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# Towards a research framework for a human development-based "bottom of the pyramid" ICT development strategy in South Africa

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# THE TRANSFER OF TECHNOLOGY AND KNOWLEDGE: A STORY OF AN ENTERPRISE SYSTEM IMPLEMENTATION

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## Abstract

*The uncertainties of information system development (ISD) provide many routes that end in poor project outcomes. These uncertainties produce opportunities for IS researchers who are continually exploring the complexities of information system development. In this paper, which is a work-in-progress, we are focusing on the implementation of enterprise systems in three universities in Malaysia.*

*We adopt a socio-technical process model which provides us with a vehicle to describe an in-depth analysis of the phenomena under examination. By examining the notions of technology and knowledge transfer in ISD, this paper explores the intricate relationships and interactions between its human and non-human actors in the attempts to construct various network alliances. We end with some suggestions for research and practice.*

*Keywords: information system development (ISD), universities, transfer of technology and knowledge, socio-technical modeling, actor-network theory (ANT)*

# 1 INTRODUCTION

Researchers in enterprise system implementation in universities show indicates that one of the main motives for their implementation is to replace legacy systems (Wagner et al. 2006; Pollock & Cornford 2004; Wagner & Newell 2004; Scott & Wagner 2003; King et al. 2002; Oliver & Romm 2002; Allen & Kern 2001). The systems which were once the backbone of the organization have with time become obsolete. Organizations today require more robust contemporary systems that are able to cope with ever changing and intensifying market competition. Replacing a legacy system is not just a matter of changing components. It may also require a complete overhaul of the organization itself. That is why it is common to see failures in enterprise system implementation in universities due to the complexities of the specifications, functional inadequacies and lack of political support (Pollock & Cornford 2004; Wagner & Newell 2004; Scott & Wagner 2003). However, not all project failures are due to organizational complexities. Understanding organizational compatibility with project managers and vendors plays a vital role in ensuring smooth project implementation<sup>1</sup>.

In general, the data analyzed in this paper was derived from three Malaysian universities where each of these organisations had technological and personnel connections with the others. While the discussion will concentrate on the enterprise system implementation project in one of the universities, some of the discussion will apply to the other two. Our study was guided by the following research questions:

- 1. What are the key actor networks in the development process and how do the networks develop and interact diachronically?**
- 2. What are the implications for research and practice resulting from our findings, particularly for similar institutions?**

The structure of the paper is as follows. Part two provides a summary of the main features of actor-network theory. In part three, an overview of the research methodology which includes the case description, data collection method and data analysis is presented. This is followed by the presentation of the findings in part four. Part five revisits the research questions in an attempt to better understand the phenomena. The paper ends with conclusions that have emerged from the study.

## 2 PREVIOUS RESEARCH

### 2.1 Actor-network Theory (ANT) and the process of translation

According to Latour (1993) the world is full of hybrid entities which contain human and non-human elements (Tatnall 2003). The development of these hybrid entities is facilitated by the heterogeneous nature within the information system environment. ANT is unique as it is engaged in both sides: ANT attempts to discuss the heterogeneity of elements in forming a network while also examining the asymmetry of its elements. In relation to generalized asymmetry, Latour (1993, p. 95) has described it as a rationale of symmetric treatment in observation on the relationship between technical computer systems and social organizations where all human and non-human elements are treated equally and are labelled as actors or actants.

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<sup>1</sup> In this paper, implementation refers to an on-going process which includes the entire development of the systems from original suggestion through to the installation of the system (Lucas 1981) and development refers to a stage within the implementation process.

The next concept we will use is the actor-network. This is considered as the most crucial part of ANT and looks at the process of building a network of actors. This process involves several main activities including interactions, negotiations and translations. In our research we will focus on the process of translation and in this paper we will concentrate on Callon's four phases of the translation process (Callon 1986). The first phase is the problematization. In this phase an issue or a problem will be identified and the role of each actors affected by the issue is defined. In this phase, some actors will establish themselves as indispensable to the solution of the problem (McMaster et al. 1997). They consider themselves to be the 'obligatory passage point' (OPP).

This process of translation is continued with the phase of interessement. According to Cordella and Shaikh (2003), translation is a circular process of interpretation of interest. Interessement is a group of actions by which an entity attempts to impose and stabilize the identity of the other actors it defines through its problematization (Callon, 1986). The moment that an actor accepts the interest defined by another actor is called enrolment (Callon, 1986). This point of enrolment can only be observed through time and it is crucial for a researcher to identify each of the different stages or phases of network building. According to Hanseth et al. (2004), during this process, programs-of-actions are inscribed where roles, competencies and responsibilities are delegated between the actors within the network. This is further elaborated through the concept of circularity of the translation process which, according to Cordella and Shaikh (2003), ensures that the interest of all actors within the future network is properly inscribed within the network. According to Latour (1992), inscription (the fourth phase) is a process of creating technical artefacts that ensures the protection of an actor's interests (Sarker et al. 2006). In layman's terms, this process can be considered as the signing of a memorandum of understanding (MoU) that binds the party to a specific objective or in ANT terms, interest. For example, a centralized enterprise system can be seen as an inscription of the interests of management who commissioned the project. However the system can become subverted to the interests of other groups in the process of its development.

### 3 RESEARCH METHOD

#### 3.1 Case descriptions

This study takes place in three universities in Malaysia that are similar, yet possess unique features. It is their similarities and uniqueness that have made this research challenging and produced a number of surprises.

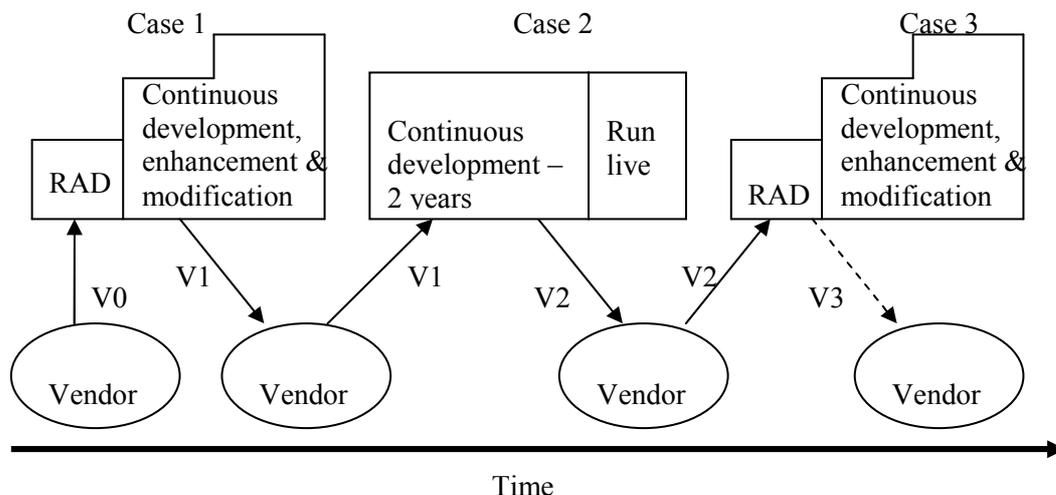


Figure 1 Inter-organization transfer of technology and knowledge

### Case 1

This is the youngest of the three universities and was established in 2002 when they implemented the integrated management system (IMS). With a current enrolment of 3,000 students and 1,000 staff, the need to maintain and further improved the IMS was essential and ongoing. The implementation of the enterprise system was an integral part of the university's strategic planning and was initiated during the university's infancy. This has ensured the smooth internalization of an electronic working culture. The head of ICT in Case 1 was later employed as the project manager in Case 3.

### Case 2

Established in 1922, this is the oldest education institution in Malaysia and under the mandate of the university act, it became a full university in 1997. The problems that arose from the islands of legacy systems created the need for a more integrated information system. Today, this dynamic and mature university comprises 16,000 students in addition to a compliment of 580 faculty and 764 management staff. The experiences and the expertise over the years have produced more stable and fully tested business processes. The implementation of such a large enterprise systems in this culturally-developed organization was completed seamlessly in 2005.

### Case 3

This university was also established in 2002, and represents an amalgamation of nine institutes which were previously managed individually. The diverse operational processes among these previously independent institutes brought about a call for an integrated management system (IMS) similar to that adopted in Case 2 to enhance their operational efficiency. With 13,000 students supported by 2,000 de-centralized staff members, the establishment of a single integrated database was thought to produce a more efficient management of resources. This two-year project launched in February 2007 has experienced the greatest number of problems encountered in any of the above noted IS development projects. For our study we will focus on one component of an integrated management system, an integrated finance module.

While the above description has emphasized the unique nature of each individual case, the one element that is common among all three cases is the 'system' (Figure 1) which has been developed on the same base system (V0 above). Depending on the timing of their implementation, any new system enhancements or modifications are integrated into the latest version. This refers to V1 and V2 in Figure 1. The system for Case 2 was developed based on Case 1's latest version. The system for Case 3 was built upon the latest version of Case 2. Whilst Case 2 is more mature in terms of its operation compared with Case 1, the base system for Case 3 was deemed to be more up-to-date and more comprehensive. However, the project manager in Case 3 resigned in August 2008, just seven months after her appointment. The project is currently being managed by the information technology department (ITD) of Case 3. As of the last visit management has no intention of appointing a new project manager.

## 3.2 Data collection

Case 1		Case 2		Case 3	
Interviewee	Min.	Interviewee	Min.	Interviewee	Min.
Bursar	50	Bursar	NA	Senior General Manager (Fin.)	70
Finance Officer 1	44	Deputy Bursar	86	Head of Unit – Finance (HQ)	44
Finance Officer 2	75	Head of Unit	NA	Head of Unit – Finance (Branch)	70
Head of ICT (ex)	59	System analyst (ICT)	53	Software Developer	72
Vice Chancellor	30	Software Developer	72		
Software Developer	72				

Table 1. The interview schedule – Cases 1, 2 and 3

Table 1 represents the list of interviews conducted during the field work in July 2008 but during the second round of interviews in March 2009, we have managed to gain responses from other actors related to the cases especially with the ex-project manager of Case 3.

The research will attempt to analyze the socio-technical relationship during the process of ERP system implementation. Therefore, the interviews were conducted with as many ERP system stakeholders as possible in order to gain an in-depth understanding of the process. Interviews were tape-recorded and verbatim transcripts were produced.

### **3.3 Data analysis**

Since this paper is a work-in-progress, the analyses of the data are only based on the available transcripts to date. Further interviews and data gathering will be undertaken in due course over the next year. The analysis began with developing a project timeline analysis for all the three cases. Initial analysis of the project timelines shows interesting yet diverse issues between the three cases. Upon reading and re-reading of the interview transcripts, a matrix of project critical events together with direct quotations was produced. During this process it became apparent that the relationship between the cases was also significant in regard to the personnel involved (their knowledge) and the vendor and its technology (the base system). Hence, this is the focus of the paper.

Next, we focused on identifying critical events that occurred during the relationship. Since the focus of the paper will be on Case 3, attention was paid to the antecedent conditions of the other two cases in relation to the third one. Based on these historical experiences, a more in-depth understanding was achieved. Finally, we applied the notion of translation within ANT to explain the dynamics of the interactions and relations during the enterprise system development. According to Monteiro and Sahay (2000), applying ANT in IS research requires the identification of key actors, interests and scenarios and to follow them through time and this is what we are attempting in this paper.

## **4 FINDINGS**

Generally, the analysis of the findings in this paper will be based on the socio-technical process model which links antecedents, event processes and context to outcomes (Lyytinen & Newman, 2008).

### **4.1 The story of an enterprise system implementation through a socio-technical process account – Antecedent conditions**

At the time of writing, Case 3 was already one and a half years into the two-year project period and approximately only thirty percent of the finance system has been developed and deployed and as of March 2009 the project period has lapsed. But still the finance system is only thirty percent developed and used. Why have they not been able to complete the other seventy percent of the system? What went wrong in this project? This paper is not an attempt to solve the problem but to better understand the phenomena of the case under study. The notion of transfer of technology will be used to further examine this case study. By adopting a process study model, this paper will use four sections: antecedent conditions, the process, context and the outcomes.

The complexities of an information systems development are not only due to the technicalities of the system itself but most of the time are also due to the intricate relationship between its socio-technical elements. In this paper, the understanding of the antecedent condition of the related actors is crucial. But understanding the history of the organization alone will not be sufficient. We assert that due to the complexities of IS development, an in-depth understanding of the history and background of the vendors (software developers) and the project managers are also crucial to our story.

#### 4.1.1 *The university as a unique organization.*

The main characteristic of the organization that should be considered in IS development is the establishment of the university which is itself an amalgamation of nine institutes. But as a result of being “nine under one roof”, many management problems surfaced. One of the most important issues within the organization was the streamlining of the business processes:

*“...the implementation of the finance system is to make sure that the processes are standardized throughout the campuses...”*

Senior General Manager (Finance) – Case 3 (17/07/2008, p. 1)

The legacy system of the university did not provide solutions to their problems. With more dispersed campuses and a higher number of students, having a non-integrated system created chaos. Within these campuses also, there were different ways of doing things with very different management styles. In addition, different work styles between the top management and the middle management posed challenges to achieving a successful project.

#### 4.1.2 *Vendor (system developer) as one of the important components of IS development*

The process of identifying a suitable vendor to supply and deliver an enterprise system is one of the most crucial parts of any project. Usually, the assurance that is given to the clients in providing a complete and usable system develops high expectations among the clients. In this particular case, the assurance or guarantee from the vendor to provide a workable system stems from their previous experiences in the same industry. A successful implementation of prior projects (Cases 1 and 2) provided that confidence. Based on the previous projects, there are several criteria that needed to be fulfilled to ensure project success. The most critical was the transfer of knowledge between the vendor (system developer) and the technical team of the organization. A dedicated technical member attached to a module ensured knowledge was captured and utilized. As the prior client in Case 2 mentioned:

*“...the good thing about the project is that our ICT team have efficiently captured the development knowledge that enable us to stand on our own... even our ICT team have understood the debit and credits of accounting transaction and the links in the systems...”*

Project Manager (Finance) – Case 2 (08/07/2008, p. 10)

He adds;

*“...even after the UAT [User Acceptance Test] there are still minor changes to ensure the completeness of the system and we have to thank the ICT team... they are able to adopt the knowledge and settle some of the problems themselves.”*

Project Manager (Finance) – Case 2 (08/07/2008, p. 10)

A successful transfer of knowledge ensures an uninterrupted progress of system development. Another important criterion is the user’s capabilities to provide complete and stable business processes. A well-developed business process that is derived from years of operational experiences ensures a smooth development for the vendors. The only development issues would be the integration aspect of the systems which was resolved through continuous coordination and integration meetings and discussions. But in contrast to these positive aspects, the inability of the vendor to comprehend or adapt to different organizational cultures has created some uncertainty towards the current project.

#### 4.1.3 *Project manager as the key player in IS development*

The project manager often plays a very important role in IS implementation. Due to their complexities, managing such a vast enterprise-wide project requires the multi-tasking capabilities of a project manager. Wide knowledge and experiences in both technical and human aspect of the projects are vital

in ensuring project success. In this case, the 20-years of experience of the project manager in IS implementation gave confidence to the clients. In addition, most of her experiences were based within the educational environment. Prior to Case 3, the project manager handled a similar implementation (i.e. Case 1) as well as a more recent one which was an e-management system. Holding the post of Head of ICT, she initiated the implementation of an enterprise system using a rapid application development (RAD) strategy.

*“...so far [an] IT project fails because it takes too long to finish the development.”*

Ex Head of ICT – Case 1 and Project Manager - Case 3 (24/07/2008, p. 1)

She further explains:

*“...to be successful, this system owner... should understand the nature of system development and rapid approach because they can't expect the software to be perfect at the 1<sup>st</sup> time when it is installed. Because of the rapid development we just deploy the 1<sup>st</sup> draft so that the user can start using it and start improving it based on their actual requirement... the system owner must be aware that they are evolving in the system development, it is part of the software development, it is not like having a complete software, this is a process of software development that the system owner must be involved 100% in the development and improvement of the software...”*

Ex Head of ICT – Case 1 and Project Manager - Case 3 (24/07/2008, p.1)

According to her, there are several pre-requisites for a successful RAD implementation. The skills and knowledge together with the commitment of the system developer (vendor) are essential. However, to date, she was not able to replicate her previous success in Case 3 by applying the same concept and strategies acquired in Case 1.

#### 4.2 The story of an enterprise system implementation through a socio-technical process account – The crisis identification<sup>2</sup>

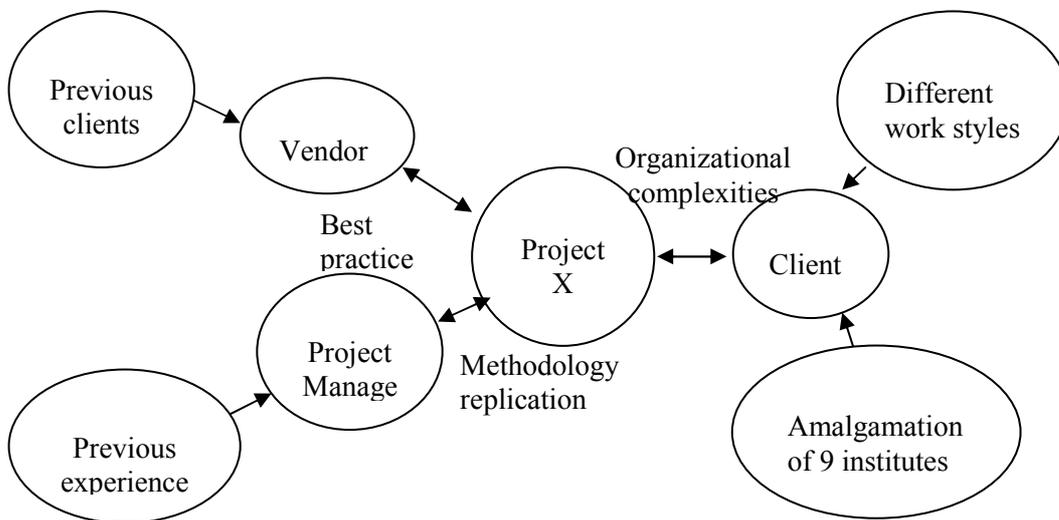


Figure 2 The ‘intention baggage’ or project actors antecedents

Figure 2 provides a summary of the historical background of the projects. Each of the actors identified in the projects have brought their own *intention baggage* or expectations to the projects. We have

<sup>2</sup> Because of space considerations we were not able to include the full process model description based on Lyytinen and Newman (2008). This will be explored in a future paper.

already noted that after two years of the development project only thirty percent of the finance system is developed and deployed. What has gone wrong? In the first part of this paper we have discussed the antecedent condition of the situation under study. It is pertinent to understand the history of the case before any further analysis is made. There are several important issues that need to be explored.

The need for such a system was identified due to the complexities of the new organizational structure. The implementation of an enterprise system will create a more streamlined and standardized business processes. The vendor (software developer)'s prior development with other clients provides a basis for an educational system's best practice. This project tried to build upon the existing best practice and further improve the systems. For the project manager, the rapid application development (RAD) approach, proven to be successful in previous projects, was to be replicated in this project with the same intention to reduce the development time of the project.

While the intention of the clients remains intact, the actors within the project organization have caused the crisis in the IS implementation.

#### *4.2.1 Misunderstanding of project complexities*

The adoption of rapid application development (RAD) approach by the project manager together with the 'adapt and adopt' method by the vendor have caused chaos within the project development team. The overall project period was two years. It seemed appropriate initially. But when the project manager came in and tried to develop and use the student intake modules within six months, the user went 'haywire'.

Although the approach was agreed unanimously in the steering committee meeting, it created doubts in the mind of the user. This was further worsened by the fact that the project manager worked on the project on a part time basis and not full time as in her previous projects. Crucially, her control over the project was further impeded because she was not able to create a *coalition* with the chairman of the steering committee and the IT director. Since there was no *alignment of interests* between the project manager and the top management, the pre-requisites for a successful RAD approach were missing. The project manager failed to create a coalition with the chairman of the steering committee and the IT director in contrast to her previous experience. This could be due to the fact that the top management did not see the importance of the approach itself or the top management had a 'laid back' working style or they were not powerful enough to handle the dominant middle manager.

*"...the chairman of the steering committee is not very powerful due to the fact that he is not able to control the group by giving leeway to them."*

Vendor (system developer) – Case 3 (01/08/2008, p. 3)

The intention of the vendor (software developer) to just employ the 'adapt and adopt' approach was also scrapped when fifty percent customization of the so called base 'best practice' system was agreed upon. In an unfavourable comparison with the vendor's other clients that manage to adopt the approach, the non-standardized business processes in Case 3 created the need for such major customizations. Currently, the reengineering of the business process is being carried out in parallel with the business requirement study (BRS) sessions.

#### *4.2.2 Misalignment of project expectations*

The project manager's critical misinterpretation was the simplification of the business process. While mainly concentrating on ensuring a smooth flow during the student intake, no attention was given to the more critical back-end process of the related modules. This was critical for the finance modules when her attention was given only to the process of issuing invoices to students rather than looking at the overall accounts receivable modules. This surfaced when the user (finance) was asked by the project manager to sign off the user acceptance test (UAT) for accounts receivable only after the student registration.

The failure of the project manager to assess the organization capabilities to comprehend such a tight deadline created major issues. This meant that the users were not able to develop complete and stable business processes through a formal process of re-engineering. As agreed by the users, the need for a thorough re-engineering exercise of the current business processes seemed crucial due to the fact that Case 3 was an amalgamation of nine institutes with different organizational processes. To make things worst, the scepticism over the system escalated when the user's requirements did not match the vendor's existing 'best practice' systems. This has instantiated the need for a customization and to date, according to the vendor, fifty percent customization has been carried out.

The departure of the project manager from office after only seven months has strained the relationship between the user and the vendor. There are many reasons speculated for her leaving. According to the vendor, the dominance of the user over the project steering committee is crucial to understand her departure. Lack of support from the chairman of the steering committee and the IT director can also be seen as a motive for leaving the project. Primarily, the task of a project manager is a boundary person or a 'buffer' between the user and the vendor. Thus, the absence of the project manager has caused a direct impact on the vendor. Any system modifications have to be completed by the vendor. Unlike the vendor's previous clients, the successful transfer of knowledge from the vendor to the IT team has enabled the clients to modify the used systems rather than relying to the vendor alone.

## 5 DISCUSSION

We begin by revisiting in turn the two research questions raised at the beginning of the paper:

### **1. What are the key actor networks in the development process and how do the networks develop and interact diachronically?**

In this particular IS implementation case study, it can be clearly identified that there were attempts in creating alliances or networks to achieve the project's objectives. **In this case both the intended network failed due to the involvement of the various actors and consequently the pre-existing organizational network became stronger and more robust.**

The problematization phase was seamlessly completed by the project manager in that she was able to create the need for a rapid system development methodology for the Case 3 IS implementation project.

Top management, the users, the IT department, the vendors and the project itself were identified as the key actors within the IS implementation. The project manager established herself as the obligatory passage point (OPP) for the project implementation. Everyone agreed on the need to develop and use the related modules within six months of the implementation process and according to the project manager this could only be achieved through RAD methodology. The intended networks are portrayed in figure 3.

Over time, the consensus that was achieved during the steering committee meeting on the application of RAD seems to have deteriorated. This was due to the project manager's failure to understand the complexities of the organization and its unique history and features. Through her experiences she recognized the pre-requisites of a RAD approach but failed to acknowledge the organizational resource capabilities that have created chaos in the project. All her planned devices in ensuring intersement within the built network collapsed. Her plan to create a coalition with top management to ensure control over the project was diminished by the user/ middle manager's dominance over the chairman of the steering committee. In addition there is no evidence showing she had achieved a good relationship with the IT director, further reducing her control over the project.

The project manager's lack of judgment over the organizational readiness towards new approaches severely impacted the overall project management thus resulting in her failure to create the network, leading to her departure from the project. The project manager, during the interview session, foresaw that the project would eventually fail. This resulted from her failure to create a partnership with the steering committee that could have then supported her.

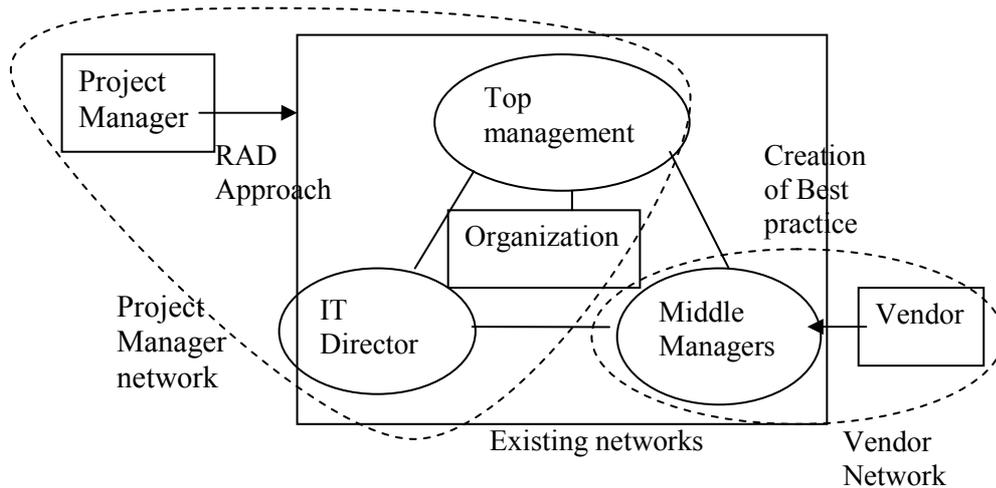


Figure 3 Intended network formation – by project actors including project manager

Further attempts to form a network between the vendor and the user within the organization took place. The vendor faced no issues during the problematization phase since the users identified the challenges of business process disintegration and non-alignment due to the merger. The latest version of the base system, the vendor, the user, the steering committee and the project manager were identified as the actors related to the problems and the vendor with its prior experiences and expertise established themselves as indispensable to the solution.

The base system, which was initially seen by the user as a perfect match to what was missing in their daily operations, was later viewed by the actors as incomplete and not full-proof. Negotiations and re-negotiations over the need to conduct a comprehensive business process re-engineering or major customizations over the based systems created tensions between the vendors and the users. Furthermore, the absence of the project manager in the complex relationship has reduced the indispensable position of the vendor in favour of a user-dominant network. The legacy left by the project manager on rapid development methodology has also impacted the overall development plans negatively.

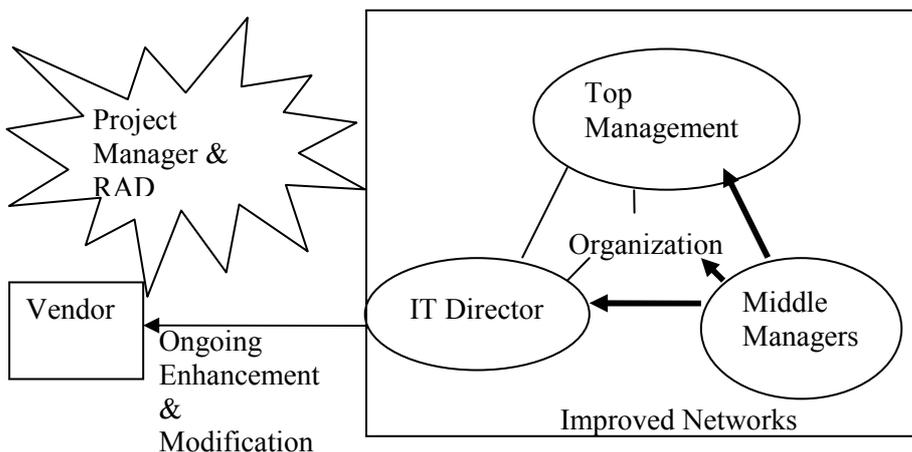


Figure 4 Actual network formations – by project actors after the project manager leaves.

The users were now more focused on modifying and enhancing the current system rather than concentrating on the undeveloped modules (Figure 4). The users established themselves as indispensable to the need for creating a more complete, full-proof and fully tested system.

Imposing themselves (i.e. the customer is always right) over the vendor to ensure compliance has to a certain degree achieved enrolment. With their strong control over the steering committee and lack of intention to appoint a project manager, the users are confident that they will complete the system although it will take more time.

In summary, both failures to complete the process of translation are due to the strength of the existing networks formed within the organization between the top management, the middle managers and the IT director. This created a problem for the vendor and the project manager when they tried to impose their wills in order to establish alliances.

## **2. What are the implications for research and practice resulting from our findings?**

This work-in-progress paper provides multiple pictures of actors in action. As discussed earlier, each of these actors had their own implicit intention or expectations towards the project. These intentions and expectations were being translated into actions during the project executions. However, the process of translating intentions and expectations into executable actions must be done with extreme care and justification. In our case, there are several instances where the converted intentions are not doable and are thus rejected. The IS development project site resembled a war zone where all the players had strategies and an action plan. Therefore, when the project manager came into the project site, based on her previous experiences, she had strategies that she thought no one could challenge. She possessed technical skills as well as soft-skills. But everything was based on her experiences. When she laid out her plans to the steering committee, they were identical to her previous projects and did not take into consideration the uniqueness of the clients and her own capability as the project manager. As clients they agreed with a strategy that provided them with the most up-to-date system that can be developed and used as fast as possible.

Due to her inadequate judgement over the client capabilities, frustrations were revealed in all the key players. The project manager also became frustrated since she was not able to realize her plans and left the project. According to the project manager, the failure to create relationship with the steering committee was due to the fact that they (the steering committee) saw her as an outside person (part of the vendor) rather than a team member within the project. The users were frustrated due to the fact that they could see what is going wrong but were not able to communicate with the project manager who was too preoccupied with her own strategies.

Lastly, the vendor, who was frustrated as a result of the project manager's concept of 'ongoing modifications' that cause them to waste most of their time modifying old systems rather than developing new systems. From the recent interviews conducted with other actors who dealt with the project manager, she was not comfortable in her role. Clearly, the research will find resonance with those studying enterprise system implementations and practitioners will recognise the problems arising from a failure to establish usable networks with the client. In our further work we will explore these issues in greater depth.

## **6 CONCLUSION**

This paper is a research-in-progress and the dynamic of the enterprise system implementation project in Case 3 has produced the continuous emergence of major events. To date, the two-year project period has lapsed with little improvements to the percentage of completion for the finance system.

At thirty percent completion, the vendor pulled out of the project site with the argument that the project period had come to an end. Prior experiences of both the vendor and the project manager are of little help in this case scenario since they are not able to replicate their history. i.e. What worked in Cases 1 and 2 seemed of little help in Case 3. The dominant network that existed before the project has inevitably been reinforced by events. We will continue to monitor the major events of case three when we analyse the interviews from the March 2009 visit and will provide updates to our story of technology and knowledge transfer in this university setting.

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