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Knowledge Transfer through User-Analyst Collaboration during Requirements Elicitation

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ABSTRACT

Requirements elicitation is a critical phase in information systems development (ISD), having significant impacts on software quality and costs. Prior research suggests that it is a collaborative activity, where system requirements-related knowledge is extensively shared between users and analysts. This *knowledge sharing* can get extremely tenuous given the different knowledge perspectives of the two participant groups. However, till date, no known research has attempted to understand how this collaborative process unfolds and how knowledge is shared between users and analysts. Using data from in-depth interviews with analysts from two organizations, the proposed research study attempts to understand how the *requirements elicitation process unfolds*, how *knowledge is shared*, and what *impedes/enables* knowledge transfer in this critical process.

Keywords

Requirements Elicitation, ISD, Collaboration, Knowledge Transfer

INTRODUCTION

Requirements elicitation is a critical phase in ISD (Curtis, Krasner and Iscoe, 1988), and successful ISD is contingent upon the user's ability to specify systems requirements (Boland, 1978), the analysts' ability to elicit requirements from the user (Davis, 1982) and on how well these requirements are modeled (Agarwal, Sinha and Tanniru, 1996). Prior literature has argued that this process is a collaborative activity between users and analysts, where extensive knowledge regarding the systems' requirements is shared between them, and is used to create specifications for an IS (Akshawi and Al-Karaghoul, 2003). This collaboration and sharing of knowledge is "a problematic process" (Urquhart, 1997), given that these two distinct groups bring in "unfamiliar language that is domain specific" into this activity (Urquhart 1997; p. 150), thereby lacking in a shared frame of reference. While there has been research that has acknowledged the existence of diverse knowledge groups in ISD (Cooper, 2000), there has not been any noticeable attempt to understand the *dynamics of collaboration* and *knowledge transfer* between these groups during the requirements elicitation process. The proposed research attempts to fill this void by attempting to answer the following questions:

From a knowledge transfer perspective, how does the collaborative process of requirements elicitation unfold?

What are the enablers/inhibitors of this knowledge transfer?

REQUIREMENTS ELICITATION AND KNOWLEDGE TRANSFER

Requirements elicitation involves the sharing and communication of knowledge, assumptions, and expectations amongst analysts and users in an effort to develop a mutual understanding of the IS requirements (Davidson, 1996). The users bring their expertise regarding the business processes and verbalize the system requirements, while the analysts bring in knowledge related to ISD, and attempt to convey possible technological solutions. This leads to the formalization of the system requirements document (Urquhart, 1997). One can therefore envisage two diverse components of requirements elicitation: 1) a process involving the transfer of this differential set of knowledge between users and analysts in an effort to develop a shared frame of reference, and 2) the enactment of this process within a collaborative frame.

Prior research has argued that knowledge transfer is a complex process (Szulanski, 1996), and has identified specific factors related to the source, the recipient, the relationship between source/recipient and the nature of the knowledge (Szulanski, 1996) that affect this process. We draw on this research to understand the knowledge transfer process and identify its enablers/inhibitors during requirements elicitation.

METHODOLOGY

In order to understand the requirements elicitation process, qualitative data from two different organizations were collected— an international software services company (TechSource), and an IT services organization at a US University (UnivTech). TechSource is headquartered in India, and is one of the top 10 players in the North American IT offshore-outsourcing market. UnivTech is a university IT organization, and focuses on in-house development of IT solutions.

In order to fully investigate the collaborative process of requirements elicitation, it is important to understand the viewpoints of both the analysts and the users. Table 1 summarizes our data collection plan. At this time, we have collected qualitative data through interviews of *analysts only* (shaded part of table) from the two organizations. The duration of the interviews ranged from 40 – 60 minutes. Interviews were tape-recorded and transcribed. The coding of the interview transcripts was done in two phases. In the first phase each researcher individually coded a transcript and generated the open codes similar to prescriptions of Grounded Theory methodology (Strauss and Corbin, 1990). Prior literature on group collaboration and knowledge transfer provided theoretical sensitivity to the researchers. In the second phase the researchers went through each transcript together, constantly comparing the codes generated by each other in the first phase. This process resulted in a set of common categories of codes generated by each researcher, and also the emergence of new categories of codes. These categories were then interpreted, and themes and inter-relationships among them identified.

TechSource (Organization 1)		UnivTech (Organization 2)	
Interviewee	Client/Nature of Project	Interviewee	Client/Nature of Project
Analyst1.1	US-based utility company specializing in the generation and distribution of electricity/Customer Service System	Project Lead2	University/Payroll-related system
Analyst1.2	Same	Analyst2.1	Same
Analyst1.3	Same	Analyst2.2	Same
Project Lead1	Same/Work Asset Management Systems	Analyst2.3	Same
Analyst1.4	Same	User2.1	Same
Analyst1.5	Same	User2.2	Same
User1.1	Same	User2.3	Same
User1.2	Same	User2.4	Same
User1.3	Same		

Table 1: Data Collection Plan

PRELIMINARY FINDINGS REGARDING REQUIREMENTS ELICITATION

Our initial analysis suggests that requirements elicitation may be viewed as a knowledge transfer activity between users and analysts, where analysts continue to gain knowledge and learn more about the requirements of the system. An analyst at TechSource highlighted:

“.. yes, you definitely learn something new... you learn more about the system...”

An interesting point is that the knowledge transfer occurs in both directions (e.g. user to analyst and vice versa). In the words of a UnivTech analyst: “*it is learning on both sides.*”

The Collaborative Modes

Our data confirmed that requirements elicitation is a collaborative activity between users and analysts, success of which lies in the ability of the two groups to work together in combining their different knowledge sets. An analyst at UnivTech highlighted: “work ... as a group, and get their requirements as a group.”

Another analyst at TechSource also suggested that requirements elicitation “is a group interaction.”

Through our interviews, another interesting issue that emerged was that requirements elicitation is not a “monolithic stage,” but is composed of distinct sets of activities (or modes) that the users and analysts engage in. While these collaboration modes were originally proposed by McGrath (1991), no known research has examined them within the context of requirements elicitation.

The collaborative process of requirements elicitation is initiated through the *inception* mode where the objective is to create a working atmosphere and understand the background motivation behind the system development. The knowledge transfer is characterized by the transfer of information about business needs/goals by the *users to the analysts*. Once, the teams are comfortable with each other, and have understood the motivation behind the project, the attention is turned towards the *problem-solving* mode where both groups struggle to understand the problem from their own perspectives and by tapping into the knowledge-base of the other. Once the users and the analysts are convinced that they have understood all facets of the problem domain, they turn their focus towards creating the solution, which in this case is the set of requirements for the project. This is the *conflict-resolution* mode, typically characterized by conflicts among the users and analysts, resulting from their differing perspectives. The aim in this mode is towards reaching a mutually agreeable perspective. The final *execution* mode is reached only if the participants have a mutual agreement regarding the system specification. This mode is characterized by the *analysts imparting information to the users* about the nature of the requirements specification document. Table 2 provides some examples of indications of these collaborative modes that we found in our data.

INCEPTION	<i>.. the business clearly says that these are things I want to implement or this is my objective ...</i>
PROBLEM-SOLVING	<i>We basically sit down at a table ... we organise some sort of a meeting ... and it sometimes takes even more than three or four meeting for this group ...this initial group of people just to figure out what they really wantAnd you get their consensus of what the requirements are, so you can scope the project.</i>
CONFLICT RESOLUTION	<i>We keep talking discussing but, parties don't agree, we don't think that it can be done and, business thinks that it has to be done, or, business thinks that, it should be done differently and we see differently...</i>
EXECUTION	<i>So once when you come up with the final requirements document, you send it to them, walk through the entire document with them to see if they understand... and both the parties agree then you sign off the document and freeze the requirement.</i>
Table 2: Collaborative modes in requirements elicitation	

Two important things to note about these collaborative modes is that, 1) they do not represent a chronological sequence, and 2) groups need not necessarily have to perform activities within each of these modes. For example, we found in UnivTech, that the analysts and users were familiar through previous involvement and for them requirements elicitation started at the problem-solving and conflict-resolution modes.

“And they trusted the whole thing because they had seen the results [from us] before. So I think we cut six months off the front of this project.”

Further, these modes are highly intertwined and do not have any clear demarcation. Some collaborative groups may even alternate between the problem solving and conflict resolution modes (several times) until an agreement is reached. As one TechSource analyst mentioned:

“..there was this back and forth going on”

Another analyst at TechSource also echoed a similar sentiment:

“then again I told you earlier, its iterative process actually, we get the requirements, we do the analysis and we identified more that needs to be changed, as a part of this thing, and we take it back to clients, clients see it again, if they find that okay these changes, are actually fine”

The collaborative group may progress from one mode to another through an internal agreement process wherein they deem that the goal of that particular mode has been accomplished. Thus, the length of involvement in any of these modes would essentially depend on the nature of the group and the context.

The Knowledge Transfer process

Underneath each of the collaborative modes mentioned above, is a knowledge transfer process, which helps in the creation of the shared frame of reference. Analysts at TechSource and UnivTech have continuously emphasized the importance of this shared frame of reference:

“..make sure that everyone is on the same page.”

This shared frame of reference is possible through the knowledge transfer process:

“.. the users are learning... and in the case of using a more or less formal methodology, all the IT folks are certainly learning business requirements and how the business has to work and synthesizing what they are hearing what they already know about other systems they have done.”

We believe that the above quote is an explicit demonstration of knowledge transfer inherent in the requirements elicitation process. Users possess domain knowledge about the relevant business processes, and the analysts possess expertise about the technical aspects of the information system. The individual knowledge of the participants therefore represents different perspectives by which the problem domain (the most important aspect of requirements elicitation) is understood. The increased learning of the participants about the other domain as they travel through the collaborative modes helps in creating a shared frame of reference regarding the problem domain. Figure 1 shows our conceptualisation of how collaboration and knowledge transfer interact within a requirements elicitation context.

We would like to caution researchers that mere transfer of knowledge will not result in the creation of the shared of frame of reference. Drawing on the knowledge transfer literature (e.g., Davenport and Prusak, 1998), we argue that it is the amount of knowledge transferred (we term it as *thickness*), and the *speed* at which it is transferred, that will ensure the creation of this shared frame of reference. The following quotes emphasize the importance of thick knowledge:

“we need to document all the business rules and we need to make sure that we don’t miss out anything, and **we may realize certain holes**, also in the system or process that have been maintained so far, that, needs to be repaired going forward.”

Thickness represents the richness of the knowledge transferred in terms of how much of the original knowledge was captured and retained. Speed becomes important because the knowledge transfer has to be extremely efficient given that most ISD groups operate under very tight deadlines and schedules. Successful requirements elicitation will in our opinion be characterized by highly *thick* knowledge that was transferred at a high *speed*. One obvious method of evaluation of *thickness* and *speed* is the existing contractual mechanisms of artifact documentation and client sign-off embedded in this process. There are two ways we believe that this can be gauged.

The number of iterations of the artifact document before a sign-off.

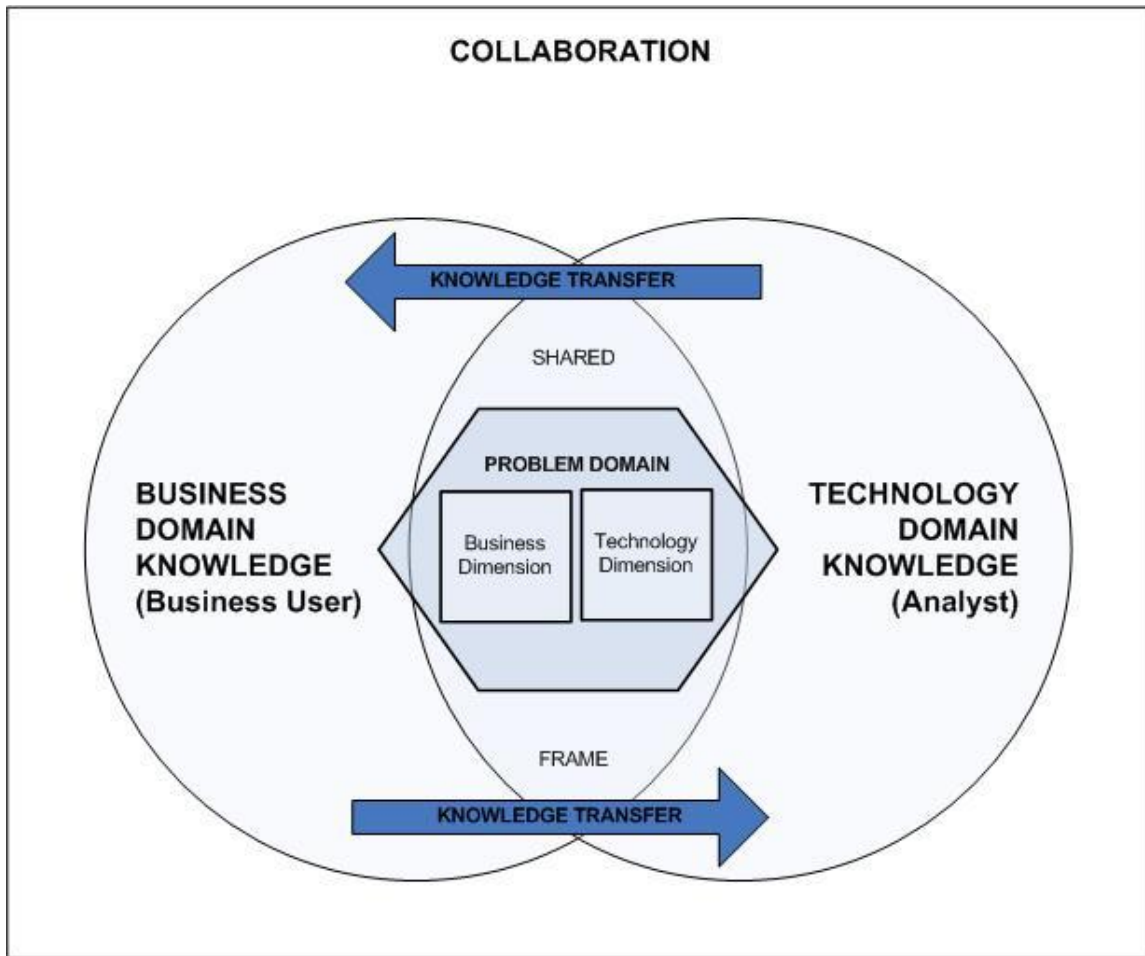


Figure1. Knowledge Transfer process in Requirements Elicitation

Post-hoc analysis of missed requirements through identifying testing defects that have roots in missing requirements.

Figure 2 depicts how we envisage the process of requirements elicitation from the perspective of collaboration and knowledge transfer.

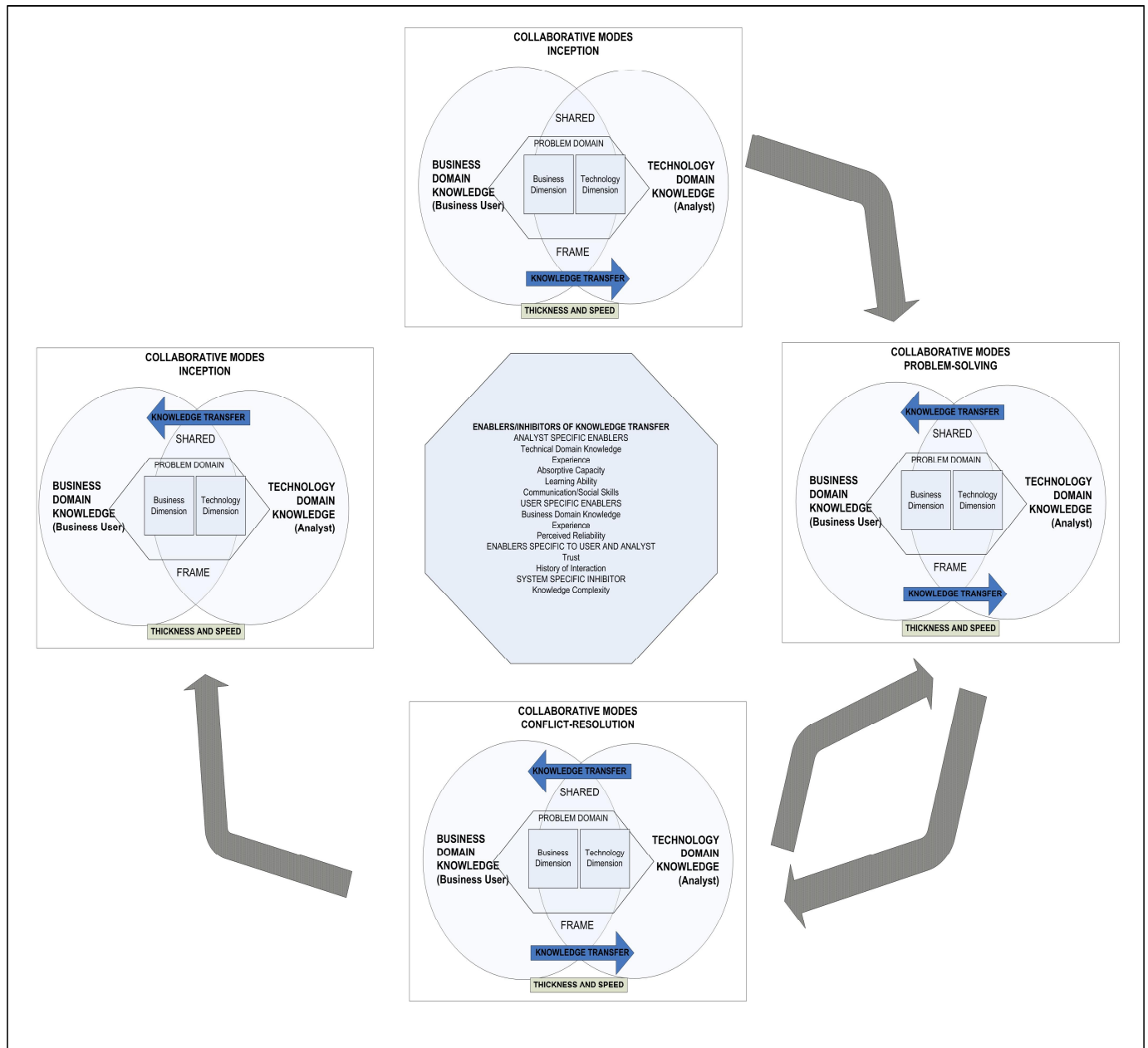


Figure 2. Requirements Elicitation Process

Enablers and inhibitors of the knowledge transfer process within the collaborative modes

Analysis of our data reiterates previous findings in the literature on factors that enable/impede the knowledge transfer process during requirements elicitation (Joshi and Sarker, 2003; Szulanski, 1996, 2000). Our data seems to suggest that these factors directly affect the *knowledge transfer process, and thus indirectly, the nature of the collaboration* (see Table 3). Which set of factor would affect knowledge transfer within a particular collaborative mode would depend on the goal of that mode. For example, during the conflict-resolution mode, when the goal is to resolve conflicts and generate a consensus, the prior history of interaction between the users/analysts would have a strong effect. We believe that these factors serve as an important contribution to practice, since it highlights the specific analyst/user related characteristics that would impede/enable knowledge transfer, and therefore provides guidelines regarding how to build an effective requirements elicitation team. As analysts at UnivTech highlighted, the composition of the team is extremely critical to the success of this process:

“To get the people that are involved, as broad a representation as you can, together”

Categories	Enablers/Inhibitors of Knowledge Transfer		Quotes
Analyst Specific	Enablers	Technical Knowledge of Analysts	<i>"If you are a person who has got lot of expertise in this particular domain... requirements gathering would be much more simple"</i>
		Experience of Analysts	<i>"I'll say if the person is more exposed to the system, if the person has actually worked along with Business, he will do a better job"</i>
		Absorptive Capacity of Analysts	<i>"I think the person who's doing requirements should be able to grasp many things and you know easily understand... what the user is trying to say."</i>
		Learning Ability of Analyst	<i>".. if the person, is quite intelligent if he can learn it quickly... better appreciate the business needs.."</i>
		Communication/Social Skill of Analyst	<i>"You should be able to communicate properly to the user...if you are talking about the soft skills, documentation and communication are very important"</i>
User Specific	Enablers	Business Knowledge of User	<i>"if user is a person who has got lot of expertise in this particular domain.....the requirements gathering would be much more simpler."</i>
		Learning ability of Users	<i>"Business users cannot, test it on their screens or on their reports, in fact that time they need to actually ask for very technical things... and they need to understand that..."</i>
		Absorptive Capacity of Users	<i>"users were quite intelligent, they had a very good appreciation of the technical things also.. So in many cases they helped us in outlining the technical things .."</i>
		Experience of Users	<i>"we make sure that we bring in the much experienced business users, so that we get reliable or confirmed, answer or confirmed understanding"</i>
		Perceived Reliability of User	<i>"Sometimes you may not be really convinced... with the response... you may feel that it is being done differently in such cases you may contact somebody else in the business..."</i>
Specific to User Analyst Relationship	Enablers	Trust between User and Analyst	<i>"I strongly believe that this entire business is running on trust... if the end users cannot trust the Business Analysts ... then actually we are going no where"</i>
		History of Interaction between Analyst and User	<i>"... we took six months off the front of the project because they had worked together; they knew where I was headed with facilitating the requirements gathering"</i>
Information System Specific	Inhibitors	Knowledge Complexity	<i>"I won't say its more difficult just that it's more complicated... just the requirement itself is big so we need [to] put more effort, more people, more parties"</i>

Table 3: Enablers/Inhibitors of Knowledge Transfer

CONTRIBUTION

While our description of the requirements elicitation process has been based on a preliminary analysis of the data, we believe that some interesting insights are already appearing. We summarize some contributions of the study below:

It suggests that requirements elicitation is not a monolithic stage, but unfolds in a set of collaborative modes, and provides some insights into these collaborative modes.

It emphasizes and illustrates that within each of the collaborative modes there is a process of knowledge transfer between the users and analysts, targeted at the creation of a *shared frame of reference* amongst them.

It introduces the concepts of “thickness of knowledge” and “speed of knowledge transfer” as two important ways of ensuring the creation of this shared frame of reference.

Finally, it identifies some key enablers/inhibitors of knowledge transfer in each of these collaborative modes, which would translate to guidelines for ISD project managers on how to build a requirements elicitation team, and make this process more efficient and effective.

FUTURE PLANS

Participants already interviewed were systems analysts in the two organizations mentioned earlier. As a result, the process of collaboration and knowledge transfer described and the inhibitors/enablers highlighted here, reflect the viewpoints of the *analysts only*. The next step in this research would constitute the following activities:

Conduct interviews with users (see table 1 for our plans) and use their perspective to make modifications/additions to our current view of the collaboration and knowledge transfer process during requirements elicitation and our set of enablers/inhibitors.

Compare the requirements elicitation process in TechSource and UnivTech, and try to isolate elements that make knowledge transfer in offshore-outsourced projects (e.g., in TechSource) different from those in in-house development projects (e.g., in UnivTech).

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