Towards a Theory of Interorganizational Collaboration: Generic Structures of Cross-Boundary Requirements Analysis[1,2]

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Abstract

In this paper, we present a series of causal maps that constitute an initial effort in the creation of a generic theory of interorganizational cross-boundary requirements analysis. Such causal structures are the result of a simulation-based study in which we explored the interactions and social processes associated with the development of trust and knowledge sharing in the development of an interorganizational information system in New York State: the Homeless Information Management System (HIMS). The paper includes the main theoretical and practical implications of the modeling and simulation work, as well as discussion of some paths to continue the exploration of collaboration in this specific context. The causal maps are organized around three themes that emerged during the modeling process. The first theme is related to *trust development*, and its recursive interactions with knowledge sharing and learning. The second theme is related to the importance of achieving *stakeholder engagement* by establishing a trusting environment as opposed to the use of authority or coercive mechanisms. The last theme is associated

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with the understanding of *requirement definition as a social process* of learning and knowledge transfer.

Introduction

Using information technologies to increase understanding of the impacts of social programs, and to improve the level of service provided to clients or users of services, is an important trend observed in both the public and the private sector. Interagency collaboration to build such information systems to improve public programs or services is appealing in many ways such as cost savings, resource sharing or improved efficiencies (Bardach 1998). When public services are provided through networks of private service providers or networks of geographically disperse and decentralized public offices, developing these information systems in a collaborative way becomes a need. In spite of the advantages of collaboration, collaborative approaches are not as common as they should be, because of our lack of understanding about how to manage the collaboration process (McCaffrey *et al.* 1995; Dawes and Pardo 2003).

The social processes associated with the development of trust and knowledge sharing are particularly important in the success of such collaborative innovation initiatives. Although interactions among stakeholders take place during the whole development process, the interactions during the initial stages, where the requirements of the technology innovation are analyzed and defined, appear to be particularly important to the success of the entire process. The use of objects such as prototypes to facilitate the definition of the innovation constitutes a viable alternative for improving the learning process and for detecting overoptimistic estimates of costs and effort associated to the full implementation of the innovation. The timing of the use of these objects, however, has an impact on the effectiveness of the social process around the definition of requirements and on the perception of the feasibility of the opportunity to collaborate.

In this paper, we present a series of causal maps that constitute an initial effort in the creation of a generic theory of interorganizational collaboration. Such causal structures are the result of a simulation-based study in which we explored the interactions of the factors mentioned in the above paragraphs in the development of an interorganizational

information system in New York State: the Homeless Information Management System (HIMS).

The paper includes the main learning and theoretical implications of the research, as well as discussion of some paths to continue the exploration of collaboration in this specific context. The paper is organized in four main sections after this brief introduction. The first describes the methods and data used in the modeling process. The second includes some of the theoretical implications of the work, in terms of three main themes that emerged during the modeling process: *trust development*, *stakeholder engagement*, and *requirement definition as a social process*. The third section discusses the practical implications of the theory, and the last one outlines some of the paths for future research and theory development.

Methods and Data

The causal maps reported in this paper constitute the main conclusions of a simulation-based theory-building project grounded on two cases of interorganizational Information Technology Projects. The first case deals with information resources for programs serving the more than 29,000 homeless people receive emergency shelter and a diversity of support services each day in New York State. Homeless services costs are estimated to be $350 million each year, $130 of which are spent on service programs (CTG 2000). The information needed to assess the effectiveness and impact of the services provided to the homeless is distributed in several agencies and nonprofits, such as the Bureau of Housing Services (BHS), and the New York City Department of Homeless Services (DHS). The lack of integration of the data sources makes very difficult to assess them. Starting in 1998, the Office of Temporary and Disability Assistance (OTDA), Bureau of Housing Services (BHS) started a series of efforts to create an integrated decision support system to help both government and nonprofit organizations to manage and assess homeless services. The system would integrate information from a variety of sources. Demographic data would be obtained from the individual shelters, payment information would come from the state Welfare Management System (WMS), shelters' information would be gathered from the BHS's providers certification database, medical information

from the State Department of Health, and data on substance abuse or other services from other State Agencies. Although BHS is an oversight agency, which manages and regulates temporary housing programs in New York State, it shares its regulatory functions in New York City with the NYC Department of Homeless Services.

The second case deals with information resources for the Division of Municipal Affairs (MA) from the New York Office of the State Comptroller (OSC), the agency responsible for monitoring the financial operations of the 3,200 local governments in the State (CTG 2001). One of MA primary roles is to gather, organize, and distribute information from and about local governments to a diversity of users. Some of the main sources and users of information are government officials, MA staff, the media, taxpayers, the Governor's office, and the State Legislature. The information gathered can take many forms, such as written correspondence, telephone calls, news articles or media reports, electronic exchanges, and individual staff notes. The diversity of sources, forms and uses of the information created a series of challenges for the new vision of MA's work, which was moving from a regulatory and auditing position towards promoting improvement in local practices through a program of services. Also in 1998, MA started an initiative to promote the creation of a "technology solution involving a widely accessible repository of contact information [..] It would provide a 'knowledge base' of information about municipalities and local officials, past services provided, and preferred modes of service delivery" (CTG 2001).

This research builds on an earlier theory building effort that yielded a simulation model for the HIMS project involving the collaboration of two actors: the Bureau of Housing Services as the initiator of the innovation, and an aggregation of shelter providers and local public agencies that represent the main stakeholders in the project. This initial modeling effort, which took place on a series of Group Model Building sessions, was continued and enriched through document analysis and individual interviews with project participants.

A basic assumption of the model is that the processes of trust development and knowledge sharing shape the collaboration patterns between the two actors in the

development of cross-boundary work. In this way, the key assets of each participant in the development of the project are two different kinds of knowledge and their accumulation of trust on the other actor in the project. By getting engaged in the project work, each actor learns about his own role and the other actor's role in the project. Moreover, each of them develops a sense of the other actor's trustworthiness.

Through the analysis of the case data, we identified three main cross-boundary activities associated with the collaboration: the definition of requirements for the prototype, the technical development of the HIMS prototype itself, and the development of a prototype definition of services and evaluation model. The simulation model also recognizes that besides the interchange of knowledge among the parties involved, new knowledge was generated. Particularly relevant to the project was the creation of a shared vision about the feasibility of the project from the providers' perspective.

To assess the theory, both model structure and behavior were compared with the experiences of HIMS participants, and the assumptions of the model were compared with experiences of a group of people participating in different projects associated with the development and implementation of the Multi-purpose Access for Customer Relations and Operational Support (MACROS) at the NYS Office of the State Comptroller.

During the development of the model, three main themes emerged in the case stories and the theories embedded in the model. These three themes appear to be particularly relevant for a theory of collaboration in IT innovations because of the importance that they have in the stories about the project, and because of the interest that researchers in the area show in several related literatures. The first theme is related to *trust development*, and its recursive interactions with knowledge sharing and learning. The second theme is related to the importance of achieving *stakeholder engagement* by establishing a trusting environment as opposed to the use of authority or coercive mechanisms. The last theme is associated with the understanding of *requirement definition as a social process* of learning and knowledge transfer. Thus, the causal maps summarizing the main learning, as well as the implications of the model are organized around these three themes.

An Initial Theory of Cross-Boundary Collaboration

This work has as an immediate antecedent in the work of Black (2002). In her work, she developed a theoretical framework to explain collaboration patterns in settings that involve the collaboration of two actors. She demonstrated the utility of the framework in two different settings; one involved the use of new scanning technologies between technicians and doctors, and the second involved interdepartmental collaboration in product development. Through this work, we found that the framework is also useful in the analysis of interorganizational collaboration for the development of IT innovations, particularly in the early stages of requirements identification and definition. More specifically, the current theory considers the presence of an organization interested in advancing the vision of an IT innovation, and its interactions with an aggregate of stakeholder organizations whose involvement is necessary for the development of the information system (see Figure 1).

An important difference between the theories developed in this work and the work of Black is related to the way in which the collaboration developed. Her work analyzed collaboration patterns as they emerged when two groups with different backgrounds collaborate in a specific task or project. This research considers the presence of a facilitation group that provides the necessary social processes and objects, as well as coordinates the timing of each participant involvement in different project-related tasks. Concretely, this theory reflects the way in which the Center for Technology in government facilitates the definition of the requirements for IT innovations.

A common element in both theories is consideration of several accumulations of knowledge as playing an important role in the collaboration process. These accumulations of knowledge are related to the extent to which each actor understands his own information needs, and the information needs of the other actors involved in the project.

Finally, this research extends Black's theory with the formal incorporation of trust and its relationships with the knowledge sharing process. We present in the following sections

some simplified feedback structures that illustrate the main theoretical contributions of this work.

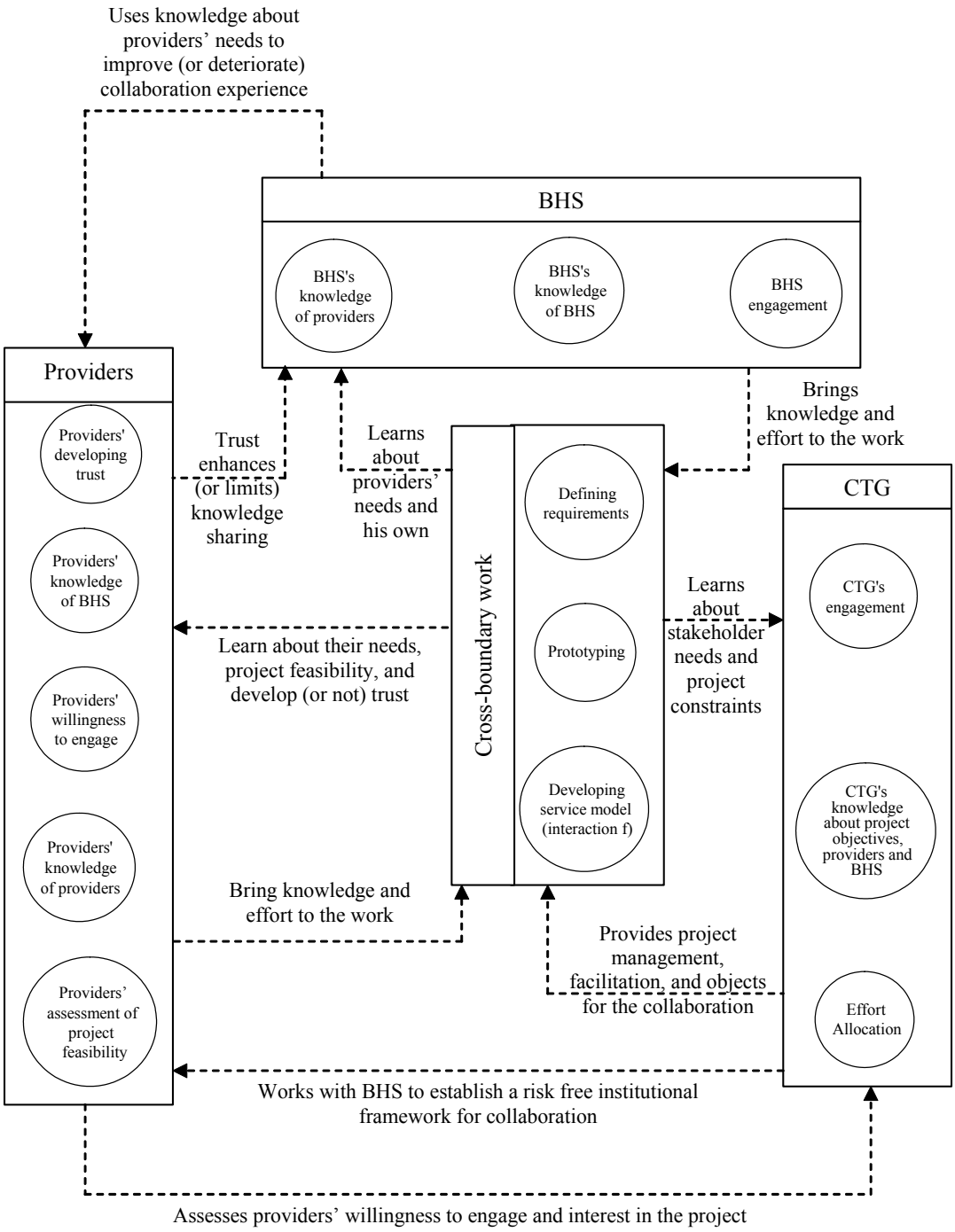

Figure 1. A Sector view of the trust-and-knowledge collaboration theory.

Trust Development

In terms of *trust development*, the research reported in this paper is not adding new constructs to the trust literature. The a priori, calculative, and knowledge-based components of trust, as well as the concepts of propensity to trust, trustworthiness or risk are present in previous efforts to integrate this rich corpus of literature (Mayer *et al.* 1995; Rousseau *et al.* 1998). Previous research also suggests the existence of links between knowledge and trust (Shapiro *et al.* 1992; Levin *et al.* 2002a). However, the discipline and rigor introduced by the use of mathematical modeling have created an original organization of those concepts around two main feedback processes presented in Figure 2 as a two-actor interaction.

As suggested in Figure 2, *our trust in them* can be conceptualized as a probability to act that results from "averaging" two different components: a calculative component, and a knowledge-based component. The knowledge-based component is in turn an "average" of *our a priori perception of their trustworthiness*, and *our perception of their trustworthiness*. *Our knowledge of them* weights the importance of each element in the averaging process. The knowledge-based component of trust is also involved with two feedback processes. A *perception bias* makes us reinforce our current *perception of their trustworthiness*. Moreover, *our trust in them* enhances (or limits) *their knowledge of our needs*, enhancing (or limiting) in turn their *ability to build trust* by using *their knowledge of our needs* to enhance *our collaboration experiences with them*. *Calculative trust* is conceptualized to be the result of our assessment of the risks and desirability of working with them. Therefore, efforts to build *institutional trust* by providing structures or regulations that penalize betrayal decrease our perception of risk, operating through the *calculative* component of trust (Zucker 1986; Shapiro *et al.* 1992).

This trust conceptualization produces a nonlinear path dependence behavior documented frequently in the literature on trust and collaboration (Burt and Knez 1996; Powell 1996; Rousseau *et al.* 1998). Moreover, the structural elements are consistent with the perception of HIMS and MACROS participants, as well as the literature on trust. The

structure is capable of reproducing the qualitative pattern of trust development in the HIMS case.

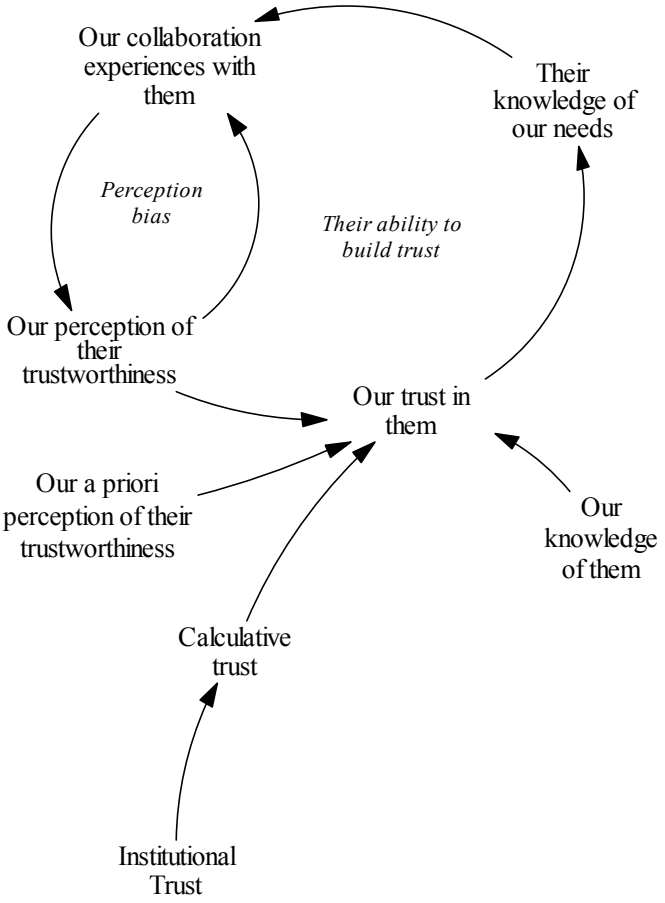

Figure 2. Feedback processes involved in the development of our trust in them.

Observed asymmetries between patterns of trust and distrust formation have led to treating trust and distrust as two different constructs that can increase or decrease independently, moving in different continua (Kramer *et al.* 1996; Lewicki *et al.* 1998). Partial experiments with the theory of trust in Figure 2 suggest that the asymmetries can exist in a single continuum, considering distrust as the lack of trust, and not a different and conceptually independent construct.

Engaging Stakeholders

Trust and collaboration are frequently linked in the literature in a reinforcing process that works as a trap or as a virtuous cycle of positive relations (Zand 1972; Kramer *et al.*

1996; Hardin 2001). However, most of these accounts are present in the literature in form of a text, or at most in the form of a single feedback loop such as the one developed by Vangen and Huxham (2003), in which they link the willingness to collaborate with positive results obtained from working together. The theory development process followed in this research points to the existence of two feedback processes that affect our willingness to engage in collaboration that operates through the calculative and knowledge-based components of trust (see Figure 3).

The development of trust is intertwined with the process of engagement, and depends itself on several knowledge accumulations that result from *doing work together*. As described in the previous section, *our trust in them* is a probability to act that comes from the aggregation of an *a priori* component, a *calculative* component, and a *history-based* component. Although the *a priori* component is considered to be more or less stable for the duration of a project, the *calculative* and *history-based* components are considered to be dynamic in nature. The *calculative* component is related to our perceptions of the risk and desirability of the project, and the *history-based* component is related to the accumulations of good and bad episodes in *our collaboration experiences with them*. The weight that a particular actor assigns to each component depends on how much she knows her collaborating counterpart, knowledge that is developed through repeated interactions and activities developed together.

Partial experiments with this structure, suggest that managing the perception of risk by *establishing institutional trust* has the potential to be a leverage point to start a collaboration process. Moreover, showing results fast is an alternative way to leverage the collaboration process.

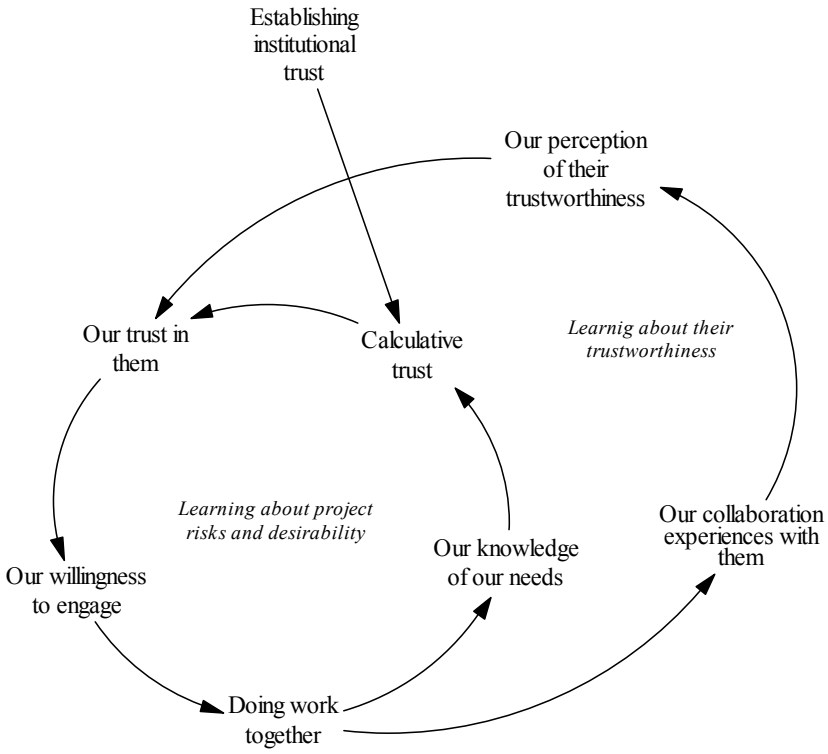

Figure 3. Calculative trust, knowledge-based trust and the process of engagement.

Requirement Definition as a Social Process

Requirement definition is conceptualized as a learning-intensive process in which users, analysts, and other stakeholders share their knowledge about information needs and uses. The main assumption about the nature of knowledge is that it is distributed. It does not only reside in the minds and bodies of individuals, but it is also socially and physically distributed (Black 2002). That is to say, particular communities develop shared meanings, frequently associated with the objects with which they interact on a regular basis (Brown and Duguid 1991; Wenger 1998). The BHS team, for example, developed during their interaction in the process particular terms to refer to the homeless services. Different actors in the project shared meanings about data and business rules specific to each of their particular practices (Figure 4).

The distributed nature of knowledge is highly consistent with the concept of knowing in action (Cook and Brown 1999; Gherardi 2001). From this perspective differences between individual, group, tacit, and explicit knowledge are elusive, and the modes of

knowledge creation proposed by Nonaka (1994) become less relevant for the discussion. For example, making explicit the tacit knowledge of providers and BHS in the development of HIMS data elements is not any more knowledge creation, but the creation of an object that can be used to share knowledge across organizational boundaries.

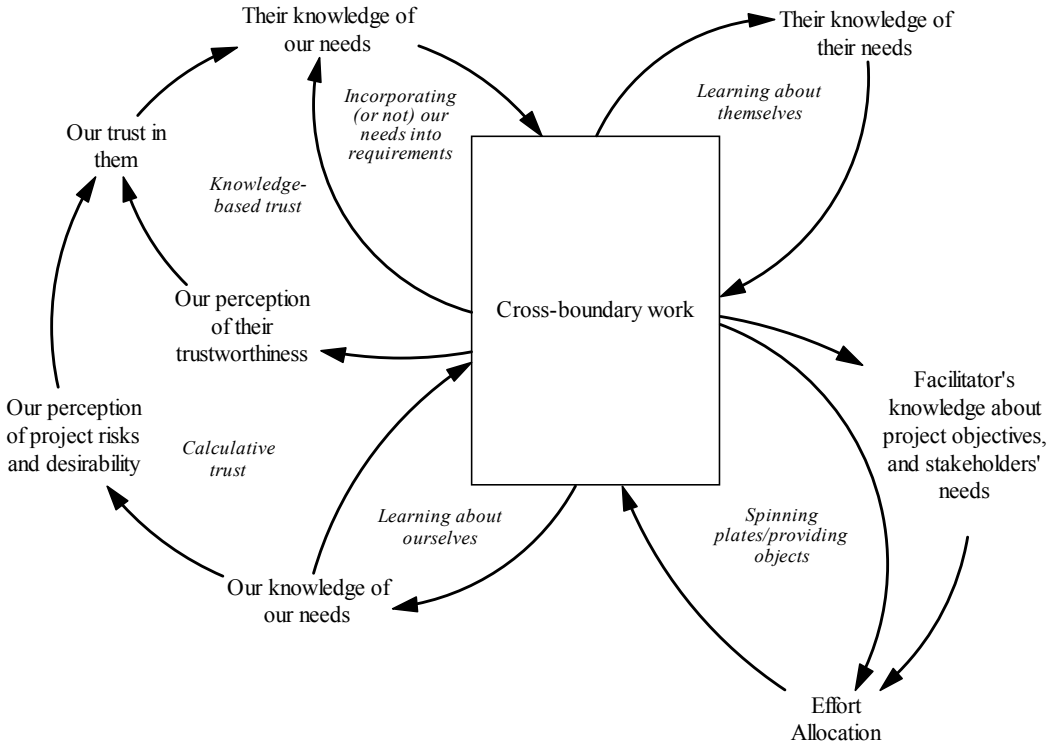

Figure 4. The impact of trust in the process of knowledge sharing across boundaries.

A more relevant discussion about the nature of knowledge sharing in a cross-boundary setting such as defining requirements for an information system can be organized in terms of the three approaches to share knowledge across boundaries identified in the literature: syntactic, semantic, and pragmatic (Saracevic 1999; Malhotra 2000; Carlile 2002a). These three approaches can be associated with three different process of knowledge sharing: transferring, translating and transforming (Carlile 2002b). *Knowledge transfer* occurs at the syntactic level, when groups of people share a basic syntax, as providers and BHS shared the data dictionaries of each of their systems and databases. *Knowledge translation* occurs when individuals or groups share meanings that promote the appropriate interpretation of the shared syntax, as providers and BHS shared the

meanings of concepts such as recidivism, length of stay, first timers or repeaters. *Knowledge transformation* occurs when groups of people understand the dependencies and practical implications of their shared understandings to their day-to-day practice, like the conversations between the prototyping team and the requirement definition team in the HIMS project, which led to adaptations and modifications in the original design and to a better understanding of the quality of the data and its implications for system implementation.

As shown in Figure 4, the knowledge sharing processes is also intertwined with the process of trust development (Levin *et al.* 2002a; Levin *et al.* 2002b; Levin *et al.* 2002c). Again, the concept is not new for the literature, but the model provides a way to integrate and explore the interactions between these two processes.

The view of requirement definition as a knowledge sharing process is consistent with current theoretical and practical approaches existent in the literature. Moreover, problems related to learning and sharing knowledge are recognized as the main obstacles to the effective development of requirements (the WITHIN, BETWEEN, and AMONG obstacles identified by Byrd (1992) are an example of it). However, and as pointed out by Black (2002), the collaboration is not limited only to the adequate sharing of knowledge, but it involves the creation of new knowledge. Providers in the HIMS project, for example, developed a shared vision about the feasibility of the project, as they learned about the differences and similarities of their practices solving the AMONG obstacles described in the literature.

The social process associated with the creation of this shared vision appears to be related with three feedback processes in the interaction (see Figure 5).

The first is related to a particular facilitation design that involves two main stages, one divergent and the other convergent in nature. The convergent part of the interaction, in which the participants look for emerging patterns in their information needs, is closely related to the development of this shared vision. Providers in the HIMS project had the opportunity to create 10 categories of services by grouping all services provided in their facilities. Through this process, they learned about themselves and created a shared

picture of the homeless services in NYS. Participants in the MACROS project have also made intensive use of this facilitation design throughout their collaboration in the project, during the early stages of definition of the technical assistance function, and during the meetings with the advisory committee. Other practitioners in IS development have found the approach to be useful in reaching agreement and in creating shared visions in the definition of requirements (Boehm *et al.* 2001; Gottesdiener 2003).

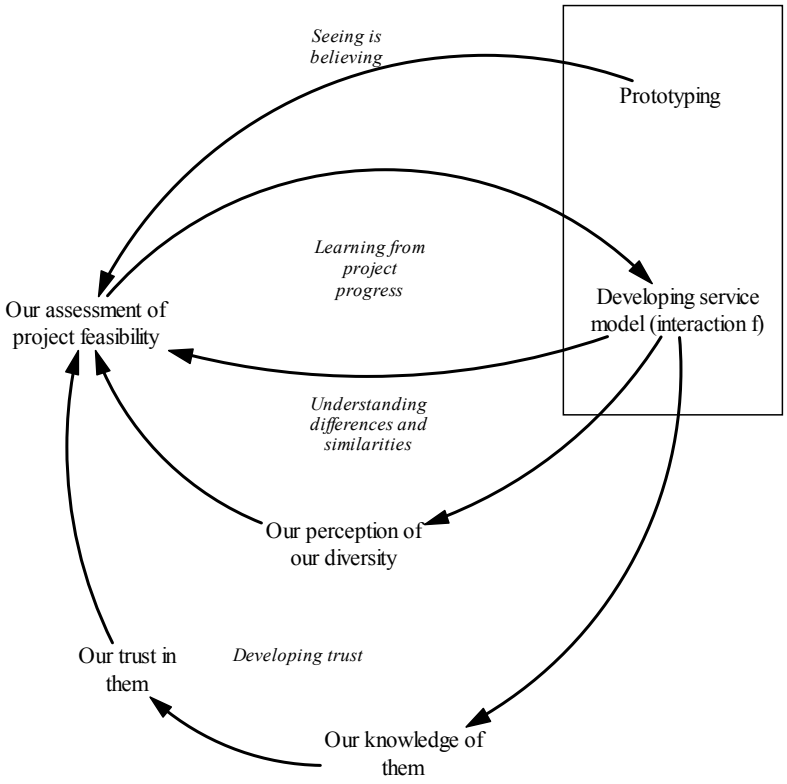

Figure 5. Knowledge creation and the social processes of requirement definition.

A second component in the social process of creating shared vision consists of the use of artifacts or boundary objects that facilitate the process of sharing knowledge across boundaries. A particularly important object in the HIMS project was the prototype itself, which constituted a concrete artifact to prove the utility and feasibility of the system. In the MACROS project, the contact repository prototype played a key role in the diffusion process. As one of the project leaders mentioned in a presentation of the project, "seeing is believing."

The last component of the social process in the HIMS development model is the effect of trust in the creation of this shared vision. Lower levels of trust will limit the effectiveness of both the process facilitation and the use of boundary objects.

Finally, another important accumulation of knowledge involved in the model is related to acquiring the experience of working together. HIMS participants acquired this experience in their continued efforts to advance the vision of HIMS. When discussing this assumption with participants of the MACROS project, for example, several of them made reference to a common meeting design used in their collaborations composed by four different stages, Forming, Storming, Norming, and Performing (Gottesdiener 2003).

Implications for practice

The theory development process—consisting of the case studies, modeling and simulation—also suggests several practical implications for groups participating in IT innovations similar to HIMS or MACROS. We will summarize the most important implications in this section of the paper.

Managing complex projects is an activity that starts with a high level of uncertainty and ambiguity. In spite of having an initial problem definition and a well-defined objective, the BHS/CTG team members spent several months learning about the project and the stakeholders, and refining their vision of the project. This learning process, however, facilitated the process of sharing their vision with their main stakeholders. Similarly, the MACROS group spent a long time drafting and redrafting their initial document to transform it in an effective communication object with the rest of the divisions at OSC. The apparently long period of inactivity in the model simulations corresponded to this initial learning process.

Planning and reflecting is a continuous process. Plans in complex projects constitute general guidelines to the development of specific project-related tasks. The initial uncertainty prevents the creation of a specific plan that can be implemented step by step. The CTG/BHS team adjusted and modified its initial plan to respond to specific constraints in the project environment such as the existent technologies in the local sites.

MACROS project leaders have also adjusted their plans several times along the process. This flexibility allowed both groups to push forward their IT innovations.

Partial simulations with the trust structure suggest that, although the a priori component of trust has an important impact in trust development, the efforts to build trust in the day-to-day interactions can overcome the initial weight of the a priori component. Moreover, early efforts to develop trust are more effective than those that occur in later stages of the interaction. Although the development of trust, because of the attention to the relationship, is a gradual process, the lack of attention to the relation can revert the process much faster. Finally, managing the institutional component of trust (i.e., reducing risk) could be a strategy to break the initial trap of distrust.

There is a cost associated to maintain the relationships with stakeholders in the process. In the theory for the HIMS case, the cumulative effort to contact providers can be considered as a proxy for this cost. Model experiments suggest that this cost is higher in those cases where there is no a previous interaction history, and those in which the leading agency places little attention to the development of a trusting environment. That is to say, placing little attention to relationship building will require from the project leader more effort contacting stakeholders in the mid and long terms.

These experiments also suggest that managing the perceptions of risk and desirability of the project can be effective ways to promote the initial engagement of stakeholders in the project. Given the current formulation of the theory, managing the perception of risk appears to be the most effective way to promote the initial work. If the project is desirable enough, collaboration can continue even when the perception of risk increases in later stages in the project. The strategy was effective for the HIMS project, and has been used successfully also by the MACROS team.

The model suggests that is hard to create a history-based trust in as short a period of time as the HIMS case. Some of the simulation experiments suggest that the most important component of trust during the development of the prototype was the calculative one. Given this situation, the team accomplishes its goals in a very similar period of time in the situation in which there is little interest in fostering a trusting environment. However,

the experiments also suggest that the knowledge-based component will be more important in subsequent project stages.

Stakeholders in interorganizational projects like HIMS or MACROS are actually different; they have developed different business processes and languages in their day-to-day work. Recognizing and reflecting these differences back to the group can be an effective strategy for building a trusting environment. However, looking for patterns in the differences to assess what is possible and what is not is an important ingredient of an effective facilitation design. Therefore, facilitation designs that include this kind of convergent process have the potential to be more effective to reach consensus compared with those that do not consider convergent processes that look for patterns of relationships, such as the grouping of services by the shelter providers in the HIMS project, or the grouping of information needs by the MACROS Advisory Committee.

The use of prototypes and the development of a trusting environment contribute to the creation of the shared vision about the feasibility of the project. Experiments with the model suggest that although the presence of each of these elements is important in the social process, the timing of each of them is also important. Lower levels of the perception of feasibility of the HIMS are associated with those scenarios where the intense part of the work with the providers took place in a different time frame than the intense part of the work developing the prototype, or those in which the intense stage of the work with the providers took place when the level of trust was low. Being sensitive to the parallel development of these three processes could yield effective social processes in the definition of requirements.

Future Research

This final section of the paper points to possible avenues to continue with the research presented here.

Although we will point to additions and extensions to the current theory, we consider that, before increasing the complexity of the theory, more experimentation with the current model is needed. The process has been intense in the development of simulation

experiments, but to fully understand the operation of the feedback mechanisms involved in the theory, we will need to keep experimenting for some period of time.

One interesting approach to conducting such explorations involves the design of partial simulations isolating parts of the model to further analyze its behavior, contrasting it with other innovation projects.

Although model assumptions were accepted as feasible by MACROS participants, we did not try to use the same model structure to explain the development of the MACROS project. In this way, an exercise could be to explore changes in the model parameters, to assess the transferability of this particular structure to the second case or to different cases. For example, similar collaboration processes can be observed in collaborative IT initiatives in Mexico, which can be considered as additional places to test the theory. Pieces of the model such as the trust structure or the providers work structure can be used in individual studies to test the theory with other empirical evidence from collaboration efforts, collecting the numeric data and observations to "calibrate" and test those dynamic hypothesis.

There are several simplifying assumptions in the model that require further exploration of situations of facilitated collaboration. For example, the model assumes that the facilitator has the experience to guide a group process involving individuals and organizations with different backgrounds and levels of technical skill. In this way, a natural way to expand or refine the theory is to add a stock of facilitation knowledge or experience to the facilitator sector.

Another area, maybe more interesting than the previous one, in which the model contains important simplifying constraints is related to the idea that the objects used during the conversations are effective enough to facilitate the translation process across practices. Although the model does include the effects of the prototype as a concrete artifact to the creation of a shared vision of the feasibility of the project, it does not include any statement about the effectiveness of the rest of the objects used in the interaction (pieces of paper, whiteboards, etc.). Thus, another interesting path of further development of the theory involves the dynamic study of such kind of objects through additional case studies.

The current model can be also transformed into a learning laboratory, where project managers can "manage" projects by assigning staff and making decisions about the allocation of effort to the different streams of work in the project.

Finally, another path to continue with this project involves the development of a series of critical success loops for the project manager of interorganizational IT projects. The work will consist of refining and testing simplified versions of the key feedback processes presented in this paper.

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