On Cross-Enterprise Collaboration

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Abstract. Globalization, specialization, and rapid innovation are changing several aspects of business operations. Many large organizations that were once self-sufficient and that could dictate processes to partners and suppliers are now finding this model difficult to sustain. In the emerging model of global service delivery several competing service providers must work collaboratively to develop business solutions, either hierarchically or as peers. Overall project failures, uncontrollable delays, and significant financial losses have been observed in many global service delivery projects, indicating the importance of finding new ways to better support cross-enterprise work. This paper puts forth directions to explore the management and coordination of complex end-to-end processes carried out collaboratively by several organizations.

Keywords: coordination, collaboration, work.

1 Introduction

Due to growing globalization [10], and the need for innovation and differentiation, the value of specialization through division of labor is more important now than ever before [12]. Specialized firms that concentrate on a narrow set of tasks can be more productive than firms that are jacks-of-all-trades. Indeed in founding modern economic theory, the opening of Adam Smith's *Wealth of Nations* said that "The greatest improvement in the productive powers of labor, and the greater part of the skill, dexterity, and judgement with which it is anywhere directed or applied, seem to have been the effects of the division of labor."

With growing specialization, however, companies that once could do it on their own find they need to collaborate with others in order to achieve large business or societal objectives. As the doing of work shifts from within a single enterprise to a distributed ecosystem of service providers, there is also greater potential flexibility and responsiveness to changing conditions [7,9,8]. Moreover, ecosystems of firms may be able to achieve open innovation more easily than concentrated modes of organization [2].

This emerging model of work, *cross-enterprise collaboration*, is the focus herein. As way of definition, we consider cross-enterprise collaboration to be when companies partner to achieve a common goal, to realize an opportunity, through

* This paper collects together contributions from several members of the SRII Special Interest Group on Cross-Enterprise Collaboration.

S. Rinderle-Ma, F. Toumani, and K. Wolf (Eds.): BPM 2011, LNCS 6896, pp. 29–37, 2011.

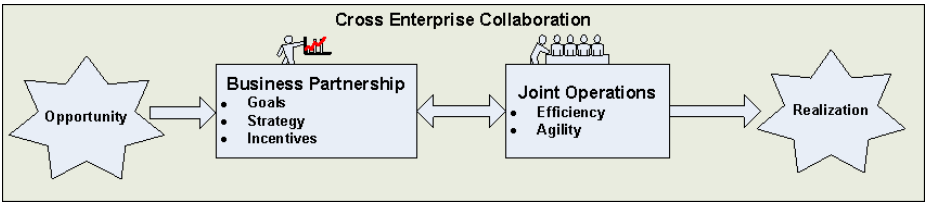

Fig. 1. Realizing opportunities through cross-enterprise collaboration

business partnership and joint operations, see Figure 1. From the perspective of this joint goal, they want to behave and operate as one organization. However, each enterprise is additionally separate and may have its own needs. Note that unlike simply integrating supply chains, cross-enterprise collaboration requires joint operations.

With the growth in cross-enterprise collaboration and the potential productivity, responsiveness, and innovation benefits that this mode of doing work may provide, it is of interest to understand the nature of problems that arise in such collaborations, and how these problems can be mitigated.

Collaboration within the enterprise is already very difficult. Recent IBM surveys of CIOs in top-performing organizations demonstrated that collaboration and integration are especially important. More than two-thirds of surveyed CIOs said they would focus more on internal collaboration and communication, compared to less than half in underperforming organizations [5]. When crossing organizational boundaries, collaboration is much harder.

Problems that arise in cross-enterprise collaborations are well recognized in industry. Consider the design and development of the Boeing 787 Dreamliner, Figure 2. To reduce the 787 Dreamliner's development time to four years from the traditional six years and development costs to 6 billion dollars from the traditional 10 billion dollars, it was developed and produced using unconventional methods new to aircraft manufacturing, where approximately 50 strategic partners of Boeing served as integrators that design/assemble different parts and subsystems. With this new model, communication and coordination among Boeing and its suppliers became critical for managing the progress of the development program [13]. A real-time collaboration system that linked together all of the various partners to a platform of product life-cycle management tools and a shared pool of design data was implemented [14, Chapter 8]. Yet there were a lot of coordination problems. Ultimately, Boeing had to redesign the entire aircraft subassembly process due to visibility, process, and management risks [13].

This is not confined simply to the case of the Boeing 787 Dreamliner. One recent market study by the Aberdeen Group examined more than 160 enterprise products that required collaboration among several engineering disciplines such as mechanical engineering, electronic engineering, computer engineering, control engineering, and system design. Among the people interviewed, 71% identified a need to improve communication and collaboration across silo disciplines; 49%

Fig. 2. Boeing 787 Dreamliner

required improved visibility; and 43% raised the need to implement or alter new product development processes for a multidisciplinary approach. The primary reason for breakdowns was the paucity of support for coordinating the overall work between the silo disciplines [8].

In studying global software development Wiredu put forth four main causes of problems, that also apply more broadly to cross-enterprise collaborations [17,16]. These are:

- *Interdependencies* that arise from distributed work processes,
- *Conflicts of interest* that arise due to distributed work teams with localized incentives,
- *Technology representation problems* that arise from distributed technologies with localized standards, and
- *Uncertainties and equivocalities* that arise due to geographically and organizationally distributed information.

In the language of economic theory, these are all different kinds of coordination costs. It is well known that coordination costs increase as the degree of specialization increases, thereby limiting the degree of specialization [1,3].

A deeper understanding of these potential problems in cross-enterprise collaboration through the development of detailed use cases as well as general abstractions and theories, along with the development of standards and technologies that support cross-enterprise collaboration, coordination costs may be reduced. With reduced coordination costs allowing greater specialization of firms, society may garner the benefits of improved productivity, agility, and innovation.

2 Goal and Scope

The goal in studying cross-enterprise collaboration is to improve the ability of organizations to collaboratively realize new opportunities. Towards this goal, we have recently formed a special interest group on cross-enterprise collaboration, under the auspices of the Service Research and Innovation Institute (SRII). A call for action and an invitation for participation was issued at the recent SRII Global Conference 2011. We welcome practitioners, researchers, and enthusiasts

to (collaboratively) further the understanding of cross-enterprise collaboration. As discussed in Section 4, there are several work streams that have been initiated towards this goal.

To clarify the scope of study, let us note that there are several kinds of work that are being done through cross-enterprise collaboration.

One kind of example is in product design and development. Whether considering the design of aircraft such as by Airbus or Boeing, or the design of motor vehicles such as by GM and Ford, there is a growing trend towards involving suppliers not just as suppliers but as partners engaged in the design process.

The growth of cross-enterprise collaboration is also happening in global software development, where projects are broken across globally distributed teams in several different organizations. Likewise for disaster recovery and its attendant command and control: whether considering multi-agency collaboration in response to the events of September 11, 2001 or recent earthquakes and tsunamis that warranted multinational collaboration. As another example, one can consider the domain of healthcare. There are hospital experts helping silo centers in developing countries, as well as multi-institutional collaborations in cancer research and treatment.

We focus on the intersection between business, operations, services, people, and work in cross-enterprise collaborations, Figure 3. We include both collaborations between enterprises and collaborations between organizations within an enterprise. Indeed, as has been noted by others, any successful alliance involves at least three sets of interactions. The first is between the two organizations. But the second is between the negotiator for the first organization and other managers in her company, while the third is between the negotiator for the second organization and other managers in his company. Understanding the internal negotiations helps to structure and manage the alliance better over time [11].

Special focus is placed on implications for Services as modular units of work. By taking a service-oriented view of work, notions of value co-creation [15] become readily apparent. Moreover, we can build up a layered notion of cross-enterprise collaboration that incorporates several dimensions, Figure 4.

3 Existing Research

With such global importance, elements of cross-enterprise collaboration have certainly been studied before and several problems have already been solved.

Writing in 2001, Hammer described a basic protocol issue in cross-enterprise collaboration [4, p. 170]:

> Expediters, schedulers, and a host of clerical personnel were required to manage the interface between Geon and OxyVinyls; a vast amount of work had to be performed twice, once on each side of the new divide. Unsurprisingly, this added work added costs.

Such basic protocol problems of cross-collaboration have certainly already been solved using modern business process management methods [6].

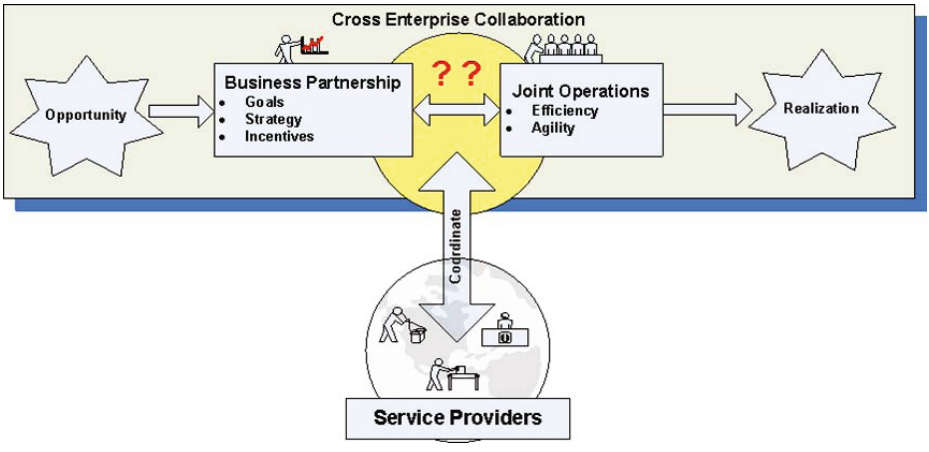

Fig. 3. The scope of cross-enterprise collaboration includes the interaction of business, operations, services, people, and work

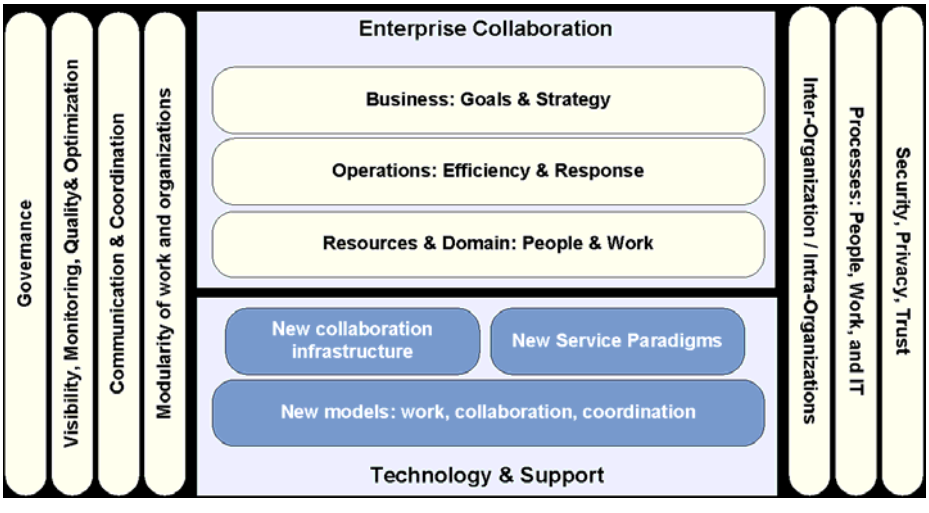

Fig. 4. Dimensions of cross-enterprise collaboration

More recent research and development, e.g. as presented at The 1st International Workshop on Cross Enterprise Collaboration, People, and Work, held in collaboration with the 8th International Conference on Business Process Management (BPM2010), has led to deeper understanding, however there is often a disciplinary separation.

Current disciplines tend to focus on a limited subset of the aspects that typify cross-enterprise collaboration; the challenge is to bring them together. Business Process Management (BPM), for example, does not adequately support

teamwork around tasks or the creation and execution of dynamic service plans. Enterprise Architecture (EA) models use a layered approach to bridge between the business and IT that does not adequately consider the role of people, process, or organization. Computer Supported Collaborative Work (CSCW) focuses on people, awareness, and distributed collaboration to enable cooperative work; but does not adequately connect this with process, data, or organization. Services Oriented Computing (SOC) tends to focus on composable bite-size processes that can be executed by machines, but does not provide the flexibility required to scale and support complex cross-organizational work. BPEL4People and similar standards do not address the full scope of cross-enterprise work or the complex needs of humans in their various roles.

The next section discusses several particular avenues of research.

4 Work Streams

As part of the SRII SIG on cross-enterprise collaboration, we have set out four major work streams.

4.1 Mapping the Domain

It is important to empirically understand, with some specificity, the demands placed on organizations and enterprises when working together. As such this stream will develop schema and taxonomies to qualitatively describe specific cross-enterprise collaborations. These schema and taxonomies will deal with the structural arrangement of collaboration, the dynamics of human interaction, and the issues/challenges that arise in cross-enterprise collaborations.

This work stream will build on extant work in case management. It will also build on work in the field of CSCW by extending it from considering the individual as the main agent of study to considering the enterprise as the main agent of study. The concepts of Awareness, Articulation work, and Appropriation stand to be of central importance.

The product of this work stream will include a standardized taxonomy of kinds of cross-enterprise collaborations, canonical use-cases for these several kinds of cross-enterprise collaborations, and a characterization of the main difficulties faced in these several kinds of cross-enterprise collaborations. Other expected outcomes include a study on the impact that emerging social computing technologies and methods have on collaboration in the context of service provision and a definition of qualitative metrics for assessing the effectiveness and efficiency of collaboration.

4.2 Formalisms and Standards

A central feature of cross-enterprise collaboration is the need to communicate across institutional boundaries, often governed by agreement frameworks, and always in support of the doing of work. As such, it is important to develop

formal standards and languages to facilitate communication for collaboration. Visibility is also a central concern of enterprises engaged in collaboration and so it is important to develop standardized quantitative metrics for assessing the effectiveness and efficiency of collaborative activities. Good languages facilitate good metrics.

This work stream will build on extant work in BPM on designing, modeling, executing, monitoring, and optimizing collaboration activities. It will also build on existing formalization structures in SOC and C2. This work stream will study cross-enterprise collaborations and develop formal languages to control and coordinate cross-enterprise collaboration in different domains. It will also develop quantitative metrics and formal end-to-end monitoring frameworks to measure the efficacy of collaboration. Finally it will develop formalisms to allow the construction of governance, privacy, and service-level agreements among enterprises. In particular, SOA formalisms and constructs may be extended to facilitate the definition, dispatch, and orchestration of work as services that can be carried out by and for organizations. When mature, these could lead to cross-industry standards for collaboration.

With the rapid introduction of new technologies and the adaption of could computing, scalable and cost-effective IT service depends on faultless automation and collaboration between many different service providers and partners. A main objective is to define a clear end-to-end view (standard interfaces and processes) of service delivery to enable companies (vendors, solution integrators/partners and end customers) to consistently integrate (or outsource to multiple IT partners) service components. Such standards should include consistent service monitoring and integration and techniques to ensure consistent End-to-End Service Delivery at Optimized Costs.

4.3 Technologies

Although cross-enterprise collaboration is possible with little technological support, the introduction of advanced technologies can greatly facilitate the process. Indeed, IT middleware is often cast as a technology to mediate between different parties, such as different business enterprises.

This work stream will build on extant work in BPM, CSCW, SOC, and Cloud Computing, as it can be applied specifically to the challenges faced in cross-enterprise collaboration, such as communication across institutional boundaries and coordination of workflows.

This work stream will work on defining the properties and requirements of computer technologies needed to support cross-enterprise collaborations. In particular, it will study the context, data, and knowledge management requirements for managing and coordinating work across organizations and their interrelationship with domain data, tools, and processes. It will also serve to standardize the requirements for IT, middleware, systems, tools, and frameworks that support cross-enterprise collaboration, and delineate relationships with current enterprise or domain specific tools and information technologies.

4.4 Abstractions and Models

Theoretical abstractions and mathematical models have had an uncanny ability to provide insights into the physical and social worlds. In particular, mathematical engineering theories have provided insights into the fundamental limits of engineered systems, no matter how much ingenuity is brought to bear on a problem. As such, developing abstractions and models of general cross-enterprise collaboration stands to provide fundamental insights. Moreover, the language of mathematics also allows the use of optimization theory which may lead to best practices and policies for cross-enterprise collaboration.

This work stream will build on extant work in information theory, control theory, theories of the firm in economics and management science, value-oriented service science, as well as optimization theory. It will also allow the incorporation of mathematically-oriented data analysis methods. In a theoretical framework, new approaches of distributed work, such as crowdsourcing, can be compared to other forms of service organization.

The product of this work stream will eventually be a mathematical theory of cross-enterprise collaboration. Shorter-term goals include optimization algorithms for particular kinds of collaboration structures and optimal control/coordination policies for cross-enterprise collaboration.

5 Closing Remarks

Whether due to cultural and organizational differences between potential partners or interoperability issues among their information technology infrastructures and business processes, there are severe challenges to making cross-enterprise collaborations work.

Building on a well-founded taxonomy of cross-enterprise collaboration developed from detailed use cases, a fundamental understanding of the cross-enterprise collaboration problem may be possible from mathematical foundations. Further, standards and technological specifications may reduce coordination costs among enterprises and allow the emergence of more specialized firms working in partnership with others in a global marketplace.

There is much work to be done.

Acknowledgments. This paper collects together contributions from several members of the SRII Special Interest Group on Cross-Enterprise Collaboration.

References

1. Becker, G.S., Murphy, K.M.: The division of labor, coordination costs, and knowledge. The Quarterly Journal of Economics 107(4), 1137–1160 (1992)
2. Chesbrough, H.: Open Services Innovation. Jossey-Bass, San Francisco (2011)
3. Ehret, M., Wirtz, J.: Division of labor between firms: Business services, non-ownership-value and the rise of the service economy. Service Science 2(3), 136–145 (2010)

4. Hammer, M.: The Agenda. Crown Business, New York (2001)
5. IBM: The essential CIO: Insights from the global chief information officer study (May 2011)
6. Leymann, F., Roller, D.: Production Workflow: Concepts and Techniques. Prentice-Hall, Upper Saddle River (2000)
7. Mehandjiev, N., Grefen, P.: Dynamic Business Process Formation for Instant Virtual Enterprises. Springer, London (2010)
8. Oppenheim, D., Bagheri, S., Ratakonda, K., Chee, Y.M.: Coordinating distributed operations. In: Maximilien, E.M., Rossi, G., Yuan, S.T., Ludwig, H., Fantinato, M. (eds.) ICSOC 2010. LNCS, vol. 6568, pp. 213–224. Springer, Heidelberg (2011)
9. Oppenheim, D., Ratakonda, K., Chee, Y.M.: Enterprise oriented services. In: Dan, A., Gittler, F., Toumani, F. (eds.) ICSOC/ServiceWave 2009. LNCS, vol. 6275, pp. 82–95. Springer, Heidelberg (2010)
10. Palmisano, S.J.: The globally integrated enterprise. Foreign Affairs 85(3), 127–136 (2006)
11. Slowinski, G., Segal, M.: The Strongest Link. Amacom, New York (2003)
12. Stigler, G.J.: The division of labor is limited by the extent of the market. The Journal of Political Economy 59(3), 185–193 (1951)
13. Tang, C.S., Zimmerman, J.D.: Managing new product development and supply chain risks: The Boeing 787 case. Supply Chain Forum 10(2), 74–86 (2009)
14. Tapscott, D., Williams, A.D.: Wikinomics: How Mass Collaboration Changes Everything. Portfolio Penguin, New York (2006), expanded edn.
15. Vargo, S.L., Maglio, P.P., Akaka, M.A.: On value and value co-creation: A service systems and service logic perspective. European Management Journal 26(3), 145–152 (2008)
16. Varshney, L.R., Oppenheim, D.V.: Coordinating global service delivery in the presence of uncertainty. In: Proceedings of the 12th International Research Symposium on Service Excellence in Management, QUIS12 (June 2011)
17. Wiredu, G.O.: A framework for the analysis of coordination in global software development. In: Proceedings of the 2006 International Workshop on Global Software Development for the Practitioner, pp. 38–44 (May 2006)