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# Embedded Knowledge and Situated Contexts: Exploring the Ground beneath Information Systems Adoption

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**Abstract**

*The study reports an unsuccessful adoption of information systems in a joint venture initiative. It proposes a knowledge transfer perspective to reconsider information systems adoption. According to this viewpoint, Information systems may be implemented successfully but the internalization can still be ineffective, leading to ultimate adoption failure. IS adoption may fail because the knowledge, embedded in information systems, emerged from the source side, is incongruent with the actual practice (knowledge) enacted from the situated context in the recipient side. A major implication of this research is that, to ensure IS adoption success, it is important to examine the embedded practice (knowledge) and its situated contexts between the source and recipient party.*

**Keywords**: IS adoption, Knowledge transfer perspective, Internalization

## 1. Introduction

What impedes IS (information systems) adoption? Previous literature has explored barriers, diffusion, and social forces inhibiting system adoption. However, a less explored dimension is how the knowledge embedded in information systems may influence adoption in a given organizational context, of which the system is originated from. This study seeks to provide a contextualist analysis of information systems adoption (based on Kostova, 1999). Specifically, this study investigates information systems implemented in a Sino-German joint venture in China.

This paper considers information systems adoption as a knowledge transfer process and explains the impediment stemming from the source and recipient contexts (Attewell, 1992; Kostova, 1999; Orlikowski et al., 1995). This offers a unique contribution to IS literature. The difficulty of IS adoption is examined through the developmental dynamics of implementation and internationalization, across two organizational contexts. This paper seeks to analyze the embedded practices (i.e. knowledge, values and assumptions) underlying a given information system and emphasizes that IS adoption requires a close examination of its embedded knowledge emerged from its situated context. Our research suggested that failure to acknowledge such contextual incongruence may cause insurmountable adoption difficulties and eventually continual IS failures may ensue.

## 2. Research Framework

There are two discernable streams of IS adoption research. The first is devoted to identifying factors associated with IS adoption difficulties. For instance, Davis (1989) suggested a technology acceptance model in which perceived usefulness and perceived ease

of system use determines user's acceptance of information systems. DeLone & McLean (1992) explained problems that may cause IS failure: system quality, information quality, IS usage, user satisfaction, individual impact, and organizational impact. Sauer (1993) summarized 12 categories of factors consist of user involvement, top management commitment, value bias, mutual understanding of business needs between the technologist and user, design quality, system performance, project management effectiveness, resources adequacy, situational stability, management control processes, implementation process, and individual difference. However, these studies failed to recognize that IS implementations are often dynamic, and that the state of specific factors can change in the course of technological adoption (Akkermans and van Helden, 2002).

A second research strand stresses the role of social actions embedded in the organizational context. Four useful perspectives have emerged to address this issue: organizational politics, organizational culture, institutional theory, and organizational learning (Robey and Boudreau, 1999). The analyses of politics, culture and institutional forces are not mutually exclusive. In many situations, these forces interact with each other in IS failure projects. An example is the London Ambulance Service's IS adoption failure (Beynon-Davis, 1995). This case study examined the adoption of a Computer Aided Dispatch System in terms of exchange relationships among the project organization, stakeholders and the environment. The resulting failure was analyzed in relation to the climate of mistrust, the unproductive culture of the London Ambulance Service, and the industry's political behavior.

However, the extant literature is insensitive to an alternative perspective which analyzes IS adoption difficulties with regards to the embedded knowledge and situated context. Attewell (1992) noted that firms fail to adopt information systems effectively because the knowledge needed to use such systems is acquired much more slowly and with considerably more difficulties. The users may have to spend several years developing an understanding of its embedded knowledge before assimilating the systems into their work routines. Robey, Ross & Boudreau (2002) highlighted two types of embedded knowledge in ERP (Enterprise Resource Planning) systems. The first barrier is related to "configuration knowledge" (related to system features). For example, most adoption difficulties stemmed from the lack of distributing configuration knowledge throughout the organization. On the other hand, "assimilation knowledge" is related to learning new work processes and technology-induced changes. This involves teaching the concepts of new process-orientation as well as providing training addressing broader organizational changes so that users may assimilate the integrated knowledge of new systems, structures and processes.

Kumar, van Dissel, and Bielli (1998) examined the adoption difficulty of an electronic marketplace called SPRINTEL in Prato, Italy. In this case, IS adoption failure needs to be understood in terms of the basic cultural differences between American and Italian societies. The research indicated that the adoption of an electronic marketplace is not only a matter of technology application but also involves transferring incongruent social values which define how interpersonal trusts and economic exchange are developed. Pratesian traders relied more on reputation mechanisms to produce trust in business exchange, rather than on the market mechanism (impersonal trust) embedded in the technology (developed by the American designers).

Lam (1997) pointed out that the nature of embedded knowledge is affected by its situated context. She found that knowledge transfer between a British and a Japanese electronics company is significantly influenced by knowledge that is embedded in three different situated contexts: education system (of a particular society), production process (e.g. sequential vs. overlapping), and community (i.e. whether knowledge is transmitted via formal documentation or informal socialization) contexts.

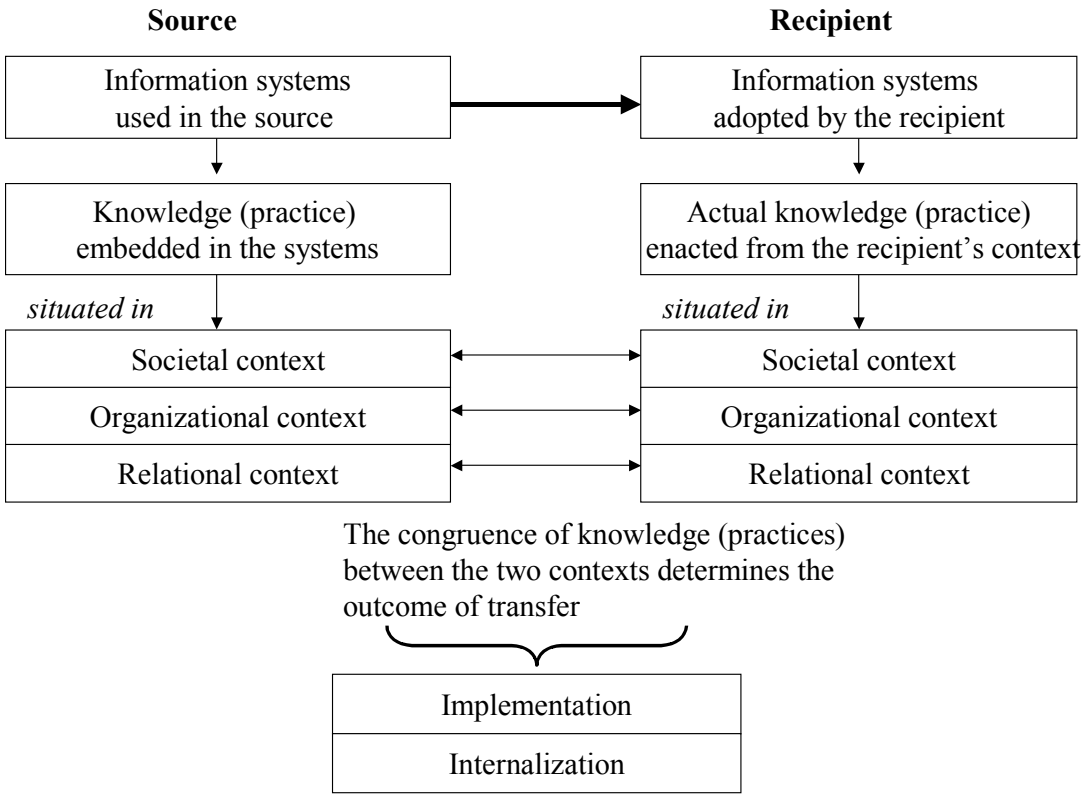
Mitev (1996) provided an empirical substantiation of embedded knowledge. She

investigated French Railways' computerized reservation system, SOCRATE (*Système Offrant à la clientèle des Réservations d'Affaires et de Tourisme en Europe*). The adoption was unsuccessful because the imposition of a technological solution resulted in unproductive power play between the managers and the staffs, leading to a strike by railway staff (relational context). The implementer failed to acknowledge that SOCRATE resulted in a drastic change in the staff's work patterns and career promotional structures (organizational context). Moreover, SOCRATE adopted the American airlines reservation systems (SABRE) to French railways. The railway station as the basic unit of system design was replaced by a concept of *relationship* between two stations, which is embedded in SABRE's design. SOCRATE had 22,000 relationships and 2,400 railway stations, whereas SABRE only had 80 relationships. The ticketing systems and price policies introduced through SOCRATE radically changed railways users' traveling behavior and rail workers' practices, which are grounded in important cultural dimension of French society (industry and societal context). The failure was thus revealing through an analysis of embedded knowledge and situated context.

In a similar vein, Kostova (1999) analyzed knowledge transfer in cross-organizational context (from parent company to subsidiaries) and suggested that the success or failure of knowledge transfer is determined by the outcome of *implementation* (i.e. how well the systems are implemented technically) and *internalization* (i.e. how well the systems are integrated with the internal processes and values). The outcomes are affected largely on the relational, organizational and societal context between the source and recipient sides. In the relational context, the influencing factors include commitment, trust, and identity. In the organizational context, corporate culture, institutional mechanism (i.e. whether the institution facilitate learning and change), and compatibility of transferred practice are the three prominent factors. In the societal context, the acceptance of practice is determined by regulative, cognitive, and normative institutional environment. For Kostova's (1999) conception, the effectiveness of transfer depends on whether the recipient has a psychological ownership of then transferred practice. However, while Kostova (1999) stressed the influence of contextual factors on the acceptance of practice, she was insensitive to how the new practice can be internalized with the recipient's existing processes, structure, and values.

The concept of knowledge embeddedness and situated context offers two major implications to IS adoption. First, information systems are not simply static, technical artifacts (Orlikowski and Iacono, 2001). Every system is embedded with certain configuration and assimilation knowledge, of which certain value systems might be "inscribed" (Knights, Noble, and Willmott, 1997). Second, such embedded knowledge is emerged from its situated context over time. Knowledge emerged from one context may not be accepted readily by people who gain their knowledge stemming from an incongruent context (Nidumolu et al., 2001; Orlikowski et al., 1995; Schultze and Boland, 2000). Consequently, the success or failure of IS adoption is determined by whether its embedded knowledge is congruent with the recipient's situated context. This concept is depicted in Figure 1, a research framework employed by the present research.

**Figure 1. An Analysis of IS Adoption from a Knowledge Transfer Perspective**




## 3. Methodology

### *3.1. Site selection*

The selected case is called BeijingAir (a disguised name), based in China. BeijingAir was the recipient firm which initiated a joint venture with GermanAir (the source; pseudonym) over a period of 15 years. The aim was to transfer GermanAir's best practices to BeijingAir. The scope of transfer includes organizational structure, aircraft maintenance expertise, human resource systems, information systems, and other managerial knowledge.

In October 2003, in order to improve its working efficiency within MRO (Maintenance, Repair, and Operation) process, BeijingAir, at the suggestion of GermanAir, implemented the SAP systems (for MRO), following GermanAir's own successful implementation of a similar system. However, the same system and the same implementation process do not lead to the anticipated result. Instead, a system which was valuable at GermanAir was found to be unacceptable by BeijingAir's employees. This case thus offers a rich context to analyze IS adoption in the background of knowledge transfer.

### *3.2. Data collection and analysis*

We visited the research site in April (2003) and the other in January (2004). Each visit lasted 10 days. In-depth interviews were conducted with various key persons associated with the SAP implementation. In BeijingAir, interviewees included Chinese managers and engineers, as well as German managers. The interviews were audio taped by the interviewers. In total, 40 interviews were conducted during the two visits. In addition to the interview data,

we collected documentation and reports referring to SAP implementation in BeijingAir. We asked questions with reference to the research framework (Figure 1). For instance, we explored how the SAP systems were used in the GermanAir by asking the German managers how the systems were supported by the relational (how people collaborate), organizational (how the systems were used to support GermanAir's existing practices), and societal (industrial background and educational systems in the German society) contexts. We then asked the Chinese managers and engineers about the problems encountered during the systems adoption period (from October 2003 to January 2004). On this basis, we traced how the systems might be incongruent with the actual practice within BeijingAir. Then, we asked the subjects to explain how the practices (knowledge) were situated in the existing relational, organizational, and societal contexts in BeijingAir and Chinese society in general. Our goal is to identify the incongruence between the knowledge embedded in the systems (employed in GermanAir) and the knowledge enacted from the actual practices (in BeijingAir). We analyze such knowledge incongruence by relating to the three levels of context in the respective company.

## 4. Research Findings

### *4.1. Company background*

BeijingAir was a subsidiary of a state-owned aircraft maintenance company, initially with the capability of providing maintenance service to Soviet-made aircrafts. As the Soviet-made aircrafts were gradually replaced by aircraft manufactured in the US and Europe, the firm needed to acquire new maintenance know-how. BeijingAir initiated a joint venture with GermanAir, a world-famous aircraft maintenance corporation which has good reputation of high efficiency and quality aircraft maintenance. By collaborating with GermanAir, BeijingAir had made significant growth. By 2003, BeijingAir's service capacity had extended to line maintenance of Boeing 737, 747, 757, 767, 777, MD11, Airbus A340, to aircraft overhaul of Boeing 737, 747, 767, 777, in addition to engine overhauls.

However, BeijingAir also encountered some roadblocks. One of the biggest challenges was low productivity. For example, it only took 35 days to complete a D check of Boeing 747 in GermanAir, while in BeijingAir it required 55 days. The extra 20 days not only meant addition cost but loss of revenues (about ￥16,000,000 loss for 20 days). An internal investigation found that the order management process in BeijingAir was ineffective. It often took 3-4 days to order a component. However, in GermanAir, with the support of SAP systems (for MRO), the process could be completed in one day. Following GermanAir's suggestion, in October 2003, BeijingAir implemented SAP to replace its old information system MAVIS, with the assistance of a domestic system integrator.

On 1 October 2003, the SAP implementation included financial management, ordering systems, and personnel management. Surprisingly, after three months, engineers in BeijingAir found that the SAP systems took them even more working days to order a component than the old systems. As one project manager noted a typical problem:

> Using MAVIS, it may take three days to order an axletree. If the axletree is urgent, we can send the order form to the material department personally and it can save some time. But using the new system, all processes should be done on computers. However, the new system does not support multiple users operating simultaneously. Often, we cannot make an order through SAP because other people are online. The situation becomes worsen. It took us 6-7 days to order a part. If it is an urgent ordering, we run the risk of operational disruption.

The German managers were perplexed by such complaints. Back in Germany, the SAP systems were used effectively to facilitate inter-departmental collaboration. The outcome could be translated into shortened turn-around-time (TAT) of aircraft maintenance. Most German managers considered the adoption failure was due to the cultural inertia situated in BeijingAir. They perceived that the organizational culture was not conducive to effective collaboration like their German parent company and most Chinese engineers were unable to take up required responsibilities. For example, one German manager explained a common problem:

> In GermanAir, if we order parts, our engineers will follow through. They will fill in the forms, constantly checking whether the parts have arrived. If anything goes wrong, they will make sure alternative parts are ready for overhaul in time. But, in BeijingAir, the engineers fill in the forms and the job is considered done. They never follow up and take further actions. The SAP systems won't work if no one wants to take any responsibility.

However, can the adoption failure really be attributed solely to the organizational cultural issues? Are these Chinese engineers really ineptitude and unable to afford responsibility? The research shows otherwise. The following sections compare the knowledge embedded in the SAP systems with the practice enacted from BeijingAir. The comparison is analyzed with reference to relational, organizational and societal context between the two parties.

### *4.2. Societal Context*

BeijingAir historically was a state-own company where political agenda has a higher priority than organizational performance. In this social system, the inter-departmental collaboration was hindered by a dual management system in which the managers execute job routines and a party secretary was placed in each major division (for facilitate the execution of political agenda). As a result, the coordination mechanisms were fragmented to serve the purpose of managerial control. This control system was still evident in 2003 even when the organizational structure was replaced with that of GermanAir.

Moreover, there were many clone products circulated in the aircraft component market in China. The quality of these components was not incomparable to those of established suppliers. BeijingAir, with limited capital, was required to strike a balance between quality and price. BeijingAir had to buy components a list of suppliers whose products can satisfy the quality requirement as well as the price requirement. But the firm also needed to protect the confidentiality. Meanwhile, it was a mandate to ensure that low quality clone components would not come from the "back door." Additionally, BeijingAir believed that employees might destroy the system inadvertently or steal confidential information from the system, if everyone was given access to the SAP systems. Components were very expensive. Any wrong order would cause cost overrun to BeijingAir. Hence, there were many auditing procedures to oversee each order placed and the ordering form of spare parts was very complex, compared to that of GermanAir. For control purpose, only a small number of engineers could have the permission to order components through the SAP systems. These engineers were also afraid to take any responsibility because any mistakes made could mean a career liability in the organization. The complex order forms, privileged access to the information systems, lack of responsible staff, and convoluted auditing procedures were in many ways incompatible with the practices assumed in the SAP systems.

In contrast, in GermanAir, every engineer was given the permission to use the SAP systems to order parts. The German firm assumed their engineers were trustworthy; they

would not steal parts by placing ghost orders; they were reliable in data entry; and they would order parts with discretion (by considering the cost and efficiency factors proactively). In GermanAir, any engineer could place order directly to the SAP systems and needed not to fill in extra manual forms.

Back to BeijingAir, the ordering forms were filled manually. Through two to three auditing procedures, the forms were sent to the selected engineers for data entry in the SAP systems. The SAP systems were also redesigned so that only one person is allowed to use the system at a particular time. After data entry, there was another auditing procedure to ensure information integrity before the electronic order was formally issued. This thus induced significant delays and system downtimes.

### *4.3. Organizational context*

In BeijingAir, the order placement center was spread over various production departments. This decentralized organizational structure is not compatible with the ordering management principle in the SAP systems, which emphasizes centralized ordering management. For example, the employees who are responsible for ordering engine parts are based in Engine Service Division. The employees who are responsible for ordering airframe parts were assigned to the Aircraft Overhaul Division. In this organization, they had to cross-order parts from other departments, which increase the complexity of coordination and order management. If the engineers from Aircraft Overhaul Division needed to order an engine component, they had to collaborate with the order-processing unit in Engine Service Division. The engineers of ordering subunit in the Engine Service Division often would give a lower priority in other division's requests than their own division, even for some urgent parts. The longer lead-time of order processing, the longer the turnaround time in the aircraft maintenance project, as one project engineer (in Aircraft Overhaul Division) remarked:

> For the components in airframe, we can process the ordering forms in our own ordering subunit. The ordering time will not take too long. But we have no control over parts processed by other ordering units. They always say that they have a lot of urgent ordering forms to deal with, but they do not know how urgent the part is in our division. In this situation, we can do nothing but waiting.

In GermanAir, the organizational principle supported every employee to place orders in real time manner. The ordering forms are centralized in a special unit, called Material Department. The electronic ordering forms would be transferred to this department through the SAP systems. The engineers could integrate the ordering forms and allocate collectively the priorities for each order. For the urgent orders, they would give them top priority by contracting suppliers immediately. GermanAir also had excellent supplier networks. In average, the urgent orders could be fulfilled within one day and the regular orders could be completed within two days, in contrast to weeks in BeijingAir.

### *4.4. Relational context*

In BeijingAir, the engineer preferred informal personal communication and were not used to writing formal documentations. Most of the documentations were not written professionally. The data-entry engineer had to trace back and check with the person who initiated the ordering documentations because the writings were almost incomprehensible. This re-checking procedure consumed a lot of time but it was necessary because, if this procedure was neglected, unclear documentations could cause wrong data entry and thus

more trouble.

The SAP systems assumed that the engineer was capable of producing accurate data entry. In GermanAir, most engineers were known for their "German Thoroughness" in writing technical documentations, even though English was not their first language. The German engineers tended to be task-oriented. In contrast, the Chinese engineers emphasize more of *Guanxi* (relationships) building and thus tended to prefer personal "chitchats" than formal communications. For them, the SAP systems seemed to make their socialization impersonal.

## 5. Discussion

This study attempts to offer an initial assessment of IS adoption difficulties by considering IS adoption as a process of knowledge transfer. It stresses the importance of the embedded knowledge and situated context. Under this assumption, IS adoption may fail because the knowledge, embedded in information systems, emerged from the source side, are incongruent with the actual practice (knowledge) enacted from the situated context in the recipient side. The selected case helps us understand why the adopted information systems may be implemented effectively but fail to be internalized within the recipient organization. A major implication of this research is that, to ensure IS adoption success, it is important to examine the embedded practice (knowledge) and its situated contexts between the source and recipient party.

Furthermore, this study also offers an opportunity to rethink Kostova's (1999) framework. Kostova (1999) concentrates mainly on the external conditions that constrain the acceptance of strategic practice (e.g. TQM practice) in the recipient side, within the parent-subsidiary context. She also treats implementation and internalization as the outcome of transfer, based on the adopter's perception (whether the user is committed and satisfied). Our analysis goes beyond seeing "context" solely as the external conditions and considers the interactions between knowledge embedded in information systems and its situated contexts (where the knowledge is developed; see Orlikowski et al., 1995; Orlikowski, 2000). Internalization is considered not just as the user's perceived acceptance of the transferred practice but also as the extent to which the knowledge embedded in the IS can be integrated into the recipient's organizational processes, structures, and value systems. This requires a mutual revision of technology and organization.

## 6. Conclusion

This study offers an alternative approach to examine IS adoption. By using knowledge transfer conception, researchers are encouraged to examine the embedded knowledge and situated context in order to explore the issues underlying information systems adoption, in contrast to the previous works on barrier removals and social analyses of IS adoption. The future work of this research may extend the scope of investigation and analyze various information systems adopted in this joint venture. This may help to refine the research framework used in this article.

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