knowledge. In addition, earlier studies have focused on analyzing the log data of LMSs, while all parts of KMSs (LMS, DMS, and CMS) produce their own specific log data and analyzing their log data can be as beneficial. Therefore, the contribution of this research is, first, to suggest utilizing and analyzing all relevant systems to knowledge management as an infrastructure for forming a knowledge-aimed VE and secondly, providing a preventative approach for conflict management in assessing the contribution of each partner in

sharing knowledge. According to the authors, filling these two gaps can accelerate moving toward a knowledge sharing-aimed VE, which is the ultimate goal of this research.

3 Knowledge Sharing-Aimed Virtual Enterprise

In this section of the research, the conceptual framework of a knowledge sharing-aimed VE is proposed. This framework is shown in Fig. 4. As represented in this figure, geographically dispersed organizations collaborate with each other in the form of a VE to share knowledge through an inter-organizational information system to achieve a common goal. Within each of these organizations, there are also different information systems related to knowledge management that provide and share knowledge flow from outside the organization among employees. In other words, at the level of the collaborative network (Fig. 1), the knowledge resources of the partners are provided to each organization through an inter-organizational information system and then at the organizational level (Fig. 2), these resources are provided through organizational information systems to knowledge workers so that they can use it in the context of organizational operations.

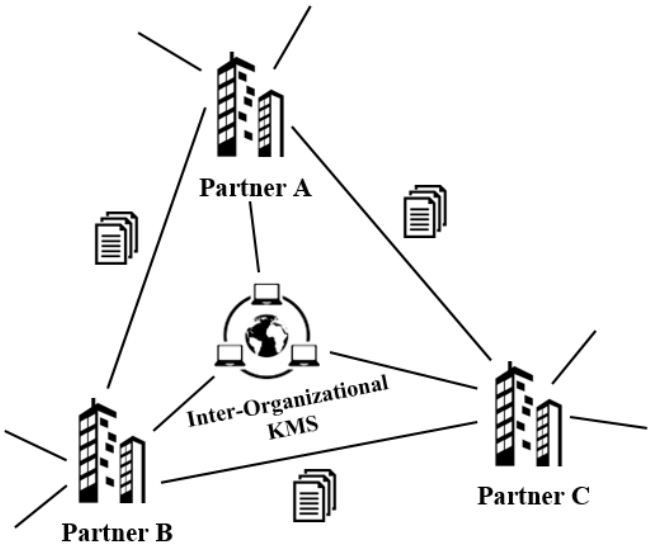

Fig. 1. Knowledge sharing in a collaborative network of business partners

The interaction of the organizations users with different parts of organizational KMSs, such as CMS, DMS, LMS, etc., produces many log files that their data analysis yields valuable results for tracking and obtaining the organizational desired knowledge goals. Log files related to KMSs consist of valuable information on how users are using the distributed knowledge. This information provides details about which knowledge worker has done which activity at what time, these activities in-

clude searching, viewing, labeling, recording, storing, retrieving, browsing, distributing, publishing, and even producing content in different formats. Therefore, the analysis of these files leads to the identification of learning patterns and the use of knowledge by individuals, which can ensure the proper sharing of knowledge among employees and their access to distributed knowledge resources.

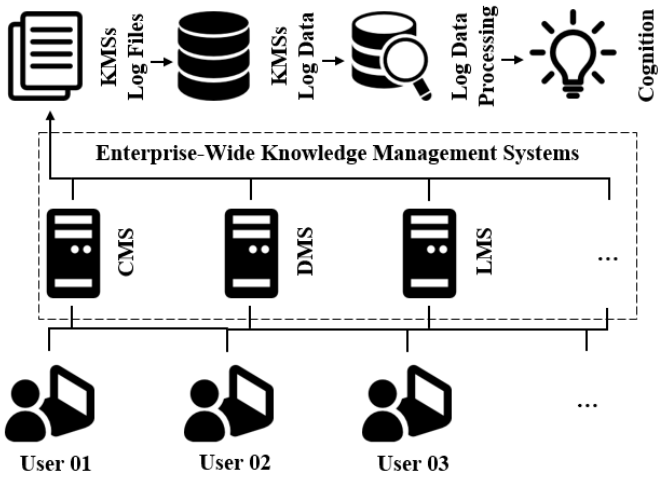

Fig. 2. The conceptual structure of a cognitive system that recognizes knowledge sharing behaviors

In this regard, in order to monitor the knowledge management and sharing process in each organization member of the VE, a cognitive system can be used so that its outputs help the organization's knowledge managers to make their decisions. As it can be seen in Fig. 3, this system connects to log files repository related to KMSs to intelligently fetch and store various items from these files. Then, in the preprocessing and cleanup stage, these raw and initial data are converted into aggregated and appropriate format for analyzing data. In the next stage, the system will use different data mining techniques to explore the log data provided so that rules and patterns can be extracted that will lead to profound knowledge and insight into the way knowledge workers work. Also, these systems will be able, over time and after interacting with data and individuals, to learn the desired knowledge patterns during the data mining process using the methods of machine learning and to offer practical suggestions. Definitely, machine learning techniques to be used depend on the aims of log files analysis which knowledge managers follow. For instance, machine learning algorithms which are used for anomaly detection (to detect abnormal behaviors) or clustering (to cluster users based on desirable and undesirable behaviors) can be applied to log files. With this regard, an example is provided in the following.

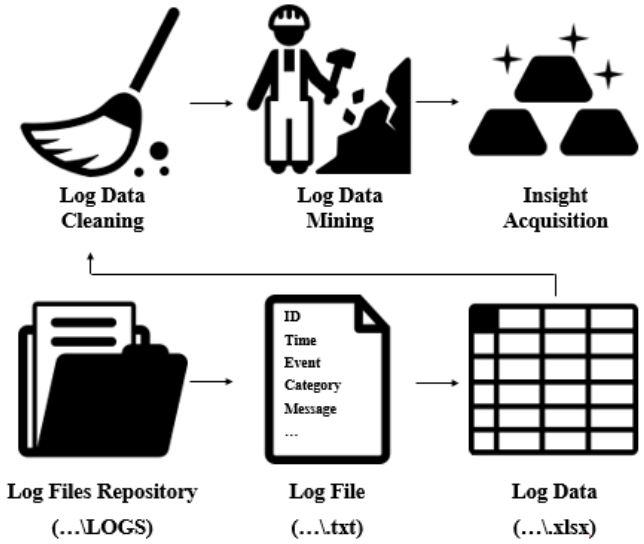

Fig. 3. Log files analysis

For example, a cognitive system, after analyzing log data, finds that a group of people in an organization still do not see new documentation published about a particular part of the project or that they have not spent enough time watching the uploaded video. To this end, the system can alert the organization's knowledge managers to follow up the issue. After an investigation, knowledge managers find that the content is not available for one of the organization's units or that it has not been created in the process of sharing. Sometimes, during the process of collaborating between organizations, new information is provided to the top managers of each organization and managers are required to convey this information to their employees so that they will be informed of the new directions of the project. Otherwise, employees of the organization, based on previous information, will perform their duties, which are not consistent with emerging plans. In such circumstances, the organization's knowledge managers provide new information to their subordinates so that they share content with other people. However, this information seems to be not available to the knowledge workers and while knowledge managers imagine that information was distributed in the organization, on the other hand, knowledge workers are completely unaware of the existence of such information. As a result, due to the heterogeneous distribution of information at the organization level, there are different orientations that ultimately don't lead to a common goal. In this situation, the importance of using the affronted cognitive system becomes increasingly essential.

Whether the entered knowledge into the organization at what time and through which channel is available to each user and how each user used or changed the knowledge is among the achievements of these cognitive systems. Now if the same mechanism is applied on the inter-organizational KMS, each organization in the VE is considered as a user of this system, as a result, it is possible to evaluate each partner in the process of sharing knowledge and measuring the extent of its participation in

this collaboration. Consequently, it becomes clear that how log data analysis in the context of a cognitive system, leads to insights for learning patterns inside the organization and also, knowledge sharing behaviors between organizations, hence, the process of managing and sharing knowledge, which is the foundation of the organizations collaboration in a VE can be improved.

4 Conclusion

Sharing knowledge resources is a key stand of collaboration in VEs in the knowledge era. Therefore, any research that contributes to improving the knowledge sharing process in such a VE will be of great importance. In this research, a conceptual framework of a VE with the aim of knowledge sharing is presented, which its implementation has two aspects of importance: Firstly, monitoring the knowledge distribution process within each of the member organizations of the network is possible. Secondly, it evaluates the participation and contribution of each VE member in the creating and sharing of knowledge resources.

The main limitation of the researchers in this study is the lack of access to the data needed to implement and test the conceptual framework provided. For future research and in order to validate this framework, researchers might collect log data from organization's KMSs. Afterward, using data mining techniques and analyzing log data would adapt and compare the results to the goals represented in this paper. In the case of matching findings with expectations, researchers can use the machine learning algorithms to implement and develop the cognitive system described in the suggested conceptual framework. Also, in the case of having access to an inter-organizational network and possessing sufficient facilities, they can implement this mechanism in one of the member organizations of the network. In addition, this step should be further extended and by using the log data analysis of the inter-organizational KMSs, conditions described in this study should be tested and evaluated by simulation.

Eventually, future research can report the results of the implementation of this framework, so that it gets out of just being a concept and proceeds into action. Also interested in this field of study can identify and report on new applications for the framework through a more detailed review of the contents of the log files of KMSs. In addition, researchers in a more comprehensive view can map out and implement this framework beyond the knowledge management domain for other types of information systems, such as Business Process Management Systems (BPMSs), in which business processes at the level of inter-organizational collaboration (VE business processes) could also be amended.

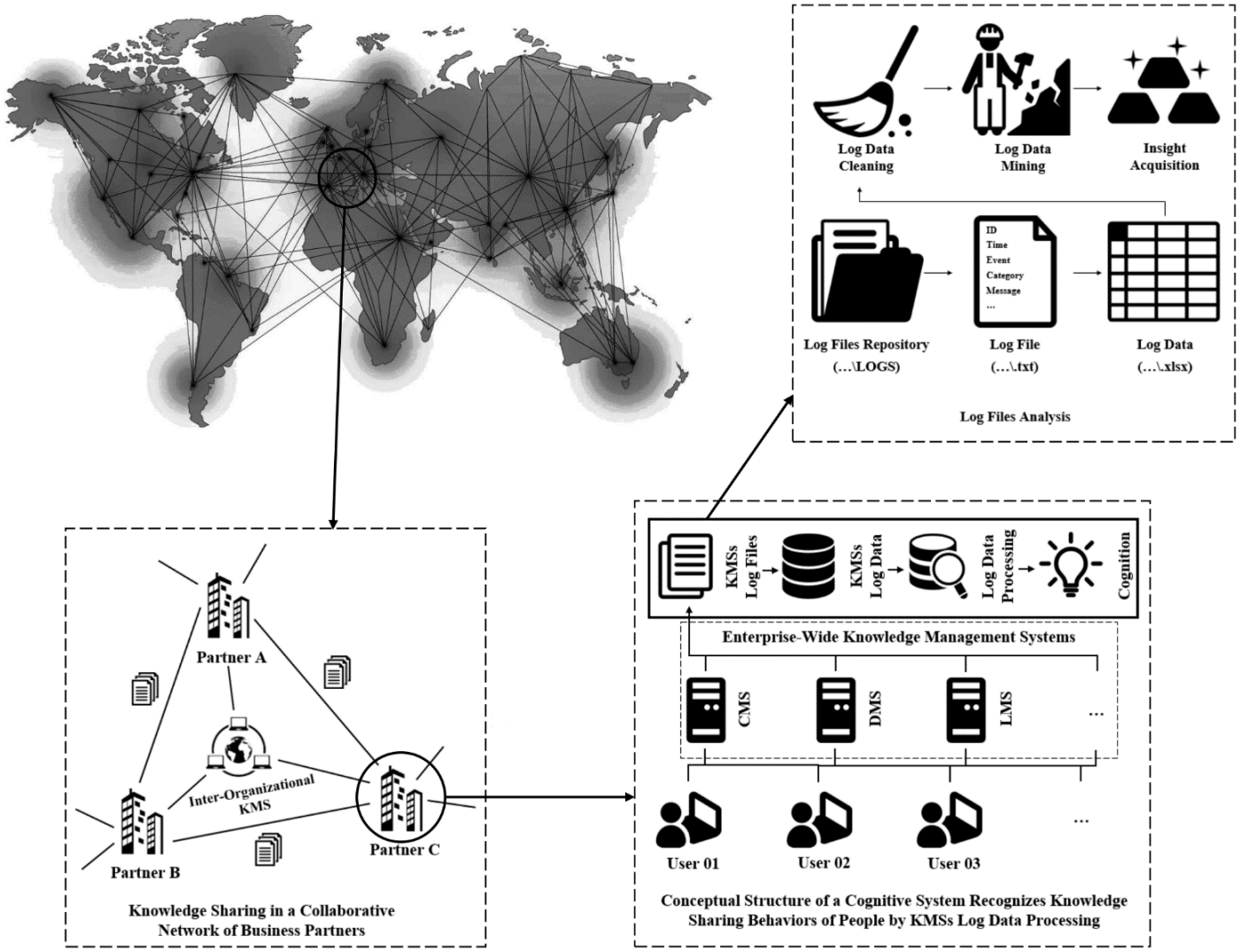

Fig. 4. The conceptual framework of a knowledge sharing-aimed virtual enterprise

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