A Meta-Study on E-Collaboration

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ABSTRACT

Collaborative activities across organizations are common when conducting business online. There have been numerous research results on different aspects of inter-organization collaborations through electronic means or in an electronic environment. However, the term 'collaboration' in Information Systems research literature often has different meanings. Also, a wide spectrum of technologies has been labeled as collaborative technology. In order to make the knowledge of the new research field cohesive and accumulative, the paradigm of electronic collaboration (e-Collaboration) has yet to be established. Thus this paper aims to provide a framework for e-Collaboration from the perspective different levels of involvements of inter-organization interactions. The framework differentiates the types of the 'collaboration' in a cohesive manner, and underlines the core characteristics of e-Collaboration - joint intellectual efforts. Moreover, a content analysis on the existing related literatures is conducted, using the framework proposed. Future research directions in the field are also discussed.

Keywords: e-collaboration, cooperation, meta-study.

INTRODUCTION

Collaborative activities are common when conducting business online. E-Business in the integrative era brings together different parties in an electronic environment, manifested in the Internet, to work closely with each other to drive towards values that are beneficial to these parties in ways that are crucial to each party. How 'close' they need to work with others is often determined by the collaborating parties and business processes that are involved.

In the past e-commerce era, industries mainly focused on conducting business transactions through electronic means, particularly on the Internet. However, to facilitate and enable buying and selling products/services is only the first step to benefit from the Internet. The value created for merely fixing an exchange agreement is limited; therefore e-commerce quickly reaches its limitation. To fulfill such an exchange agreement requires coordination and cooperation between the buyer and the seller. It often requires services such as financial and logistics arrangements provided by third party service providers. The real benefit of conducting business on the Internet would come from the ability of conducting and aligning business processes, sharing resources, or even intellectual exchange among these parties. We call these activities on the Internet, e-business.

These different types of interactions (often referred to as collaborations) among buyers, sellers, and third party service providers are one of the major themes in e-business study [Scott & Kaindl 2000, Johnson & Whang 2002, Thuraisingham et al. 2002]. Many researchers use two terms, collaborative commerce and collaborative business interchangeably [Li & Du 2004] to describe these interactions, while in fact the term commerce often refers to buy-and-sell activities only and collaborative business emphasizes the more extensive inter-organization interactions in e-business.

Nowadays, there are a number of empirical studies, theories and models building, and technology and application development works in Information Systems research, concerning the inter-organization collaboration in electronic environments. The use of the term 'collaboration' varies widely and in some cases the meanings are not the same even within the same context. For example, collaboration in 'so and so' is enabled by electronic communications (such as emails) and the effects can be felt throughout within the organization. Such kind of collaboration could not alone facilitate 'inter-organization workflow integration or collaborative product design' as the interactions among designers in different geographical locations call for more than just electronic communications, but more of interactivity that can be achieved among the designers in an any-to-any fashion. How should we distinguish these two 'types' of collaborations and if these types are some commonality and/or differences?

These views suffer from the same underlying need where interactions are required independent of the closeness, or integration that collaboration calls for. This inconsistent and interchangeable use of the term hinders the clear research directions to enable collaborations in e-Business. We can so far as to say that collaboration is about interactions between two or more organizations, if the interactions are the same in an electronic environment, or in the Internet.

Also, a sensible question to ask is that with the existing Internet technology, whether or not two organizations can collaborate electronically. The answer is "yes" if collaboration merely means sharing information among organizations. To many researchers who are working on inter-organization workflow integration or collaborative product design, their answer is "no." Our next question would be what collaboration is. If we can facilitate workflow integration and/or collaborative product design, does it means we can facilitate collaboration? Last but not the least, we would like to know what have been achieved and

subsequently what still needs to be done for inter-organization collaboration.

To answer these questions, we need to have a clear understanding of electronic collaboration (e-collaboration). It is important for the research community to reach a consensus on the understanding for the field to continue develop. An unambiguous paradigm can serve such propose therefore is crucial for the development of a scientific field [1]. In this paper, we are proposing a paradigm for e-collaboration.

DIVERSED VIEWS

Collaboration has been broadly investigated in various fields, such as corporate governance [2], organization behavior [3], and marketing research [4]. Collaboration could develop as driven from technology advances, from inter-organization research, and/or from the push of e-Business.

As the advancement of information technologies, organizations become easier to interact with others electronically. The online inter-organization activities ranges from simple data or document transmissions, information sharing to complicated virtual teamwork, knowledge sharing, or distributed joint decision making. Using collaborative technologies to enable inter-organization collaboration has been extensively promoted by many researchers. It is believed to bring significant benefits in R&D [5], Business Process Reengineering (BPR) [6], supply chain [7], logistics management [8], and so forth. However, the 'collaboration' in these Information Systems research often means differently. Here are some examples:

•Collaborative learning. Computer-mediated collaborative learning among individuals emerged in the early 1990's [9]. It typically utilized such technologies as email, discussion board, file transfer, and chart room to enable participants learn as a group without physically meeting each other [10]. The use of the technologies makes the learning process cooperative and group-oriented, resulting in enhanced student learning and evaluation of classroom experiences.

•Collaborative filtering. Goldberg et al. [11] proposed an experimental mail system, one of the early collaborative filtering applications, which allowed the people to help others by recording their comments to the documents they read. Terveen et al. [12] developed another experimental system that automatically recognizes and reuses recommendations from Usenet news messages. As more collaborative filtering systems emerge, the performance evaluation of the systems becomes important. Herlocker et al. [13] empirically examined a number of key factors that were used to evaluate the collaborative filtering recommender systems. It is to note that these systems/tools feature the participants' voluntary of providing their data or comments without constraints or expectation of direct rewards. Here, cooperation and group-oriented are no long what the 'collaboration' stands for.

•Collaborative business process. Going beyond the business document exchange between business partners, many inter-organization interactions, which are often labeled as collaborative process, have been investigated. Raghunathan and Yeh [14] proposed an approach to determine the optimal number of retailers that a manufacturer should partner with in such a collaborative process as the continuous replenishment. Furthermore, Welty and Becerra-Fernandez [15] argue that computer-based interaction technologies (e.g. ActionsWork Metro, labeled as a business collaboration software, which records and manages the human interactions in a business process) can enhance the trust among supply chain partners. The 'collaboration' in these studies implicitly means coordinating the activities of multiple business partners with their individual business interests.

•Collaborative engineering or collaborative design. As production and operations becomes more specialized, there is an increasing need for organizations to form a team for joint design. Collaborative engineering allows individuals or organizations to compose a team of experts and work on a same project concurrently [16]. Computer-supported collaborative design was prompted to incorporate many interdependent design issues in the design process [17]. Typically, these systems/tools provide facilitations to the intellectual exchange among the participants involved in collaborative engineering or design. Moreover, collaborative design accentuates to reach a communal acceptable solution or design.

The aforementioned 'collaboration's are endowed with diverse implicit connotations by different researchers. The 'collaboration' in collaborative filtering mainly involves to information posting by one people for other unknown people, and does not require to actively form a group (feature of collaborative learning, engineering or design) to achieve a common goal. The 'collaboration' in collaborative learning primarily refers to working together via information sharing facilitators, while the prefix 'collaborative' in collaborative design specially highlights the high-level intellectual interactions for joint design.
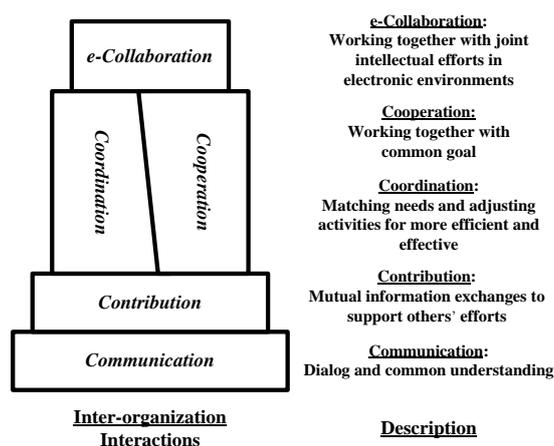
These diverse views on what the 'collaboration' should be and should do raise difficulties in idea communication, theory development and knowledge accumulation within the research community of e-collaboration. Looking on the bright side, the various interpretations provide considerable insights to conceptualize inter-organization electronic collaboration. In these studies, the involvement of multiple parties is frequently mentioned, group-oriented or working together are often required, and shared vision or a common goal are not rarely highlighted.

E-COLLABORATION FRAMEWORK

Taylor-Powell et al. [18] proposed a conceptual interpretation of collaboration and other related terms (e.g. coalition and cooperation) for evaluating the works of collaboratives (i.e. a group working together to achieve a shared vision) within educational programs. The research also identified five types of relationships among parties (i.e. communication, contribution, coordination, cooperation, and collaboration) and proposed some guidelines for evaluating the collaborative process of the educational programs.

Using the set of terms, we propose a framework for inter-organization e-collaboration (Figure 1). Some important features of the inter-organization interactions are specified.

In our framework, communication is fundamental, supporting dialog and common understanding, while contribution benefits multiple parties by mutual support based on communication. Coordination further integrates parties by matching their individual needs and adjusting activities. To achieve common goals, cooperation or working together is typically necessary. Furthermore, collaboration comes when exchange of intellectual thinking or share of knowledge is required.

e-Collaboration:
Working together with joint intellectual efforts in electronic environments

Cooperation:
Working together with common goal

Coordination:
Matching needs and adjusting activities for more efficient and effective

Contribution:
Mutual information exchanges to support others' efforts

Communication:
Dialog and common understanding

Inter-organization Interactions   **Description**

Figure 1 Types of Inter-Organization Interactions

Here e-collaboration refers to the process of working together with joint intellectual efforts in an electronic environment. Information technologies are used to facilitate the parties to work together and to contribute with joint intellectual efforts. E-Collaboration can facilitate the offering of existing or newly created common products or services with reallocation of controlled resources among multiple parties.

With respect to each type of the interactions, different information technologies and tools are often required. For example, if two organizations are going to communicate electronically, UDDI (Universal Description, Discovery & Identification) may be used to discover and identify each other in an electronic environment, and such technologies as XML, DTD, and namespace can help establish common understanding between the two parties. As two-party communication is established, SOAP may be used by an organization to contribute other organizations by offering information with direct rewards. With these bases, organizations may leverage such process management techniques as workflow description technologies to coordinate their business interactions, or use such group support systems as CFPR (Collaborative Planning, Forecasting, and Replenishment) to cooperate with other parties and achieve common goal as a group. Furthermore, organizations can collaboratively make decisions or design new products with advanced information technologies that allow them exchange intellectual thinking, and share knowledge.

META-STUDY

In order to create a cohesive view out of the existing 'collaboration' works, a content analysis of the related literatures is conducted using the framework proposed.

Selection of Studies
We develop the following criteria to identify the related literatures that are to be included in this content analysis.

Table 1 Research Methodologies Used in the Research on Electronic Collaboration (1999-2012)

Methodology	Empirical study (Survey)	Case study or field study	Experimental study	Technology development or system design	Modeling	Meta-analysis
MISQ	5	5	1	1	1	3
JMIS	16	5	1	5	5	0
ISR	11	1	3	0	0	2
I&M	19	8	6	1	2	1
EJIS	6	11	2	2	1	0
DSS	5	4	2	15	4	1
CACM	1	9	0	11	2	3
Sum	**63**	**43**	**15**	**35**	**15**	**10**

As electronic collaboration is typically driven by technology advancement and e-business, we limited our literature search to those studies in Information Systems research. We searched for related works in the respected journals, including MIS Quarterly (MISQ), Journal of MIS (JMIS), Information Systems Research (ISR), Information and Management (I&M), European Journal of Information Systems (EJIS), Decision Support Systems (DSS), and Communication of the ACM (CACM). These journals are consistently ranked as leading MIS journals [Rainer & Miller 2005, Lowry et al. 2004].

Secondly, we examined each issue of each volume of the journals published in the last fourteen years (1999-2012). This time range is determined largely due to the evolution of Web technologies for the collaborative activities [Chu et al. 2007].

Thirdly, we conducted the search using the phases, including communication, contribution, coordination, cooperation, electronic collaboration, collaborative technology, collaboration, collaborative commerce, and collaborative business. The academic search engines, including Science Direct, EBSCO host, IngentaConnect, and ACM Digital Library, were used to ensure we do not overlook the related articles, labeled with the 'collaboration'. The articles that have a matching phase in the article title, in the author-supplied abstract, or in the keywords were identified. Thereafter, the articles identified by the search were screened to exclude the unrelated articles that do not concentrate on the 'collaboration' issues.

Having the comprehensive search and screen, 181 related articles were found.

The Analysis
The abovementioned articles were reviewed and outlined from the following aspects, such as research methodologies, information technologies or systems, research issues or topics, and research findings. We also coded the articles using the framework proposed.

Research methodology used
While a wide spectrum of research methodologies (Table 1) was used in addressing the 'collaboration' in electronic environments, three methodologies are widely used, i.e. empirical study (survey), case study or field study, and technology development or system design. It generally supports that the research of electronic collaboration grows as a cross-discipline area of Information Systems (IS), Computer Science (CS), and Organizational studies (OS).

Moreover, the leading IS journals seems to prefer to publish certain types of research works in terms of research methodology. MISQ, EJIS, and CACM appreciate the distinct outcomes of case/field studies of the 'collaboration' works, while JMIS and ISR tend to accept the empirical works with a considerable number of objects. As to the technology development or system design, DSS and CACM publish a number of design works. It is also noted that I&M maintains a balance of the variety of the publications in terms of research methodology.

Table 2   Research Issues in the Research of e-collaboration

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
e-Collaboration		Virtual team for new product: Technology adaption	Virtual team for new product: Innovation; Nonconsensual negotiation	Effects of IT on creation; Collaborative engineering	Effects of collaboration on performance; Collaborative engineering; Collaborative writing	Role of interpersonal traits; Effects on virtual team; Collaboration inhibitors	Ontological structure of knowledge sharing; Social tie and knowledge sharing on collaboration	Collaboration on product design; Collaboration on decision quality; Knowledge construction; Wikis;	Digital network with collaboration; IT-based features with knowledge contribution; IT innovation on collaboration; Distributed leadership	Social capital on knowledge integration;
Cooperation	Leadership in team building; Technology integration		Fit effects between task, structure, and process; Virtual reality	Effects of social capital;	Meeting satisfaction; Virtual team building	Impact of collaborative conflict management style on performance		Groupware on productivity	Process and technology challenges; CPFR; Horizontal cooperation	Boundary; CIT adoption; Emergence of new project team
Coordination	Horizontal mechanism; Challenges of IT implementation	E-commerce application design	Organization boundary		Enterprise application integration		Annotated Business HyperChain; Semantic technology; Process portal	IT integration for supply chain ; coordination pattern; Workflow; Semantic e-business	Business process management system; Agile integration; ICT and coordination performance	Challenges with group coordination
Contribution	Content demonstration; Development approach of multiagent system		Profiling system; People awareness; Expert finder	Multimedia annotation system	Collaborative Web mining	Virtual cities	IT-enabled contextualization	Knowledge web portal; Electronic knowledge repository	Trust and reputation system for online service	Awareness displays; Information diffusion on bidding behavior; Task relevance assessment
Communication			Mobile and wireless technology		Transaction protocol	Data-centric design; Data model			Access control; Agile Integration Modeling Language; P2P network	

Research issues or topics addressed

Here we shape the research landscape of electronic collaboration in terms of research issues or topics. The important research issues were identified and were categorized using the framework proposed (Table 2).

As to the current research related to e-collaboration, virtual team is one of the major research objects. The technology adaption [19], the radical innovation [20], and the impact of heterogeneity and collaborative conflict management style [21] have been explored in the inter-organization virtual team. A number of challenges to the inter-organization interactions have also been addressed, such as nonconsensual negotiation [22], collaboration inhibitors [23], and distributed leadership [24]. Moreover, such applications as collaborative engineering [25], and collaborative writing [26] have been consi derable studied.

If multiple organizations intend to work together with others, how to develop a team with the right partners in a right way is important. Volkoff et al. [27] addressed the key leadership roles in different stages of the development and implementation process of a team. Huang et al. [28] empirically studied how a group support system (GSS) may be used to foster better team cohesion, better team commitment, and better collaboration. Besides, Dennis et al. [29] proposed a Fit-Appropriation model to address the fit between the task and the GSS structure and the appropriation that involves the structure and the process. The outcomes of cooperation have been addressed in terms of meeting satisfaction [30], corporate productivity and operations [31], and supply chain performance [32].

A number of existing researches related to coordination concentrate on the architectural design or the use of the information technology, such as e-commerce application design [33], enterprise application integration [Irani et al. 2003], annotated technology [34], semantic technology [35], and business process management system [36]. Challenges associated with IT implementation and group coordination have attracted considerable research efforts [37].

Moreover, it is easily observed that existing literatures related to contribution have developed a number of business applications, while those literatures related to communication endeavors to respond to the new needs raised by the higher

levels of inter-organization interactions.

Correctness of term use
As mentioned, researchers are using the terms about e-collaboration inconsistently and interchangeably throughout the years. Studies that address the topic may misuse term by over-claiming or under-claiming them. Therefore, we apply our paradigm, which provide a clear definition and understanding of collaboration-related concepts, to judge the correctness of term uses.

There are three special issues related to the research on electronic collaboration (i.e., Collaborative Virtual Design Environments and Global Applications of Collaborative Technology in CACM in 2001, and Emerging Issues in Collaborative Commerce in DSS in 2007) in our pool of articles, resulting in a sudden increment of the number of the related articles in 2001 and in 2007, respectively. Thus, the three-year average of the number of related articles is reported to alleviate bias. To specify, we include the studies in the current year as well as the previous two years when judging correctness of terms used in the articles.

By referring to our proposed paradigm, articles are classified as over-claimed, under-claimed and correct. After a removal of 7 articles that do not claim any of 5C terms, 174 articles finally enter into the classification. The percentage of each category is reported in Figure 2.
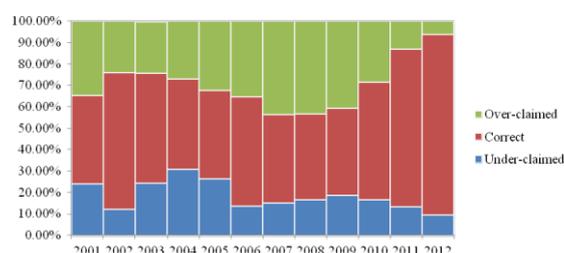
**Figure 2 Correctness of Term Uses in Research on e-Collaboration (2001-2012)**

We observe that the number of studies which over-claim the collaboration-related concepts is more than those under-claim them, as expected. It implies that researchers tend to regard what they investigate as higher-level type of interaction.

Furthermore, the inconsistent understanding of concepts appeared in the earlier studies have caused lots of misuses of terms. However, as the figure shows, the correctness increases significantly after 2007, which indicates that researchers gradually reach a consensus in recent years. This convergence also provides evidence that our paradigm portrays the trend of understanding e-collaboration well.

DISCUSSIONS

Major Research Themes
With the review of the 'collaboration' articles, we abstract three key research contents, i.e. intention of interactions, inter-organization relationships or structures, and information technology or collaborative technology in particular, and identify the corresponding important topics by the inter-dependence between the key contents (Figure 3). Here we simply label the inter-dependence as task-technology fit, task-structure fit, and structure-technology fit, respectively. Six research themes in the research of electronic collaboration are then identified.
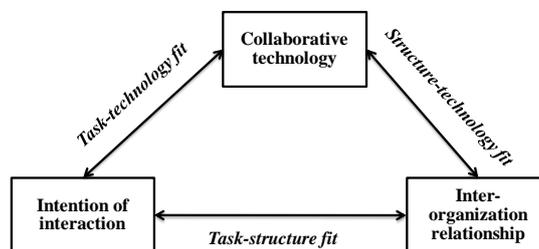
Figure 3 Six Research Themes in the Research of Electronic Collaboration

(T.1) Collaborative technology. Section 4.2.2 elaborates the state of the art of the technical works that facilitate or enable the collaboration in electronic environments. The research in this theme often requires the researchers with considerable expertise in Computer Science.

(T.2) Intention of interaction. As the increasing globalization, organizations need to work closely with partners, thus creating a number of different needs in terms of inter-organization interactions. The existing practical needs (such as joint design of new

product, the sharing of know-how) and the prospects (such as RFID-enabled supply chain integration) would considerable drive the growth of the research on electronic collaboration.

(T.3) Inter-organization relationship. The impacts of the inter-organization relationships or structures (such as corporate alliance, virtual team, and horizontal integration) on electronic collaboration have been studied. However, having Table 2, an academic researcher in Organization Studies is likely to find that there are a number of related research questions have not been addressed.

(T.4) Task-technology fit. Here a systematic approach with evaluation techniques have to be developed to assess the fit between the task (i.e. the intention) and the collaborative technology. It is common that in different research context (i.e. different types of inter-organization interactions) the fit may change.

(T.5) Structure-technology fit. Typically, the configuration of inter-organization relationships (such as trust and reputation) would considerably affect the implementation and the outcomes of a collaborative application. On the other hand, the advanced collaborative technology often drives the organizations to work closer.

(T.6) Task-structure fit. Here would be a research topic in the field of Organizational studies. New thinking is needed, with respect to the new research context of electronic collaboration.

Future Research Directions

We further draw the roadmap of electronic collaboration by integrating the above research themes with the framework proposed. A pyramid of research themes of electronic collaboration is then constructed (Figure 4). With the pyramid, the existing research outcomes could be easily articulated in a cohesive view. More importantly, the holes on the pyramid can be easily identified, along with some of the important future research directions.

As an academic research field, electronic collaboration is far from mature. The future research directions can be portrayed by answering the following questions: (1) are the existing technologies sufficient to enable joint intellectual efforts; (2) does the selected collaborative technology fit well to the emerging needs of the inter-organization interactions; (3) with respect to a certain type of interaction, are the inter-organization relationships appropriately developed, using the collaborative technology.

If you were an industrial practitioner, the following questions may be important to you: (1) are joint intellectual efforts a must to my business; (2) does my business relationship fit to my business needs (3) does my corporate select the right collaborative technology, with respect to my business needs and my business relationships with partners.
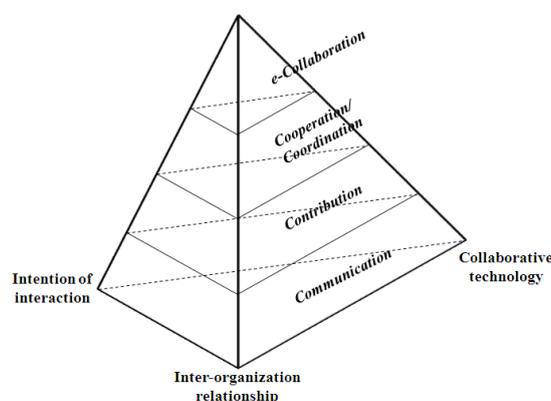

Figure 4 The Pyramid of Research Themes of Electronic Collaboration

In this paper, the diverse existing views on inter-organization electronic collaboration are reviewed. A framework is proposed to make the views cohesive for the emerging field of electronic collaboration. The core of e-collaboration is underlined. Moreover, a content analysis on the related literatures is conducted using the proposed framework.

For future research, it should be interesting to see a mathematical illustration of the framework. An extensive review on the respected articles in the 'pure' journals of Computer Science and Organization studies is likely to contribute to the new field of electronic collaboration.

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