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Barriers to ERP Implementation: An Action Research

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Abstract

This paper examines the implementation of Enterprise Resource Planning (ERP) system in a multinational organization. In doing so, it evaluates and critiques the existing literature, and then provides an alternative analysis of ERP implementation based on the concept of knowledge integration, which involves the on-going interaction cross-functionally between organizational members. By examining the case company through action research, the paper elaborates three distinctive but interrelated types of barrier that inhibit the implementation of ERP, namely relation-, structured- and knowledge-based barriers. The central message of the paper is that the implementation of ERP is not merely a technological task influenced by users' perceived usefulness. Also, the implementation of ERP is a cross-functional knowledge integration process enabled by the establishment and maintenance of social relationship intra- and inter-organizationally.

Keywords: ERP Implementation, Knowledge Integration, B2B E-commerce

1. Introduction

The growing popularity of Enterprise Resource Planning (ERP) systems can be largely explained by the change of business environment, such as the prevalence of e-commerce, as well as firms' increasing needs for infrastructures that fully integrate different information systems and business processes (Davenport, 2000). The hope of increasing productivity and efficiency, particularly the management of global operation (Bond et al., 1999; Glover et al., 1999), as a means of raising organizational competitiveness (Davenport, 1998; Waglem, 1998) underlies the rationality behind firms' motivation of adopting ERP systems. Despite its potential benefits to firms, the implementation of ERP can be complicated and problematic, as ERP system software is not a standard package which we purchase off the shelf (Davenport, 1998).

While prior studies have provided useful insights into ERP implementation (e.g. Scheer and Habermann, 2000; Markus et al., 2000; Everdingen et al., 2000; Kumar and Hillegersberg, 2000), almost none has highlighted the barriers encountered in the implementation process from the viewpoint of knowledge integration (Grant, 1999). Specifically, our understanding of the decisive change from employing a decentralized to a centralized information system strategy is limited. The essence of knowledge integration is to create an environment in which the knowledge infrastructure can effectively support the core organizational capabilities (Grant, 1999). Therefore successful ERP implementation can also be seen as developing new cross-functional knowledge, capabilities and competence for the organization.

Thus, together with the importance of understanding the barriers and finding solutions to overcome them, the extent of theoretical development of knowledge integration has aroused our curiosity in exploring the phenomenon further. Instead of providing prescriptions on how knowledge can be integrated in the process, this article aims to understand the dynamic nature of the barriers that hinder knowledge integration as well as the implementation process. Specifically, in-depth action research is conducted in a multinational enterprise implementing its strategic ERP system.

2. Literature Review

Previous studies indicate that ERP implementation involves significant change. For example, the multi-dimension of ERP implementation has triggered fundamental changes in the areas of structure (Al-Mashari and Zairi, 2000), culture (Soh et al., 2000), information strategy (Rizzi and Zamboni, 1999), and ERP distribution (Markus et al., 2000). These studies reveal that ERP implementation is a highly complex process and concludes that further research is needed to investigate issues which influence the success and failure of ERP implementation. Markus et al., (2000) and Ross (1999) caution that major problems can arise from social, cultural barriers and user resistance in most implementations, especially in multi-site organizations where significant levels of integration and coordination are required between business strategy, software configuration, technical platform, and management execution.

Similarly, as pointed out by Soh et al., (2000), a common challenge in adopting package software (such as an ERP system) successfully has been on the issue of "misfits" – the gap between the pre-written functionality offered and that required by the adopting organization. Specifically, in their study of Singaporean hospitals, Soh et al. (2000) found different types of misfits, resolution strategies employed and the related impact on organizations adopting the ERP systems. According to their analysis, it was the knowledge gap between the three parties (key users, IS department personnel, and the ERP vendor) to the ERP implementation process as the cause. While Soh et al. (2000: 50) had cautioned about the difficulties and importance of integrating the knowledge of all parties involved in the implementation process, they fail to outline the barriers which prevent people from integrating their knowledge successfully.

Thus, we argue that the critical challenge of integrating knowledge in the case of ERP implementation lies in the ability in bringing key parties together – vendors, key users and IS personnel (Soh et al., 2000). Derived from this argument, knowledge integration in the implementation process applies not only to multiple sources of knowledge (Pisano, 1994) but also to solving conflicts of knowledge capabilities, cultural and social impact (Teece et al., 1997) brought forward by different parties to the implementation process. This integration process is often met with obstacles, as knowledge is frequently tacit and embedded within routines of which few are stand-alone. Tacit knowledge within the system makes knowledge integration in these implementations slow and painful (Nonaka, 1994; Grant, 1999).

Therefore, in striving to understand the barriers of knowledge integration encountered during the ERP implementation, we adopted a view that sees knowledge per se as socially embedded and these knowledge sources are participants of these social systems (Wenger, 2000; Huber, 1991). In other words, this study will examine the dynamic nature of the barriers that were found during the ERP implementation, and a particular focus will be on the relational, structural and knowledge-based barriers.

3. Research Method

We have adopted a participative action research (AR) methodology with semi-iterative processes to develop a higher level of internal consistency in our findings (Kock, 1997). AR provides an excellent basis for an exploratory study of the implementation process. As such, it enables us to investigate the complexity and issues within the organizational context of the enterprise (Braa and Vidgen, 1999). The unit of our analysis is the implementation team where knowledge integration activities, related to the ERP implementation, is centered, while a broader organizational context is taken into account. Specifically, this study focuses on documenting the discord between these activities (Blackler, 1995). In a way, the researcher's role will be one of facilitating throughout the process of the research and creates insights through 'expert' opinion in the research process (Greenwood, 1999).

As part of the study, a complete participatory on-site study performing the role of a member within the implementation team was carried out. There was a total immersion within the context of the study. This provided excellent access and openness in terms of rapport and information. Significant access to the knowledge base and documents within the organization were given the understanding that the research will be an active part of the organizational ERP implementation. It is important to note that the organizational users are active users and being on site allows action to be tracked based on the data collected (Greenwood, 1999). Field notes of daily observations were taken as well as recording of events. This provided a deep understanding of the social and organizational context of the study.

A period of six months was spent documenting and participating at the research site during the ERP implementation. Data collection is done through multiple interviews, attending workshops, brainstorming sessions, informal conversations, socialization, discussions and meeting; this allows the researchers to "build the picture of the organization" using a joint construction of descriptive accounts of the situation (Stringer, 1996).

As part of the data analysis, the main themes found earlier were thrown back into sessions during the later stages of the implementation as part of the iteration process to gather active contextual implications and to simulate exploration to other issues or create a more in-depth analysis. This further creates a collaborative verification of the existence and that these data are contextually correct. For additional validation, method and data triangulation (Yin, 1984) were used as internal checks on the validity of the data. The comparative method approach is used while data is being collected. Data collection stage is concluded when repeated themes occur and information reached saturation (Glaser and Strauss, 1967). With the data collection done, we identified common themes, summarized the findings and iterated the action research until specific findings had shown strong relationship to the specific theme area.

4. Case Study

The company is a multinational organization whose business spans various products and services such as financial services, oil, transportation, manufacturing from semiconductors to power plants. The organization operates in 190 countries and is among the world leaders in electrical and electronic engineering. The organization has established its operations in Asia with regional headquarters in Singapore. It has a diverse Intranet and IT infrastructure across the region to support its operations.

In the recent years, the enterprise has made several acquisitions to expand its business and growth. Unfortunately, such moves have resulted in wide inconsistency in its IT infrastructures and business practices. In view of this the management in Europe has decided to adopt ERP as its core new business strategy in order to manage the diverse needs of its fast changing and growing business worldwide. The objective of the ERP implementation was to create a shared service hub for the organizational logistics and financial systems so as to facilitate multi-functional information sharing. Specifically, this objective created the opportunity to create standards within individual regions and facilitate a shared corporate service within the organization for the business, to utilize and provide a transparent network between these business units. Moreover, as commented by a senior manager, implementing ERP systems is important because the organization has grown from a traditional supply chain operation their legacy systems including CRM tools, knowledge warehousing tools functionally still lacked the capability to manage the diversity of information. The ERP system that the organization has selected is the SAP/R3 package, one that is based on SAP AG system.

Technically, the plan was to develop a common ERP platform but using multiple implementations because of the growing divergence of the business. The ERP system was to be implemented in three stages: initial preparatory stage, information analysis and requirement determination stage and implementation stage.

The entire project was estimated at US$32 billion which provides a full global rollout and infrastructure upgrading. Due to the size of the implementation and different corporate practices within different global regions, the project is divided into 3 separate entities: Europe, US and Asia (an additional entity is planned for offices not in the 3 regional groups). The distributed and decentralized management nature of the organization resulted in the business units (BUs) having very diverse implementations of each individual business area in the region.

4.1 Initial preparatory stage

The initial stage in the ERP implementation was to set up the implementation team in Singapore and to establish social networks within the organization. The Singapore team consisted of about 20 members (local as well as foreign members). Technically, the team's immediate task was to evaluate existing legacy systems and the regional practices which differed from other regions. This had to be done as the corporate policy of decentralization and autonomy resulted in having very different information systems and business practices. Initially, this decentralized policy was seen as a threat to the ERP initiatives as BUs had been fairly happy with the culture of having different practices. This decentralized tradition held implications which the team had to address before technical changes could be made. Socially, the team had to try to change the mindsets of some people through mediating and familiarizing themselves with the existing corporate environment. In particular, an initiative to socialize with the commercial heads and BU managers was taken to build trust. "This familiarization effort provided the team with better knowledge and appreciation of the organization culture, practices and systems which proved later to be very useful for the team in the implementation of ERP", as commented by an informant.

There was also a learning process to re-conceptualize the software implementation, because individual members came from diverse backgrounds and had a completely differing

understanding of the SAP system. For example, initially there were several requests for information which were related to the SAP that were defined as "vague" and "incomplete". The team discussions not only lacked understanding and in-depth knowledge on the processes, but also the context in which the implementation was taking place e.g. corporate terms, corporate policies and practices. It took several informal meetings and exchanges before a common understanding and a set of objectives was reached.

During the initial information and planning stage, discussion with the BUs had resulted in some conflicts in interest because of their different logistic and financial practices. These conflicts included how cost control and accounting, logistical policies should be practiced. For example, there were significant gaps in the financial practices and logistic practices between BUs which were results of autonomy given to them The diverse practices among the BUs had made incorporating best practices into the workflow difficult, as recalled by a manager.

To bridge the difference, senior management intervened and resolved disagreement in some of the heated discussion during key strategy formulating processes. As an informant explained, this was possible because the senior management involved were generally respected by the commercial heads of these BUs. Therefore, significant political differences can be resolved through process of mediation.

By the end of this initial preparatory phase, the team had established social contacts, gathered necessary knowledge and information within the organization. The team was in a better position to focus on managing the information and requirement phase. By then, a total of six old (redundant) systems were replaced by the incoming ERP functions.

4.2 Information analysis and requirement determination stage

The stage of information analysis and requirement determination is a critical stage in the ERP implementation. During this time, the team focuses on identifying process owners and potential process partners locally as well as contacting external partners for the ERP implementation. According to our notes taken in a discussion with the steering committee, the organization realized that global coordination and managing local and global resources were essential to reduce redundancies and for effective integration.

However, it was not as easy to achieve this realization as previously thought. For a start, the team faced an uphill task of having to search for information and extracting knowledge from the work processes. The problems arising from these are highly complex due to the complicated links with vendors and customers, established in the past through a long-term relationship. The teams developed strategies for user participation in sourcing for these hidden, unknown and complex routines.

In some cases, the team had to first solve the problem of integration across boundaries and functions which were considered highly complex due to the nature of the knowledge networks that have been built around the legacy systems for years. To do that, attempts were made to document some of this knowledge but found that significant tacit knowledge and relationships were part of these legacy system.

This required someone experienced and knowledgeable in the details of these legacy systems, however there were no clear candidates available for this task. As a result, they had to start

some of these tedious processes from scratch, as most of the previous knowledge was not documented. In other words, the team realized that they had to bring together members of different teams for documenting related processes in order to gain a collective knowledge of what was done across functions. This exercise helped the implementation team in evaluating certain needs for redundancy as well as common functions which were taking place.

In a way, the Information analysis and requirement gathering stage analyses the gaps and new requirements needed to prepare way for the implementation. The team spent significant portion of the time in preparing BUs for the change when the ERP goes "live" in the Implementation phase.

4.3 Implementation Stage

Once the system was coded according to the needs of the systems and business practices, the team's objective was then to bring the ERP system into the production environment. Frequent technical meetings were carried out among the consultants and the technical developers. The users were asked to assist in verifying and finalizing the data that were extracted from the legacy systems (usually on 3-tier architecture) using automated data-extraction tools (e.g. Sybase, VB Report applications and ODBC connectors).

Throughout the implementation process, the team was constantly reminded by the BUs manager of the need for a functionally complex and culturally sensitive system - one that would support an autonomous environment of control and competition.

The team discovered that at the beginning of the implementation stage, most users were reluctant to take up new responsibilities or offers of help through participating in discussions for fear of being held to blame. The team had to introduce a participative policy capable of nurturing a new understanding and building trust among the users. As noted by an informant,

> "After the participative policy was introduced, I noticed that personal responsibility was emphasized, employees were not blamed when things go wrong, rather, they were often offered help. Mistakes made were taken as 'lessons learnt' and viewed as opportunities for learning. Most people takes it upon himself or herself to solve problems to ensure things are smooth flowing, even if it does not arise within their sphere of work. The ownership and responsibility for failures was reduced down to a minimum."

Overall the implementation was seen, according to the steering committee, as a cutover to production from the technical perspective. The business perspective was seen as chaotic in the first two weeks after the implementation. User feedback was captured in a post implementation review.

5. Analysis and Lessons Learnt

5.1 Relation-based Barriers

5.1.1 The Challenge in building Networked Relationships in the Early Stage

The lack of attention to relation-based barriers often results in complication during the enterprise system implementation (Hammer and Champy, 1993, Davenport, 2000). Based on our own observation, social impact on the implementation process was also evident (Markus, et al., 2000). As we have seen in this case, the organization was determined that it needed to foster and create a set of supportive working relationships for the ERP implementation. We found that supportive relationships alone can help improving significant breakdowns in communication and can also be a vital link to effective knowledge integration which plays a big role in implementation (Taylor, 1998).

In the beginning, the organization was aware that that everyone in the implementation team was totally new to each other, hence making it difficult for achieving immediate relationship building processes, unless a strong support was established. Two relation-based barriers were identified and removed by the team. The first barrier identified was that when the team was first formed almost everyone is a stranger to each other as they were chosen to represent their various groups in a multi-dimension implementation team (Teece et al., 97). This began to create some problems but was discovered by the management almost instantly. Specifically, the ERP team then instigated a process of relationship building through an increased information sharing and an increase in social interaction among users and the implementation team members.

Secondly, during the initial preparation stage, the team realized that there was a large portion of the knowledge within the ERP implementation that was non-codifiable and socially sensitive, which could create user resistance.

To overcome this obstacle, the organization had encouraged user participation to allow the identification of tacit knowledge within the work processes. It was done through informal discussions and numerous brainstorming sessions. As a result, stronger common knowledge links were found fostering social relationships among the users and the team. These relationships were crucial as the team used them to determine its ERP implementation requirement later. Based on our finding, we agreed with Markus and Keil (1994) that user participation is not the total solution in ERP implementation. However, we did realize that having a "relation-based knowledge link" among the active users could help determine the appropriate implementation requirement. This was because, as shown in this case, having a strong "relation-based knowledge link" provides a governed structure through which meaningful user discussions can take place and conflicts which Markus and Keil (1994) discussed can be significantly reduced.

5.1.2 Roles of Communities of Practice

In the implementation phase, it was noted that large portions of the information and knowledge is embedded within the business practices, so users were often recruited for their social networks and their knowledge of the workflow. These people formed strategic groups to facilitate and enhance the value of their co-existence. These groups of people later formed

their communities of practice (Wenger, 1999), which were found able to share insights of the organization (Wenger, 2000). These communities were evolved as a result of knowledge sharing needs and were used to coordinate activities across different regions. In a way, we found that, members of these communities provide expertise of the global workflow and global insights of how the global information systems infrastructure has functioned. They not only provided the expertise but also helped increase knowledge integration during regional ERP implementation.

They differ from network relationships as they are existing communities that are linked through their interest and practices (Wenger, 1999, Storck and Hill, 2000) and not by the simple reason of socialization. Members of these communities were critical to the implementation as they understood some of complex knowledge embedded in the systems more than others, especially when knowledge and events within one part of the organization was contextually different to other parts of the organization. In other words, members of these global communities play a supportive role to the "global corporate ERP ecology".

In fact, we discovered that some of the knowledge transfers were done through informal channels of the communities. The distributed nature of knowledge within the enterprise helped created socially embedded structures which have evolved over time. Such embedded structures are important to the organization, as the global knowledge and expertise needed in the implementation were found dispersed around the organization. On the other hand, while the temporal nature of these communities (Storck and Hill, 2000) makes identification of knowledge difficult during the initial information gathering and requirement stages, it was found useful in adapting to the "ecology". In other words, the communities played a big role in facilitating the implementation by providing the contextual support.

5.2 Structure-based Barriers

5.2.1 Should the ERP Systems be Similar to the Legacy System?

The case evidence shows that most of the users seem to be interested in how consistent and similar the new ERP system was when compared to the legacy systems. This was partly due to the failures encountered in some of the earlier ERP implementations in certain parts of the region which resulted in having more work for the users which many in the organization called it "undesirable innovation". It also resulted in high duplication of efforts and global inconsistency in routines. Segmented knowledge links were made across the region.

This particular concern also shows users' reluctance to change and re-learn in this situation. The concern about users preferring old procedures and not adapting to the new ERP environment was prevailing [Soh et al., 2000, Taylor, 1998]. The team saw this as a technological constraint as well as a social issue from the perspective of mindset or culture. To change the mindset, what the ERP team did in the last phase of implementation was make the system look outwardly similar to the legacy. They did this by integrating knowledge through mapping of information, processes and routines of the legacy system into these ERP systems with the use of conversion templates (Taylor, 1998). For identification of the knowledge, the team mapped the existing knowledge captured within manuals and databases directly into the ERP implementation through calculations and re-codification into what the users defined as familiar. The codification of existing and familiar knowledge within the ERP system was directed towards person-to-person communication. Hansen (1999) has defined it as more personalized approach to knowledge.

Willcocks and Skyes (2000) argue that the real value adding opportunity of ERP is to radically re-shape the business to exploit the new automation which was more than just communication. However, the need for a familiar environment to bridge its cultural, practices and core competency within the inadequate standard functionalities (see Scott and Kaindl, (2000), and O'Conner and Dodd, (2000) resulted in customization in several areas of the ERP implementation instead of changing the social and organizational environment.

5.2.2 Enabling Structures within the Organization as Barriers
Harrison and Leitch's (2000) study indicates the importance of creating knowledge- enabling structures around its existing information systems for enabling intra-organizational knowledge transfer and sharing. These organizational structures are frequently seen as the construction of "organizational memory" and "organizational culture". Their existence in the organization has been for more than just economic reasons (Boudreau and Robey, 1999). However, in the process of creating these enabling structures, sometimes they become barriers as shown in our case. For example, we discovered that boundaries created as enabling structures within the organization could be hindrances to cross-functional knowledge integration.

In the case, although the organization has a matrix-based structure with a flat hierarchy but because of the need for cross-functional innovation, the organization has created complex relationships through overlapping functional BUs. As a result, most of the important knowledge within the organization has been embedded and sometimes hidden in the network. Therefore, this networked structure makes boundary penetration difficult and the exchanges of tacit knowledge also impossible. Unlike indicated in Walsh and Ungson's (1991) study, users in this organization were not very much in control of handling these knowledge-enabling structures. Instead, they were creating boundaries around their groups which prevented smooth flow of knowledge for the implementation to work properly.

On the other hand, in a sense, by establishing enabling structure could also trigger "structural integration" which can create innovation and flexibility needed in a cross-functional project arrangement (Kanter, 1988). In particular, we discovered that structural integration helps to improve knowledge integration through users' willingness to share information and ideas in the form of political transparency or process de-layering. As our findings suggests, the process of de-layering increases knowledge span in terms of knowledge dissemination just as well as the former structurally designed hierarchy (Bahrami, 1992). In a way, these enabling structures are significantly similar to what hierarchies do in terms of knowledge and information dissemination but lack the political transparency of networked and hypertext organization (Nonaka, 1994). These structural changes in the context of the ERP implementation are the ones that are political and cultural in nature. These can create an additional dimension of social politics within the ERP implementation indicated by Markus et al., (2000).

5.3 Knowledge-based Barriers

5.3.1 Managing Conflicting Interest and Knowledge between BUs

The ERP implementation is, in essence, an integrative mechanism, connecting diverse departments so as to establish an integrated process (Hammer, 1999). Due to the decentralized organizational structure design and an autonomous environment, the

organization has created abundance of highly adaptive and effective logistic and financial systems within individual BUs. In other words, each of these BUs units have their own separate logistic and financial systems which were customized for their products and services to ensure that the BUs' interests and highly specialized knowledge were effectively managed and not changed. In other words, the autonomy given to these BUs had resulted in diversity of interest and competencies (Teece et al., 1997) in specific knowledge areas (Pisano, 1994) which made implementation of ERP fairly difficult.

In a way, the issue of conflicts in knowledge and interest was seen as the primary cause of some of the breakdowns in implementation. This is because conflicts could affect the effectiveness of reach and span in knowledge sharing (Grant, 1999). This may also imply that knowledge embedded in the ERP system will need to be sufficiently generic (context-independent work processes) to allow smoother processing of knowledge integration of multiple BUs, retained standardization and transparency throughout the organization leading to imperfect integration. The ERP system in this study has itself developed a standard to manage conflicts through what we seen as a "best practice reference model" that created a contextual cyber "ba" (Nonaka, 1991) which predefined expectations and process knowledge to facilitate integrated communications (Scheer and Habermann, 2000).

We also noted that innovative cooperation was not evident in the implementation process as the organizational culture is one of competition. In fact, it was in the ERP implementation that the management realized that several of its processes were redundant. While redundancy of information created within the ERP does encourage knowledge creation links (Nonaka, 1991), it also helped reduced conflicts and generate knowledge between teams.

5.3.2 Integrating With External-based Knowledge

The effect of integrating with external knowledge was cited to have played a significant role in the growth of the organization which such integration have provided the set of service infrastructures that spanned across boundaries and BUs (see Fuchs et al., 2000, Broadbent et al., 1999).

It is also worthy to note that the future for organizations to go into e-business is to ensure that it do not work in isolation (Scheer and Habermann, 2000). E-business demands that the organization be global and effectively managing cooperation and alliances which are geographically distributed (Bond et al., 1999; Glover et al., 1999.) Hence, so were the company's global partners who are already global and do not just use a single channel for distribution and communication as the global market is made up of complex value chains (Anderson, 2000). These chains are significant in e-commerce through the implementation of virtual links and virtual organizations that can reduce the time-space factor altogether. In the case of this organization, the ERP system has shown significant impact on inter-organizational transformation and business alliances through social and cultural changes.

The effort to integrate with the external linkages and knowledge during the ERP implementation was found supported not only through electronic communication means, but also a continuous working relationship which resulted in creating "knowledge links". These knowledge links are important to the organization as they create new capabilities (Badaracco, 1991) as well as across organizational boundaries. We established that these knowledge links ensured that cross-organizational knowledge integration and communication could be effectively maintained. This sentiment was similar to that mentioned in Soliman and

Youssef's (1998) work which has highlighted the impact of communications on ERP systems implementation.

6. Conclusion

There are significant amounts of uncertainty and risk in the ERP implementation. However, very little is known about how an organization adapts to the new information system environment in which our study revealed significant contextual, social and cultural changes.

In this study, an ERP implementation process of 6 months was examined to understand the barriers encountered. The table shows barriers found in different phases of the ERP implementation.

Stages	Barriers	Issues
Initial Preparatory Stage	Relationships Structural	Network Relationships Communities of Practice Legacy Systems Organisational Practices Conflict
Information analysis and requirement determination stage	Knowledge Structural	Knowledge Sharing Organisational Routines
Implementation Stage	Knowledge Structural	Mindset & Culture Cultural Conflicts

Table 1

Findings show that there are significant barriers in the implementation process and that the process is interdependent of the socio-technical constructs found in the organization. The study contributes significant insights on the complexity in integrating knowledge during the ERP implementation process. It also discussed the underlying social construction of knowledge integration within the ERP implementation. The main theoretical contribution of this paper is in highlighting the complex barriers of knowledge integration that underlies many ERP implementations. Finally, we conclude that to be successful in ERP implementation, there has to effective maintenance of a socially collaborative relationship as well as a technological collaboration.

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