Developing the Mobile Service Applications of a Micropayment Platform(MPP): the Perspective of Actor-Network Theory

Jen Wel Chen

Dept. of Information Management
National Taiwan University
Dept. of Business Administration
Chinese Culture University
Taipei, Taiwan
d95725009@ntu.edu.tw

Hsiao-Chi Wu

Dept. of Information Management
National Taiwan University
Taipei, Taiwan
hciwu69@gmail.com

Ching-Cha Hsieh

Dept. of Information Management
National Taiwan University
Taipei, Taiwan
cchsieh@im.ntu.edu.tw

Abstract— **Service applications for micropayment technology have become increasingly accepted among consumers. Current research on micropayment primarily discusses issues from markets' and users' perspectives, but rarely from the standpoints of enterprises'. This study examines the joint development of micropayment platforms (MPP) by various enterprises, asking: (1) why organizations develop MPP mobile service applications, (2) how they position the MPP's role, and (3) how they form project alliances. Analyzing an example of MPP development at a private Taiwanese university, this paper adopts Actor-Network Theory (ANT) concepts such as "translation" to explain not only how the different interests of stakeholders influence MPP development, but also how the identification of MPP solutions reversely conditions the selection of collaborators. Finally, this study provides practical and theoretical implications for understanding the mutually-shaping complexity and dynamics between multiple organizations and technology solutions.**

Keywords: Micropayment, mobile payment, Actor Network Theory, Near Field Communication

I. INTRODUCTION

Service applications for micropayment technology have become increasingly accepted among consumers. In the US annually, there are now more than four hundred billion transactions under US five dollars, for a total as high as one trillion US [1]. The economic effects of these micropayments are impossible to ignore.

Micropayment platforms (MPP) are a standard inter-organization information system, requiring the cooperation of various enterprises for their development and implementation. They are subject to the interests and intentions of the partnering institutions, whose preferences are also conditioned by the group-selected MPP technological solution. As a result, the MPP development process is both highly complex and dynamic.

Current research on MPP primarily emphasizes technological development[2, 3], consumer equality[4], and the connection schemes of various payment systems[5]. Research on MPP is diverse however, and other studies examine the use of electronic purse systems in different countries[6, 7], offer economic analysis of micropayment systems[8, 9], evaluate transaction costs[10, 11], explain why MPP succeeds and fails[12-14], and identify new mobile payment applications [8, 16, 17].

All of this research however, starts from the perspective of markets and users, and thus neglects the standpoint of enterprises. In response, this study discusses the mechanisms through which stakeholder participants in this technology form partnerships, how their respective interests interrelate, and how these interests influence the infrastructure and functions of MPP. These issues are examined through a special case study involving a three-year inter-organization MPP that employs Near Field Communication (NFC) to develop mobile service applications for a private Taiwanese university. Specifically, this study answers the following questions: (1) why the enterprise developed MPP mobile service applications, (2) how it positioned the MPP's role, and (3) how it formed alliances for the project; i.e., how it recruited and negotiated with other organizations to jointly develop MPP.

Adopting Actor-Network Theory (ANT), we analyze the project formation and choices of NFC and MPP in order to understand why this university developed MPP techniques for integrated campus services.

II. MICROPAYMENTS

A micropayment usually refers to a single transaction of less than US five dollars [1]. The proportion of transaction fees for micropayments is also much higher than other payment channels like credit cards or checks. These transaction costs are critical for the acceptance of micropayments[10], although the following two features transform micropayments into a real payment tool: (1) it serves as a unit of accounting or a standard of value, (2) and it can be used as an interchangeable medium or payment tool to facilitate transactions and reduce redundant transaction costs[15]. The current transaction fee for micropayment is proportionally high, but the electronic payment system is able to provide the advantages of lower transaction costs and quicker transaction times. Micropayments would be more likely to succeed through the linkage of electronic payment system.

Current techniques for electronic payment processing can be divided into three types:(1) credit-based solutions, (2) account-based solutions, and (3) value-stored application[1]. These payment solutions comfortably fit into the micropayment environment due to their cost, speed and convenience. Micropayments are smoothly developed into electronic payment systems through these three channels.

In mobile commerce, micropayment is also an important and interesting service for mobile financial applications. For example, a payer can employ a mobile device through a local wireless network to purchase desired goods or services. Micropayments can also assist with telephone calls to numbers where per-minute charges equal the cost of vending items, or with pre-paid purchases from a service provider, bank, or credit-card company[16]. Dahlberg et al. [17] note that the majority of research on these applications for mobile payment focuses on technological development and consumer acceptance of technology; few consider the perspective of payment service providers.

Within the current business environment, information technology (IT) is a key tool for organizations to promote their competitive advantages and differentiate themselves from their competitors[18, 19]. The development of MPP however, requires collaboration between various partners. The intentions and interests of these involved organizations increase the complexities of the MPP. Furthermore, the social relationships of these organizations affect this development process, as does the essential nature of MPP technology. These factors prevent the evaluation of MPP development by simply looking at the strategies and intentions of the involved parties.

III. ACTOR-NETWORK THEORY

In IT research fields, Actor-Network Theory (ANT) is a widely accepted approach for understanding the complex social interaction of technological changes[20] and explaining the socialized processes of technology development and introduction in different contexts[21]. ANT was developed within the field of sociology of science and technology[22, 23]. ANT scholars thought that researchers should observe the fusion and relationships among science, technology, and society by tracing science in action, i.e., boundlessly following the actions of actors[22]. A key feature of ANT is that actors can be both human and nonhuman, e.g., technological artifacts[20].

The purpose of ANT is to examine, through the actors in a network, the actions and motivations of actors and the heterogeneous network that links relationships and aligns interests. ANT can explain how actors (human and technological) with different interests jointly create a relatively stable arrangement of technology[23], so as to express and understand the features and approaches of information technology development. One notable example of this approach is Michel Callon [23], who utilized the word "translation" to refer to the creation of actor-networks. Here, a focal actor is the key actor driving the process of recruiting other actors into the actor-network, transferring its intention, purpose, recognition and behavior to them so that they share common behavior and viewpoints. In this way, an actor-network is not just a simple combination of actors, but rather the seed of a focal actor, who redefines and rearranges the interests, roles, functions and positions of each partner into a new actor-network. The process of translation consists of four stages:

- Problematization: During the problem-formulating stage, the focal actor defines the identification and interests of the other actors who share initial common interests. By defining problems and solutions, concerned actors can be confirmed and their roles identified.
- Interessement: The focal actor convinces the other actors that the interests defined by the focal actor are actually in line with their own interests.
- Enrollment: The focal actor persuades the other actors to accept a set of strategies and the definition of their roles in the developing actor-network.
- Mobilization: The focal actor, by using a set of methods, ensures that the actor-network operates according to mutual agreement so the network remains stable.

During the network building process, the focal actor aligns the interests of all actors according to the network's interest and recruits recognized actors to establish the actor-network. Accordingly, the focal actor transforms itself into an obligatory passage point (OPP) for all network actors. This process of translation is a suitable model for understanding the interaction of multiple social groups in the development of MPP.

IV. RESEARCH METHOD

This study employs the case study research method. Case studies allow the researcher to investigate the interrelationships and dynamics of research phenomena and contexts under a natural setting[24]. MPP involves various organizations whose actions and interests influence and are influenced by MPP development. Thus, MPP development is not strictly predetermined, but rather emerges from continuous party alignments and negotiations.

Data were collected from March, 2006 to December, 2008 through participant observation, semi-structured interviews, meeting minutes, and project files, as depicted in Table I. These multiple sources helped ensure data authenticity and validity.

TABLE I.   THE TYPES AND ILLUSTRATIONS OF EMPIRICAL DATA

Data type	Illustrations
Participant observation	Observation period: 2006.3-2008.12 One of the authors works at CU, he participated in digital campus projects
Semi-structured interviews	Eight single person interviews. Each interview lasted 90 to 120 minutes. Some interviewees were interviewed twice depending on the situation.
Meeting minutes	99 recorded minutes, including discussions on the cooperation and negotiation of enterprises, technology, managers' meetings, and technology group meetings.
Documents	104 files , including project reports, proposals, technical documents, memorandums, official documents, presentations, and historical data.

V. CASE DESCRIPTION

CU (anonymous) was the first university to issue student ID smartcards (UPass) in Taiwan. CU invests significant resources on IT and aims to develop its digital campus as an important characteristic and competing advantage. In 1998, CU launched the contact IC card as a student ID smartcard, and gradually integrated various campus services. In 2005,

CU converted UPass into a RFID (radio-frequency identification) stored value card, and integrated twelve campus services in three major fields: building access control, campus administration services, and payment tools. UPass campus services develop in three periods:

A. The period of digital campus presentation

In April, 2006, CU held a press conference to demonstrate the further development of its digital campus vision with a joint program between a transportation company(EZCard), local bank(Bank C), carbonated beverages vendor(Vendor C), international software company(SWHouse-1), and a system installation hardware company(HWHouse-1). More than 40 schools, several high technology companies, and related government organizations participated in the press conference mentioned above. Afterwards, several schools showed their own interest in such programs, and asked CU and Bank C to help promote the MPP of integrated campus services for their own schools. The development team of UPass thus began considering the possibility of promotion.

B. The period of MPP development

After the conference, CU discussed its goals for the next stage of campus services and its new technology. The school regarded MPP as the key development for future campus services, and decided that future expansion of MPP was best handled by other institutions such as EZCard rather than by the university itself.

CU tried to convince Bank C to develop certain MPP (as Solution-2) suitable for its campus. These efforts were unsuccessful however, as the bank's existing MPP features (QPay, as Solution-3) were credit card based, which by law face certain restrictions on school campuses. Bank C was required to adjust its QPay mechanism and supply related equipment to interested university campuses—measures the Bank eventually abandoned despite university demand, due to legal concerns regarding their credit card business.

Meanwhile, EZCard successfully issued student ID smartcards for CU as part of value-stored application (Solution-7) jointly supported by Bank C and three other local banks. Here however, legal concerns still existed, as transportation passes by law may not provide MPP functions.

Despite these setbacks, CU continued to seek new MPP alternatives. It found that the technology scheme of online MPP(as Solution-4) issued by local Bank S was quite similar to current MPP (Solution-1). CU recruited Bank S as a cooperating partner to help expand MPP. Coincidentally, at the time a leading retail enterprise (Retail K) also intended to seek the cooperation of a bank to promote its own MPP (as Solution-5). As a result, Bank S ceased negotiations with CU in order to actively focus on courting Retail K—a battle it eventually lost to Bank C.

CU's latest MPP partnering solution involved SmartPay, an account-based system (Solution-8) promoted by a bank association (Org-2). SmartPay serves as a account based MPP system in collaboration with 22 banks. Its value can be stored through ATM transfers, which is convenient for many campus applications. Currently however, Solution-8 is still under incubation, and not yet officially released.

It should be noted that during its attempts to expand MPP services, the university's existing MPP system was still operating smoothly without urgent need for replacement. With the success of its press conference and subsequent additional interactions with other enterprises and universities, CU simply expected new possible projects to promote campus services.

C. The emergence of a NFC solution

Through SWHouse-1, CU discovered the installation of a NFC campus application solution at a university (AU) in Austria. The IT department dean of CU visited AU in 2007, and CU determined that the techniques of NFC were compatible with the existing campus system. Encouraged by SWHouse-1, CU formed an NFC mobile network and found a new banking partner, Bank U. After explaining its existing campus services as well as the consumer finance opportunities combined in NFC cellular phones, Bank U was deeply motivated and willing to offer its cooperation.

With the MPP-NFC solution (Solution-9) as its target, CU and Bank U applied for a government technology project encouraging mobile payments as a financial innovation (PMPTFI). Bank U also recruited a systems integration company, SWHouse-2, to jointly develop NFC micropayment and clearing mechanisms for CU's campus. Still in need of a telecommunications partner, CU demonstrated its campus services to Taiwan's leading telecom firm, Mobile K, which was willing to participate in the project. CU then invited a professor from AU as a consultant, and the NFC mobile payment platform was officially established.

Overall, the 2006 press conference of the CU student ID smartcard acted as a catalyst, leading to the involvement and competition of as many as six banks, four universities, and nine possible MPP solutions. Four groups were formed during the process until finally, the governmental technology project PMPTFI was established. Figure 1 and Table II display the thirty actors and nine MPP solutions involved during this MPP development process.

TABLE II. CU MPP SOLUTIONS

MPP	Focal actor	Features
1	CU	Account-based, on-line and off-line dollars by CU
2	CU	Account-based, on-line and off-line dollars by Bank C
3	Bank C	QPay, credit card based, off-line dollars
4	Bank S	Ecoin, account-based, on-line dollars
5	Retail K	ICash, value-stored application, off-line dollars
6	Bank C	QPay II, top-up solution, off-line dollars
7	EZCard	EazyCard, transportation ticket, value-stored application, off-line dollars. Since April 2010, used for payment at over 10,000 locations in Taiwan.
8	Org-2	SmartPay, account-based, on-line dollars
9	Bank U Mobile K	Mobile NFC, value-stored application, on-line and off-line dollars

VI. Analysis

From the point when CU successfully demonstrated the integration of campus services with student ID smartcards, the process of seeking the next IT development solution can be divided into three periods. Here, we demonstrate the changes in relationships between CU and other actors through the employment of ANT.

This study employs ANT as a theoretical lens, treating the various MPP techniques as equal actors. Using ANT, we can clearly understand the detailed process and dynamics of the RFID solution to the NFC mobile payment project. Adopting the analysis of the four elements of translation proposed by Callon[23], we discuss the phenomena from the following three aspects.

A. Problematization

After the press conference, CU defined the problem as "innovation diffusion" to attract the participation of other actors. However, other actors did not proactively seek a partnership. This forced CU to redefine the problem in order to find other actors. The recruitment of Bank S is a typical example. CU redefined the problem as "MPP development in campus" as a way to encourage and engage banks. Thus, before the network successfully formed, CU had to redefine the problem repeatedly in order to acquire partners. Table III presents the ways CU defined its problem at different periods.

TABLE III.   PROBLEMATIZATIONS FOR CU

Time period	Problematization
Digital campus presentation	"Innovation diffusion" enables integration between payment card and campus services
MPP development	"MPP development in campus" implies the increasing card volume for banks
Emergence of NFC solution	Technology innovation of campus services keeps CU leading IT in Taiwan

B. Interessement and Enrollment

Under different contexts, CU defined different questions in order to attract different actors in various domains. Even the actors within the original network, e.g. Bank C, still sought other opportunities for linking other actors to form new network relationships. Issuing student ID smartcards enabled banks to increase their card volume, although it did not convince them of further participation. CU did not have alternative strategies to attract banks for developing MPP. Furthermore, an interesting new target (the MPP of Retail K) opened for banks in the MPP market. These consequences led to multiple actors and an unstable network relationship in the period of MPP development. This situation was not resolved until CU discovered its NFC mobile solution and recruited partners in Bank U and SWHouse-2.

C. Mobilization

Bank U was enrolled into the network owing to the interests defined by CU. SWHouse-2 was recruited as well. These recruited actors formed a network through mobilization through the alignment of their interests. Meanwhile, MPP solutions act as an equal actor to filter and determine the formation of the actor-network. For example, Solution-9 led to the enrollment of telecommunication enterprise Mobile K, whereas Solution-3 and Solution-7 were unable to form stable networks due to legal constraints.

However, actors may also betray their original network in favor of the appeal of other networks, or simply cease to invest resources into the original network. For example, Bank C escaped from their original network through its attraction to Solution-5 with Retail K. This eventually led to CU's association with Bank U, SWHouse-2, and Mobil K in the application of their governmental project, i.e. PMPTFI, which becomes the OPP in order to form a stable relationship of network. This action may prevent the betrayal of other actors, help negotiate a precise goal, gain economic support, and direct all the interests of actors toward a common goal. When more resources are invested, this will facilitate the participation of other actors as needed.

In ANT, CU MPP development is also a process of "translation". The actor's interests are firstly translated into specific needs which will be further translated into the system solution. The system solution will then be adopted by actors, who translate it into the context of their specific work practices. Thus, CU recruits different actors for each specific technology solution. After CU recruits actors, i.e. Bank U, SWHouse-2, and Mobile K, into the actor-network in the last stage, the technology scheme has to be changed in order to include their requests. The change of technology scheme stimulates the generation of mobile NFC solution which turns into the core of MPP application developments.

VII. Discussion

This study analyzes the development process of the MPP NFC solution, elaborating on the complex relationship between multiple organizations and technology. The case study above demonstrates how CU MPP development differs from the conventional development of information systems. The processes of MPP development are emergent and unexpected, support Orlikowski's [25] arguments, and are gradually clarified through the contact of various actors. Each actor pursues its own interest as well as takes into account the common interest of other actors. Through interactions among actors, the cooperative relationship for inter-organization is formed. Even under this cooperation however, actors still seek other opportunities for linking other actors to form more beneficial cooperative partnerships. CU must continuously recruit other organizations, revise its interests and its micropayment solution, and prevent actor betrayal. Therefore, the goal of technology development, the scheme of the MPP system, and the collaborative groupings are not pre-planned but rather emergent and unexpected. Through this process, a leading organization may form an inter-organization cooperation network.

From the ANT perspective, MMP technology will have some effects on selection and formation network. Therefore, these effects trigger interaction among network actors. The selecton of network also limited technology choices. Base on history of developing NFC platform and the role of participants, that can be understand more clearly the nature

of this case. This study realizes that CU continuously repositioned the direction of MPP development over a period of three years. The complexities and dynamics presented in the case can be summarized as follows.

A. MPP development as a process of redefining roles and interests

Requiring multiple partners in the development of MPP usually detracts from the original cooperative theme on account of opposing thoughts and interests. The CU MPP position shifted from original innovation diffusion, to the development of MPP, then to the NFC solution. This demonstrates that problematization is not a one-time activity but a continuous ongoing process [26]. We found that CU not only continued discussing possible developments of campus services and innovation of their MPP scheme, but also sought the cooperation of other actors and redefined their actor-network. Thus, the IT developmental processes of CU campus services are a mixture of changes and eliminations. This process is based on a multi-directional model, rather than a linear model. Technology can have more than one developmental result.

B. Each actor as a latent actor-network

CU actively pursued cooperative organizations to develop its campus services, but the final MPP solution network was promoted by outside actor SWHouse-1. It forced CU to reposition the MPP, i.e. consumers' services on NFC cellular phones. Moreover, the request by several universities to Bank C for MPP made Bank C reconsider the Solution-2 proposed by CU. To adapt Solution-2, Bank C had to upgrade QPay (Solution-3) to QPay II (Solution-6) for campus needs.

Past studies of ANT discuss the development of information systems focusing on the actor-network created by focal actors [26, 27]. However, Monteiro[29] suggests actors may be included into a new, more complete actor-network. In other words, other actors in the network can also play the role of focal actor. According to their own interests, they will seek other outside opportunities or link other actors to form a new actor-network. This latent actor-network influences the interests and stability of the original network.

This implies that to understand the changing processes of MPP development, researchers must not only observe the network of CU recruitment, but also the networks of other actors. We find that from a macro level (based on micropayment markets), each actor can seek other resources to form other latent actor-networks that may influence and break the existing stable network relationship, and result in changes to the MPP solutions.

C. Temporary actors as the catalyst of actions

Once CU can not align mutual actors' interest, the network will not be formed and the developments of MPP development will not be carried out. In previous research on ANT, temporary actors in unformed network are usually neglected. Groothuis and Akbar[28] argue that temporary actors act as a catalyst, and they can affect actor decisions and actions within the network. In case of CU, these temporary actors, though not being part actor of the final network, did have critical influences and trigger further actions by CU.

For example, when School-2 consults with CU about the development of campus smartcards, it stimulates CU to actively think how to diffuse its results to other campuses. Furthermore, with the contact of the NFC forum, CU is inspired to realize the NFC technique, and finally promote the NFC solution of MPP. Retail K's issuance of its ICash card quickly disrupts the negotiation and cooperation between CU and Bank S. ANT scholars should consider how to account for these influential temporary actors.

VIII. CONCLUSION

This study applies the ANT perspective to the development of an inter-organization system. We examine the complex relationships between organizations and technology under the research setting of the development of MPP in CU. The characteristics of the technology solution filter the choices of participant organizations when an enterprise chooses that solution. Meanwhile, when recruiting the participant organizations, the alignment of mutual interests forces enterprises to continuously adapt the goals of MPP and adjust the technology solution before the goal of campus services can be set.

Current research on micropayment primarily discusses issues from markets and user perspectives, but rarely from the standpoints of enterprises. The main contributions of this study are two fold. (1) In practice, the development of an inter-organization information system, e.g. MPP, is usually an emergent and unexpected process. The organization must continuously redefine its own role and technology scheme, and also align mutual actors' interests when searching for collaborative organizations. From an ANT perspective, our study finds that problematization is not a one-time activity but an on-going process. (2) Theoretically, there are rare phenomena in previous ANT literature. One is that each actor of a network represents another latent actor-network, which affects and breaks existing stable network relationships. The other is that temporary actors do influence the focal actor to redefine the problems and roles of other actors.

Our findings provide two main directions for future research. Additional effort is needed to investigate the degree of connectivity among various actor-networks. Furthermore, given the results above, more information is needed on how temporary actors influence changes in actor-networks.

REFERENCES

[1] S. Ching, A. Tai, J. Pong *et al.*, "Don't Let Micropayments Penalize You-- Experience From The City University Of Hong Kong," *The Journal of Academic Librarianship,* vol. 35, no. 1, pp. 86-97, 2009.

[2] S. Jarecki, and A. Odlyzko, "An efficient micropayment system based on probabilistic polling," in Proceedings of Financial Cryptography Conference, Lecture Notes in Computer Science, Springer Verlag, 1997, pp. 173-191.

[3] R. Rivest, and A. Shamir, "PayWord and MicroMint: Two simple micropayment schemes," in 4th International Security Protocols Conference, 1996, pp. 69-87.

[4] S. Yen, "PayFair: A prepaid Internet micropayment scheme ensuring customer fairness," *IEE Proceedings-Computers and Digital Techniques,* vol. 148, pp. 207, 2001.

[5] R. Parhonyi, D. Quartel, A. Pras *et al.*, "An interconnection architecture for micropayment systems," in Proceedings of the 7th international conference on Electronic commerce, Xi'an, China, 2005, pp. 640.

[6] F. Prior, and J. Santoma, "The Use of Prepaid Cards for Banking the Poor : Comparative Study Analysing the Development of Prepaid Systems in the United States and Europe," *IESE Research Papers*, 2008.

[7] L. Van Hove, "Electronic purses in Euroland: why do penetration and usage rates differ?," *SUERF Studies*, M. Balling, ed.: Vienna, Austria: Société Universitaire Européenne de Recherches Financières, 2004.

[8] Y. Au, and R. Kauffman, "The economics of mobile payments: Understanding stakeholder issues for an emerging financial technology application," *Electronic Commerce Research and Applications,* vol. 7, no. 2, pp. 141-164, 2008.

[9] C. Schmidt, and R. Muller, "A framework for micropayment evaluation," *Netnomics,* vol. 1, no. 2, pp. 187-200, 1999.

[10] B. Neuman, "Security, payment, and privacy for network commerce," *IEEE Journal on Selected Areas in Communications,* vol. 13, no. 8, pp. 1523-1531, 1995.

[11] I. Papaefstathiou, C. Manifavas, and B. Capital, "Evaluation of micropayment transaction costs," *Journal of Electronic Commerce Research,* vol. 5, no. 2, pp. 99-113, 2004.

[12] W. Tan, and S. Chen, "An analysis of the factors influencing success of bank-issued micropayment system in Taiwan," *Journal of Systems and Information Technology,* vol. 10, no. 1, pp. 5-21, 2008.

[13] W. Tan, "Factors Affecting Non Bank-Issued POS E-micropayment Choice: A Study of Taiwan Market," *Journal of Internet Banking and Commerce,* vol. 13, no. 3, http://www.arraydev.com/commerce/jibc/2008-12/TAN.pdf, 2008.

[14] C. Clark, "Shopping Without Cash: The Emergence of the E-purse," *Economic Perspectives, Federal Reserve Bank of Chicago, issue Q IV*, pp. 34-51, 2005.

[15] R. Weintraub, *Introduction to Monetary Economics: Money, Banking, and Economic Activity*: Ronald Press Co., 1969.

[16] U. Varshney, and R. Vetter, "Mobile commerce: framework, applications and networking support," *Mobile Networks and Applications,* vol. 7, no. 3, pp. 185-198, 2002.

[17] T. Dahlberg, N. Mallat, J. Ondrus *et al.*, "Past, present and future of mobile payments research: A literature review," *Electronic Commerce Research and Applications,* vol. 7, no. 2, pp. 165-181, 2008.

[18] B. Ives, and G. Learmonth, "The information system as a competitive weapon," *Communications of the ACM,* vol. 27, no. 12, pp. 1193 - 1201, 1984.

[19] C. Wiseman, and I. MacMillan, "Creating competitive weapons from information systems," *Journal of Business Strategy,* vol. 5, no. 2, pp. 42-49, 1984.

[20] G. Walsham, "Actor-network theory and IS research: current status and future prospects," *Lee, AS, Liebenau, J. and DeGross, JI (Eds.) Information Systems and Qualitative Research*, pp. 466-480, 1997.

[21] M. Akrich, "The de-scription of technical objects," *Bijker, W. and Law, J. (Eds.) Shaping technology, building society: Studies in Sociotechnical Change. Mass, MIT Press*, pp. 205-224, 1992.

[22] B. Latour, *Science in action: How to follow scientists and engineers through society*: Harvard Univ Pr, 1987.

[23] M. Callon, "Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay," *John Law (Eds) Power, Action and Belief: A New Sociology of Knowledge,* vol. London: Routledge & Kegan Paul, pp. 196-233, 1986.

[24] R. Yin, *Case study research*: Sage publications Newbury Park, Calif, 1994.

[25] W. Orlikowski, "Improvising Organizational Transformation Over Time: A Situated Change Perspective," *Information Systems Research,* vol. 7, no. 1, pp. 63-92, 1996.

[26] S. Sarker, and A. Sidorova, "Understanding business process change failure: An actor-network perspective," *Journal of Management Information Systems,* vol. 23, no. 1, pp. 51-86, 2006.

[27] B. Ajad, and S. Faraj, "Examining Alignment of Frames Using Actor-Network Constructs: The Implementation of an IT Project," AMCIS 2007 Proceedings, pp. 258, 2007.

[28] A. Groothuis, and Y. Akbar, "Organizational transformation—from multinational to global: An early dynamic modeling perspective," Global Business and Organizational Excellence, vol. 26, no. 4, pp. 47-61, 2007.

[29] E. Monteiro, "Actor-Network Theory and Information Infrastructure," *From Control to Drift. The Dynamics of Corporate Information Infrastructures*, C. C. Associates, ed., pp. 71-83, Oxford: Oxford University Press, 2000.
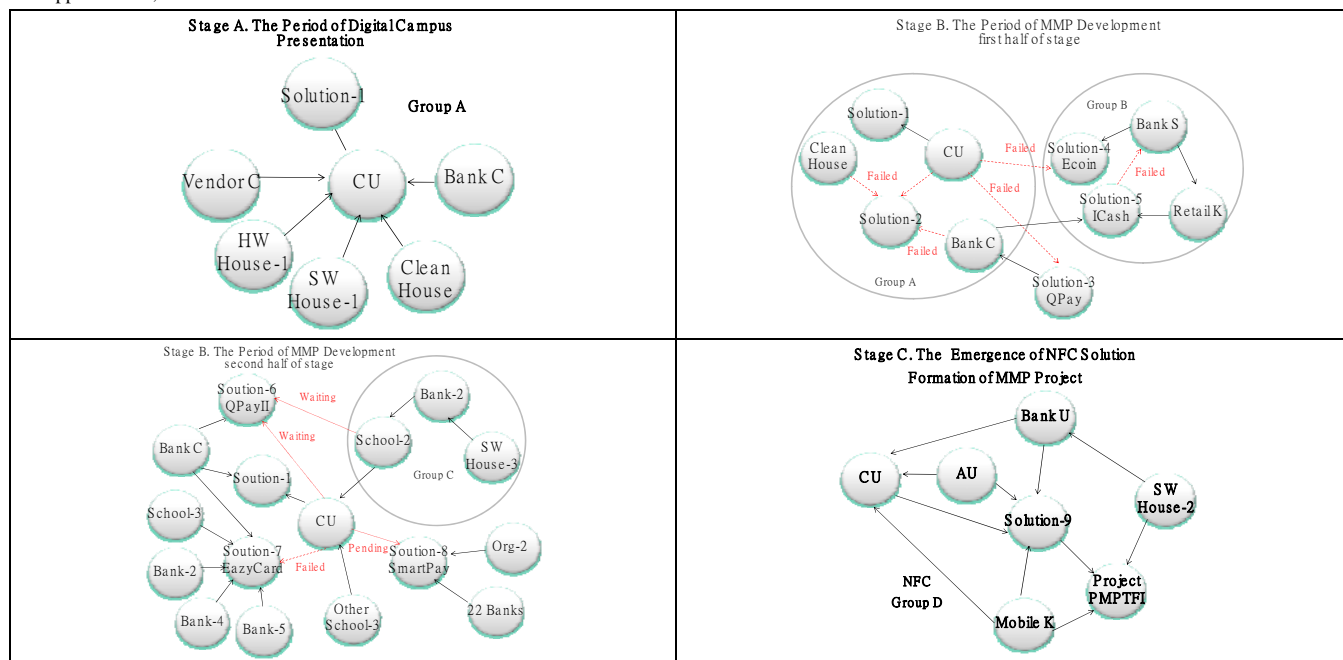
Figure 1.   Change process of developing the NFC solution of MPP in CU