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Extension of DEMO approach towards effective application of business process automation: RPA application

In Partial fulfillment of the Doctoral Degree

By

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Supervised by Professor Dr. Junichi, Iijima

A dissertation submitted to the

Industrial Engineering and Economics Course

Department of Industrial Engineering and Economics

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To my family…

Abstract

As one of the most renowned branches in the management field, business process management witnessed many achievements in scholar research, while the applications in the industry also bring about various best practices that contribute to the development of business process management.

From the beginning of a business process, the managerial efforts started to be embodied by business process modeling and analysis, followingly, the business process model is monitored and tracked by business process monitoring tools. And the result of the business process is eventually evaluated by business process mining techniques. To consolidate these methodologies and techniques into one platform, business process management systems (BPMSs) came into being. And this technological solution also embedded the function of business process automation, in which the rule-based business process is automatically conducted in an efficient way. Especially for mega-sized organizations, business process automation contributes to their cost reduction and performance enhancement in the context of business process reengineering. Based on this context, unnecessary and redundant process are identified and eliminated before the automation, so that the loss caused by the redundancy will not be maximized with the automation.

However, it unintentionally strengthened the barriers for small and medium-sized enterprises that desire to automate their business processes, as business process reengineering

requires to have considerable cost from the beginning. To resolve the issue of heavy investment in business process management systems, a solution called RPA (Robotic Process Automation) was proposed. RPA focuses on automating the original business process, which does not result in the costs required for business process reengineering. For instance, since the target user of RPA is the employee with no engineering background, the solution that RPA offers do not require the investment on extra IT human resource. Based on these appealing points of RPA, the aim of RPA is to free human workers from tedious and repetitive tasks, so that human workers can concentrate more on sophisticated tasks. And by doing so, better performance and lower costs can be achieved.

However, aside from the utility and relevance of RPA, when adopting RPA to organizations, it has nothing different from the other new technologies. The effective acceptance of RPA is calling for more structured and methodological support. Noticing about this issue, I decided to apply the design science research methodology to the development of the solution.

At first, with the basic understanding of the negative acceptance of RPA, I started the problem and motivation identification process. I first designed and conducted a demonstration project to testify the claimed RPA functions. And this real user experience motivated me to investigate more about relevant problems about acceptance in the natural settings of RPA application. Therefore, a survey study was conducted in RPA user companies in China. Eventually, I defined three relevant problems to be solved in the perception and the intention to use RPA to improve the acceptance of RPA.

Followingly, I initially set up the objective of the solution as a methodology that can cover all three identified problems, and eventually narrow it down to the development of a business process modeling methodology grounded from DEMO approach. Since the DEMO approach introduces the perspective of human capabilities and responsibilities in the business process, it is considered as a plausible structured methodology to create relevant business process models for RPA application, and further contribute to the enhancement of the perception and the intention to use RPA.

Preceding, the developed extensions of the DEMO approach were demonstrated and evaluated by case studies with four real RPA users from two companies. In the case studies, semi-structured interviews were conducted, and the interview data were further analyzed by the grounded theory approach. The utility and relevance of the artifacts were demonstrated.

This research work makes four contributions as follows, 1) the academic discussion about the connection between human workers and business process automation has been enriched; 2) the methodological modeling part of DEMO has been extended in its construction model and process model.;3) academic research in the RPA field has been empowered by profound theory and methodology; 4) case study under the topic of RPA has been enriched.

Keywords: *Business Process Management, RPA (Robotic Process Automation), PSI theory, DEMO (Design and Engineering Methodology for Organizations), Design Science.*

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Chapter 1 Introduction

1.1 Research background

In the evolution of Business Process Management (BPM), Business Process Automation(BPA) plays a major role to facilitate organizations to remain relevant and competitive (Mohapatra, 2009). By modeling business activities in rule-based business processes for administration and management, Business Process Automation(BPA) contributes to productivity enhancement and error elimination and therefore achieves labor-saving (Melchert, Winter, & Klesse, 2004). Still, researches and business practices on Business Process Automation (BPA) are in progress. On one hand, various researchers and practitioners identified classified and generalized many academic definitions, concepts and best practices on Business Process Automation (BPA). However, other scholars argued that simply accelerate business processes may not lead to higher efficiencies. Practitioners are required to re-conceptualize, re-think and re-design about business processes in an integrated way if they desire to enhance operational performances. Therefore, they insisted that Business Process Reengineering(BPR) should be taken into consideration when conducting business process transformations (Hammer, 1990).

Correspondingly, Business Process Reengineering (BPR) was widely adopted in delivering information and technology solutions such as ERP (Enterprise Resource Planning), SCM (Supply Chain Management), CRM (Customer Relationship Management). These solutions have been well developed and implemented in multiple industries and have become

the major players of IT-enablers of Business Process Management(BPM) in the last two decades (Watson & Holmes, 2009). Meanwhile, in the last few years, criticisms on the above IT solutions pointed out that adoptions and deployment of Business Process Reengineering(BPR) inevitably causes additional financial and organizational burdens, since it takes a long time to achieve financial returns (Willcocks, Lacity, & Craig, 2015). In this context, a solution called "Robotic Process Automation (RPA)" came into being. By utilizing software tools, this "Robotic Process Automation (RPA)" aims to automate tedious and repetitive human tasks. And since it works at the user-interface level, only light weighted IT resources requires to be involved. And the major point that it differs from ERP (Enterprise Resource Planning), SCM (Supply Chain Management), CRM (Customer Relationship Management) is that the implementation of "Robotic Process Automation (RPA)" does not emphasize on Business Process Reengineering (BPR). Instead, it aims at only automating the existing business process. Namely, it does not call for a revolution to happen in the original business process but provides an effective way to automate the tasks.

Although RPA attempted to solve the emerging problems in the adoption and application of business process automation, high cost and late return of investment, as a new technology to be introduced to the organizations, RPA has nothing different from the other new technologies. For instance, while the employees are confusing about the name of RPA, the claimed benefits that RPA aims to bring is also under questioning. How to achieve the effective acceptance of RPA from the beginning became the major topic under discussion.

1.2 Research methodology

As a promising solution in business process automation, it is expecting that RPA application can further be scaled up, especially to small and medium-sized organizations that are hindered by the cost burden of business process reengineering solutions in the past. Therefore, to facilitate the effective adoption and usage of RPA, my research determined to start from identifying relevant problems and the associated solution prior to the adoption and usage, the acceptance of RPA.

As illustrated in Figure 1-1, my research followed the design science research methodology proposed by Peffers et al. (2007) and the major research activities are also shown in Figure 1-1. This section elaborates on the reasoning process about the necessities of these research activities and providing brief explanations about them.

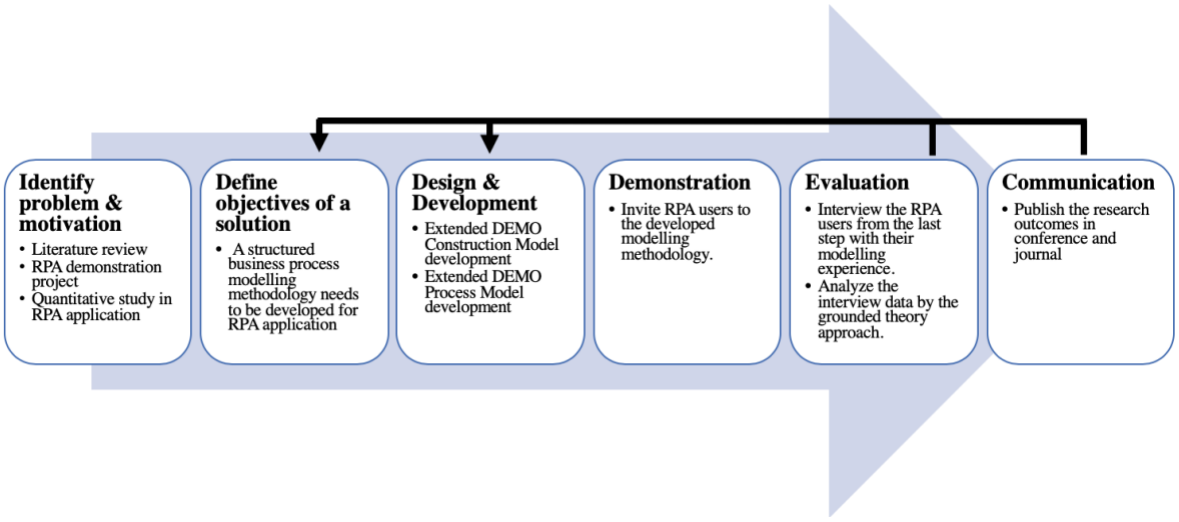

Figure 1-1 Research methodology in design science research approach (Peffers et al., 2007)

- Identify problem and motivation

In this stage, like most of the design science research projects in IS, I started my research work by literature review. Considering the feature of RPA, it was born in practitioners' application, so in addition to the available research in academia, I also collected a lot of information from the industry such as consulting companies that provide RPA solutions and RPA software vendors. By doing so, I was enabled to create a comprehensive conceptualization and understanding of RPA. Followingly, among the diverse definitions of RPA, most of them tend to praise the powerful functionality and the bright future of RPA. For me, before I officially start to develop artifact related to RPA, practical using experience of RPA is essential and so that the solution of mine can possibly be more relevant. Therefore, I designed and developed a demonstration project which tested two well-known functions of RPA, 1) document generation; 2) email sending. And this project did enable me to experience the merits that RPA is able to bring to the organizations, cost reduction and performance enhancement. However, as my demonstration was completed in the artificial setting, namely, in the lab, it was lack of the data from the natural settings which can highly contribute to identifying the most relevant problem in the RPA field. Thus, I decided to proceed with my investigation into a quantitative study in the RPA industry. Adapting from the classic TAM model, in this study, I intended to figure out the positive external factors that are related to both the perception of RPA and the intention to use RPA, and this study eventually helped me to sort out the research problems in RPA application as follows,

1. A shared vision of the RPA application needs to be developed.

2. User participation of the RPA application needs to be improved.

3. User involvement of the RPA application needs to be improved.

These three problems made me recall the excellence that exhibits in the results of my RPA demonstration project in which tedious tasks of the large amount can be done in minutes by RPA. So, if RPA can be properly applied in the organizations, it can potentially help organizations achieve fundamental cost reduction and performance improvement. Therefore, these potential benefits essentially motivated me to resolve the three research problems identified above. After all, RPA, as one of new technologies to be applied in organizations, I believed that the improvement of the external factors to the perception and the intention to use RPA can contribute to the following effective acceptance by providing a good starting point for the later application.

- Define the objectives of a solution

Based on the above three problems, I started to work on the setting up of the objectives of a solution. And the objectives gradually became clear. At first, I roughly set up the major objectives of this solution as, a solution that can cope with all these three matters of RPA. Then, I proceeded by adding one feature for this solution, this solution should be structured and methodological that can be scaled up into different RPA application cases. The determination of this feature inspired me to narrow down into one direction. Since RPA is applied to business process automation, business process modeling is required to

be done from the beginning. Therefore, a structured, methodological and scalable solution is supposed to contribute to business process modeling. Therefore, I started to look for a business process modeling methodology that can discuss all these three topics. Most of the methodology focuses only on providing detailed process steps in sequence but has no concern about building a shared vision or improving user participation and user involvement. Eventually, I found the most plausible solution, DEMO (Design and Engineering Method for Organizations). DEMO aims at providing a skeleton of the business process and differs itself from the other modeling methodology in the capture of primary responsibility unit and human capabilities. And I assumed that this process skeleton can contribute to the creation of a shared vision, while the responsibility unit and human capabilities classification may have a positive impact on user participation and user involvement. I then decided to evaluate this assumption in the following demonstration and evaluation periods.

At that time, the only problem left for me was that the original DEMO approach is tailored for highlighting the importance of human-oriented works so that it is a lack of discussions about the involvement of technology. But this at the same time left me more space in methodology design and development by generating a business process methodology as a solution for better acceptance of RPA while maintaining the unique aspects that DEMO introduces to the modeling world. In the end, it was possible for me to establish the objectives of the solution. I decided to extend the original DEMO modeling methodology and make it fit for the modeling of the RPA application. As a

trial, I decided to extend the first two DEMO modeling methodologies, the Construction model and Process model.

- Design & Development

In this stage, I focused on the extension of the Construction model and Process model. The detailed process can be found in chapter 5 and chapter 6. After conducting literature review of DEMO in both methodological research and application research, I found that although the modeling methodology of Construction model has been discussed in a way that different human capabilities may excel at certain business tasks (de Jong & Dietz, 2010), the explicit discussion of how to model technology involved business process is not available. Also, Dietz (2006a) pointed out human capabilities in Forma and Informa can be imitated by technology in some cases, but he did not provide the associated modeling principles for both Construction Model and Process Model either.

So, my design and development process grounded from the previous research and the original methodologies of DEMO and I Was aware that new methodology needs to be developed in completing my solution. Therefore, I attempted iteratively not only to introduce DEMO viewpoints into the analysis of RPA application but also to produce the explicit and practical modeling procedures that can be applied to the RPA application case.

- Demonstration

  Since my problems are collected from the RPA users in the industry, the solution that I developed needs to overcome challenges in real business environments. Therefore, the demonstration for my artifact requires to be conducted in natural settings as well. Specifically, I invited four RPA users from two companies to apply my methodology into their business process modeling and create the corresponding extended DEMO Construction models and Process models.

- Evaluation

  Following the demonstration, the evaluation was conducted by having semi-structured interviews with those four RPA users. The interview questions include both their experiences about my modeling methodology and other open suggestions or comments. The interview data were then analyzed by using the grounded theory approach and so that the performance of my developed artifacts can be compared to the predefined objectives of the solution in a systematic and structured way. The details for the evaluation can be found in chapter 5.3 and chapter 6.3.

- Communication

  All the research outcomes have been published in international conferences and journals to share the state-of-art challenges and research gaps in RPA application, while possible solutions grounded from the DEMO perspective are also presented.

Chapter 2 Problem and motivation identification

2.1 The definitions of RPA

The term “RPA” was firstly introduced by industry practitioners. In effect, the development of RPA in both academia and industry are in the early stage, and widely adopted definitions and concepts related to RPA are incomplete. In this paper, I revised various definitions and concepts from multiple sources to comprehend the evolution of RPA.

In industry, practitioners derive their definitions of “RPA” mainly from the application and configuration activities of RPA software. Thus, most definitions of “RPA” essentially describe attributes of RPA software. And these definitions specify in the first place of “Robotic” in “Robotic Process Automation” does not refer to physical robots’ involvement but stands for specific software tools for BPA (Business Process Automation). Among them, Lowes (2016) from Deloitte points out that RPA software mainly has three activities, 1) automate existing activities; 2) manipulate data; 3) cooperate with other in-house IT systems. Diepeveen, Matcher, and Lewkowicz (2016) further argued that these activities were implemented without impacting existing in-house IT infrastructure and IT systems. On the other hand, Fulton, O’Sullivan, and Rayment (2016) indicated that the major difference between RPA software and existing business process software is that RPA software works only at user interface layer which enables business people with little IT expertise to apply RPA software easily if having certain training. Also, what RPA software can do is not just limited in replicating tasks that used to be done by employees. Following

predefined business rules and logic, RPA software is capable of making reactions (e.g. exception handling, human intervention notification) to triggers from both in and outside of the organization (KOFAX, 2017). Furthermore, Atroley, et.al (2015) from KPMG indicate that these reactions can be further upgraded by advanced artificial intelligence techniques and proposed three classes to classify RPA software. Until 2017, RPA was officially filed as one of the patents of Accenture Global Solutions Limited Dublin in USPTO. In this patent, RPA is firstly defined as any methods, equipment, IT systems and computer programs that enable automating manual business processes (Bataller, Jacquot, & Torres, 2017).

Meanwhile, very limited researches have been conducted in academia. Researchers from the outsourcing unit of the London School of Economics consider RPA as the promising trend of business process outsourcing. By doing case studies among several organizations which have put RPA software into use, from the perspective of business service automation, they define RPA as a software-based solution which configures RPA software to automate business processes in a certain organization (Willcocks et al., 2015). For RPA software, they explain deeply the idea that RPA software work only at the user interface layer. Essentially, through the user interface, RPA software interact with other IT systems by logging onto them and proceed activities like what humans did in the past (Willcocks et al., 2015). In the meantime, they emphasized that RPA software can potentially free human workers from tedious and repetitive tasks (Lhuer, 2016).

2.2 RPA Demonstration project

Based on the investigation and review of the definitions of RPA, I was able to have a basic understanding of the current development and application of RPA in industry and the on-going research progress in academia. However, although many videos provided by software vendors are available online and each of them attempts to present multiple appealing points of RPA, in its easy-to-use and contribution in cost reduction and performance improvement, I believe that it is necessary for me to obtain user experience of RPA if I would like to conduct profound and comprehensive research in the context of RPA. Therefore, I designed an RPA demonstration project, in which two of the most well-known functions of RPA are realized, one is an auto-report generation and the other one is auto-email sending. The project description is as follows in Figure 2-1,

There are 5 world development PDF report from 2015 to 2019, published by the World Bank. The RPA application extracted the first two pages of the overview of each report and generated 5 PDF overview reports. Then, these 5 PDF overview reports are added into one PDF overview reports. Meanwhile, the RPA application also conducted word mining for each report and eventually extracted the keywords for each report showing in word cloud images. And a keywords report that contains keywords of 2015 to 2019 world development report is generated in PDF form. In the end, the keywords report is sent to a dedicated recipient by email.

Figure 2-1 Process description of RPA demonstration project

For delivering the above functions of RPA in an efficient way, I decided to use Python 3.7 as the programming language and SPYDER was used as the IDE (Integrated Development Environment) for its powerful support to Python.

Referring to the work Sweigart (2015), in the implementation of the project, each of the functions was realized by various packages from the Python community. The functions that operate with PDF documents are mainly supported by package, PyPDF2 and PDFMiner. The word cloud images were generated by calling the package, wordcloud. But the application of wordcloud requires to have some other packages to support (See details in the appendix). Eventually, the email sending related functions was realized by package, smtplib and email. The completed application codes can be found in the appendix. And the running flow of this RPA demonstration project is illustrated by a flowchart in Figure 2-2.

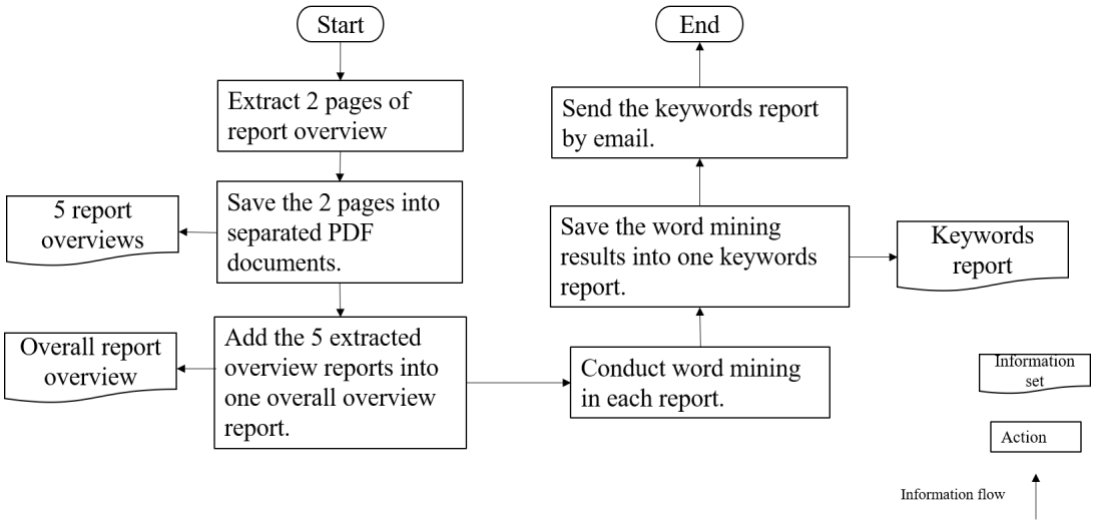

Figure 2-2 Flowchart of RPA demonstration project

2.3 Survey study of the perception of RPA in Chinese companies

After finishing the demonstration project of RPA, I was impressed with the functionality of RPA that it can free human workers from tedious and repetitive work like PDF content mining, report making, and email sending. However, due to the environmental limitations,

the program that I made cannot deal with a huge number of tasks which is claimed as one of the major features of RPA. So, in order to identify the most relevant problems and gain motivations in RPA filed, I designed a survey study to investigate the acceptance of RPA in Chinese companies.

I started by conducting a literature review by reading through 32 case studies in RPA application (See appendix) to synthesize the issues in each RPA application. Eventually, I found that for the companies that show negative acceptance of RPA, different industries share three representative issues as follows, 1) the user company does not share a common vision for RPA application; 2) the RPA users are not clear about their responsibilities; 3) the RPA application may make users less engaged to their work. However, the empirical evidence that explains the relationships between these three findings and the acceptance of RPA was to be discovered and thus motivated me to conduct a survey study.

Based on these three issues that may relate to the negative acceptance of RPA, to obtain structured implications in improving the actual use of RPA, I designed a research model shown in Figure 2-1. This research model is adapted from the most profound model in investigating a set of factors that affect the acceptance of technology for an individual, TAM (Technology Acceptance Model) (Davis, 1985) (Davis, Bagozzi, & Warshaw, 1989). This set of factors can be understood as the external factors caused by the surrounding environment and the internal factors from this individual, including the perception of this technology and the relating intention to use this technology. Many types of research indicate that the external

factors are proportional to the internal factors, and the internal factors make mediating effects between external factors and the acceptance of the technology.

In my research, I finalized the goal as investigating the external factors that may affect the internal factors, including the perception of RPA and the intention to use of RPA. Therefore, I conceptualized the three issues into well-defined constructs and then considered the constructs as external factors. Then, I testified about the relationships between the external factors and the internal factors.

2.3.1 Conceptual background

The variables used in the research model are represented by a 7-point Likert scale between “Strongly disagree” and “Strongly agree” in the survey questions(Brooke, 1996).

- **Perception of RPA**

Originally in TAM (Davis, 1985) (Davis et al., 1989), the perception of a specific technology refers to the degree to which an individual is aware of a certain type of technology. This perception is further featured as perceived usefulness and perceived ease of use. And I found that these two features of perception are widely used in investigating the technology that has not been used in the organization. However, in my research, I believed that the above two features may not be enough to reflect on this perception change. Therefore, I decided to adapt the perception features from the research of

Agarwal and Prasad (1998). In their research, the perception of technology includes, 1) relative advantage; 2) ease of use 3) compatibility. In my research, I contextualized these three features in RPA application and proposed the following definitions, 1) relative advantage of RPA, it refers to the advantage brought by RPA especially compared to the previous solution; 2) ease of use of RPA, it refers to the easiness of mastering the method to use RPA; 3) compatibility of RPA, it refers to the compatible level between RPA and the legacy system.

- **Continual intention to use RPA**

In TAM (Davis, 1985), intention to use new technology is defined as the degree to which an individual is motivated to use this technology. As previously mentioned, since my research focuses on RPA users who have experiences to use RPA, I decided to contextualize the definition of intention to use RPA further. While considering the previous using experiences of RPA users, I focused only on the continual intention to use RPA among these users. And therefore, I adapted the constructs from Luarn and Lin (2005), Shiau and Chau (2016) and Hong, Lin, and Hsieh (2017), in which the motivation of using RPA in the future as well as the frequency change and whether the user will recommend RPA to others are measured.

- **External factor 1- A shared vision of RPA application**

In the research of Pearce and Ensley (2004), a shared vision is defined as a common mental model of the future development shared by the organization. Also, Gutiérrez, Bustinza, and

Molina (2012) indicate that this shared vision exhibits the employee's ability to share the image of achieving the future success of the organization. Further, Senge and Sterman's (1992) research shows the positive effect that shared vision can make to the good relationship between professionals as well as their long-time commitment to the organization.

Based on these research outcomes, when analyzing the literature review data, I could, therefore, conceptualize the first representative issue of RPA application into the shortage of shared vision of the future use of RPA. Accordingly, the first external factor was determined as, a shared vision of RPA application, which refers to the degree to which a clear vision about the future use of RPA is shared by the organization.

- **External factor 2- The RPA user participation**

According to Barki and Hartwick (1994), user participation is defined as a series of behaviors or activities performed by users in the system development process. In another research by them (Hartwick & Barki, 1994), they further identified the overall responsibility of users as one of the dimensions of user participation. And as previously discussed, one of the representative issues in RPA application is the vagueness of responsibility scope of the users. Therefore, I decided to introduce the concept of user participation to the second external factor.

Specifically, the second external factor was defined as, the RPA user participation, which refers to the degree to which RPA user is clear about the relating responsibilities in the RPA usage.

- **External factor 3-The RPA user involvement**

Barki and Hartwick (1994) also differentiated user participation from user involvement and defined user involvement as a subjective psychological state in which employees feel relevant to an information system. Further, Santosa, Ii, and Chan's (2005) research imply that the higher user involvement would lead to higher user satisfaction levels, which inspired me that user involvement may potentially have impacts on the psychological state change in user groups. Meanwhile, in the last issue that I synthesized from the literature review, surprisingly, the application of RPA led to a drop of employee's engagement to their work. In order to measure this psychological state change, I considered user involvement as the external factor to represent this issue.

Specifically, the last factor is defined as, the RPA user involvement. It refers to the degree to which RPA users can clearly feel relevant to their work after using RPA. Here, in order to highlight the difference between user involvement and user participation, inspired by the research from (Kappelman & McLean, 1991), I considered user involvement as a decedent of user participation. So, in this research, I only focus on the personal relevance occurring after an individual's actual use of an information system.

2.3.2 Research model & hypothesis

The aim of this study is to identify and justify the key factors that affect the perception of RPA and the intention to use RPA in the current RPA user groups. Precisely, in order to justify the reliability of the issues that I collected from the interviews and provide relating

empirical evidence, I conceptualized three external factors on a one-to-one basis as follows, 1) a shared vision of RPA application; 2) the RPA user participation; 3) the RPA user involvement. Starting from these three factors, I expected to test the effects that they may make to both the perception of RPA and Intention to use RPA. Figure 2-3 depicts these relationships to be tested in the research model.

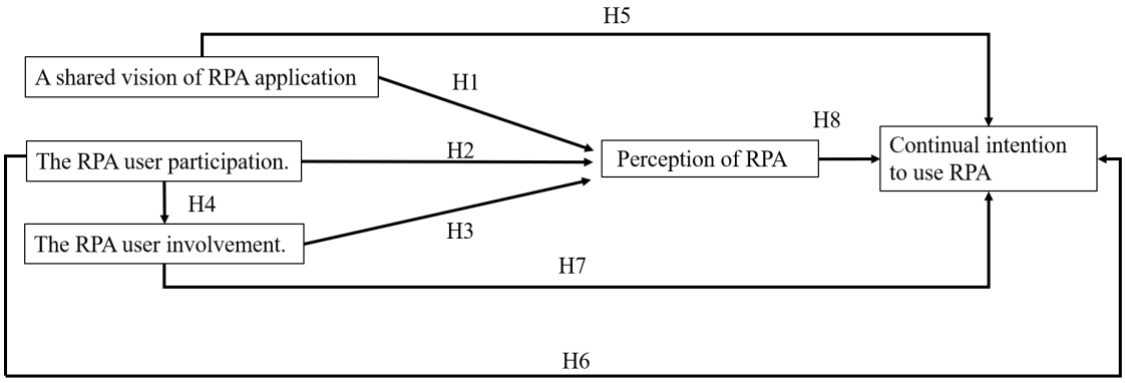

Figure 2-3 Research model of RPA survey study in China

In the original TAM(Davis, 1985), it has been well justified that the perception of an information system is proportional to the intention to use this system (Lin & Lu, 2000; Park & society, 2009). Namely, if an information system can be properly perceived, people will have more intention to use this system. And therefore, in my adapted researches of TAM, perception of an information system is often considered as playing mediator between external factors and continual intention to use the system. So, in the beginning, I first set up the first set of hypotheses including hypotheses 1 to 3 to testify the relationships between the three external factors that I defined and the perception of RPA. And I expected the external factors would positively contribute to the perception of RPA for RPA users as follows,

H1: A shared vision of the RPA application positively affects the perception of RPA.

H2: The RPA user participation positively affects the perception of RPA.

H3: The RPA user involvement RPA positively affects the perception of RPA.

On the other hand, as explained in section 2.5, since user involvement is recognized as the decedent of user participation, in the next hypothesis, I accordingly aimed to testify this relationship by assuming user participation has a positive influence on user involvement, as shown in H4.

H4: The RPA user participation positively affects RPA user involvement.

To deliver complete investigation in RPA context by adapting TAM (Davis, 1985), in the next set of hypotheses, including hypothesis 5 to 7, I moved to testify the direct relationships between the external factors and the continual intention to use RPA, without considering about the mediating effects brought by the perception of RPA. And in this research, I first expected all relationships between them to be positive.

H5: A shared vision of RPA positively affects the continual intention to use RPA.

H6: The RPA user participation positively affects the continual intention to use RPA.

H7: The RPA user involvement positively affects the continual intention to use RPA.

As previously discussed, although various kinds of researches have demonstrated the solid positive relationship between the perception of RPA and the intention to use RPA (Kuo & Yen, 2009; Chang & Cheung, 2001; Lean, Zailani, Ramayah, & Fernando, 2009), a similar

conclusion is not available in RPA context. And therefore, I proposed the last hypothesis aiming to demonstrate this well-testified proportional relationship between the perception of RPA and the continual intention to use RPA and I also expected positive relationships to be discovered, as shown in H8,

H8: The perception of RPA positively affects the continual intention to use RPA.

2.3.3 Data analysis

- **Data collection**

The sampling was conducted in the four major cities of China, where the companies made the best use of the state-of-art technology achievements into their organizations. I invited 1280 full-time workers from 183 organizations to complete my survey and eventually received 168 effective responses from 35 organizations.

The demographic profile for the responses is shown in Table 2-1. Over 40 percent of companies are from the finance industry and 26.5 percent of companies from the business process outsourcing industry also play as one of the major RPA users. And 45.8 percent of the responses are from the finance and accounting department. Most people (84.6 percent) are ordinary employees with no management jobs. For the company size, most responses are from a company size of 300 to 1000 employees, 62.1 percent.

Table 2-1 Demographic information of RPA survey study in China

Sample size: 168					
Industry	**Percent**	**Department**	**Percent**	**Position**	**Percent**
Finance	40.5%	Administration	25.2%	Employee	84.6%
Manufacturing	12%	Finance & accounting	45.8%	Manager	15.4%
Public sector	6%	Marketing	12.6%		
Retailing	10%	Research &	7.1%		
BPO	26.5	Development	9.3%		
Others	5%	Production			
Company size		**Company location**			
Less than 50	15.5%	Beijing	33.2%		
50-300	17.9%	Shanghai	16.8%		
300-1000	62.1%	Guangzhou	10.4%		
More than 1000	5.5%	Shenzhen	31.2%		
		Others	8.4%		

- **The test of the measurement model**

The test and analysis of the data collected were conducted by IBM SPSS Statistics 25. The evaluation of the measurement model includes the test of reliability, convergent validity, discriminant validity. Among them, the reliability evaluation was completed by testing the Cronbach's alpha (Hair, Black, Babin, Anderson, & Tatham, 2010) of each factor (see Table 2-2), the composite reliability (CR) (Chin, Marcolin, & Newsted, 2003) (see Table 2-2) and the significance of items loading (Chin et al., 2003) (see Table 2-4). All Cronbach's alpha values and composite reliability value exceed the level of 0.70 and all the significance level of item loadings achieve the level of 0.01. Therefore, the reliability of the measurement model is confirmed.

Table 2-2 Test of the measurement model

Construct	Cronbach's alpha	AVE	CR	Construct correlation						
				SV	UP	UI	RA	EU	CO	CI
SV	0.87	0.68	0.89	**0.82**						
UP	0.89	0.71	0.88	0.36	**0.84**					
UI	0.91	0.79	0.92	0.17	0.20	**0.89**				
RA	0.94	0.80	0.92	0.09	0.29	0.21	**0.89**			
EU	0.89	0.71	0.88	0.34	0.34	0.33	0.24	**0.84**		
CO	0.88	0.77	0.91	-0.03	0.11	0.15	0.27	0.24	**0.87**	
CI	0.89	0.69	0.87	0.24	0.51	0.15	0.42	0.42	0.15	**0.83**

Note: SV= shared value; UP= user participation; UI= user involvement; RA= relative advantage; EU= ease of use; CO= compatibility; CI= continual intention to use.

The convergent validity was evaluated with AVE (average variance extracted) (Chin et al., 2003)and factor analysis. As shown in Table 2-2, all the AVE values exceed the level of 0.50. Meanwhile, for identifying the latent constructs, factors were extracted by a principal axis factoring method with varimax rotation. Table 2-3 gives information about construct operationalization. And Table 2-4 gives the results of item loadings and eigenvalues of each variable. And for the variables that have eigenvalues greater than one (Kaiser,1960), seven factors were extracted, and their cumulative ratio is 83.061%. As seven factors were proposed in the measurement model, the extracted seven factors that exhibit acceptable explainability to the variables and were therefore chosen. Also, the values of all item loadings are greater than 0.50. Therefore, the convergent validity of the measurement model is also confirmed.

The discriminant validity was evaluated by comparing the square root of AVEs and construct correlations (Gefen & Straub, 2005) (see Table 2-2). And the results indicate that all the construct correlation values are less than the square root of the AVE (see diagonal values in Table 2-2), which suggests that the correlations between the proposed constructs are

not significant. And thus, the discriminant validity of the measurement model is also appropriate.

Table 2-3 Construct operationalization

Constructs	Items	Sources
A shared vision of RPA application	**SV1**: The leadership of the company shares a common vision of the RPA application's future. **SV2**: I agree on the RPA application is important for our organization. **SV3**: Our unit shares the same ambition and vision with other units on the RPA application. **SV4**: In RPA application, people in our unit are enthusiastic about pursuing the collective goals and missions of the whole organization.	All items adapted from (Gutiérrez, Bustinza, & Molina, 2012)
The RPA user participation	**UP1**: I am clear about my responsibility in the RPA application. **UP2**: I am clear about my colleague's responsibility in the RPA application. **UP2**: I am clear about how to make changes when exceptions occur in the RPA application.	All items adapted from (Barki & Hartwick, 1994)
The RPA user involvement	After using RPA, I am clear that using RPA (to finish my previous task) **UI1**: Extremely essential (1) Extremely nonessential (7) **UI2**: Extremely fundamental (1) Extremely trivial (7) **UI3**: Extremely significant (1) Extremely insignificant (7)	All items adapted from (Santosa et al., 2005)
Perception of RPA	● **Perception of Relative advantage** **RA1**: I can perceive that RPA can enhance my effectiveness to do my job. **RA2:** I can perceive that RPA can make it easier for me to do my job.	All items adapted from (Agarwal & Prasad, 1998)

	RA3: I can perceive that RPA can give me greater control to do my job. ● **Perception of Ease of use** **EU1:** I can perceive that RPA can be mastered with acceptable effort. **EU2:** I can perceive that RPA can be controlled to do whatever I want it to do. **EU3:** I can perceive that my interaction with RPA can be easy and manageable. ● **Perception of Compatibility** **CO1:** I can perceive that RPA fits into my current work style. **CO2:** I can perceive that I do not need to alter much about my current work style. **CO3:** I can perceive that RPA can be integrated with the current way that I work.	
Continual intention to use RPA	**CI1:** I intend to continue using RPA in the future. **CI2:** I intend to use RPA more frequently in the future. **CI3:** I will recommend RPA to others.	All items adapted from (Luarn & Lin, 2005) (Shiau & Chau, 2016) (Hong et al., 2017)

Table 2-4 Factor analysis

	SV	RA	UI	CO	UP	CI	EU
SV1	.858	.035	.106	-.030	.195	.030	.071
SV2	.859	.087	.014	.048	.020	.096	.130
SV3	.634	-.098	.016	-.038	.212	.071	.131
SV4	.746	.073	.059	-.089	.072	.063	.117
RA1	.001	.867	-.091	.145	.139	.219	.056
RA2	.071	.875	-.146	.106	.125	.148	.103
RA3	.035	.839	-.161	.176	.091	.163	.129
UI1	-.045	-.071	.774	.182	.119	.021	.169
UI2	.063	-.107	.928	.060	.075	.069	.134
UI3	.192	-.207	.860	.007	.046	.077	.121
CO1	.036	.169	.017	.815	.053	-.009	.074
CO2	-.033	.126	.098	.866	.018	.055	.112
CO3	-.110	.063	.111	.799	.029	.075	.080
UP1	.254	.111	.076	.005	.768	.198	.159
UP2	.247	.099	.114	.019	.775	.235	.049
UP3	.061	.152	.076	.097	.814	.203	.123
CI1	.152	.161	.149	.003	.186	.770	.191
CI2	-.070	.262	.054	.017	.291	.730	.199
CI3	.207	.188	-.017	.135	.239	.831	.112
EU1	.225	.072	.225	.105	.111	.263	.681
EU2	.197	.105	.186	.052	.147	.209	.856
EU3	.124	.124	.101	.174	.095	.056	.832
Eigenvalue	6.352	3.426	2.825	1.939	1.524	1.129	1.079

Note: Principal axis factoring with varimax rotation; SV= shared value; RA= relative advantage; UI= user involvement; CO= compatibility; UP= user participation; CI= continual intention to use; EU= ease of use; CI= continual intention to use.

- **The test of the structural model**

As shown in Table 2-5 and Figure 2-1, the structural model was assessed by regression analysis. Since the path coefficients are found positively significant in each hypothesis, all hypotheses are therefore concluded as supported. And since the T values results are greater than the one-tailed critical T values for the sample size of 168, therefore, it shows that the significant variances were found between the two variables in each hypothesis.

Table 2-5 Test of the hypothesis

Construct	Path coefficient	T value	Result
H1: SV→PE	0.16*	1.780	Significant
H2: UP→PE	0.35**	3.521	Significant
H3: UI→PE	0.15*	1.662	Significant
H4: UP→UI	0.20*	1.821	Significant
H5: SV→CI	0.14*	1.651	Significant
H6: UP→CI	0.30**	3.224	Significant
H7: UI→CI	0.15*	1.712	Significant
H8: PE→CI	0.26**	1.933	Significant

Note: SV= shared value; UP= user participation; UI= user involvement; RA= relative advantage; EU= ease of use; CO= compatibility; CI= continual intention to use. ** p<0.01 one tailed T-value = 2.326, * p<0.05 one tailed T-value = 1.645

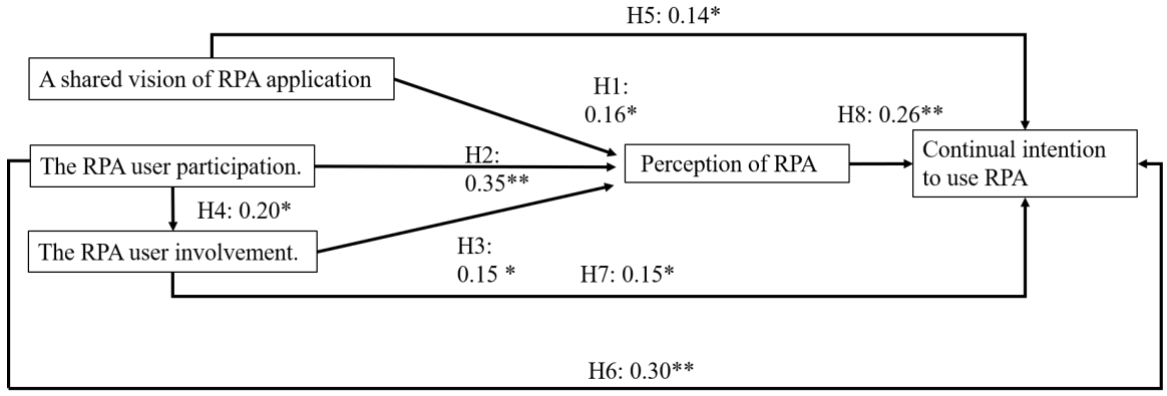

Figure 2-4 Test of the structural model

2.3.4 Discussion

In the structural model, I proposed three external factors that may have a positive effect on the perception of RPA and the continual intention to use RPA. Eventually, I found that a shared vision of RPA application and the RPA user participation, and the RPA user involvement have positive effects on both the continual perception of RPA and the intention to use RPA. Among them, the RPA user participation plays as the most important role.

Meanwhile, for the RPA user involvement, a positive relationship was found between RPA user participation and the RPA user involvement. And the positive effect brought by the perception of RPA to the continual intention to use RPA is also justified.

2.4 Conclusions

Not surprisingly, a shared vision of RPA application can have a positive effect on the perception of RPA and the continual intention to use RPA. For RPA as a state-of-art business process technology, if the vision of its application can be shared within the organization, the employee can be more likely to have a clear perception for it, which further contributes to the continual intention to use RPA. And similarly, Reich and Benbasat's (1996) research indicated that the significance of shared vision when adopting new technology to the organization. Therefore, for practice, organizations should initially ensure a shared vision to be built up when introducing RPA to the company.

On the other hand, my research differentiates user involvement from user participation. While user involvement refers to the subjective psychological state of how engaged users feel about the application of RPA, user participation represents the job responsibilities of the users when they apply RPA. The results suggest that if the users are clear about their tasks and responsibility to perform in RPA application, they will have a clearer perception of RPA and further will be more willing and feel more engaged to continually use RPA. And this finding is in line with the research from Dillon and Morris (1996), as they indicated that the actual participation of employees can improve their

acceptance of new technology. Therefore, for organizations, they should pay efforts to create more opportunities to make the employees become familiar with their job responsibilities in RPA application in participation.

According to my results, the RPA user participation plays the most significant role among the three external factors that I identified. Namely, for better acceptance of RPA, it requires to ensure that employees are clear about their scope of responsibilities. My result further shows that, if employees can participate more to the RPA application, they would feel more engaged and involved to the application and this positive relationship can then contribute to better perception and generate continual intention to use RPA, as indicated by the supported hypothesis, the RPA user involvement has positive effect on both the perception and the continual intention to use RPA. On the other hand, according to the result, a shared vision of RPA vision should also be appreciated in the RPA application, and how to accelerate the establishment of this shared vision becomes the key.

Therefore, here, I concluded the research problems into three questions to be solved as follows,

1. A shared vision of the RPA application needs to be developed.
2. The user participation of the RPA application needs to be improved.
3. The user involvement of the RPA application needs to be improved.

Chapter 3 Theoretical background

Based on the above three problems, I started to work on setting up the objectives of the solution. At first, I roughly set up the major objective of this solution as, a solution that can cope with all these three matters of RPA application. Then, I proceeded by adding one feature for this solution, this solution should be structured and methodological that can be scaled up into different RPA application cases. The determination of this feature inspired me to narrow down one direction. Since RPA is applied in business process automation, business process modeling is required from the origin. Therefore, a structured, methodological and scalable solution is supposed to contribute to business process modeling. After this, I started to look for a business process modeling methodology that can develop a shared vision of RPA application, while both the user participation and user involvement in the RPA application can also become clear.

3.1 Research gaps in business process modeling

In Business Process Management, managerial efforts are usually paid on the effective business process models to provide a comprehensive understanding of the ongoing business activities and enable the following analysis(R. S. Aguilar-Saven, 2004). According to Aguilar-Saven (2004), the modeling purpose of the business process depends on the abstraction purpose of the target organization. For instance, the purpose of modeling a business process can be understanding and analyzing the business process (K. T. Phalp, 1998). Specifically, for descriptive aim, the Flow Chart technique is for establishing a logical sequence of a set of

business activities(Lakin, Capon, & Botten, 1996). Also, concentrating on the responsibility specification and human interaction in the business processes, RAD (Role activity diagrams) (Holt, Ramsey, & Grimes, 1983) and RID (Role interaction diagrams) (Booch, 2006)provide more details of the business process. Also, the Gantt Chart introduced a new dimension, time scale, to manage the work duration performance of business process models (R. Aguilar-Saven, 2001).

On the other hand, inspired by traditional software development methodologies, numerous techniques have been applied in business process automation (K. Phalp & Shepperd, 2000), for instance, Data Flow techniques especially present the data flowing in different subjects of the business activities (Li & Chen, 2009), while UML (Unified Modelling Language) is utilized in modeling both static and dynamic areas of software systems (Russell, van der Aalst, Ter Hofstede, & Wohed, 2006). Further, for enabling multiple purposes of structuring, analysis, and simulation at the same time, the modeling techniques have been developed further. Among them, the Workflow technique is renowned for its modeling in information transmission among different stakeholders by following predefined rules in business process technologies (Fischer, 1994). On the other hand, Coloured- Petri-Net (CPN) is a technique that orients the transitions of actions and states of the business process and enables the communications between different systems in business process technologies (Jensen, 2013). Also, in both academic research and practical use of business process technologies, BPMN (Business Process Modelling Notation) is renowned for its flexible inclusiveness of any new process elements and the improved understanding shared by IT and businesspeople (White, 2008).

However, if concerning the productivity enhancement brought by business process automation, none of the above modeling techniques provide relating structured conceptualization and models. When it comes to the case of RPA, state-of-art business process modeling methodologies do not provide enough support for the better use of RPA. For instance, the most widely used BPMN 2.0 (AllIyer, 2016) methodology is famous for its easiness to be used by different stakeholders in terms of presenting the business process from the process view. But it fails to differentiate the responsibility of the stakeholders when they apply RPA into their previous job.

As a result, I found DEMO (Design and Engineering Method for Organizations), a business process modeling methodology that provides the conceptualization of how business process automation can contribute to business processes in organizations. From the perspectives of human responsibilities and human capabilities, DEMO provides theoretical discussions in differentiating business processes that can be facilitated by technologies and the ones that can only be implemented by a human.

However, I also found that the discussions of business process technologies in DEMO have not been transformed into relating methodologies of creating business process models. And this shortage left me a research gap that the methodological part of the DEMO approach is waiting to be enriched. Therefore, after achieving full conceptualization of productivity enhancement by DEMO theoretical discussions, I decided to develop the corresponding business process modeling techniques stemming from the original DEMO approach.

The following sections present the theoretical background of the original DEMO approach, including the underlying theory and the relating business process modeling methodologies.

3.2 PSI (Performing in Social Interaction) theory (Dietz, 2015)

Taking a coordination-centric view, PSI theory focuses on the human collaborations manifested by various business processes in organizations (Dietz, 2015). Based on this negotiation view, PSI theory differs from the well-established process-view by proposing and enriching the following aspects in business process, 1) human interactions, it stresses on the aspect that the labor division in organizations are implemented by the execution of tasks and the coordination of these tasks(Mintzberg, 1989), namely organizational work is essentially the combination of production and coordination(Dietz, 2015); 2) human capabilities in business process, it proposes that in both production and coordination, human mainly perform three different types of capabilities to complete the tasks(Dietz, 2006); 3) human qualities in business process, it differentiates authority, responsibility from accountability to emphasize the given institutional impacts. The explanation of these three aspects is elaborated in the following sections.

3.2.1 Human interactions in business process

According to PSI theory, organizational work is completed by human interactions. Moreover, these human interactions are categorized by their purpose as,1) *Production* is delivering

products or services to the environment as requested. In *Production*, activities are identified in the *Production act*. A *Production fact* is created by executing a relating *Production act*; 2) *Coordination* is making the efforts on communication and negotiation for delivering the products as requested. In *Coordination*, communication and negotiation activities are identified as *Coordination act*. A *Coordination fact* is created by executing the *Coordination act* (Dietz, 2006b).

Further, for all *Coordination* that serves for one *Production* purpose, the combination of this *Coordination* and *Production* is defined as a *Transaction* (Dietz, 2006b). When executing a *Transaction*, a primary responsibility unit is defined as an *Actor role*. For the *Actor role* who initiates the *Transaction*, he or she is called an *Initiator*. *An executor* is the actor role who execute the *Transaction*. Therefore, one *Transaction* has only one corresponding responsibility unit.

3.2.2 Human capabilities in business process

On the other hand, PSI theory also investigates the human capabilities performed in a business process. For the capability that brings about original new things, it is classified as *Performa* capability. This capability is entitled only to human beings, which cannot be imitated by any technologies(Dietz, 2006). Then, the capability of coping with the content of existed information is defined as *Informa*(Dietz, 2006). Moreover, the capability of dealing with the format of the existed information is defined as *Forma*(Dietz, 2006b). Therefore, in a business process, *Performa* capability is considered as the most superior capability of humans

in organizational environments and is supported by *Informa* and *Forma*; and *Informa* is defined as the second superior capability for its second higher complexity and is supported by *Forma* as the lowest complexity level.

Correspondingly, the *Transaction* that delivers products by using *Performa* capability is defined as Original Transaction; the *Transaction* that delivers products by using *Informa* capability is defined as Informational Transaction; the *Transaction* that delivers products by using *Forma* capability is defined as Documental Transaction.

3.2.3 Human qualities in business process

In PSI theory, it introduces three aspects of human qualities to show the given institutional impacts in business process, 1) *Authority*, it refers to the right of an actor role to perform adequate coordination acts (Dietz, 2015). Dietz (2015) also indicates that sometimes, *Delegation* is unavoidable in the case in which some parts of the authority must be delegated to the other actor role in particular tasks. 2) *Responsibility*, according to Dietz (2015), after an actor role is entitled with specific authority, he or she is considered as being responsible for acting properly by following the principles and rules of that authorized role; 3) *Accountability*, it refers to the obligation of providing justification for certain acts (Dietz,2015). In PSI theory, it suggests every *actor role* is both responsible and accountable for his or her acts.

3.3 DEMO 2.0 (Design and Engineering Method for Organizations)

DEMO is a business process modeling methodology that manifests PSI theory and it was originally developed by Dietz (2006). The latest version of the DEMO approach, DEMO 3.0, omits the discussion on unnecessary activities in a business process. However, these activities are often automated by technologies, which is the major research scope of my research. Therefore, this research was completed under the theoretical background of the DEMO 2.0 approach.

DEMO 2.0 approach is a formal business process modeling methodology, which is constituted by four aspect models shown in Figure 3-1. The abstraction levels increase from the bottom to the top. And the DEMO approach starts from the top of the pyramid to create a Construction Model and grasp the structure of the enterprise by a set of transactions and actor

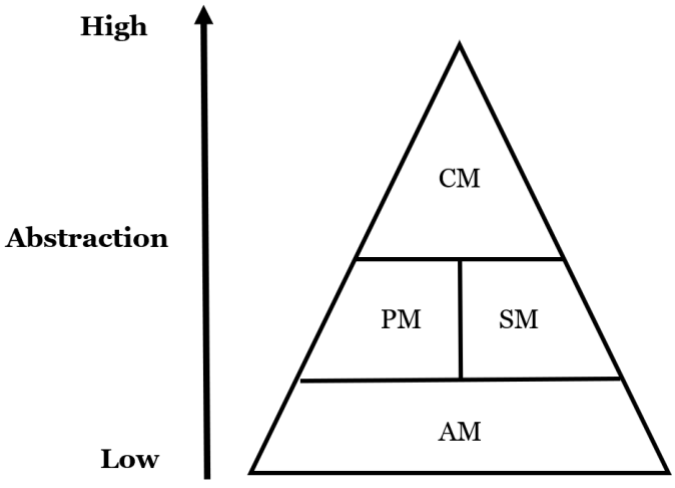

Figure 3-1 DEMO aspect models

roles. Following that, the details evolve into two directions. One is Process Model and it focuses on presenting the transition of the lawful state for a business case by a sequence of

process steps. The other is State Model which is to present the state transitions of productions. Ultimately, it goes into Action Model to clarify the most detailed information of action rules for actors to react properly.

3.3.1 DEMO 2.0 Construction Model

In this research, the artifacts that I planned to develop stem from the Construction Model and the Process Model of DEMO 2.0. The modeling methodology details are elaborated more in the following paragraphs. Basic examples are also provided by using the illustration rules of DEMO 2.0.

In line with the human interactions and human capabilities perspectives, the Construction Model in DEMO 2.0 is created to illustrate the most concise analysis result of a business process. In this Construction Model, the Actor roles of both Initiators and Executors (as shown in Figure 3-2) are identified and differentiated by the Initiator link and Executor

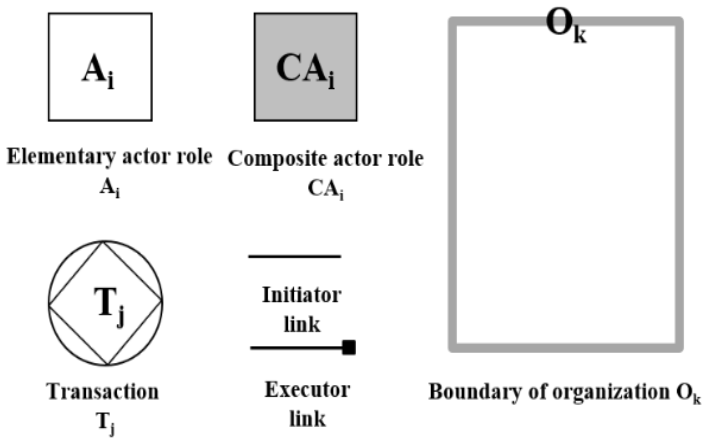

Figure 3-2 Illustration legends of DEMO

link (as illustrated in Figure 3-2). Also, it introduces a Composite actor role to represent the subjects from outside of the organization. However, Transaction in Construction Model only

presents the Production aspects but omits the Coordination aspects of a business process. Further, by using the boundary of the organization to separate the scope of interest in a business process, the original Construction Model only concerns about activities in which Performa capabilities are performed.

A basic example of the Construction Model in DEMO 2.0 is illustrated in Figure 3-3. This is an example of a transaction between a client and a florist (Dietz, 2006b). The process description is as follows,

> *A client makes a request to a florist for buying a bouquet of flowers. And the florist makes a bouquet of flowers as requested and close the transaction by hands it over to the client.*

Figure 3-3 Process description of a transaction between a client and a florist

In this example, the client is identified as an initiator for initiating the transaction while the florist is thus identified as the executor. Since the major responsibility that the

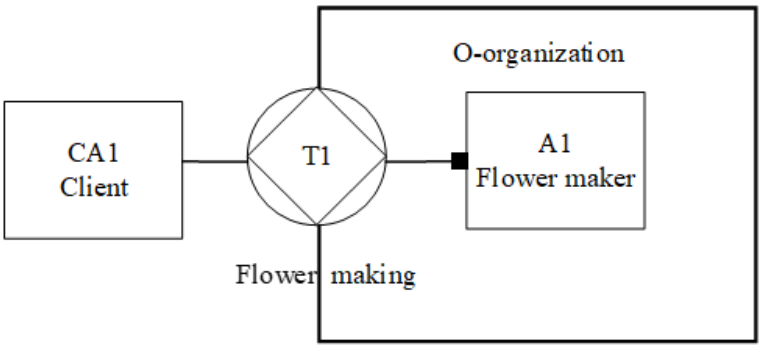

Figure 3-4 Construction model of bouquet making

florist takes in this transaction is to make the flower, the transaction is thus named as flower making. And the florist is then illustrated as a flower maker in the Construction Model as shown in Figure 3-4.

3.3.2 DEMO 2.0 Process Model

In DEMO 2.0, the Process Model provides the second level of abstraction by illustrating the coordination acts and the relating flows between them in a business process. Figure 3-5 shows an efficient coordination act starts from the effectuating decision of initiator (Dietz, 2006). At *Performa* level, he or she exposes the original new commitment out of nothing. Then it proceeds to the *Informa* level to formulate thoughts around this original new commitment and enters the *Forma* level by uttering sentences to express the thoughts. For the executor, once it can perceive the sentence expressed by the initiator, the *notational correspondence* between them is built up. And then if the executor can perceive the meaning

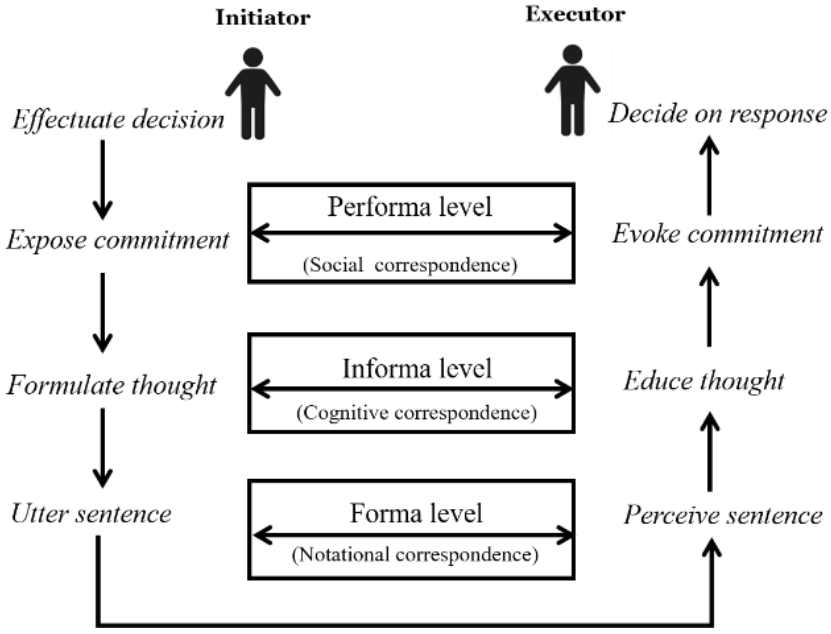

Figure 3-5 The process of a coordination act (Dietz, 2015)

of the initiator's thought from the sentence, the **c***ognitive correspondence* is established. Eventually, if the executor decides to evoke relevant commitments, then *social correspondence* is confirmed and based on which, the executor then decides on a response.

Continually using the flower making example by (Dietz, 2006), a basic pattern of the DEMO Process Model is given in Figure 3-6. In this basic pattern, both Coordination and Production are illustrated, but the detailing only proceeds to Coordination aspect, in which coordination acts are patterned into four types, *1) request; 2) promise; 3) state; 4) accept***.** Taking an explanation example from Dietz (2006), it is a process in purchasing flower between a client and a florist:

> Client: I'd like to have such a bouquet. (Request)
>
> Florist: Very well, sir. (Promise)
>
> Florist: Preparing flowers (Execution)
>
> Florist: Here you are. (State)
>
> Client: Thanks. (Accept)

Figure 3-6 Coordination process between a client and a florist (Dietz ,2006)

This process is initiated by a request of a bouquet of flowers from a client as the *Initiator* and followed by a promise from the florist as the *Executor* to deliver the bouquet of flowers. Then the florist starts to prepare the bouquet of flowers. When the florist finished preparation, he makes a statement "Here you are!" to notify the client about the product. The client replies with "Thank you" to indicate the acceptance of this product. Also, to illustrate the legends of the original DEMO Process Model, the Process Model of purchasing flower case is illustrated in Figure 3-7. Starting from "in," Figure 3-7 can be read from the upper left part of the figure. After that, the arrows are used to illustrate the process flows in the transitions of Acts. From "request" to "accept," the process ends with the symbol of "end." Here, it requires to indicate that I intentionally introduced the symbol of "end" to maintain

the symmetry of the starting point symbol of “in” and improve the readability of the model. The illustration of the Process Model is in Figure 3-7.

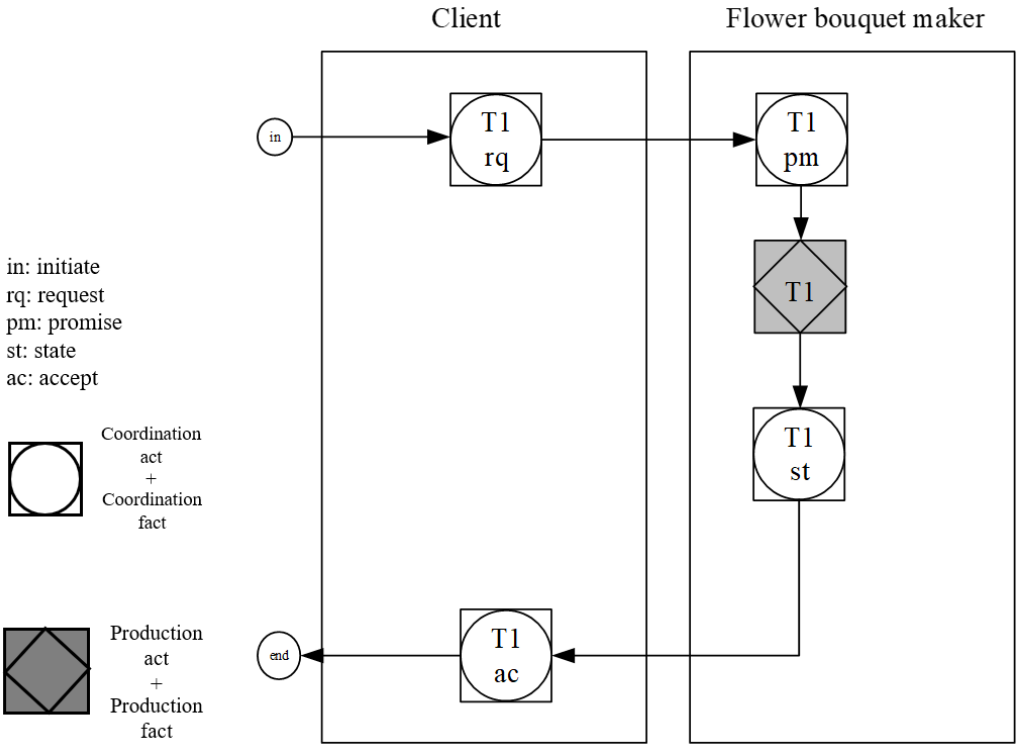

Figure 3-7 Process model of the transaction of flower making

3.4 Research gaps in DEMO methodology

As a well-known Business Process Modeling methodology in the construction view, DEMO has been applied in conducting research for filling out various research gaps. Therefore, I started my problem identification by reviewing these research outcomes. Among them, some efforts Was paid on fulfilling the theoretical foundations of DEMO itself, for instance, In 2007, for improving the portability and expanding the audience scope of DEMO, (Cordeiro, Filipe, & Liu) proposed the UML 2.0 profile for DEMO approach by providing the

representations of the four aspect models of DEMO. Also, the mathematical background of the DEMO was investigated by Suga and Iijima (2018) in analyzing and synthesizing enterprise models and proposed an algebraic structure of one aspect model in DEMO.

On the other hand, DEMO was applied in improving the theoretical foundations of other modeling methodologies, for instance, Nuffel, Mulder, and Kervel (2009) applied the DEMO approach into enhancing the formal semantics of BPMN (Business Process Modeling Notation). Further, Mr´az, et al.(2017) provided a complete method in converting DEMO methodology into BPMN 2.0 to discuss multiple situations like rejection and revocation in the business process. In dealing with the lack of modeling guidance of the enterprise architecture methodology, ArchiMate, the transformation method of DEMO to ArchiMate was developed by Kinderen, Gaaloul, and Proper (2012).

Also, Integrating DEMO with other methodologies was considered as promising research direction, such as the integration of e3Value from value modeling methodology and DEMO was developed by Pombinho, Aveiro, and Tribolet (2012) to model service systems and proceeded to develop a modeling methodology of specifying Value Networks (Pombinho, Tribolet, & Aveiro, 2014). And KrouIl and Land (2011) combined Normalized System Theory and DEMO to construct a methodology for Agile Enterprise Information System development. For improving the decision-making process in business transactions, DEMO was combined with Markov Decision Process in developing a methodology of eliciting business rules by Guerreiro (2013). And Babkin and Sergeev (2013) proposed a

decision support method to measure quantitative costs estimation in the enterprise restructuring process by integrating DEMO methodology with Transaction Costs theory.

Meanwhile, other research groups applied the DEMO approach into various organizational settings to analyze and solve issues in real-life scenarios. For instance, in the context of business organizations, Geskus (2008) applied DEMO into constructing Quality Management Systems for obtaining a consistent and concise structure of the enterprises. In 2010, for enhancing enterprise governance, (Henriques, Tribolet, & Hoogervorst, 2010) investigated how DEMO can be used in formulating organizational competence. Also, Dudok, Guerreiro, Babkin, Pergl, and Kervel (2015) represented DEMO models in enterprise operational analysis to guarantee the completeness and the conformance of the business process. In the software development process, Thuan, L.G.Dietz, and Lang (2010) introduced DEMO to the requirement analysis phase by providing a new framework of requirement definition. Further, Albani and Dietz (2011) applied DEMO into developing a methodology of Enterprise Information Systems development for identifying stable business components that model and realize predefined business logic.

On the other hand, DEMO has also been used in dealing with issues of other organizational backgrounds. For instance, in the field of disaster management, Mongula (2009) applied DEMO in dealing with the coordination issues among various stakeholders in the Flood Control domain. Also, Leelawat et al. (2015) adopted DEMO in determining essential components of a disaster warning system with a typhoon case study.

However, in theoretical discussions, when concerning the three types of human capabilities defined in DEMO, only de Jong (2009) indicated a complete process of how these three capabilities connect to each other. And it was further elucidated how the organization is realized by the interactions of performing these three capabilities (de Jong & Dietz, 2010). But if including the capture of all three types of human capabilities in the business process, his researches did not provide generic modeling procedures for building up DEMO models of other business processes. In practical applications, Deen, Mijs, and Land (2017) created the DEMO Construction models for a Library information system, including the illustration of all three types of human capabilities. However, this kind of application context has never been extended to model the situation when technology is applied to enhance these human capabilities in the business process, in which technologies enhance Informa capability and Forma capability.

At this stage, it was clear for me that, very limited research has been conducted to discuss the business process modeling in business process automation in the field of DEMO. However, Dietz (2006) provided a few discussions about how technologies can imitate the Informa and Forma capabilities of human beings, both in coordination and production, which laid the theoretical foundation for me to dig deeper into the DEMO2.0 approach. And these ideas are briefly explained as follows,

As indicated in the original DEMO approach, human capabilities are categorized in Performa, Informa, and Forma. While Performa capability is entitled only to humans in bringing about original new things, a business process that requires to perform Informa

capability in manipulating the content and Forma capability in handling the format, has been enhanced by various technologies. In Production, with the help of technologies, for instance, Informa capability is enhanced in calculating and deducing information based on existing information, while Forma capability is enhanced in copying the existing data and converting the format of the data (Dietz, 2006). In Coordination, Forma capability witnessed improvements in information transferring by email systems. And the Informa technologies aim at improving the generation of intellectual understandings between actor roles and are well-known as diverse artificial intelligence technologies(Dietz, 2006).

Eventually, I noticed the potentials of the DEMO approach for its extensive discussion about business process automation and its process modeling. However, it does not provide associated modeling methodologies to model the process of business process automation, which motivated me to first extend the theoretical part of the DEMO approach. At this stage, I was still not clear about which DEMO modeling methodology can contribute to my solution, but I decided to start with the extension of the first two DEMO modeling methodologies, the Construction model and Process model and intended to justify its utility in the later demonstration and evaluation.

Chapter 4 Research methodology background

4.1 Design Science Research Methodology in Information Systems

To proceed with the introduction of my research methodology background, I would like to first introduce the definition of design science by Hubka and Eder (2012). And the understanding of this definition was followed thoroughly in my research process.

"Design Science is to be understood as a system of logically related knowledge, which should contain and organize the complete knowledge about and for designing" (Hubka & Eder, 2012)

As an applied research discipline, information system research focuses on filling the gap between organization and technology and it is often supported by many well-established theories, especially from the discipline of computer science and engineering, social science and economics(Peffers et al., 2007). Judging from the achievements that "design" has made in these fields, it calls for a paradigm of Design Science to be developed in information systems research and make IS research deliver more relevant and influential outcomes for solving the issues between IT and organization (Peffers et al., 2007).

In response to the requirements and calling for the research that applies "design" as a research methodology, in 1990, (Nunamaker Jr, Chen, & Purdin, 1990) proposed that system development can be applied as a research methodology in delivering fruitful IS research outcomes. In this system development methodology, it contains five stages that can be

iterated as required. However, their idea did absorb the essence from the normal design process, but they did not name their proposal as anything related to design science. Followingly, in the context of EIS(Executive Information System), Walls, Widmeyer, and El Sawy (1992) first proposed an Information System Design Theory to be used in generating an effective information system. They considered "design" as both a noun and a verb. And therefore, the theory indicates that a design theory should differentiate a design product created by meta-design from a design process by following a design method. And these two aspects are dependent on each other. Further, March and Smith (1995) claimed that research in IS should make a contribution to resolving the problems met by practitioners and therefore both natural science research and design science research should make a contribution to developing practical solutions. And they accordingly suggested a research framework for the information system research, constituted by the dimension of research activity and the dimension of research output. In this framework, while the dimension of research activity is both attributed to natural science and design science, they stressed on the significance of design science research by proposing the design science research output as the second dimension.

Ever since the above-mentioned research in the 1990s, research in design science finally witnessed prosperous evolution in both its methodology and formalization development. Among the methodology and formalization development research, various research focuses on articulating design science research activities(Iivari, 2005; March & Storey, 2008; Österle et al., 2011; Venable, Pries-Heje, & Baskerville, 2012; Winter, 2008).

Five iterative steps from the problem aware to the conclusion were introduced by Vaishnavi and Kuechler (2004), and they also indicated that the suggestion after the awareness is abductive while the following development and evaluation before the conclusion are deductive. Venable (2006) proposed an activity framework of design science research activities for effective theory building as the output. Considering design science research as solving nested problems, Wieringa (2009) provided eight guidelines to conduct design science research in a practical way. On the other hand, as the evaluation is commonly considered as a necessary research activity of design science research, several research projects proposed various for effective evaluation. (Pries-Heje, Baskerville, & Venable, 2008) proposed a strategic evaluation framework for design science research by the dimension of the ex-ante period and the ex-post period of the creation of the IS artifact, and the dimension of the contextual setting of the IS artifact setting, either in a natural setting such as case studies or artificial setting such as lab experiments. And they also put both design product and design process into consideration when establishing the evaluation framework. According to the six types of IS artifacts, (Peffers et al., 2012) suggested rigorous evaluation methods respectively for an associated artifact by analyzing the published design sciences research outcomes.

Two research proposals have become the most representative and widely accepted methodology of conducting design science research in information systems. One is the three-cycle view by Hevner (2007), he argued about the uniqueness of design science research by stating that design science research is the embodiment of the cycle of relevance, knowledge,

and rigor. Evolving from the seven guidelines of design science research in information systems (Von Alan et al., 2004), the other one is the six iterative steps methodology that suggests procedural guidance for design science research to be conducted in information system context(Peffers et al., 2007). And more investigation of these two proposals is elaborated in the following sections.

4.1.1 Three cycle view in Design Science Research

As shown in Figure 4-1, Hevner (2007) proposed that design science research is embodied by the interaction activities from three cycles, 1) relevance cycle; 2) design cycle; 3) rigor cycle. And all these three cycles continually obtain input and generate output from and to the associated environment. He further defined that while the relevance cycle absorbs the input from the practical environments and ensures that the collected requirements are relevant, the relevance cycle also introduces the research achievements as the output to the practical environment. Meanwhile, the rigor cycle provides grounding theories from scientific theories and expertise as the input and adds the newly created artifacts such as design products or design processes as the output to the knowledge base. The design cycle is oriented in the

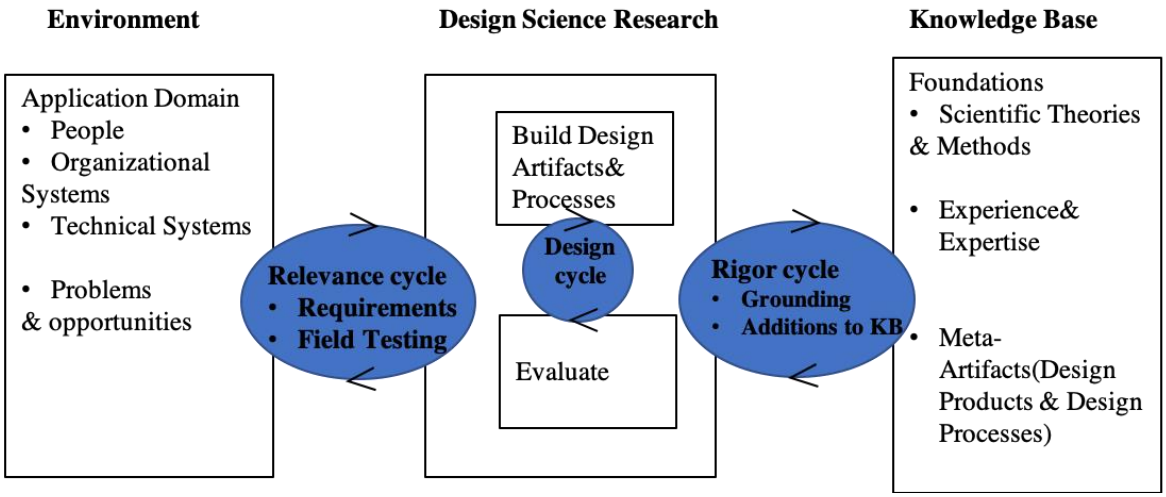

Figure 4-1 Three cycle view of design science (Hevner, 2007)

design science research and constituted by the loop activities of building and designing artifacts or process as the input and the following evaluation as the output.

The three-cycle view by Hevner (2007) is widely believed in laying the foundation in design science research for its highlighting the uniqueness and characteristics of design science research and suggesting the request research activities when conducting design science research. Based on this three cycle view, in 2013, he further proposed a design science research contribution framework to evaluate the generated artifact by the dimension of application domain maturity and the dimension of the solution domain(Gregor & Hevner, 2013).

However, for IS researchers who would like to initiate their research in design science, Hevner's work may help in shaping the primary understanding of design science research. They may then struggle in finding the starting point and setting up the ending conditions for their research, while how to make the balance between the activities discussed in the three-cycle may become another challenge for them. And in complementary to the

three-cycle view, Peffers et al. (2007) proposed a procedural methodology for design science research, in which they indicated 6 steps to follow in sequence, 1) Identify problem & motivation; 2) Define objective of a solution; 3) Design and development; 4) Demonstration; 5) Evaluation; 6) Communication. And they also suggest that, after evaluation of communication, according to the result, the process can be iterated from 2) define objectives of a solution or 3) design and development. More explanations of their work are in the next section.

4.1.2 Design Science Research Methodology

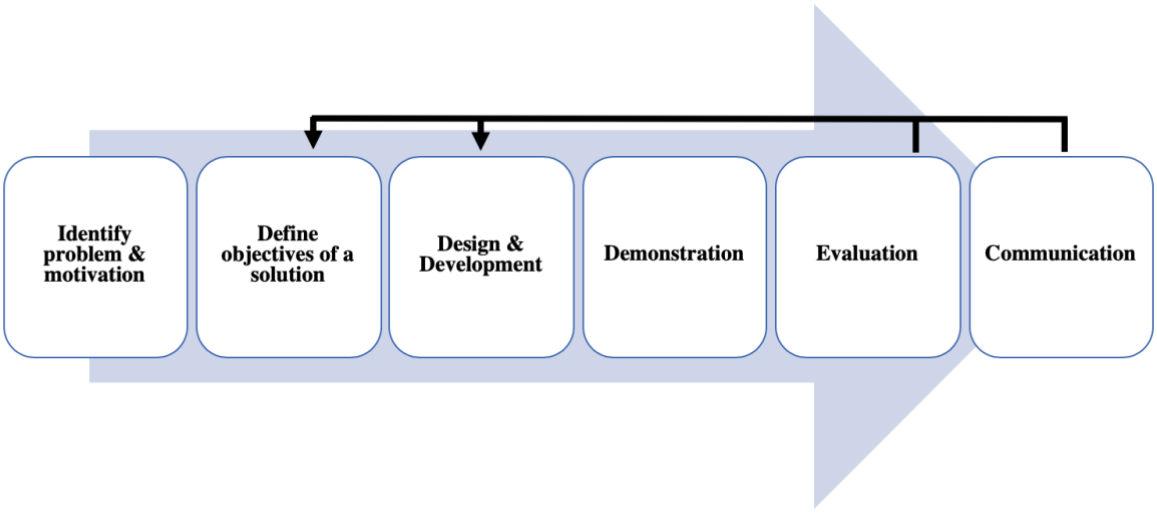

Figure 4-2 Design science research methodology (Peffers et al. ,2007)

As illustrated in Figure 4-2, Peffers et al. (2007) argued that the purpose of this design science research methodology is to facilitate the effective production of artifact and the presentation of the generated artifact in design science research. And they further defined the six procedures as follows,

1)identify problem and motivation. In this step, a clear and structured research problem needs to be conceptualized and identified to enable the following effective solution development. And once the motivation is identified in this first step, it can motivate both the research to devote themselves to the subsequent research and the audience to understand the reasoning process of the research and become attracted to the research results; 2) define objectives of a solution. In this step, based on the state of art solution, it needs to set up possible and feasible objectives of a solution in a rational way and these objectives can either be quantitative or qualitative; 3) design & development. In this step, a designed object as the design artifact is created and this creative activity should deliver both the architecture and the functionality of the artifact;4) demonstration. In this step, the generated artifact in the last step needs to be demonstrated in its usefulness of solving one or more instances of the identified problem. 5) evaluation. In this step, it requires to observe and evaluate the demonstration of created artifacts and compare the performance to the objectives set up in step 2. And the comparison result can help to decide whether it needs to iterate to step 3 or it can proceed to the next step. 6) communication. In this step, it encourages the researcher to publish scholarly research outcomes so that both the identified problem and the created artifacts can be reached by other relevant audiences and researchers. And Peffers et al. (2007) also suggested that the communication result may bring about a new iteration of a certain artifact to step 2, solution objectives define or step 3, design and development.

This design science research methodology does not largely deviate from other well-known research methodologies in IS, except for step 5, evaluation. Since the result of the

evaluation is considered as a decision point of either iterate to the previous step and revised the artifact or proceed to publish the research outcomes by communication, the effective evaluation method is expected to deliver better artifacts. In 2012, (Peffers et al.) continually proposed a set of evaluation methodologies for the design science research methodology. In this evaluation methodology, by analyzing the evaluation methodologies from 148 scholar publications, they categorized artifacts created in design science research into six types and suggested the most associated evaluation method for each type.

In this research, Peffer's work (Peffer 2007;2012) opened the gate of the design science research for me and showed me that one image that by the end of the road, how unique and interesting that design science research outcome can be. However, to get to the end of the road, I followed the design science research methodology by Peffers et al. (2007) since their research provides me the practical and feasible methods to produce robust design science artifacts. The customized research design by following design science research methodology can be found in section 4.3.

4.2 Grounded Theory Approach

With the proposal of the discovery of grounded theory (BG Glaser & Strauss, 1967), this approach aims to encourage researchers not to limit in the attribution of well-established theories, but innovate to discover and develop theories relating to their inquiries(Locke, 1996). Robrecht (1995) also pointed out that widely used in qualitative research, grounded

theory approach is an approach that provides operational rules to reveal the theoretical conceptualization and stresses that theory should stem from data instead of prior knowledge.

While being extensively applied in theory building in multiple research fields, such as education(Haig, 1995), nursing and management(Backman & Kyngäs, 1999), the methodological part of the grounded theory has evolved to two schools. The authors of the proposal of the discovery of grounded theory, Glaser and Strauss, their core ideas of grounded theory gradually diverted from the original joint work. In terms of the generated theory, Heath and Cowley (2004) indicated that, while (Strauss & Corbin, 1990) suggest the constructed theory should be under a certain specified framework. And their approach aims at producing a liner set of causes and effects that can explain the observations and eventually lead to the theory. In contrast, Barney Glaser (1978) stressed that induction should be insisted all the way through the process of grounded theory, and therefore a theory can be discovered rather than developed around a prior-known research work.

Also, as a different type of theory is expected to be delivered by applying the approach, they suggest different research procedures. Barney Glaser (1978) indicated that substantive coding should be repetitively conducted until acceptable categories emerge, and a theory emerges based on the refinement of these categories. However, Strauss and Corbin (1998) suggested three phases should be conducted in sequence, 1) Open coding; 2) Axial coding; 3) Selective coding. But they clarified that the purpose of these three phases is not to encourage rigid procedures to follow but the subtle suggestions for keeping the balance

between the complexities of the theory and the completeness of the theory (Heath & Cowley, 2004).

In IS, since the early 1990s, various qualitative research started to promote the usefulness of the grounded theory approach to be applied in IS research (W. Orlikowski, 1993; W. J. Orlikowski & Baroudi, 1991; Toraskar, 1991; Walsham, 1995). Among them, (W. Orlikowski, 1993) explicitly listed three reasons for her suggestion to use the grounded theory approach, 1) information system as an applied research field, it has no previous theory to follow and this attribute leaves space for researchers to adopt the grounded theory approach into theory development;2) it provides effective linkage between the complexities of the organization and the understanding of the phenomena;2) it can help to capture and study the process and change in organization. Her statements contribute much to the expansion of the usage of the grounded theory approach(Urquhart, 2007).

Initially, the scholars in IS all traced back to the original proposal of the grounded theory approach by BG Glaser and Strauss (1967) and attempted to conduct their research projects by following the principles by Barney Glaser (1978), in which substantive coding needs to be repetitively conducted and the data collected should speak for itself and no preconception is expected (B. G. Glaser, 1992). However, judging from the attribute of an information system that it constantly borrowed established theories from other research fields, the parsimony theory generated by applying Glaser's approach faces the challenge of lacking plausibility and justification(Urquhart, 2007). And therefore, it encouraged the researcher to embrace the viewpoints of (Strauss & Corbin, 1998) and started to work on

formulating principles and guidelines for the application of the grounded theory approach in information systems.

Tailoring for the grounded theory research of information system, Urquhart, Lehmann, and Myers (2010) proposed five practical guidelines to be insisted on the different stages of the coding process. 1) Constant comparison, it refers to constantly compare the data labeled as one category to the other category so that the consistency in category identification can be remained (Charmaz, 2006); 2) iterative conceptualization, it emphasizes the final categories should be developed by iterative processes to ensure the rigor; 3) theoretical sampling, it stresses that the importance of having analytic ground in data sampling and so that the theory can be developed with a comprehensive view; 4) scaling up, this guideline suggests the researcher pay attention to the development of low-level theories that can hardly be generalized to a broader scope;5) theoretical integration, it suggests the researchers compare the developed theories to the previous theories or the theories in similar fields to contribute to the generation of formal theories.

In my research, I first ensured that the above five guidelines have been well understood and a shared understanding has been created between the coders. And I started my application of grounded theory approach by following the process steps provided by Charmaz (2006), in which I divided my research process into three stages to enable the theory development under the framework of adapted TAM as explained in chapter 2, 1) Open coding, this step focuses on picking up the actions made in that data and is open to any conceptualization possibilities; 2) Axial coding, the purpose in this step is to identify the

categories clustered by the open codes by its properties and dimensions; 3) Theoretical coding, this step is to specify how possible that the categories from Axial codes can relate to each other by searching for feasible theoretical frameworks in the knowledge base of the coder(Flick, 2013). A more detailed explanation of the research design can be found in the next section.

Chapter 5 Design & Development: Extension of DEMO Construction Model

5.1 Development of Extended DEMO Construction Model

As is presented in section 3.4, business process automation majors in reinforcing Informa and Forma capabilities of human workers performed in a business process. Therefore, based on the original Construction model and theoretical perspectives in human interactions and human capabilities, in this section, I developed an Extended Construction Model to elucidate the Informa and Forma aspects of a business process and their relations with Performa aspect.

The modeling methodology of Extended DEMO Construction model

The original Construction Model does not present the Coordination aspect of a business process, for maintaining the consistency in abstraction, I also omitted the discussion on Coordination aspect of a business process in the developed model.

For highlighting the contributions of the business process automation in imitating human capabilities discussed in section 3.4, in my extension work, in addition to the original Performa capability, I focused on modeling both the Informa and Forma capability imitated in Production activity of a business process. The extension was achieved by step 4 and step 6 in Figure 5-1. In step 4, based on the Production Facts generated by each Transaction, the Transactions can be classified into, 1) Original Transaction; 2) Informational Transaction; 3) Documental Transaction. Specifically, recalling the explanation in section 3.2, Performa is identified as the most superior capability entitled to human and followed by Informa and

Forma. In one Transaction, among all created Production Facts, I focused on the performed capability of the highest superiority level and classified the Transaction based on it. Moreover, in step 6, for highlighting the different capabilities performed, the connection links between different types of Transactions are also identified to illustrate the relationships between Actor roles and Transactions.

Naming principles of the Extended construction model of DEMO

From a construction perspective, DEMO defines actor roles as the primary responsibility unit in a Transaction and provides two types of actor roles, Initiator and Executor related to the Transaction. For the actor role who is responsible for executing the transaction, namely, the executor, he or she is named after the transaction to highlight this responsibility. For instance, the executor of "membership registration" is named "membership register." Meanwhile, the numbering consistency between executor and transaction should also be consistent. For instance, "A1" refers to "Actor role 1" and is responsible for executing "T1", namely, Transaction 1.

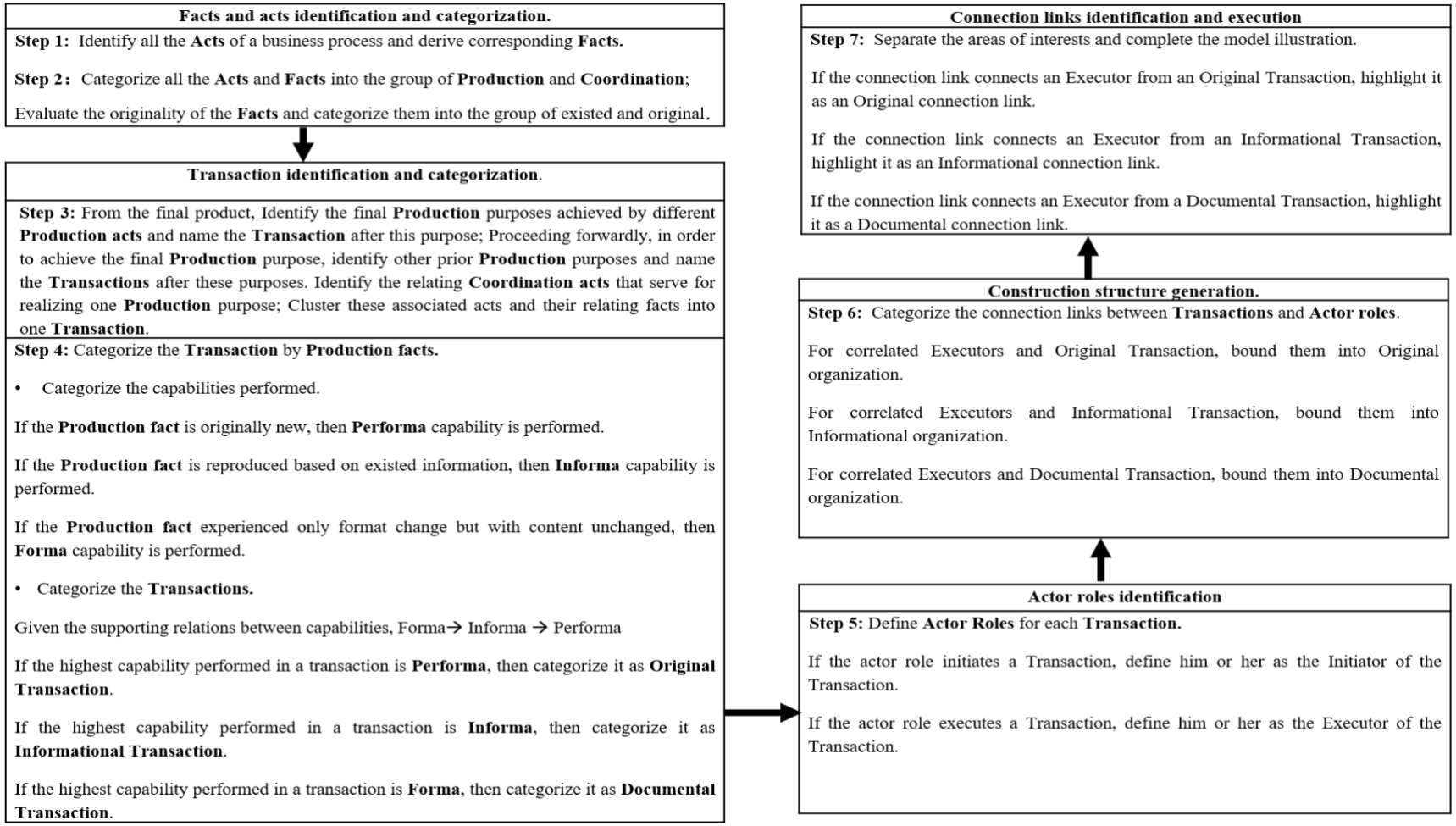

Figure 5-1 The modeling methodology of Extended DEMO Construction Model

5.2 Illustration of Extended DEMO Construction Model

In this section, I illustrated the Extended DEMO Construction Model by conducting a deep-dive field study with a Chinese Bank X. I first presented the field study context as follows,

Bank X was planning to introduce RPA to its financial department. Although their RPA solution provider has already proposed business process automation plan to their process of publishing invoice report as a pilot project, the financial department management was not completely convinced by the plan for two reasons, 1) since they had fully qualified employees to deliver satisfying outcomes, why they had to apply RPA to the AS-IS process? 2) RPA solution providers only appealed their available RPA techniques, but would these techniques genuinely make contributions to the AS-IS process?

In this context, I created an Extended DEMO Construction Model for their process of publishing invoice reports in Bank X, aiming at providing a systematic business process model in highlighting potential contributions that can be brought by RPA in the human capabilities and human interaction aspects of the process.

The AS-IS process of publishing an invoice report started by a back-office agent of the financial department. Also, the case description ant the flow chart is illustrated in Figure 5-2 and Figure 5-3, respectively.

The back-office agent first selects invoice documents to be verified and move all of them into the same folder. For all these documents, he then sorts out the required data and inputs them into an Excel file. After that, he logs into the invoice verification website and inputs the collected data from the Excel file. And, he verifies the data on this platform and inputs the verified data into another Excel file. Based on the checking and calculating the verified data, the back-office agent generates the invoice report and closes the process.

Figure 5-2 Process description of publishing invoice report of Bank X.

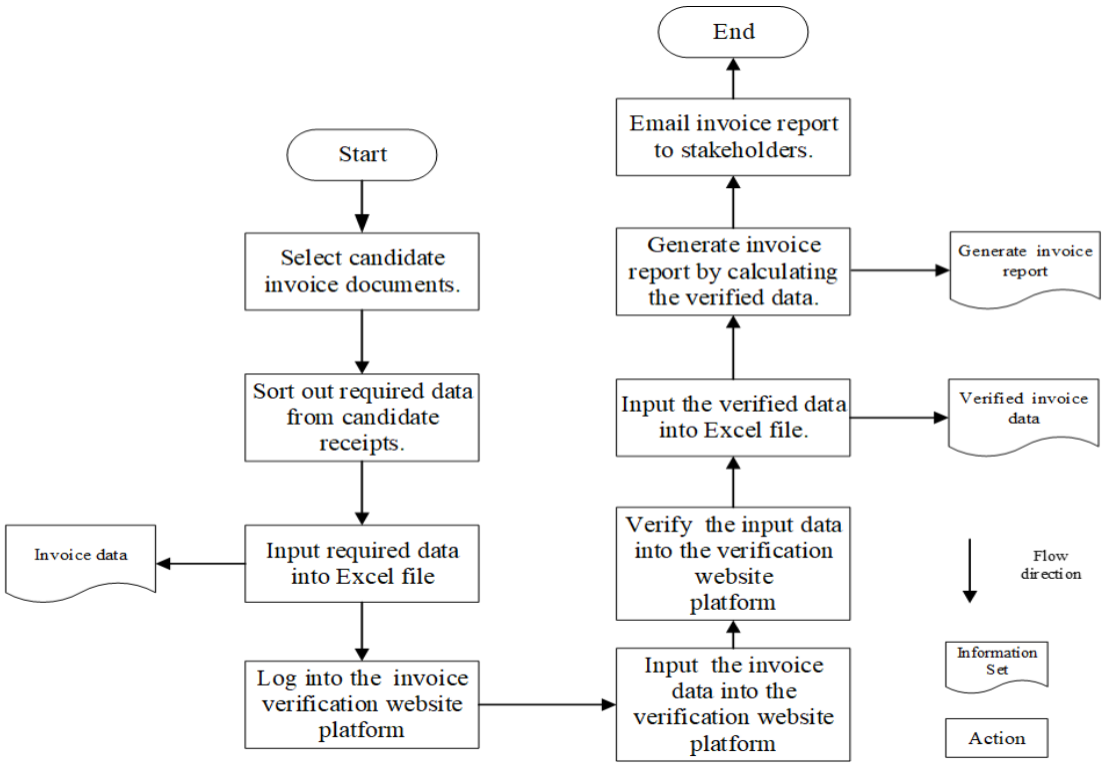

Figure 5-3 Flowchart of publishing invoice report of Bank X.

Step 1: *Identify all the* ***Acts*** *of a business process and derive corresponding* ***Facts****.*

In the first step, I picked out every action shown as steps in Figure 3 and identified them as Acts in DEMO approach. Then, a corresponding Fact was derived by executing an Act, and I highlighted this accomplishment of action by describing the facts in Present Perfect Tense as shown in Table 5-1. Differing from the Flowchart methodology, in DEMO approach, I indicated the actor of each Act from the beginning, for instance, in the case of publishing invoice report, the back-office agent is the only actor of all Acts.

Table 5-1 Result of step 1 in Extended DEMO Construction model of publishing invoice report

Acts	Facts
Back-office agent selects candidate invoice documents.	Candidate invoice documents have been selected.
Back-office agent sorts out required data.	Required data has been sorted out.
Back-office agent inputs required data to an Excel file.	Required data has been input to an Excel file.
Back-office agent logs into the verification platform.	Invoice verification platform has been logged into.
Back-office agent inputs the required data to the invoice verification platform.	Required data has been input to the platform.
Back-office agent verifies the input data on the platform.	Input data has been verified.
Back-office agent inputs the verified data into an Excel file.	Verified data has been input into an Excel file.
Back-office agent generates the invoice report.	Invoice report has been generated.
Back-office agent emails the invoice report to stakeholders.	Invoice report has been emailed.

Step 2: *Categorize all the* ***Acts*** *and* ***Facts*** *into the group of* ***Production*** *and* ***Coordination****; Evaluate the originality of the* ***Facts*** *and categorize them into the group of existed and original.*

In Step 2, I first categorized all the **Acts** and **Facts** that I identified and derived in step 1 into either **Production** or **Coordination**. If the **Act** was completed only by one actor, for

instance, the *Back-office agent selects candidate invoice documents*, this type of **Act** and the **Fact** produced by executing this **Act** was categorized as **Production**. On the other hand, if the **Act** is required to involve more than one actor, I considered **Coordination** activities happened between them to deliver products collaboratively. In the process of publishing an invoice report, only the last **Act** made by the back-office agent involved the email receivers as the other actor. I then identified this **Act** as making a statement in **Coordination** activities.

When evaluating the originalities of **Facts**, I added more discussions with Bank X to situate my developed artifacts into their cases. Also, according to the discussion, the selection of candidate invoice documents did not have standardized rules to refer to. Instead, the selection was handled under specific situations in their practical business scenarios. Also, therefore, in the process of publishing an invoice report, Bank X stressed the originalities of selected invoice documents could only be brought only by human workers. Therefore, I categorized

the **Fact**, *Candidate invoice documents have been selected*, as an original **Fact**. This original fact was highlighted in the shadow area in Table 5-2.

Table 5-2 Result of step 2 in Extended DEMO Construction model of publishing invoice report

Acts/Facts types	Acts	Facts
Production	Back-office agent selects candidate invoice documents.	Candidate invoice documents have been selected.
	Back-office agent sorts out required data.	Required data has been sorted out.
	Back-office agent inputs required data to an Excel file.	Required data has been input to an Excel file.
	Back-office agent logs into the invoice verification platform.	Invoice verification platform has been logged into.
	Back-office agent inputs the required data to the platform.	Required data has been input to the platform.
	Back-office agent verifies the input data on the platform.	Input data has been verified.
	Back-office agent inputs the verified data into an Excel file.	Verified data has been input into an Excel file.
	Back-office agent creates the invoice report.	Invoice report has been created.
Coordination	Back-office agent emails the invoice report to stakeholders.	Invoice report has been emailed.

Based on these documents, the rest facts could be created by either manipulating existed data or dealing with the format of the data, which did not contribute to originality creation. I then classified the rest of the **Facts** as existed **Facts**. The analysis result for step 2 is shown in Table 5-2.

Step 3: *From the final product, Identify the final* ***production*** *purposes achieved by different* ***Production acts*** *and name the* ***Transaction*** *after this purpose; Proceeding forwardly, in order to achieve the final* ***Production*** *purpose, identify other prior* ***Production*** *purposes and name the* ***Transactions*** *after these purposes. Identify the relating* ***Coordination acts*** *that serve for realizing one* ***Production*** *purpose; Cluster these associated acts and their relating facts into one* ***Transaction****.*

I started by identifying the **Production** purpose of this process. In the beginning, since the final product as the result of the process is presented, it is affirmative to identify the last Production purpose initially.

The last **Production** purpose was identified as publishing the invoice report. So, therefore, the third transaction was named as T3 Invoice publication. For completing this publication, it was required to first accomplish the Production on publishing the report by calculating verified data. However, for Coordination acts, I did find out that, the completion of the invoice report publication was sending the generated reports to relating stakeholders. And this Coordination act was therefore attributed to Transaction 3.

For publishing the invoice report, the first prior production purpose is verifying the data to be published. And therefore, I named the second transaction as **T2 Invoice verifying**. Since the verification was executed on the online platform, the **Production act** started from logging into this verification platform. Then, the data verification was completed by inputting the required data and had them verified on the platform. And the verified results was stored in an Excel file. Regarding the **Coordination** acts that serve for achieving this production purpose, the original process description did not show the necessities of coordinating with other actors, and I maintained this feature for **Transaction 2**.

Before the data can be verified, due to the data verification scope, it is required to select data from the raw datasets in documents. Therefore, the second prior **Production** purpose is selecting invoice data. And I then named the first **Transaction** after this purpose, **T1 Invoice selecting**. In this **Transaction**, to prepare these invoice data, it is required to start from the **Production act** of selecting candidate invoice documents followed by sorting out required data out of these documents. Eventually, the data to be verified Was stored in an Excel file. For the same reason with **Transaction 2**, the **Coordination** acts were omitted to be discussed. The result of step 3 analysis was shown in Table 5-3.

Table 5-3 Result of step 3 in Extended DEMO Construction model of publishing invoice report

Production acts	Coordination acts	Transactions
Back-office agent selects candidate invoice documents.	Omitted in the process	T1 Invoice selecting
Back-office agent sorts out required data.		
Back-office agent inputs required data to an Excel file.		
Back-office agent logs into the invoice verification platform.	Omitted in the process	T2 Invoice verifying
Back-office agent inputs the required data to the platform.		
Back-office agent verifies the input data on the platform.		
Back-office agent inputs the verified data into an Excel file.		
Back-office agent creates the invoice report.	Back-office agent emails the invoice report to stakeholders.	T3 Invoice report publishing

Step 4: *Categorize the* ***Transaction*** *by* ***Production fact****.*

As explained in section 3.2, in a business process, the human capabilities of **Performa**, **Informa**, and **Forma** support each other to complete business tasks. The originality brought by **Performa** activities is supported by **Informa** activities in dealing with information content. Meanwhile, the manipulation of information content is supported by handling information format by **Forma** activities. For highlighting this supporting relation, in this step, the **Transactions** are classified based on the highest capability performed in **Production Acts** of a Transaction.

Recalling the original fact identified in step 2, *selected candidate invoice documents*, represented that all **Coordination** and **Production** occurring in Transaction 1 Was to deliver this original **Fact**. And therefore, Transaction 1, Invoice selecting, was classified as an **Original Transaction**.

Further work in this step was to categorize Transaction 2 and Transaction 3. For Transaction 2, the **Production Facts** created was, *verified invoice data,* which was obtained based on the calculation of the existed invoice data and no original **Production Facts** Was created. And thus, in the second transaction, the highest capability performed is **Informa** and is then identified as **Informational Transaction**.

As for Transaction 3, I found out that the report was generated by filling out the verified invoice data into the report templates and was then sent to stakeholders. So, it was affirmative that no content change occurred, and no originality was brought in Transaction 3, but only the

verified data was transferred from Excel file to a PDF file and then to email. So, therefore, in Transaction 3, **Forma** is the highest capability performed and is then identified as **Documental Transaction**. The analysis result of step 4 as shown in Table 5-4.

Table 5-4 Result of step 4 in Extended DEMO Construction model of publishing invoice report

Transactions	Transaction types
T1 Invoice selecting	Original
T2 Invoice verifying	Informational
T3 Invoice publishing	Documental

Step 5: *Define* ***Actor Roles*** *for each* ***Transaction***.

To identify the responsibility unit in each transaction, in this step, I first named the executor for each transaction after the responsibility performed to deliver the products. From T1 Invoice selecting, the executor was named as **Invoice selector**. And for T2 Invoice verifying and T3 Invoice publishing, the executors were named as **Invoice selector** and **Invoice publisher**, respectively.

Based on the identified executors, I proceeded to identify initiators. For the first transaction, I found it was self-activated and thus identified the initiator also as **Invoice selector**. After the first transaction was accomplished, the **Invoice selector** continued to initiate the second transaction of Invoice verifying. Eventually, the last transaction was

initiated by **Invoice verifier** when the verification was accomplished. Table 5-5 shows the analysis result of step 5.

Table 5-5 Result of step 5 in Extended DEMO Construction model of publishing invoice report

Transactions	Initiators	Executors
T1 Invoice selecting	Invoice selector	Invoice selector
T2 Invoice verifying	Invoice selector	Invoice verifier
T3 Invoice publishing	Invoice verifier	Invoice publisher

Step 6: *Categorize the connection links between* ***Transactions*** *and* ***Actor roles.***

The categorization of connection links in this step lies in the types of transactions that the **Executors** and **Initiators** involve. By this categorization rule, I identified the connection link as **Original link** for T1 Invoice selecting between **Initiator** as Invoice selector and **Executor** as Invoice selector. While the connection link for T2 Invoice verifying between Invoice selector and Invoice verifier was identified as **Information link**, **Documental link** was identified for T3 Invoice publishing. Table 5-6 shows the analysis result for this step.

Table 5-6 Result of step 5 in Extended DEMO Construction model of publishing invoice report

Initiators	Transactions	Executors	Connection links types
Invoice selector	T1 Invoice selecting	Invoice selector	Original
Invoice selector	T2 Invoice verifying	Invoice verifier	Informational
Invoice verifier	T3 Invoice publishing	Invoice publisher	Documental

Step 7: *Separate the scopes of interest and complete the model illustration.*

The last step is to summarize the analysis result and complete the model illustration. In this step, I separated the areas of interest by three types of **Organizations** as explained in section 3.2, 1) Original organization; 2) Informational organization;3) Documental organization. These organizations were constituted by different transactions and related actor roles and linked by connection links.

For Transaction 1 as an original transaction, together with Invoice selector as both of its initiator and executor constituted the **Original organization**. And **Informational organization** contained Transaction 2 and its executor while Transaction 3 and its executors were in **Documental organization**. The final model illustration was illustrated in Figure 5-4, and the Extended DEMO Construction Model legends Was also shown.

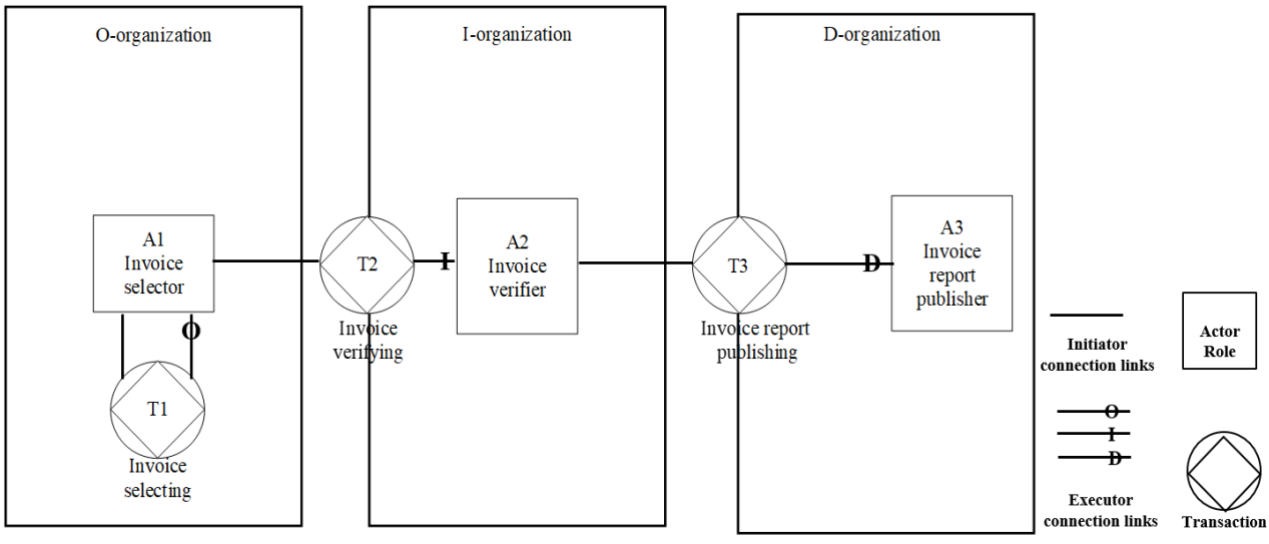

Figure 5-4 The Extended DEMO Construction Model of publishing an invoice report

5.3 Demonstration and Evaluation of Extended DEMO Construction Model

In the demonstration section of this chapter, as is presented in the research design. As suggested by Peffers et al. (2012), I decided to conduct case studies for my developed modeling methodology. Therefore, I invited four RPA users from two companies to apply the extended DEMO construction modeling methodology into the modeling of their RPA application cases. And then for evaluation, according to their user experience, I conducted semi-structured interviews with them. To obtain structured evaluation opinions from their experiences, I then used the grounded theory approach to analyze the interview data.

One of the companies is bank X as mentioned in section 5.2. However, this time for demonstration and evaluation, I asked them to model one of the other RPA application cases, credit card fraud investigation. Two interviewees from the customer call center were invited to join the interview, one is a project manager who is responsible for the management of the

> *A client calls the customer center of a bank to report for that he or she became a victim of a credit card fraud. The staff makes a record about this case and saves the case into the database. Then, staff from the customer center contact the card swiping place that was reported as the credit card fraud and ask for the payment information. And then the staff saved the payment information into database. RPA then collects this payment information and send it to the client by email.*

Figure 5-5 The case description of credit card fraud investigation

RPA application project, and the other is a software engineer who works for the implementation of the RPA. The case description is as shown in Figure 5-5,

The other company is a fund company, two employees from the information and technology department were invited to join this interview. And they were both software engineers who work for the implementation of RPA application in other departments of the company. And this RPA application case is to generate a report automatically and send it to the relating stakeholders. The process description is as shown in Figure 5-6,

RPA scraps online data from specific websites and calculate the required indexes and then save the data into database. RPA invites analyst to send their weekly reports every Friday. RPA capture required data from the reports and save the data into data base. Then RPA make the reports by inserting data into report template and send emails to the employees.

Figure 5-6 The case description of automatic report generation

For these two RPA-involved business processes, while the four employees were invited to create the extended DEMO construction models, I also create the extended DEMO construction models for them for comparison and discussion in the following interviews. The created DEMO models and the interview data can be found in the appendix C. However, here, for providing evaluation results, I only present the codebook generated by using the grounded theory approach, as shown in Table 5-7 and Table 5-8.

The interview data were analyzed by three coding processes, open coding, axial coding and theoretical coding. For providing the most plausible reasoning process that leads to the theoretical framework of the adapted TAM model, two coders iteratively conducted the coding process. And eventually, the coding results showed that the extended construction model can be used to develop a shared vision of RPA and improve the user participation of RPA.

For axial coding, the open codes were synthesized into opinions from the group of managers and the group of employees. And it first requires clarifying that, in this synthetization, the group of managers refers to the employees who are assigned with specific managerial tasks, responsibility (Hales, 1986), and have relating titles in the evaluation system of the company. And for the group of employees, it refers to the ordinary employees in the company.

For the contribution to the development of a shared vision of RPA, the extended construction model can facilitate both the employees and the managers to clarify a shared vision of RPA. Specifically, the extended construction model can be used as a powerful tool to grasp the essence of RPA application in a short time, especially in the promotion activities of RPA from the achievements of one pilot project. Also, the extended construction model can be used in the reference model to make managerial decisions for the future implementation of RPA. On the other hand, the extended construction model can provide a consistent perspective from the beginning, while it also works as a core skeleton in the future implementation of RPA.

For the facilitation of improving the user participation of RPA, the extended construction model can help the employee become clearer for both their responsibilities and capabilities. In terms of a clear understanding of responsibility, the extended construction model can first help the employees understand their responsibilities in the RPA application, it can also work as a guideline for the following implementation of the responsibilities. As for the capabilities, the extended construction model can help the employee themselves to obtain better personal career growth, if they can know better about the things that they are good at. Also, the organizations can attempt to prioritize their human resource from the capability optimization perspective.

The above coding results show the utility of the developed artifact, the modeling methodology of extended DEMO construction model, by doing a case study with practitioners from the field. And therefore, the developed artifact is considered as an effective design science research outcome. Also, the opinions from the industry injected fresh points into my design science research cycle and based on these opinions, I believe that more relevant design science research artifacts can be delivered in my future research.

Table 5-7 codebook of the interview data of extended DEMO Construction model-1

Theoretical codes	Axial codes		Open codes
A shared vision can be improved by the extended DEMO construction model.	**An extended construction model can provide a shared mindset and a consistent perspective for the RPA users from the beginning.**	**An extended construction model can help to construct a shared mindset and toolkit for the promotion of RPA for managers.**	Construction Model can help to build up a shared vision for managers in the promotion of RPA application.
			The construction model is powerful to build up a shared vision to managers with no knowledge base of RPA.
			Managers can grasp the process essence in a short time through the construction model.
		An extended construction model can provide a consistent perspective of RPA from the beginning for employees.	Construction models can help not only with building up the understanding of RPA but also the re-allocation of their human resources and therefore provide managerial suggestions.
			Construction Model can contribute to the implementation of managerial decisions that constitute the predefined vision by managers.
			The construction model can inspire managers to think about the reallocation of human resources by providing a shared toolkit.
	An extended construction model can provide a reference model and a core skeleton in the following operation and application of RPA.	**The extended construction model can be used as a reference model of operation and implementation in RPA application for managers.**	Although problems are met, the Construction model can make people feel confident and comfortable to use RPA by providing one shared simple starting point.
			People are waiting for consistency from the beginning.
			The construction model can help to build up an unchanged future image of RPA for employees.
		An extended construction model can provide a core skeleton in the future RPA operations for employees.	Construction Model can provide a general understanding and a shared aim of between employees.
			The construction model can help to improve the acceptance of RPA by providing a core skeleton for the future use of RPA.
			Transactions in the construction model can show a clear operational skeleton for employees.

Table 5-8 codebook of the interview data of extended DEMO Construction model-2

Theoretical codes	Axial codes		Open codes
The user participation can be improved by the extended DEMO construction model.	**An extended construction model can clarify the responsibilities of the employees**	**An extended construction model can help employees better understand their responsibility.**	The introduction of responsibility can deepen the understanding of RPA for employees.
			RPA only excels at tedious and repetitive work and construction models can make employees should stay Ill aware of their responsibility.
			The construction model can provide a shared understanding of RPA from the responsibility point of view, which is basic but significant for employees.
			Classification of human capability and separation of human responsibility are quite useful, future use is expected.
			The construction model emphasizes the responsibility assignment by setting up executors.
		An extended construction model can help the implementation of responsibility assignment.	One employee can play as several actor roles and thus can be highlighted by several responsibility units in the construction model.
			The construction model makes several responsibilities entitled to one employee clearer.
			Construction models can help the employee get accustomed to their new responsibility in a timely way.
			Classification of the active roles makes the responsibility distribution becomes clear.
			Iteratively process to ensure no responsibility unit overlaps.
	An extended construction model can clarify the capabilities of the employees	**An extended construction model can help the employees get to know their strengths in capabilities.**	Employees can then focus on Performa application and deal with those Informa and Forma that cannot be coped with RPA.
			The construction model can help with employees' personal growth through capability identification in the long run.
			Capability classification as a new concept is also structured guidance.
		The extended construction model can help the employees to re-allocate and re-prioritize their human resources from a capability perspective.	The construction model not only makes employees re-think about their core completeness in capabilities but also provides the directions to work on.
			Capability classification can be used for human resource optimization.
			Classification of human capability and separation of human responsibility are quite useful, future use is expected.
			The construction model highlights the advancement level of human capabilities by the illustration order.

Chapter 6 Design & Development: Extension of DEMO Process Model

6.1 Development of Extended DEMO Process Model

In my previous research, I proposed modeling procedures of Extended DEMO Construction Model inspired by the discussions of business process technology from PSI theory. In this section, continuously drawing upon from PSI theory, I endeavored to further propose the Extended DEMO Process Model.

Specifically, the extended part focuses on highlighting the Informa and Forma capabilities performed in Coordination acts. And this highlight is achieved by introducing Step 3 in Figure 6-1. Also, in this Extended DEMO Process Model, for providing the basic structure of my proposal, in step 1 of Figure 8, I suggested to initially map actions of the process into the DEMO Basic Transaction pattern, 1) Request; 2) Promise; 3) Execution (Production); 4) State; 5) Accept. And this suggestion continuously to fulfill the basic representation by only discussing the acceptance situation as the ending condition of the business process. However, it does not rule out other situations existing in real business scenarios.

The methodology is shown in Figure 6-1. It starts from step 1, “Map the original actions into DEMO Basic Transaction pattern”, in which the actions of the business process are mapped into DEMO Basic Transaction pattern of either Coordination or Production. Consecutively, step 2 is to produce corresponding Facts of Production and Coordination based on Acts. In step 3, referring to how to differentiate capability performed in Transactions, the produced Facts are used to differentiate which human capability is performed in corresponding Acts. And Following

in step 4, I start by identifying unique Production purposes required to deliver the final product. Under these purposes, I then named the Transactions directly after them. Also, for the Production and Coordination acts that made for one purpose, I cluster them into one Transaction. In step 5, I differentiate Actor roles by their responsibility units, and for the unit that initiates one Transaction is identified as Initiator, while a unit that executes one Transaction is identified as Executor and is named after the Transaction. The last step, step 6 is to illustrate the previous result by using the Extended DEMO Process Model legends shown in Figure 6-2.

As shown in Figure 6-2, grounded from the original legends, I proposed the Extended DEMO Process Model legends to enable the corresponding model illustration of my methodology. Specifically, my extended work lies in inserting the dimension of human capabilities (Performa, Informa, Forma) to the original DEMO Process Model. In this insertion, since business process technology can only enhance **Informa** and **Forma** capabilities, the extended legend also focuses on illustrating only the contributions in these two aspects.

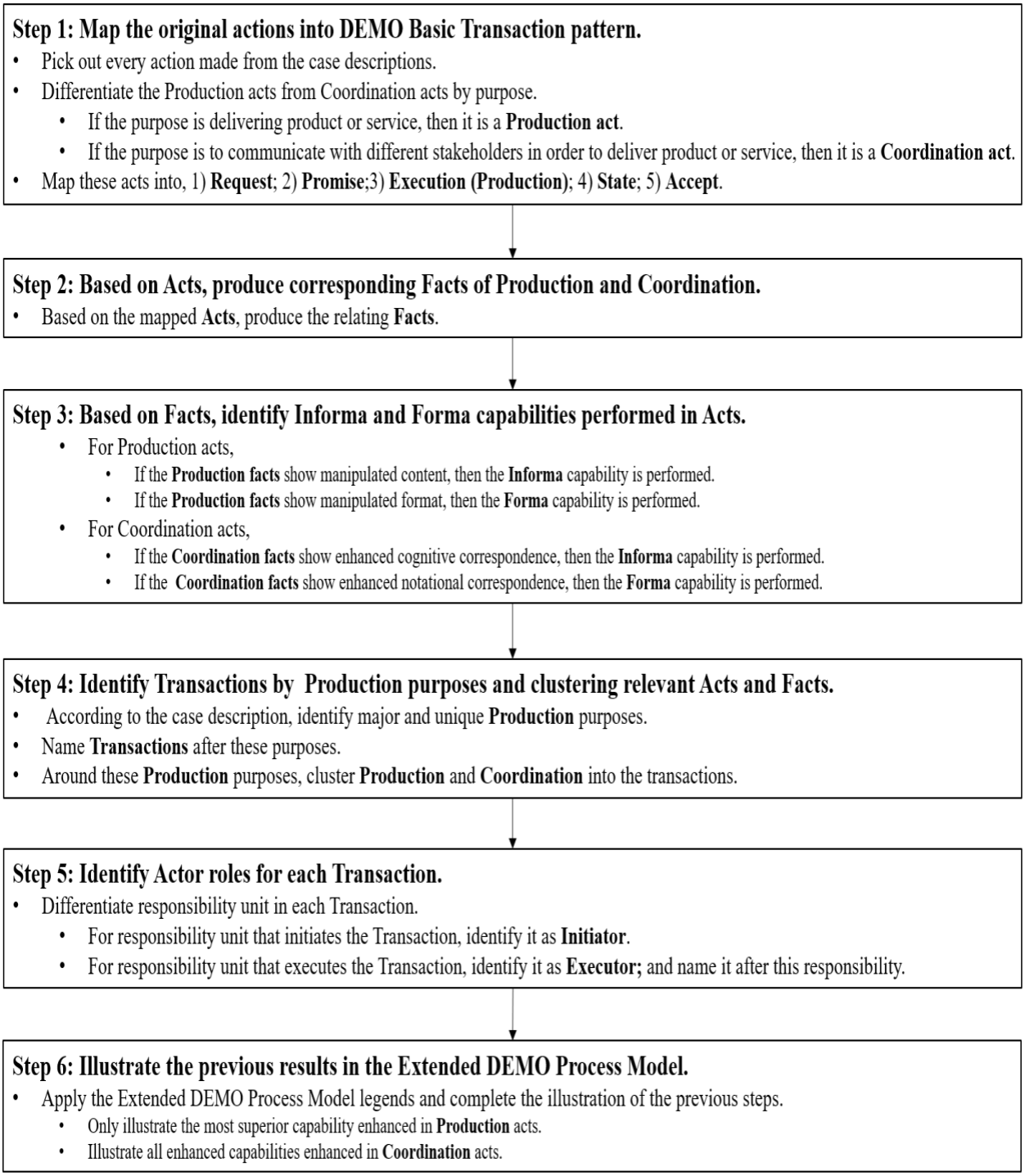

Figure 6-1 Extended DEMO Process modelling methodology

In the definition of modeling legends, I named the following legends to distinguish my methodology from the original DEMO Process modeling methodology as follows,

- Negotiation, illustrated in a diamond on the arrow and refers to performed Informa capability in Coordination.
- Transfer, illustrated in a disk on the arrow and refers to performed Forma capability in Coordination.
- Reproduction, illustrated in diamond in the disk and refers to performed Informa capability in Production.
- Operation, illustrated in a disk in the disk and refers to performed Forma capability in Production.

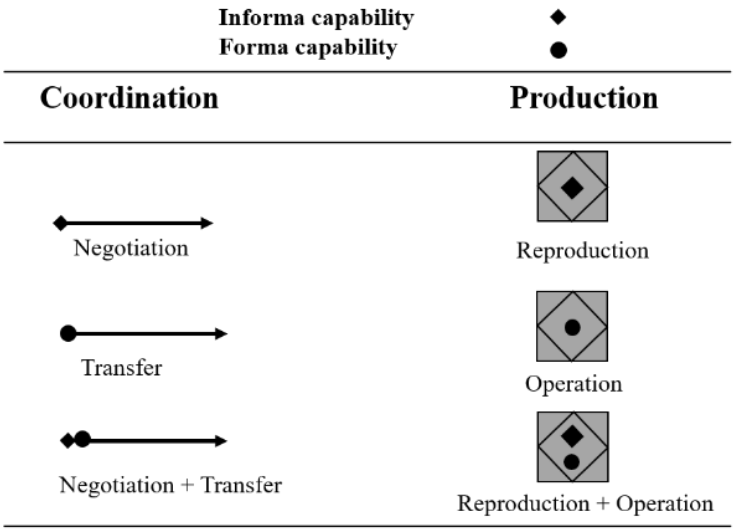

Figure 6-2 Legends of Extended DEMO Process modelling methodology

6.2 Illustration of Extended DEMO Process Model

To illustrate my methodology of the Extended DEMO Process Model, I invited one structured case of RPA application in academic publication and created an Extended DEMO Process Model for this case. The case description before the application of RPA is in Figure 6-3,

For presenting my proposal in a generic image, my illustration only concerns with one scenario that may happen in the context of generating payment receipt, which is constituted by a series of DEMO Basic Transaction Acts.

> *"A client calls and requests the payment receipt, a front office agent creates the case on a CRM system. Then a back - office agent opens the case in the CRM, copies and pastes the ID of the customer on the accounts receivable system and generates the payment receipt on a pdf file. A back-office agent writes and sends an email to the customer with the payment receipt attached and closes the case on the CRM" (Aguirre & Rodriguez, 2017).*

Figure 6-3 Case description of the illustration of extended DEMO Process modelling methodology

Step 1: Map the original actions into DEMO Basic Transaction pattern

In the first step, I picked out every action made in the case of generating payment receipt and identified them as Acts described in the original DEMO modeling approach. Further, these identified Acts are mapped into the DEMO Basic Transaction pattern by their features.

As shown in Table 6-1, for Production acts, by fixating two conditions to meet, 1) Act purpose is delivering products or services to the environment; 2) Act can be done without interactions with other stakeholders, I confirmed one Production act made by a front office

agent and five Production acts by a back-office agent. As a result, I mapped them into the Execution Act. For instance, “a front-office agent creates the case in CRM system”, the purpose of this Act is to create a case as requested and it can be accomplished only by this front-office agent.

On the other hand, for Coordination acts, by concerning two features of the Acts, 1) Act purpose is communicating and negotiating with other stakeholders to deliver products; 2) Act must be completed by interactions between stakeholders. I confirmed two Coordination acts occurred between a client and a front-office agent. And two Coordination acts occurred between the back-office agent and the client. For instance, “a client calls and requests for the payment receipt”, the purpose of this Act is to request the other stakeholder, and it must be completed based on the interaction between this client and the front-office agent. However, as illustrated in Table 1 by “*”, the last Coordination act, “the client accepts with the received payment receipt”, was inserted by us to create and represent a completed process constituted by DEMO Basic Transaction Acts.

Table 6-1 Result of step 1 in Extended DEMO Process model of generating payment receipt

Organizational work	Acts	DEMO Basic Transaction Acts
Production	1. A front-office agent creates the case in CRM system.	Execution
	2. A back-office agent opens the case in the CRM.	Execution
	3. A back-office agent copies and pastes the ID of the customer on the accounts receivable system.	Execution
	4. A back-office agent generates the payment receipt on a pdf file.	Execution
	5. A back-office agent writes an email to the customer with the payment receipt attached.	Execution
	6. A back-office agent closes the case in CRM system.	Execution
Coordination	1. A client calls and requests for the payment receipt.	Request
	2. A front office agent takes the client's call.	Promise
	3. A back-office agent sends an email to the customer.	State
	*. The client accepts with the received payment receipt.	Accept

Step 2: Based on Acts, produce corresponding Facts of Production and Coordination.

A Fact is defined as the result of completing an Act. Therefore, based on the Acts that I identified in step 1, I produced the corresponding Facts as shown in Table 6-2. For highlighting the accomplished feature of a Fact, I used the present perfect tense to describe a

Table 6-2 Result of step 2 in Extended DEMO Process model of generating payment receipt

Organizational work	Acts	Facts
Production	1. A front-office agent creates the case in CRM system.	A customer case has been created in CRM system.
	2. A back-office agent opens the case in CRM system.	A customer case has been opened in CRM system.
	3. A back-office agent copies and pastes the ID of the customer on the accounts receivable system.	A customer ID has been copied and pasted on the accounts receivable system.
	4. A back-office agent generates the payment receipt on a pdf file.	A payment receipt has been generated on a pdf file.
	5. A back-office agent writes an email with the payment receipt attached.	A email has been written with the payment receipt attached.
	6. A back-office agent closes the case in CRM system.	A case has been closed in CRM system.
Coordination	1. A client calls and requests for the payment receipt.	A call has been made for requesting for the payment receipt.
	2. A front-office agent takes the client's call.	A call has been taken.
	3. A back-office agent sends an email to the customer.	An email has been sent to the customer.
	*. The client accepts with the received payment receipt.	The received payment receipt has been accepted.

Fact. For instance, after completing the first Production act, the result is, “a customer case has been created in the CRM system”, which serves as the Fact of this Production act.

Step 3: Based on Facts, identify Informa and Forma capabilities performed in Acts.

In this step, since business process technologies can only enhance either Informa or Forma capabilities in organizational works, I intended to highlight these contributions in the Extended DEMO Process Model, as illustrated in Table 6-3.

I started by figuring out different capabilities in Production acts. For Production facts, I started by the identification of Performa capability and confirmed the originality of the fact, “a client case has been created in CRM system” since before this creation, the client case is not existing in the business process. Moreover, based on existing information, if manipulated information content is found in one Production fact, for instance, in the Fact, “a payment receipt has been generated on a pdf file”, it is clear that the information content of a payment receipt is created based on existing data stored in CRM system. Therefore, I identified that the Informa capability is performed in this Production act. On the other hand, if the manipulated format is found in one Production fact, for instance, in the Fact, “A customer case has been opened in CRM system”, the information format was initially in the format for database storage but is now represented in the graphical interface by opening the customer case. Therefore, the Production fact is manipulated in terms of information format. And I identified it as Forma capability is performed. Similarly, the other Production acts are categorized under the same reasoning process.

For Coordination acts, in the Fact, “an email has been sent to the customer”, the establishment of notational correspondence (explained in Figure 1) has been strengthened in transition speed due to the application of the email system. However, no information content change is caused by this application, and therefore I confirmed Forma capability is performed in making this Coordination act. In contrast, for the rest of Coordination acts, the completion of each one of them must be realized by the accomplishment of social correspondence, namely at Performa level as explained in Figure 1. For instance, in the Fact, “a call has been made for requesting for the payment receipt”, it can never be created if there is no social correspondence between this client and the front-office agent. Specifically, due to the established social correspondence between them, when the client intends to make this request, he or she reaches the front-office agent who is responsible and capable to deal with his or her request. And the other Performa performed Coordination acts Was confirmed by the same reasoning process.

Table 6-3 Result of step 3 in Extended DEMO Process model of generating payment receipt

Organizational work	Facts	Performed capabilities
Production	1. A client case has been created in CRM system.	Performa
	2. A client case has been opened in CRM system.	Forma
	3. A client ID has been copied and pasted on the accounts receivable system.	Forma
	4. A payment receipt has been generated on a pdf file.	Informa
	5. A email has been written with the payment receipt attached.	Informa
	6. A client case has been closed in CRM system.	Forma
Coordination	1. A call has been made for requesting for the payment receipt.	Performa
	2. A call has been taken.	Performa
	3. An email has been sent to the customer.	Forma
	*. The received payment receipt has been accepted.	Performa

Step 4: Identify Transactions by Production purposes and clustering relevant Acts and Facts.

This step requires to analyze through the original case description again to synthesize Production purposes. These purposes serve in delivering the final product and must have no overlaps with each other. In this case, the only Production purpose is generating a payment receipt. And I then named the Transaction after this purpose, *Transaction 1, Generating payment receipt.*

Since there is only one Production purpose in this Transaction, all Acts, including Coordination acts and Production acts are executed to achieve this purpose, by delivering sub-products and by negotiating and communicating with the other stakeholders. However, in another business case, it is required to cluster Acts of Production and Coordination into the same Production purpose one by one.

Step 5: Identify Actor roles for each Transaction.

This step is to clarify the primary responsibility unit for each Transaction. I continually applied the Actor roles concept defined in the original DEMO approach. For Transaction 1, "generating payment receipt", it is initiated by a call from a client. Therefore, I identified the client as the **Initiator** in this Transaction. On the other hand, for highlighting the responsibility unit performed in executing this Transaction, the **Executor** of this Transaction is named directly after its responsibility as, **payment receipt generator**. In this case, due to the responsibility scope of both the front-office agent and the back-office agent is limited to generating the payment receipt,

here the actor role of payment receipt generator is essentially performed by front-office and back-office agent.

Step 6: Illustrate the previous results in the Extended DEMO Process Model.

The last step is to assemble all previous results into an Extended DEMO Process Model by illustrating how the Acts are connected.

As shown in Figure 6-4, the process of generating payment receipt starts from "in" on the upper left part of the right part of the figure. And it follows by the "promise" of generating this payment receipt made by the payment receipt generator, as shown as "pm" in Figure 6-4. After the promise is made, the payment receipt generator starts to produce the payment receipt in "execution/ production", as shown as a shaded block in Figure 6-4. Also, the results of step 3 are illustrated. The performed Informa and Forma capabilities in Production is depicted as a disk in the diamond. Once the Production is finished, the payment receipt generator continues to "state" about this accomplishment to the client, as shown as "st" in Figure 6-4. And the performed Forma capability is depicted by a disk on the arrow of "st." The process is ended with an "acceptance" by the client, as shown as "ac" in Figure 6-4. And I apply the notation of "end" in Figure 6-4 to illustrate the termination of the process.

According to Aguirre and Rodriguez (2017), in the process of generating payment receipt, RPA is applied in dealing with the work that used to be completed by the back-office agent. And if interpreting this application by Extended DEMO Process Model, RPA contributes to improve both the Informa and Forma capabilities in the Production of the payment receipt(as shown as

shaded block in Figure 11), while it also shows capability in enhancing the Forma capabilities in making “state” Coordination act to the client by sending email.

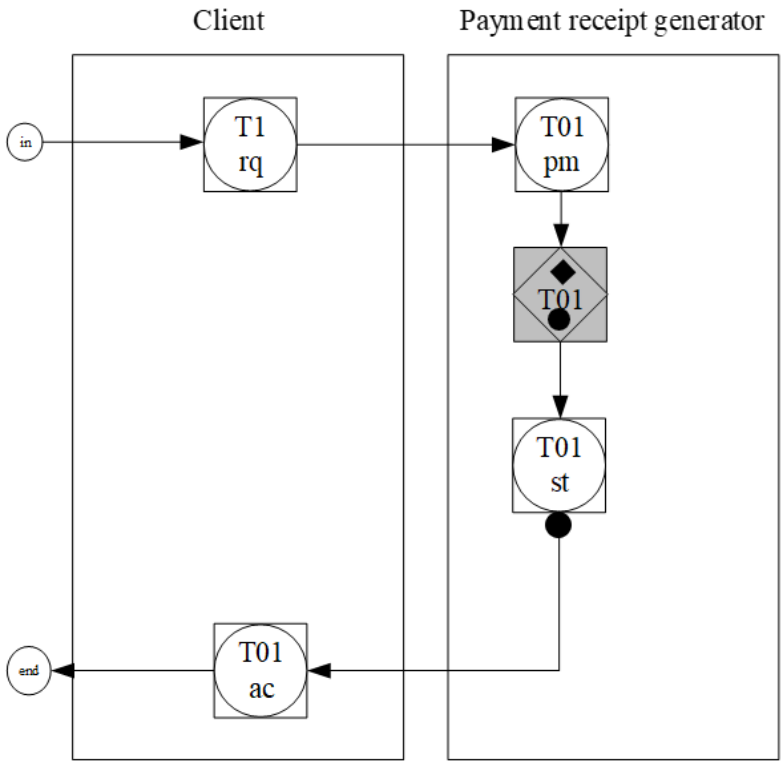

Figure 6-4 Extended DEMO Process Model of generating payment receipt

6.3 Demonstration and Evaluation of Extended DEMO Process Model

In the demonstration section of this chapter, as is presented in the research design. As suggested by Peffers et al. (2012), I decided to conduct case studies for my developed modeling methodology. Therefore, I invited four RPA users from two companies to apply the extended DEMO construction modeling methodology into the modeling of their RPA application cases. And then for evaluation, according to their user experience, I conducted semi-structured

interviews with them. To obtain structured evaluation opinions from their experiences, I then used the grounded theory approach to analyze the interview data.

One of the companies is the same bank X as mentioned in section 5.2. However, this time for demonstration and evaluation, I asked them to model one of the other RPA application cases, credit card fraud investigation. Two interviewees from the customer call center were invited to join the interview, one is a project manager who is responsible for the management of the RPA application project, and the other is a software engineer who works for the implementation of the RPA. The case description is as follows,

> *A client calls the customer center of a bank to report for that he or she became a victim of a credit card fraud. The staff makes a record about this case and saves the case into the database. Then, staff from the customer center contact the card swiping place that was reported as the credit card fraud and ask for the payment information. And then the staff saved the payment information into database. RPA then collects this payment information and send it to the client by email.*

Figure 6-5 The case description of credit card fraud investigation

The other company is a fund company, two employees from the information and technology department were invited to join this interview. And they were both software engineers who work for the implementation of RPA application in other departments of the company. And this RPA application case is to generate a report automatically and send it to the relating stakeholders. The process description is as follows,

RPA scraps online data from specific websites and calculate the required indexes and then save the data into database. RPA invites analyst to send their weekly reports every Friday. RPA capture required data from the reports and save the data into data base. Then RPA make the reports by inserting data into report template and send emails to the employees.

Figure 6-6 The case description of automatic report generation

For these two RPA-involved business processes, while the four employees were invited to create the extended DEMO construction models, I also create the extended DEMO construction models for them for comparison and discussion in the following interviews. The created DEMO models and the interview data can be found in the appendix. However, here, for providing evaluation results, I only present the codebook generated by using the grounded theory approach, as shown in Table 6-4.

Similar to the evaluation that I conducted in section 5.3, here, for obtaining the most plausible reasoning process that leads to the theoretical framework of the adapted TAM model, two coders conducted the coding process iteratively. And eventually, two axial codes are linked to the theoretical code and show that the user involvement can be improved by the extended DEMO process model.

For axial coding, the open codes were synthesized into opinions from the group of managers and the group of employees. And it first requires clarifying that, in this synthetization, the group of managers refers to the employees who are assigned with specific managerial tasks, responsibility (Hales, 1986), and have relating titles in the evaluation system of the company. And for the group of employees, it refers to the ordinary employees in the company.

For this contribution, the extended DEMO process model can help with clarifying both the source of motivation to use RPA and how to positively coordinate with RPA. In this case, once the source of motivation to use RPA for employees becomes clear, a clear starting point for user involvement can be fixed. Further, for the following implementation in coordination, since the extended DEMO process model can clearly illustrate how to positively coordinate with RPA, it becomes clear for the users to get involved in the RPA application.

As discussed above, the demonstration and evaluation that I conducted for the extended DEMO process model show that the artifact that I developed is useful to improve the user involvement in the RPA application. Meanwhile, the opinions from the industry have been well absorbed into my design science cycle and more artifacts are expected to be delivered in my future research.

Table 6-4 codebook of the interview data of extended DEMO Process model

Theoretical codes	Axial codes		Open codes
The user involvement can be improved by the extended DEMO process model.	**An extended process model can help clarifying the sources of motivation to use RPA.**	**Extended process model can help the employees clarifying the positive impact by using RPA.**	Process model can make employee feel more engaged to their RPA-involved work.
			Process model allows self-action to happen, which encourage the active move by the employees in the RPA application.
			Employees can then focus on Performa application and deal with those Informa and Forma that cannot be coped with RPA
		Extended process model can help the employees understanding the supportive role of RPA.	Process model can help people understand that RPA will become ally to facilitate and coordinate with human's work.
			Process model can highlight the supportive role played by the RPA, instead of a replacement to the worker.
	An extended process model can help clarifying how to positively coordinate with RPA.	**Extended process model can show the importance of coordination between human workers and RPA.**	Process model can provide a concrete understanding of how RPA can facilitate human workers.
			Process model emphasized the coordination between actor roles.
			Capability illustration in Process model can accelerate the coordination between the stakeholders and enable the error tracing.
		Extended process model can support the operation in the coordination between human workers and RPA.	Process model can illustrate coordination in a concise way and support the flowchart.
			Capability illustration in Process model can help the improvement of coordination.
			Process model can help with making employee know about their responsibility and their colleague's responsibility in the coordination.

Chapter 7 Discussion and Conclusion

7.1 Suggestions for research

In this research, I developed two DEMO related artifacts by using design science research methodology, and the utility of the artifacts is demonstrated by case studies conducted in the RPA user companies. On one hand, I did experience the methodological gaps in DEMO are waiting to be solved, on the other hand, I experienced both the flexibilities and innovativeness provided by design science research methodology. Therefore, in this section, I present a few research implications for both DEMO and design science research.

7.1.1 Suggestions for research in DEMO

- The interaction between human beings and technology calls for attention.

  From the foundation book written by Dietz (2006a), DEMO has never changed its genes in a human-oriented perspective when presenting business process modeling. The capability that cannot be imitated by technology is defined as the original capability of a human. Meanwhile, the human is defined as the only subject that can take responsibility. And the coordination acts between human workers are also highlighted in the process model.

  Further, Dietz (2006a) explicitly indicated that the tasks completed by artificial intelligence are only imitating one of human capabilities, but it cannot fully replace humans in bringing about original new things. Therefore, in business process modeling, original activities done by human workers should be put into the first concern.

  I fully agree with his argument in the non-replacement of human workers, especially in certain tasks that require to have originality and create something from nothing. However,

currently, artificial intelligence technology as a buzzword has been abused in creating confusion and frauds, DEMO, as a human-oriented business process modeling technology, should put more attention to clarifying the confusion and facilitate the artificial intelligence technology to be understood in a proper way. Also, instead of simply arguing works done by technology are not significant, how to make human workers best collaborate with technology instead of being afraid or against it is a topic worth having discussions.

7.1.2 Suggestions for research in design science research

- If the developed artifact is a methodology, a case study in a natural setting is an effective demonstration and evaluation method.

  In my research, based on the objective of the solution that I defined, a business process methodology is identified as the artifact to develop. Since I aim at providing a solution to the effective application of RPA, the most suitable evaluation way for this solution is the case study in a natural setting. According to my evaluation experience in the natural setting, it does not only helps me obtaining the relevant viewpoints from the industry, but also inspired and motivated me to dig deep into the research of introducing more DEMO modeling methodologies as formalization and standardization modeling tools into the effective usage of RPA. Therefore, I believe, especially for the method developed as a design science artifact, a case study is a highly recommended way for demonstration and evaluation.

7.2 Implications for practice

Based on the theoretical discussions on the business process technologies in PSI theory, I developed two artifacts, 1) Extended DEMO Construction Model; 2) Extended DEMO Process Modeling methodology, in the context of RPA.

Recalling that the primary purpose of the DEMO model is to create a skeleton of the business process in organizations (Dietz, 2006a), I believed that it could also provide the blueprint for clarifying issues and providing guidance on solving the issues in the business process. Therefore, I then attempted to highlight this issue structuring and solving the feature of DEMO model is maintained in my extended model. I first collected emerging issues in RPA applications by having interviews with three Japanese companies,1) company A is a security company and they Was considering to apply more RPA applications in their settlement business department; 2) company B is providing IT services for finance industry and they Was collaborating with an RPA software vendor, UiPath and helping their customers with the deployment of UiPath products; 3) company C is a business process outsourcing company and was developing their own RPA software products. In this context, I first sorted out the representative issues caused by RPA. Next, for providing renewed conceptualization of their issues of RPA application and suggestions, I applied my developed artifacts into analyzing their RPA applications.

Issue #1: When RPA involves, employees became less productive and motivated in their works.

This issue is mainly caused by the stereotype created by the name of RPA. Since RPA applies the term “Robotic” as part of its name, it accidentally introduces an image of physical robots of RPA to human workers. Correspondingly, instead of collaborating with RPA in completing their

tasks, some human workers expect RPA to fully replace some parts of their roles and become less committed to their works.

Suggestion #1: RPA should be considered only as an optimization technology but not a replacement technology.

In response to Issue #1, it is required to provide a systematic conceptualization of RPA applications to organizations. And I found that this conceptualization can be achieved by introducing the categories of RPA application proposed in the taxonomy of RPA application as follows,

In Production, the human capability of creating original new stuff, namely, Performa, cannot be imitated by RPA.

Although RPA excels at executing rule-based tasks, the Production tasks in which originality is required cannot be generalized in rules and executed by RPA. And therefore, in the Production activities of the organizations, they should re-clarify their business process by highlighting the originality of the Fact and then identifying human capabilities into the categories of Performa, Informa, and Forma. Based on these categories, the organizations should correspondingly shift their employees to focus on more sophisticated Production works in which Performa capability is required to bring about original products or services.

In Coordination, coordination acts can only be partially enhanced by RPA.

As shown in Figure 5, the current RPA shows a limited application in handling Coordination acts. One of the reasons for this limitation is from the technology limit. However, another reason is that performing Performa capability and making effective *social correspondence* in

negotiation activities of Coordination, can only be properly handled by human workers. For instance, in the process of providing excellent customer services in the customer call center, making effective commitments to customers can only be realized by human workers. Therefore, the company should figure out, in performing Coordination acts, instead of full replacement, how to collaborate with RPA by making RPA contribute more to establishing cognitive and *notational correspondence* in *Informa* and *Forma* capabilities required activities.

To sum up, when applying RPA in organizations, how to optimize their current personnel becomes the key. While re-assigning more tasks with Performa capability required to their employees, companies should also shift their focus to deploy RPA in Reproduction, Transfer, and Negotiation (as explained in Figure 6-2).

Issue #2: Insufficient process governance of RPA may cause uncontrollable actions.

Although RPA operational process flow usually has completed error tracing the path, if the process governance was insufficient, RPA was nothing different from other automation technologies in causing uncontrollable actions and amplifying the number of errors.

Suggestion#2: For each RPA-enabled process, the responsibility of RPA should be clarified.

In response to Issue #2, also, to managing the operational process flow of RPA, I suggest introducing the Extended DEMO Process Model to the process governance of RPA. In clarifying responsibilities taken by RPA, Extended DEMO Process Model can provide two dimensions, 1) human capability; 2) human interaction, for shaping a structured responsibility scope of RPA.

Specifically, by using the DEMO Basic Transaction pattern, I discussed several viable Acts that RPA may contribute to the enhancement of Informa capability and Forma capability in

Coordination and Production activities, while Human workers should take full responsibility for applying Performa capability to guarantee the RPA activities are all meaningful.

Request

If RPA aims at enhancing *Informa* capability in making a request, it requires to ensure that the enhanced request was understandable to the *Executor* as requested. On the other hand, if *Forma* capability is enhanced in making this request, it requires to ensure the enhanced request by RPA applies perceivable interaction way to the *Executor*.

For the human worker who applies *Performa* capability in making a request, it requires to ensure that this request is made on purpose to the correct stakeholder, not just initiated by RPA freely.

Promise

If RPA works as an *Executor* and aims at enhancing *Informa* capability in making a promise, it requires to ensure that this promise is understandable to the *Initiator*. On the other hand, if it only enhances the *Forma* capability in making a promise, it requires to ensure the way to express the enhanced promise by RPA is perceivable to the *Initiator*.

For the human worker who applies *Performa* capability in making a promise, he requires to guarantee the decision- making of this promise to *Initiator* is determined by himself, but not just by RPA freely.

Execution (Production)

If RPA contributes to the Production part of the process, and majors in delivering products or services with *Informa* capability performed, before it starts to produce, it requires to ensure that its operations make use of the appropriate existing information. On the other hand, if RPA deals with improving production with *Forma* capability performed, its execution process cannot have any impact on the information content.

For the Human workers in Production, they do not necessarily apply *Performa* capability in every Transaction in which RPA involves, since not every product has to be originally created. And therefore, organizations are required to have clear definitions of the original Facts in their organizations when they automate the Production process with RPA.

State

After Execution/Production, if RPA enhances the *Informa* Capability in making a statement, it requires to ensure the statement captures understandable information of the production result to the *Initiator* waiting for this statement. On the other hand, if RPA only enhances the *Forma* capability required for making this statement, it requires to ensure the way that RPA applies to communicate with *Initiator* can be perceived by him or her.

For human workers applying *Performa* capability in making a statement, before the statement is officially made, he requires to determine if the statement is necessary to make. For instance, if the initiator is a client waiting for a product, instead of stating about the failure of the product requested, this human worker is required to trigger the re-production process timely.

Accept

If RPA deals with enhancing *Informa* capability in making acceptance and close the process, it requires to ensure that the acceptance is understandable to the *Executor* who delivers the product or service. On the other hand, if *Forma* capability is enhanced in making acceptance by RPA, RPA needs to make sure the acceptance information can be perceived by the *Initiator*.

For the human worker who applies *Performa* capability in deciding on acceptance, while he or she should be aware that although the enhanced capabilities in making *Informa* and *Forma* activities are achieved by RPA, this human worker requires to make the final decision on acceptance.

7.3 Conclusions and limitations

In this research, by following the design science research methodology, I developed two artifacts as solutions for emerging problems in the adoption and application of RPA, based on the DEMO approach. And these two artifacts were demonstrated for its relevance and utility by conducting case studies with RPA user companies. My research mainly made four contributions as follows,

- The academic discussion about the connection between human workers and technology has been enriched.

  Undoubtedly, the research and development of artificial intelligence technology are currently in its golden age. Countless research efforts are paid on imitating human capabilities to the largest extent and achieve the tasks beyond the reach of normal human beings. Not to mention that the shock and panic that AlphaGo caused on the day when it

beat the best human chess player (F.-Y. Wang et al., 2016). And all these facts simply make people with no science background became confused and even afraid about the future when the AI becomes more powerful than the current.

The progress on AI development should definitely be well appreciated in any case. However, the associated research on discussing the connection and relation between technology and humans should also keep in pace. In addition to the widely discussed ethical issues (Bostrom & Superintelligence, 2003), the perspectives of responsibility and capability in this research widened the discussion scope. While avoiding the ethical issues that might be caused by technologies, clarifying the responsibilities of human stakeholders and identifying the original human capabilities can potentially contribute to the construction of effective collaboration between human and technology.

- The methodological modeling part for DEMO has been extended.

In the latest version of DEMO, DEMO 3.0, it further excluded the discussion of business activities that are handled by technologies, by defining these tasks as second-priority tasks. And the original claim that human-oriented tasks should be put into the first priority is further emphasized (Dietz, 2006a).

In contrast, my research grounded from DEMO 2.0 in which technology-involved activities are discussed under the PSI theory perspective. The main reason for this decision is that I believed that the modeling perspectives provided by DEMO can play as a comprehensive and profound tool to clarify and alleviate people's confusion about the application of technology in their working environments and make a timely and positive

response to this inevitable change. After all, better collaboration between technology and human can eventually lead to a bright future of human society.

- Academic research in RPA field has been empowered by profound theory and methodology.

  Still, as a buzzword in the industry, attention to RPA has never been lack of. While multiple software vendors appeal about the fancy functionalities of RPA, consulting companies also contribute to the promotion of RPA by providing full-track solutions to their clients.

  However, when it moves to academic research, case studies (Lacity, 2016; Lacity, Willcocks, & Craig, 2015a, 2015b) (Özbilgin, Tatli, Mary, & Nord, 2005; Willcocks & Lacity, 2016; Willcocks et al., 2015) and technical proposals (Geyer-Klingeberg et al., 2018) (Leopold, van der Aa, & Reijers, 2018) (Leshob, Bourgouin, & Renard, 2018) are prosperous. RPA application has never been discussed in the context of a profound theory and methodology like DEMO. Therefore, my research introduced a new perspective supported by DEMO, it can not only empower the academic research achievements but also inspire more research to be conducted in RPA field.

- The case study under the topic of RPA application has been enriched.

  Focusing on the demonstration and evaluation of my developed artifacts, the case studies that I conducted also reveals the current development status of RPA application.

Different from the claimed little efforts require to be paid in the adoption of RPA, my case study should that RPA application is lack of support for better perception and intention to use RPA. It is true that my developed artifacts are demonstrated for its utility and relevance, however, this ongoing situation calls for more research efforts to put into.

One of the major limitations of this research is the sampling group in the survey study. Since the data was collected from the companies located in the major cities in China, these companies may genetically be more willing to adopt new technologies. It is expecting that future research can be conducted with companies in different contexts such as from traditional industries or less developed areas.

Also, my research confirmed the significance of three external factors in the adapted TAM model, however, the evaluation has only been conducted in the case of RPA application. More investigation is expected to be made with other technologies.

7.4 Future research

- Demonstration and evaluation with more technologies.

  As mentioned in the limitations of this research, my developed artifacts are based on the research problems identified from the RPA field, and the demonstration and evaluation are conducted in the context of RPA application accordingly. However, I believe that DEMO can potentially be used in a wider context of other technologies to resolve more emerging issues. Therefore, my future research may proceed to demonstrate and evaluate my methodologies under the background of other technologies. And a more scalable and generalized modeling methodology is expecting to be developed.

- Extension on the DEMO state model and action model.

  In my research, I completed the extension of DEMO construction model and process model, which are two of the most abstract modeling methodologies in DEMO. Preceding, DEMO also provides the modeling methodologies that capture more details about the business

process. In my case study, the practitioners also show interest in more formalization rules and principles from DEMO perspective, according to them, the detailed DEMO viewpoints have the potential to facilitate the standardization in the RPA application process. And this requirement further motivated me to continue my future research into the extension of the DEMO state model and action model.

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Appendix A RPA Demonstration project codes for chapter 2.2

```
#import required packages
import smtplib
from email.mime.text import MIMEText
from email.mime.multipart import MIMEMultipart
from email.header import Header
from email.mime.application import MIMEApplication
from pdfminer.pdfinterp import PDFResourceManager,PDFPageInterpreter
from pdfminer.converter import TextConverter
from pdfminer.pdfpage import PDFPage
import os
from wordcloud import WordCloud
from docx import Document
from docx.shared import Inches
from docx.shared import Pt
from docx.shared import RGBColor
from docx.enum.text import WD_ALIGN_PARAGRAPH
import win32com.client
import matplotlib.pyplot as plt
import PyPDF2

#The generation of report overview 2015
start_page1 = 0
end_page1 = 1
output1 = PyPDF2.PdfFileWriter()
pdf_file1 = PyPDF2.PdfFileReader(open('D:\\anaconda\\world bank reports\\2015-WorldDevelopmentReport.pdf','rb'))
pdf_pages_len1 = pdf_file1.getNumPages()
for i in range(start_page1, end_page1):
    output1.addPage(pdf_file1.getPage(i))
outputStream1 = open('D:\\anaconda\\world bank reports\\2015 overview\\coverpage.pdf','wb')
output1.write(outputStream1)
outputStream1.close()
start_page = 20
end_page = 21
output2 = PyPDF2.PdfFileWriter()
pdf_file2 = PyPDF2.PdfFileReader(open('D:\\anaconda\\world bank reports\\2015-WorldDevelopmentReport.pdf', 'rb'))
pdf_pages_len2 = pdf_file2.getNumPages()
for i in range(start_page, end_page):
    output2.addPage(pdf_file2.getPage(i))
outputStream2 = open('D:\\anaconda\\world bank reports\\2015 overview\\overview.pdf', 'wb')
output2.write(outputStream2)
outputStream2.close()
pdfFiles = []
for filename in os.listdir('D:\\anaconda\\world bank reports\\2015 overview'):
    if filename.endswith('.pdf'):
```

Figure 1 RPA Demonstration project codes-1 for chapter 2.2

```
        pdfFiles.append(filename)
pdfFiles.sort(key = str.lower)
pdfWriter = PyPDF2.PdfFileWriter()
for filename in pdfFiles:
    pdfFileObj = open(os.path.join('D:\\anaconda\\world bank reports\\2015 overview',filename),'rb')
    pdfReader = PyPDF2.PdfFileReader(pdfFileObj)
    for pageNum in range(0,pdfReader.numPages):
        pageObj = pdfReader.getPage(pageNum)
        pdfWriter.addPage(pageObj)
pdfOutput = open('world development report 2015-overview.pdf','wb')
pdfWriter.write(pdfOutput)
pdfOutput.close()

#The generation of report overview 2016
start_page = 0
end_page = 1
output1 = PyPDF2.PdfFileWriter()
pdf_file1 = PyPDF2.PdfFileReader(open('D:\\anaconda\\world bank reports\\2016-WorldDevelopmentReport.pdf','rb'))
pdf_pages_len1 = pdf_file1.getNumPages()
for i in range(start_page, end_page):
    output1.addPage(pdf_file1.getPage(i))
outputStream1 = open('D:\\anaconda\\world bank reports\\2016 overview\\coverpage.pdf','wb')
output1.write(outputStream1)
outputStream1.close()
start_page = 27
end_page = 28
output2 = PyPDF2.PdfFileWriter()
pdf_file2 = PyPDF2.PdfFileReader(open('D:\\anaconda\\world bank reports\\2016-WorldDevelopmentReport.pdf', 'rb'))
pdf_pages_len2 = pdf_file2.getNumPages()
for i in range(start_page, end_page):
    output2.addPage(pdf_file2.getPage(i))
outputStream2 = open('D:\\anaconda\\world bank reports\\2016 overview\\overview.pdf', 'wb')
output2.write(outputStream2)
outputStream2.close()
pdfFiles = []
for filename in os.listdir('D:\\anaconda\\world bank reports\\2016 overview'):
    if filename.endswith('.pdf'):
        pdfFiles.append(filename)
pdfFiles.sort(key = str.lower)
pdfWriter = PyPDF2.PdfFileWriter()
for filename in pdfFiles:
    pdfFileObj = open(os.path.join('D:\\anaconda\\world bank reports\\2016 overview',filename),'rb')
    pdfReader = PyPDF2.PdfFileReader(pdfFileObj)
    for pageNum in range(0,pdfReader.numPages):
```

Figure 2 RPA Demonstration project codes-2 for chapter 2.2

```
        pageObj = pdfReader.getPage(pageNum)
        pdfWriter.addPage(pageObj)
pdfOutput = open('world development report 2016-overview.pdf','wb')
pdfWriter.write(pdfOutput)
pdfOutput.close()

#The generation of report overview 2017
start_page = 0
end_page = 1
output1 = PyPDF2.PdfFileWriter()
pdf_file1 = PyPDF2.PdfFileReader(open('D:\\anaconda\\world bank reports\\2017-WorldDevelopmentReport.pdf','rb'))
pdf_pages_len1 = pdf_file1.getNumPages()
for i in range(start_page, end_page):
    output1.addPage(pdf_file1.getPage(i))
outputStream1 = open('D:\\anaconda\\world bank reports\\2017 overview\\coverpage.pdf','wb')
output1.write(outputStream1)
outputStream1.close()
start_page = 26
end_page = 27
output2 = PyPDF2.PdfFileWriter()
pdf_file2 = PyPDF2.PdfFileReader(open('D:\\anaconda\\world bank reports\\2017-WorldDevelopmentReport.pdf', 'rb'))
pdf_pages_len2 = pdf_file2.getNumPages()
for i in range(start_page, end_page):
    output2.addPage(pdf_file2.getPage(i))
outputStream2 = open('D:\\anaconda\\world bank reports\\2017 overview\\overview.pdf', 'wb')
output2.write(outputStream2)
outputStream2.close()
pdfFiles = []
for filename in os.listdir('D:\\anaconda\\world bank reports\\2017 overview'):
    if filename.endswith('.pdf'):
        pdfFiles.append(filename)
pdfFiles.sort(key = str.lower)
pdfWriter = PyPDF2.PdfFileWriter()
for filename in pdfFiles:
    pdfFileObj = open(os.path.join('D:\\anaconda\\world bank reports\\2017 overview',filename),'rb')
    pdfReader = PyPDF2.PdfFileReader(pdfFileObj)
    for pageNum in range(0,pdfReader.numPages):
        pageObj = pdfReader.getPage(pageNum)
        pdfWriter.addPage(pageObj)
pdfOutput = open('world development report 2017-overview.pdf','wb')
pdfWriter.write(pdfOutput)
pdfOutput.close()
```

Figure 3 RPA Demonstration project codes-3 for chapter 2.2

```
#The generation of report overview 2018
start_page = 0
end_page = 1
output1 = PyPDF2.PdfFileWriter()
pdf_file1 = PyPDF2.PdfFileReader(open('D:\\anaconda\\world bank reports\\2018-WorldDevelopmentReport.pdf','rb'))
pdf_pages_len1 = pdf_file1.getNumPages()
for i in range(start_page, end_page):
    output1.addPage(pdf_file1.getPage(i))
outputStream1 = open('D:\\anaconda\\world bank reports\\2018 overview\\coverpage.pdf','wb')
output1.write(outputStream1)
outputStream1.close()
start_page = 22
end_page = 23
output2 = PyPDF2.PdfFileWriter()
pdf_file2 = PyPDF2.PdfFileReader(open('D:\\anaconda\\world bank reports\\2018-WorldDevelopmentReport.pdf', 'rb'))
pdf_pages_len2 = pdf_file2.getNumPages()
for i in range(start_page, end_page):
    output2.addPage(pdf_file2.getPage(i))
outputStream2 = open('D:\\anaconda\\world bank reports\\2018 overview\\overview.pdf', 'wb')
output2.write(outputStream2)
outputStream2.close()
pdfFiles = []
for filename in os.listdir('D:\\anaconda\\world bank reports\\2018 overview'):
    if filename.endswith('.pdf'):
        pdfFiles.append(filename)
pdfFiles.sort(key = str.lower)
pdfWriter = PyPDF2.PdfFileWriter()
for filename in pdfFiles:
    pdfFileObj = open(os.path.join('D:\\anaconda\\world bank reports\\2018 overview',filename),'rb')
    pdfReader = PyPDF2.PdfFileReader(pdfFileObj)
    for pageNum in range(0,pdfReader.numPages):
        pageObj = pdfReader.getPage(pageNum)
        pdfWriter.addPage(pageObj)
pdfOutput = open('world development report 2018-overview.pdf','wb')
pdfWriter.write(pdfOutput)
pdfOutput.close()

#The generation of report overview 2019
start_page = 0
end_page = 1

output1 = PyPDF2.PdfFileWriter()
pdf_file1 = PyPDF2.PdfFileReader(open('D:\\anaconda\\world bank reports\\2019-WorldDevelopmentReport.pdf','rb'))
pdf_pages_len1 = pdf_file1.getNumPages()
```

Figure 4 RPA Demonstration project codes-4 for chapter 2.2

```
pdfOutput = open('world development report 2015-2019-overview.pdf','wb')
pdfWriter.write(pdfOutput)
pdfOutput.close()

#Convert report 2015 from PDF to txt and create wordcloud image
rmg1 = PDFResourceManager()
filename1 = os.path.join("D:\\anaconda\\world bank reports\\2015-WorldDevelopmentReport.pdf")
fout1 = open("D:\\anaconda\\world bank reports\\2015 overview\\2015-WorldDevelopmentReport.txt","wb")
conv1 = TextConverter(rmg1,fout1)
interpreter=PDFPageInterpreter(rmg1,conv1)
with open(filename1,"rb")as fin1:
    for page1 in PDFPage.get_pages(fin1):
        interpreter.process_page(page1)
fout1.close()

text = open("D:\\anaconda\\world bank reports\\2015 overview\\2015-WorldDevelopmentReport.txt",encoding="gb18030",errors= "ignore").read()
wordcloud = WordCloud().generate(text)
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
wordcloud.to_file("D:\\anaconda\\world bank reports\\2015 overview\\2015-WorldDevelopmentReport.png")

#Convert report 2016 from PDF to txt and create wordcloud image
rmg1 = PDFResourceManager()
filename1 = os.path.join("D:\\anaconda\\world bank reports\\2016-WorldDevelopmentReport.pdf")
fout1 = open("D:\\anaconda\\world bank reports\\2016 overview\\2016-WorldDevelopmentReport.txt","wb")
conv1 = TextConverter(rmg1,fout1)
interpreter=PDFPageInterpreter(rmg1,conv1)
with open(filename1,"rb")as fin1:
    for page1 in PDFPage.get_pages(fin1):
        interpreter.process_page(page1)
fout1.close()

text = open("D:\\anaconda\\world bank reports\\2016 overview\\2016-WorldDevelopmentReport.txt",encoding="gb18030",errors= "ignore").read()
wordcloud = WordCloud().generate(text)
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
wordcloud.to_file("D:\\anaconda\\world bank reports\\2016 overview\\2016-WorldDevelopmentReport.png")

```

Figure 5 RPA Demonstration project codes-5 for chapter 2.2

```
#Convert report 2017 from PDF to txt and create wordcloud image
rmg1 = PDFResourceManager()
filename1 = os.path.join("D:\\anaconda\\world bank reports\\2017-WorldDevelopmentReport.pdf")
fout1 = open("D:\\anaconda\\world bank reports\\2017 overview\\2017-WorldDevelopmentReport.txt","wb")
conv1 = TextConverter(rmg1,fout1)
interpreter=PDFPageInterpreter(rmg1,conv1)
with open(filename1,"rb")as fin1:
    for page1 in PDFPage.get_pages(fin1):
        interpreter.process_page(page1)
fout1.close()

text = open("D:\\anaconda\\world bank reports\\2017 overview\\2017-WorldDevelopmentReport.txt",encoding="gb18030",errors= "ignore").read()
wordcloud = WordCloud().generate(text)
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
wordcloud.to_file("D:\\anaconda\\world bank reports\\2017 overview\\2017-WorldDevelopmentReport.png")

#Convert report 2018 from PDF to txt and create wordcloud image
rmg1 = PDFResourceManager()
filename1 = os.path.join("D:\\anaconda\\world bank reports\\2018-WorldDevelopmentReport.pdf")
fout1 = open("D:\\anaconda\\world bank reports\\2018 overview\\2018-WorldDevelopmentReport.txt","wb")
conv1 = TextConverter(rmg1,fout1)
interpreter=PDFPageInterpreter(rmg1,conv1)
with open(filename1,"rb")as fin1:
    for page1 in PDFPage.get_pages(fin1):
        interpreter.process_page(page1)
fout1.close()

text = open("D:\\anaconda\\world bank reports\\2018 overview\\2018-WorldDevelopmentReport.txt",encoding="gb18030",errors= "ignore").read()
wordcloud = WordCloud().generate(text)
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
wordcloud.to_file("D:\\anaconda\\world bank reports\\2018 overview\\2018-WorldDevelopmentReport.png")

#Convert report 2019 from PDF to txt and create wordcloud image
rmg1 = PDFResourceManager()
filename1 = os.path.join("D:\\anaconda\\world bank reports\\2019-WorldDevelopmentReport.pdf")
fout1 = open("D:\\anaconda\\world bank reports\\2019 overview\\2019-WorldDevelopmentReport.txt","wb")
conv1 = TextConverter(rmg1,fout1)
interpreter=PDFPageInterpreter(rmg1,conv1)
```

Figure 6 RPA Demonstration project codes-6 for chapter 2.2

```
with open(filename1,"rb")as fin1:
    for page1 in PDFPage.get_pages(fin1):
        interpreter.process_page(page1)
fout1.close()

text = open("D:\\anaconda\\world bank reports\\2019 overview\\2019-WorldDevelopmentReport.txt",encoding="gb18030",errors= "ignore").read()
wordcloud = WordCloud().generate(text)
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
wordcloud.to_file("D:\\anaconda\\world bank reports\\2019 overview\\2019-WorldDevelopmentReport.png")

# Create different font styles to be used in keywords report
document = Document()

UserStyle1 = document.styles.add_style('UserStyle1', 1)
UserStyle1.font.size = Pt(40)
UserStyle1.font.color.rgb = RGBColor(249, 226, 127)
UserStyle1.paragraph_format.alignment = WD_ALIGN_PARAGRAPH.CENTER

UserStyle2 = document.styles.add_style('UserStyle2', 1)
UserStyle2.font.size = Pt(40)
UserStyle2.font.color.rgb = RGBColor(170,221,108)
UserStyle2.paragraph_format.alignment = WD_ALIGN_PARAGRAPH.CENTER

UserStyle3 = document.styles.add_style('UserStyle3', 1)
UserStyle3.font.size = Pt(40)
UserStyle3.font.color.rgb = RGBColor(8, 175, 148)
UserStyle3.paragraph_format.alignment = WD_ALIGN_PARAGRAPH.CENTER

UserStyle4 = document.styles.add_style('UserStyle4', 1)
UserStyle4.font.size = Pt(40)
UserStyle4.font.color.rgb = RGBColor(8, 100, 170)
UserStyle4.paragraph_format.alignment = WD_ALIGN_PARAGRAPH.CENTER

UserStyle5 = document.styles.add_style('UserStyle5', 1)
UserStyle5.font.size = Pt(40)
UserStyle5.font.color.rgb = RGBColor(91, 189, 255)
UserStyle5.paragraph_format.alignment = WD_ALIGN_PARAGRAPH.CENTER

```

Figure 7 RPA Demonstration project codes-7 for chapter 2.2

```
#Add wordcloud keywords image into one word document
document.add_paragraph("Keywords 2015", style = UserStyle1 )
document.add_picture( "D:\\anaconda\\world bank reports\\2015 overview\\2015-WorldDevelopmentReport.png", width=Inches(6.0))
last_paragraph = document.paragraphs[-1]
last_paragraph.alignment = WD_ALIGN_PARAGRAPH.CENTER
document.add_page_break()

document.add_paragraph("Keywords 2016", style = UserStyle2 )
document.add_picture( "D:\\anaconda\\world bank reports\\2016 overview\\2016-WorldDevelopmentReport.png", width=Inches(6.0))
last_paragraph = document.paragraphs[-1]
last_paragraph.alignment = WD_ALIGN_PARAGRAPH.CENTER
document.add_page_break()

document.add_paragraph("Keywords 2017", style = UserStyle3 )
document.add_picture( "D:\\anaconda\\world bank reports\\2017 overview\\2017-WorldDevelopmentReport.png", width=Inches(6.0))
last_paragraph = document.paragraphs[-1]
last_paragraph.alignment = WD_ALIGN_PARAGRAPH.CENTER
document.add_page_break()

document.add_paragraph("Keywords 2018", style = UserStyle4 )
document.add_picture( "D:\\anaconda\\world bank reports\\2018 overview\\2018-WorldDevelopmentReport.png", width=Inches(6.0))
last_paragraph = document.paragraphs[-1]
last_paragraph.alignment = WD_ALIGN_PARAGRAPH.CENTER
document.add_page_break()

document.add_paragraph("Keywords 2019", style = UserStyle5 )
document.add_picture( "D:\\anaconda\\world bank reports\\2019 overview\\2019-WorldDevelopmentReport.png", width=Inches(6.0))
last_paragraph = document.paragraphs[-1]
last_paragraph.alignment = WD_ALIGN_PARAGRAPH.CENTER
document.add_page_break()

document.save("world development report 2015-2019-keywords.docx")

#Save the word document of keywords report into PDF form
word = win32com.client.Dispatch("Word.Application")
doc = word.Documents.Open(os.path.join("D:\\anaconda\\world development report 2015-2019-keywords.docx"))
doc.SaveAs("D:\\anaconda\\world development report 2015-2019-keywords.pdf", FileFormat=17)
doc.Close()
word.Quit()
```

```
#Create the email content for the keywords report
amail = MIMEMultipart()
amail['Subject'] = Header('Keywords of World development report 2015-2019')
amail.attach(MIMEText('Dear colleague,\n\n\n Please find the attatched keywords of world development report 2015-2019!\n\n\n Have a nice weekend : ) \n\n\n Best regards, \n\n\n

#Add the keywords report as the attacthment
with open('world development report 2015-2019-keywords.pdf', 'rb') as f:

    atc = MIMEApplication(open('world development report 2015-2019-keywords.pdf','rb').read())
    atc.add_header('Content-Disposition', 'attachment', filename='world development report 2015-2019-keywords.pdf')
    amail.attach(atc)

#Login to the email and send email
abc = smtplib.SMTP('smtp.gmail.com',587)
abc.starttls()
abc.login('innovative0business@gmail.com','922888txh')
abc.sendmail('innovative0business@gmail.com','tianxiaohan1993@gmail.com',
        amail.as_string())
abc.quit()
```

Figure 8 RPA Demonstration project codes-8 for chapter 2.2

Appendix B RPA case studies for chapter 2.3

Function areas	Case name	Case descriptions
Technical support	Uipath. (2018a). Use cases of RPA Facilitating IT process Transformation. https://www.uipath.com/blog/use-cases-it-transformation-rpa	The case describes how password reset request can be dealt with RPA solutions (Uipath, 2018c).
	Uipath. (2017). RPA Calls for a Mentality Shift in IT Services. https://www.uipath.com/blog/rpa-for-it-services	The case describes how RPA solutions can contribute to both end-user computing and enterprise computing (Uipath, 2017).
	Anywhere, A. (2017a). ACH in the cloud: Game-changing bots streamline operations and provide on-demand scaling. https://www.automationanywhere.com/images/casestudy/ACH_Banking_Case_Study.pdf	The case describes how RPA solutions can be applied in Automated clearing house and IT system updates. (Anywhere, 2017a)
	Robotic Process Automation： 6 real world use cases. https://thoughtonomy.com/wp-content/uploads/2017/09/White-Paper-Design-6-Use-Cases-Mid-Quality.pdf	This case describes that RPA solutions can be applied into the data validation, regular testing, diagnostics and fault remediation in the IT development process (Thoughtonomy, 2016).
Human resource	Mindfields. (2018a). Automation of Express HR for Employee Onboarding. https://www.mindfieldsglobal.com/automation-of-express-hr-for-employee-onboarding-0	This case describes how RPA solutions can be applied into employee on-boarding process (Mindfields, 2018e).
	Mindfields. (2018b). Automation of Success Factors for Workforce Management. https://www.mindfieldsglobal.com/automation-of-success-factors-for-workforce-management-0	This case describes how RPA solutions can be applied in workforce management (Mindfields, 2018g).
	Futurism. (2018). Robotic Process Automation (RPA) simpli es HR processes for a global MNC. https://www.futurismtechnologies.com/case study/rpa-hr-processes-for-a-global-mnc/	This case describes how RPA solutions can be applied in coping with some tasks in talent acquisition, employee data administration, employee experience and HR reporting and analytics (Futurism, 2018).
	EY. (2017). Using Robotic Process Automation to Transform Payroll Administration. http://gpminstitute.com/publications-resources/Global-Payroll-Magazine/july-2017-issue/using-robotic-process-automation-to-transform-payroll-administration	This case describes how RPA solutions can be applied in payroll administration (EY, 2017).
Marketing& sales	Infosys. (2018b). Robots deliver savings in the Trade promotions process of a leading consumer packaged goods company. https://www.infosysbpm.com/offerings/functions/robotics-process-automation/case-studies/Documents/robots-deliver-savings.pdf	This case describes how RPA solutions can be applied in trade promotion management (Infosys, 2018b).
	Mindfields. (2018c). Automation of Salesforce Interactions with multiple Social Media platforms. https://www.mindfieldsglobal.com/rpa-case-study-automating-salesforce-interactions-with-multiple-social-media-platforms	This case describes how RPA solutions can be applied into capturing sales leads from various Ibsites in sales activities (Mindfields, 2018f).
	Blueprism. (2018b). Blue Prism Software supports Shop Dwasct Product Launch.	This case describes how RPA solutions can be applied into launching new products (Blueprism, 2018b).

	https://www.blueprism.com/uploads/resources/case-studies/shopdwasct-product-launch-case-study.pdf	
	Mindfields. (2018d). Product management services in legacy systems https://www.mindfieldsglobal.com/product-management-services-in-legacy-systems	This case describes how RPA solutions can be applied in product management process (Mindfields, 2018c).
Finance	Infosys. (2018a). Robotic Process Automation (RPA) simplifies insurance process for a leading developer of solutions and services in the insurance and financial services industry. https://www.infosysbpm.com/offerings/functions/robotics-process-automation/case-studies/Documents/rpa-simplifies-insurance-processes.pdf	This case describes how RPA solutions can be applied into financial processes such as, payments, withdrawal and surrender (Infosys, 2018a).
	Uipath. (2018b). RPA continues to accerlerate finance and accounting transformation. https://www.uipath.com/blog/finance-accounting-transformation-rpa	This case describes how RPA solutions can be applied into accounting process such as invoice processing (Uipath, 2018b).
	Automating Report Generation Process of Multiple Spreadsheets. Mindfields. (2018e). Automating Report Generation Process for Multiple Spredsheets. https://www.mindfieldsglobal.com/rpacasestudy-automating-report-generation-process	This case describes how RPA solutions can be applied into generating profit & loss reports (Mindfields, 2018b).
	Anywhere, A. (2017b). Disrupting an Industry: RPA Differentiates Leading global marketing services provider from the Pack. https://www.automationanywhere.com/images/casestudy/CaseStudyQuadGraphics.pdf	This case describes how RPA solutions can be applied into generating billing reports, reconciliations (Anywhere, 2017b).
	Anywhere, A. (2016a). Automating F&A processes takes a trucking company the extra mile. https://www.automationanywhere.com/images/casestudy/Genpact_trucking_logistics.pdf	This case describes how RPA solutions can be applied into billing and the relating tracking process. (Anywhere, 2016a)
Supply chain	Anywhere, A. (2016b). Picture-perfect Purchase Order Fulfillment: A human-robot partnership story. https://www.automationanywhere.com/images/casestudy/Genpact_picture_perfect.pdf	This case describes how RPA solutions can be applied into purchase order fulfillment process (Anywhere, 2016b).
	Anywhere, A. (2018a). Next Gen Billing Portal: RPA helps a technology pioneer deliver more value by introducing a Digital Workforce. https://www.automationanywhere.com/images/casestudy/Case-Study-Juniper.pdf	This case describes how RPA solutions can be applied into invoice to cash process (Anywhere, 2018a).
	Mindfields. (2018e). Automating Supplier Invoices. https://www.mindfieldsglobal.com/automating-supplier-invoices	This case describes how RPA solutions can be applied into automating supplier invoices (Mindfields, 2018d).
	Anywhere, A. (2018b). Rapid ROI from RPA: Synergy automates billing to realize significant value. https://www.automationanywhere.com/images/casestudy/Case-Study-Synergy.pdf	This case describes how RPA solutions can be applied into Procure to pay (Anywhere, 2018b).
	Mindfileds. (2018f). Automating salesforce data entry and validation for a global bank https://www.mindfieldsglobal.com/rpa-case-study-automating-salesforce-data-entry-and-validation	This case describes how RPA solutions can be applied into the order fulfilling process in its data entry and validation (Mindfields, 2018c).
	Uipath. (2018c). Benefits and Impact of RPA for Supply Chain Management.	This case describes how RPA solutions can be applied into shipment status communication (Uipath, 2018a).

	https://www.uipath.com/blog/rpa-the-glue-for-supply-chain-management.	
Customer services	Mindfields. (2018g). Automating Patient Receipting. https://www.mindfieldsglobal.com/automating-patient-receipting-0	This case describes how RPA solutions can be applied into automating patient receipting (Mindfields, 2018a).
	Mindfields. (2018h). User account management. https://www.mindfieldsglobal.com/user-account-management	This case describes how RPA solutions can be applied into automating user account management (Mindfields, 2018i).
	Mindfields. (2018i). Request Management services in legacy and multiple systems. https://www.mindfieldsglobal.com/request-management-services-in-legacy-and-multiple-systems	This case describes how RPA solutions can be applied into handling to customer requests (Mindfields, 2018h).
	Mindfileds. (2018j). Managing portal information through legacy systems. https://www.mindfieldsglobal.com/managing-portal-information-through-legacy-systems.	This case describes how RPA solutions can be applied in validating customer information in legacy portals (Mindfileds, 2018c).
	Mindfileds. (2018k). Validating data from various internal and external sources. https://www.mindfieldsglobal.com/validating-data-from-various-internal-and-external-sources	This case describes how RPA solutions can be applied in validating customer information both in external and internal sources (Mindfileds, 2018e).
	Mindfileds. (2018h). Payment request services in legacy systems. https://www.mindfieldsglobal.com/payment-request-services-in-legacy-an-multiple-systems	This case describes how RPA solutions can be applied in automating handling customer payment requests (Mindfileds, 2018d).
	Blueprism. (2018a). Blueprism drives efficiencies at the co-operative bank. https://www.blueprism.com/uploads/resources/case-studies/blue-prism-coop-bank-manual-efficiency-case-study.pdf	This case describes how RPA solutions can be applied in automating customer account closure (Blueprism, 2018a).
	Mindfileds. (2018i). Automation of Salesforce for Customer Services. https://www.mindfieldsglobal.com/automation-of-salesforce-for-customer-services-0	This case describes how RPA solutions can be applied in loan statement request (Mindfileds, 2018a).
	Mindfileds. (2018j). Automation of salesforce for customer statements https://www.mindfieldsglobal.com/automation-of-salesforce-for-customer-statements-0	This case describes how RPA solutions can be applied in customer payment statement (Mindfileds, 2018b).

Survey questions in English

Survey title: Investigating the factors that affect the perception of RPA and intention to use RPA among RPA users.

Survey background:

This survey is conducted by Tokyo Institute of Technology, Iijima Lab, Phd candidate, Xiaohan Tian. And the purpose is to investigate the factors that affect the perception of RPA and intention to use RPA among RPA users. According to your using experience of RPA, in the following questions given specific topic about RPA, please tell us your opinion by rating the agreement levels from 1 ~7.

The survey will take about 15 mins,

This section is to collect Demographic information,

1. Please specify your industry,

   Finance/ Manufacturing/Insurance/ Public sectors/Retail/ BPO/others

2. Please specify your age:

3. Please specify your gender,

   Male/ Female

4. Please specify your division:

5. Please specify your position,

   Management position/ employee

6. Please specify the number of employees of your organization,

   0~10/ 10~50 /50+ ~ 300/300~1000/1000+

This section is about a shared vision of RPA application in your organization,

To what degree do you agree with the following statements,

7. The leadership of the company shares a common vision of the RPA application's future.

   Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

8. Our unit shares the same ambition and vision with other units on RPA application.

   Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

9. I agree on the RPA application is important for our organization.

   Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

10. In RPA application, people on our unit are enthusiastic about pursuing the collective goals and missions of the whole organization.

    Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

This section is about the RPA user participation

To what degree do you agree with the following statements,

11. I am clear about my responsibility in RPA application.

    Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

12. I am clear about my colleague's responsibility in RPA application.

Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

13. I am clear about how to make changes when exceptions occur in RPA application.

Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

This section is about the RPA user involvement,

After using RPA, I am clear that using RPA is ~ (to finish my previous task)

14. Extremely essential (1) ~Neither essential nor nonessential (4) ~ Extremely nonessential (7)
15. Extremely fundamental (1) ~Neither fundamental nor trivial (4) ~Extremely trivial (7)
16. Extremely significant (1) ~Neither significant nor insignificant (4) ~ Extremely insignificant (7)

This section is about the perception of RPA,

To what degree do you agree with the following statements,

- Perception of Relative advantage

17. I can perceive that RPA can enhance my effectiveness to do my job.

Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

18. I can perceive that RPA can make it easier for me to do my job.

Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

19. I can perceive that RPA can give me greater control to do my job.

Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

- Perception of Ease of use

20. I can perceive that RPA can be mastered with acceptable effort.

Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

21. I can perceive that RPA can be controlled to do whatever I want it to do.

Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

22. I can perceive that my interaction with RPA can be easy and manageable.

Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

- Perception of Compatibility

23. I can perceive that RPA fits into my current work style.

Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

24. I can perceive that I do not need to alter much about my current work style.

    Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

25. I can perceive that RPA can be integrated with the current way that I work.

    Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

This part is about the intention to use RPA,

To what degree do you agree with the following statements,

26. I intend to continue using RPA in the future.

    Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

27. I intend to use RPA more frequently in the future.

    Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

28. I will recommend RPA to others.

    Extremely disagree (1) ~ Neither agree nor disagree (4) ~ Extremely agree (7)

Survey questions in Chinese

问卷主题：在 RPA 用户中，对 RPA 的认知及使用意愿影响因素的相关调查

问卷背景：

本调查是由东京工业大学，饭岛实验室，博士候选人，田潇涵发起。目的是对 RPA 认知及使用意愿的影响因素进行调查研究。请根据你的 RPA 使用体验，在以下对 RPA 相关的问题当中，用 1-7 几个等级来表达你对问题描述的认同程度，

本调查的填写大概需要花费 15 分钟，

此部分是为收集用户信息，

1. 请选择你的行业，

   金融业/ 制造业/保险业/ 公共事业/零售业/ 商业流程外包业/其他

2. 请填写你的年龄:

3. 请选择你的性别,

   男性/女性

4. 请填写你的部门:

5. 请填写你的职务,

   管理职/普通职员

6. 请选择你公司的规模,

   0~10/ 10~50 /50+ ~ 300/300~1000/1000+

此部分是用于调查贵公司对于 RPA 使用的共同愿景,

多大程度上，你同意以下表述,

7. 公司管理层对于 RPA 使用的未来有着一致的共同愿景.

   非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

8. 我们部门和其他部门对于 RPA 的使用有一致的愿景.

   非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

9. 我们同意 RPA 对于我们公司非常重要。

   非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

10. 在 RPA 运用中，我们部门的人非常热衷于协助完成公司制定的共同目标。

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

此部分是用于调查贵公司 RPA 用户的参与度

多大程度上，你同意以下表述,

11. 我对于自己在 RPA 运用中的职责非常清楚，

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

12. 我对于同事在 RPA 运用中的职责非常清楚，

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

13. 我非常清楚如何处理在 RPA 运用中的突发事件，

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

此部分是用于调查贵公司 RPA 用户的投入度

使用RPA之后，我非常清楚RPA是~ (来帮助我完成之前的工作)

14. 非常有必要的(1) ~很难说(4) ~ 非常不必要的 (7)
15. 非常基本的(1) ~很难说(4) ~非常多余的(7)
16. 意义非常重大(1) ~很难说 (4) ~ 完全没有意义(7)

此部分是用于调查贵公司 RPA 用户对于 RPA 的认知

多大程度上，你同意以下表述，

- RPA 的相对优势

17. 我能感受到 RPA 提高了我的工作效率。

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

18. 我能感受到 RPA 让我的工作变轻松了。

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

19. 我能感受到 RPA 让我更好的掌控了我的工作。

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

- RPA 的易于使用程度

20. 我能感受到 RPA 的运用可以被轻易掌握。

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

21. 我能感受到 RPA 可以被随心所欲使用。

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

22. 我能感受到自己与 RPA 的互动非常流畅及易于管理。

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

- RPA 的兼容度

23. 我能感受到 RPA 可以兼容于我现有的工作方式。

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

24. 我能感受到使用 RPA 不需要改变太多我现有的工作方式。

    非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

25. 我能感受到 RPA 可以被整合到我现有的工作方式中。

非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

此部分是用于调查贵公司 RPA 用户对于 RPA 的使用意愿

多大程度上，你同意以下表述，

26. 我倾向于在未来的工作中继续使用 RPA。

非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

27. 我倾向于在未来的工作中更频繁地使用 RPA。

非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

28. 我会把 RPA 推荐给其他人。

非常不同意 (1) ~ 很难说 (4) ~ 非常同意 (7)

Appendix C Interview data for chapter 5.3 and chapter 6.3

Case 1 Customer inquiry reply (Credit card fraud investigation)-Bank

Process description:

A client calls the customer center of a bank to report for that he or she became a victim of a credit card fraud. The staff makes a record about this case and saves the case into the database. Then, staff from the customer center contact the card swiping place that was reported as the credit card fraud and ask for the payment information. And then the staff saved the payment information into database. RPA then collects this payment information and send it to the client by email.

A: Xiaohan Tian

B1: Project manager

B2: Software engineer

A: Hi! I would like to ask that do you guys found it easy and clear to use the extended DEMO methodology when you Was creating construction model and process model?

B1: Ill, for me, I found it easy to use. If you just follow the steps, it is easy to create a construction model.

As for process model, since it follows the process flow, the only difference is that it adds some acts, so based on the established construction model, it was not difficult for me to create the process model.

B2: I think maybe because of the language issue. Sometimes it was a bit challenging to understand the content of some steps. However, according to my understanding, I tried to build up a construction model and then the process model.

A：Could you give me some specific examples, when you guys Was creating construction model and process model, what kind of problems did you encounter with? And did you find some relative advantage of process model and construction model?

B1: I personally like the classification of human being capability, Performa, Informa and Forma a lot. I think it is quite concise and understandable to identify the capabilities performed in the process in a standardized way. And I think the most importance for this

classification is not just to introduce a new concept of a classification. It also gives some hints as a guidance. For companies, if RPA is deployed to enhance the capability of informa and forma and then deal with certain tasks, how to optimize employee's performa capability becomes the key. Similarly, since process model is somehow related to flow chart, but here four acts are provided, which is quite refresh. Base on this, the different human capabilities are also illustrated in the model. I think it can help with the process optimization and show how RPA facilitates employees to complete their works. A more concrete understanding can be created by the process model.

B2: For me, the largest problem that I encountered with was the classification. Since I am working as a software engineer, every time when I am coding, the conditions for making each judgement have to be very specific and clear. If not so, the program cannot function Ill. However, when I was dealing with the classification of human capabilities, sometimes I found it confusing, which made me a bit hesitating to make the decision. The easiest thing was probably to identify forma, since you can easily tell if the information content is changed or not. But differentiating informa and performa was quite challenging. And it also applies to process model, sometimes I did not think there exist perfect match between the actual actions and the four acts. And my question is that, if this is the case, what am I supposed to do in order to build up the relating process model.

A: After comparing your models with my models, do you guys have any problems or comments?

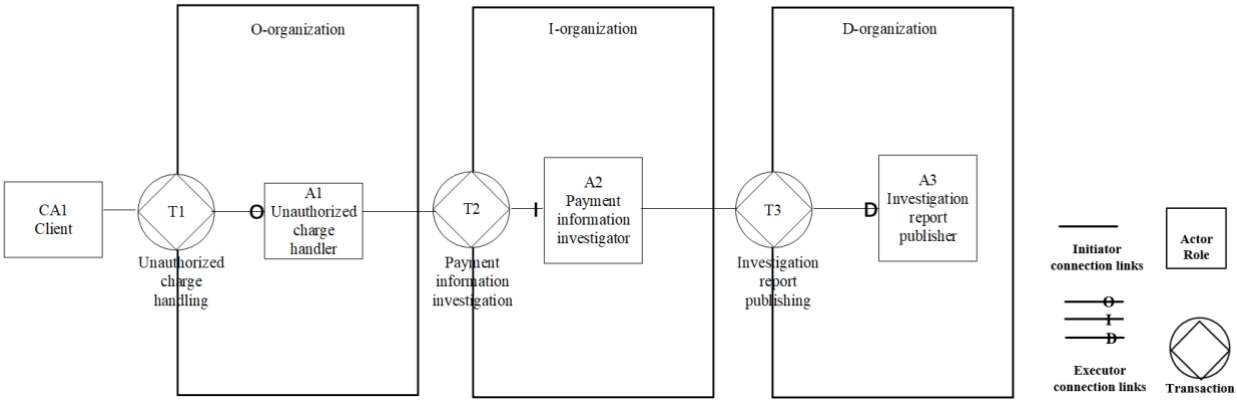

Figure 1 Construction model of credit card fraud investigation (Created by Xiaohan Tian)

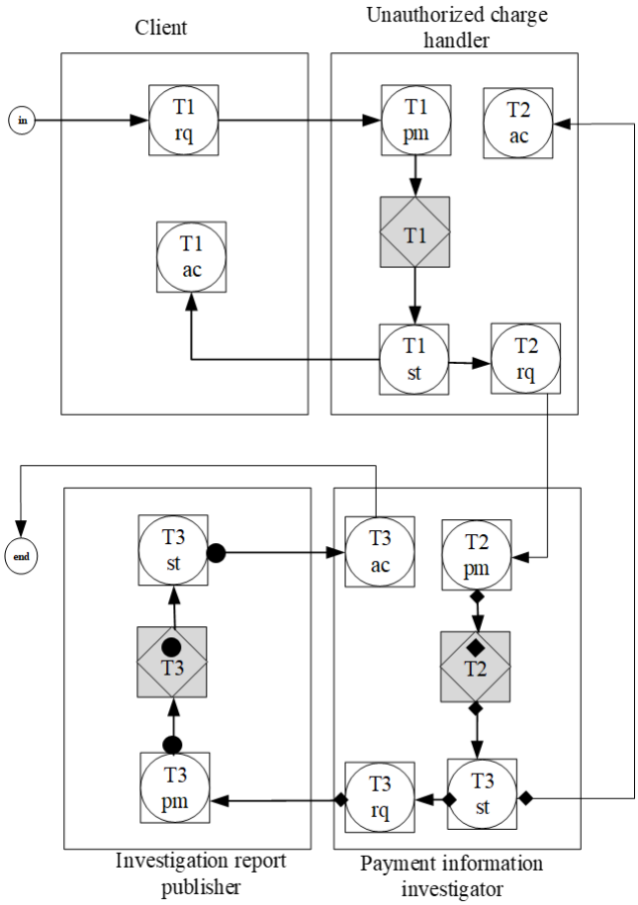

Figure 2 Process model of credit card fraud investigation (Created by Xiaohan Tian)

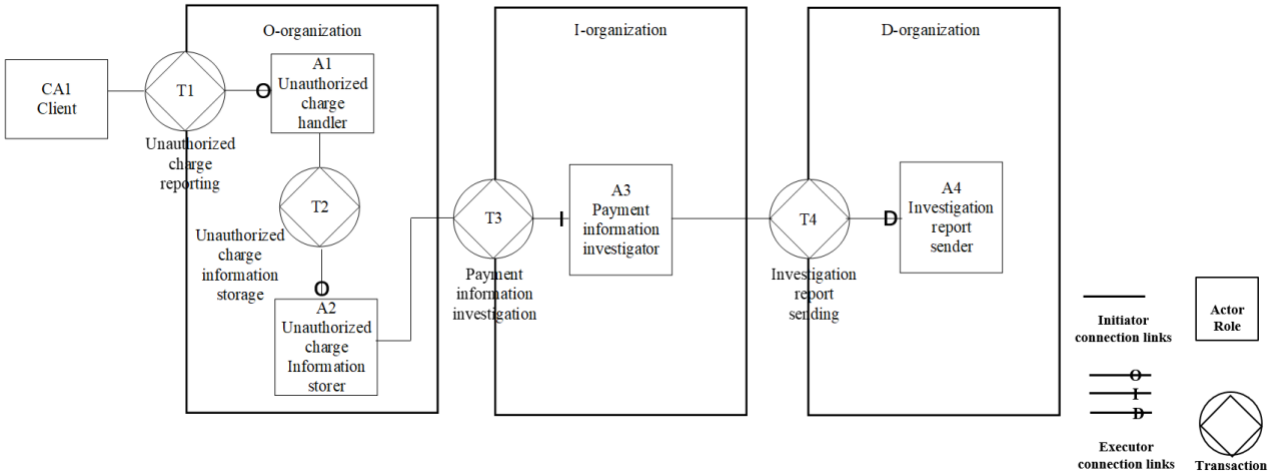

Figure 3 Construction model of credit card fraud investigation (Created by B1)

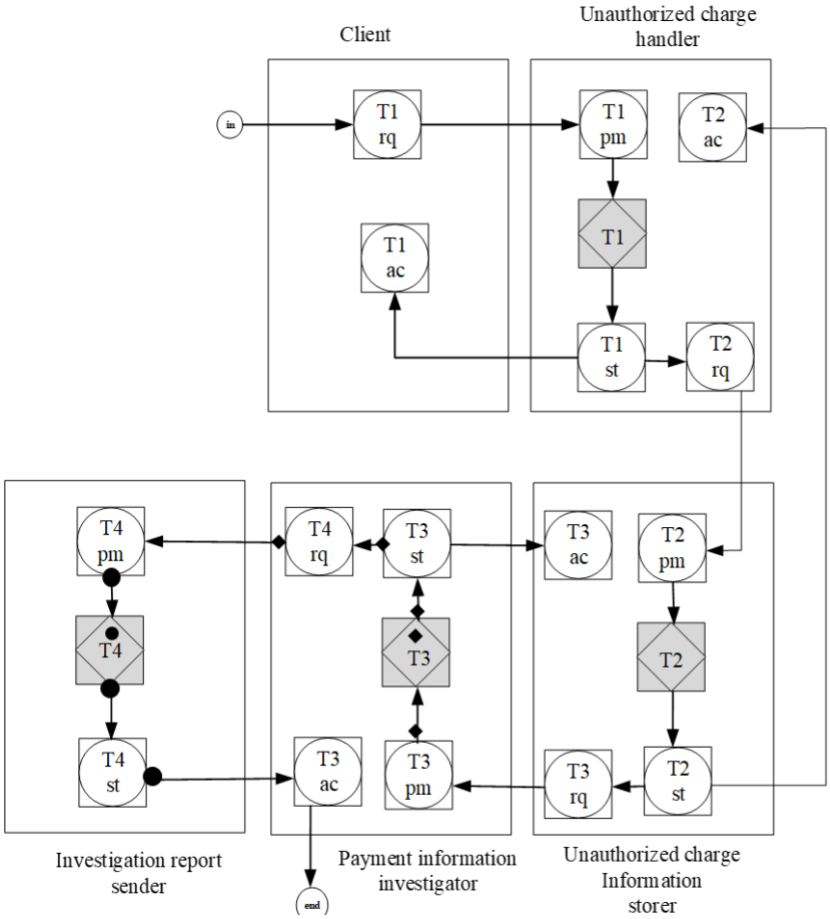

Figure 4 Construction model of credit card fraud investigation (Created by B2)

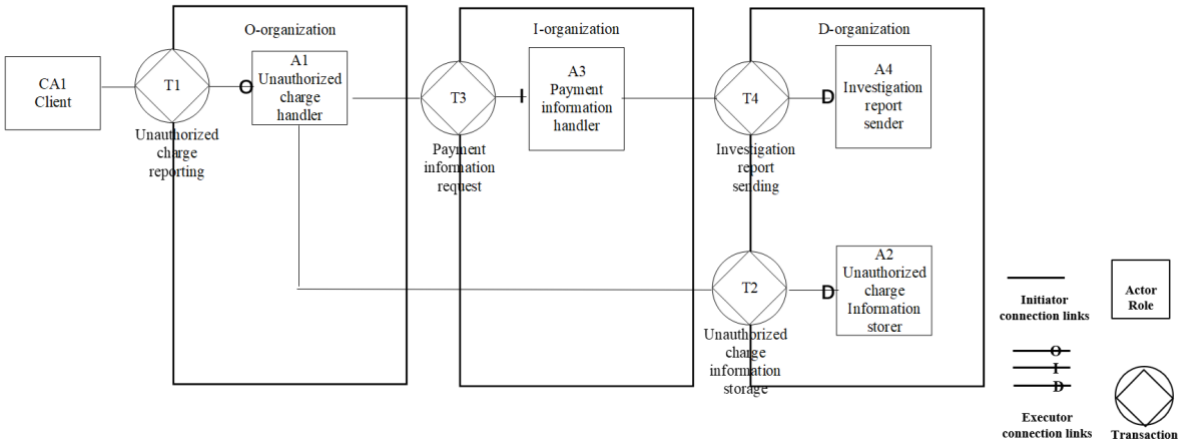

Figure 5 Construction model of credit card fraud investigation (Created by B2)

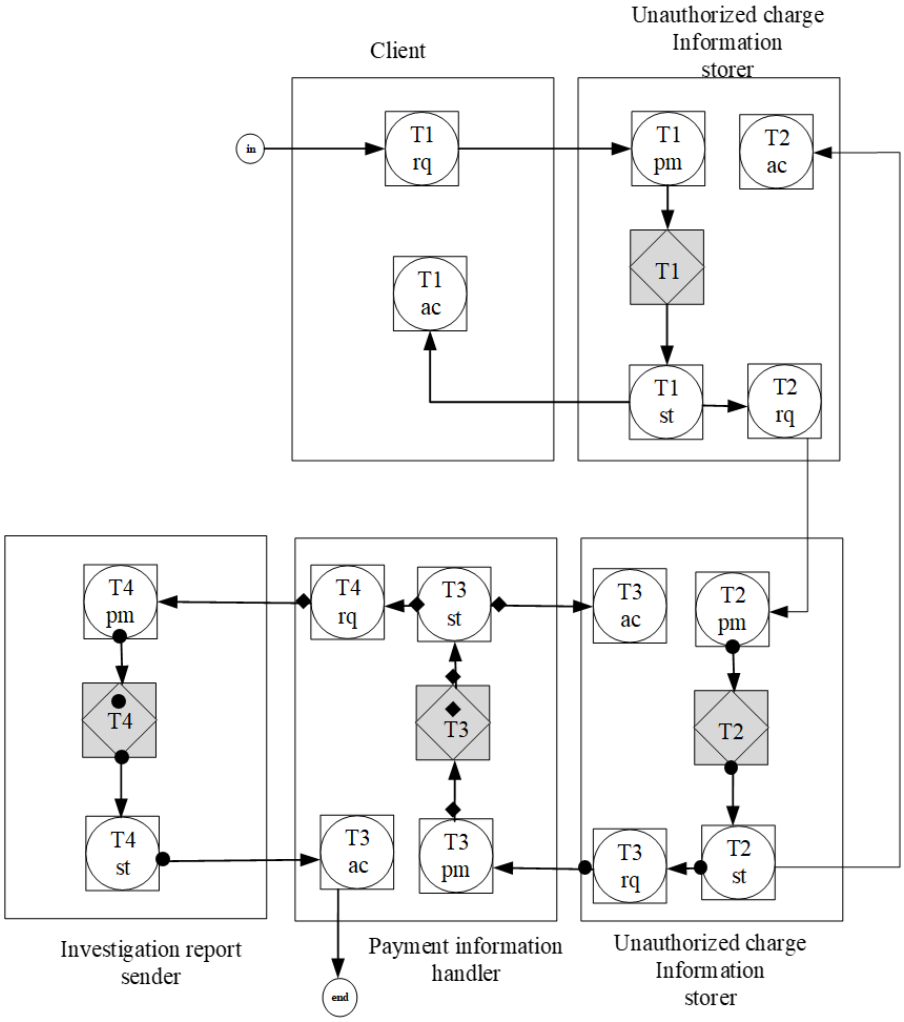

Figure 6 Process model of credit card fraud investigation (Created by B2)

B1: I noticed that our classifications of transactions are different, can you elaborate more on

that? Your way of classification.

B2: Yeah, I have one more transaction than you as Ill. So, I must be different in the classification of human capabilities.

A: Okay, let me explain the different parts. I noticed that both of you two separate data storage as a single transaction.。It is true that data storage is one step in the process, but my first transaction actually includes the data storage activity. When I defined the first transaction, from the phone call taking to the data storage, I considered them as one responsibility unit. And the following investigation is the other responsibility unit. Since the purpose of construction model is to provide the most abstract model, so I should try to avoid the redundancy and meet this goal. Do you think my explanation make sense?

B1,B2: Sounds reasonable, if so, next time when I create DEMO models, I would pay special attention to this abstraction issue.

A: Then, I found that it seems that you guys have different opinions about the original capability human beings. Although both of you two have one separated transaction called data storage, one of you count it as performing performa and the other one counted it in forma. The problem here is that, it is true that different process may have different interpretations about performa. Let me introduce one way here. If one action can be coded and then realized completely by technology, then it is definitely not an original human behavior. Conversely, in different cases, if every time it has to be handled by human since no code can be synthesized, then it can be considered not original. It must be resolved by human workers. So, for the data storage in your case, this action is supposed to be identified as performing forma capability for two reasons, first it can be coded, second no information

content is changed. However, in my first transaction, it simply considers the action of data storage as one process step of "execution". In addition to that, the handling cannot be simply coded, instead, it is handled case by case. Therefore, eventually I considered this transaction as performing Performa.

B1,B2: So, following your explanation, somehow I can understand your reasoning process of creating construction model and feel deeper connections between Process model and Construction model. Then the Process model can be generated accordingly.

A: Correct, in the case of your company, the process model doesn't show much special points. It works like, when one transaction is closed (accept), the next transaction would then start.

A： So, after the creation of construction model and process model, what kind of impacts do you think that it may bring to the RPA application?

B1: I feel like comparing with the normal flowcharts, the creation of construction model can give me a general understanding about the process. And although I did not perfectly apply the approach, after the your explanation of the differences made by us, I feel like now I are sharing the same aim for the RPA future application.

On the other hand, I bet my boss would love Construction model, since Before I start to dig deep into the process details and make report to him, I can have a big picture at hand and show him in a few minutes. Then, for me, I found it quite fresh and useful for the "responsibility" concept introduced by Construction model. Especially in the application of RPA, sometimes people are quite confused about the name of RPA, since it represents

robotic process automation, does it mean the robot will do my work and I can just play at office? So, in this sense, when apply for RPA, by introducing and emphasizing the concept of "responsibility", it can help deepening people's understanding to RPA. A key point here is that, it seems like that RPA can replace some of your repetitive and tedious work, but you are still the only person who should be responsible for these jobs. For instance, if RPA input or output something unexpected, human workers must give on-time response, instead of letting this exception be expanded and wider range of loss might be caused in this case. Understanding of RPA like this seems to be very basic and simple, since machine would never be responsible for anything. However, it is still very significant to help employees build up this shared understanding in the very beginning. And I really like the idea of capability classification in the construction model, because I think it no just makes employees restart to think about their core competitiveness and put more efforts on that, but also give them directions for the future growth.

For me, process model provides the emphasize of coordination between different actor roles. Although the coordination is simply synthesized into four acts, these four acts are quite representative in my opinion. Especially in the RPA application, emphasizing how human workers can better coordinate with RPA is important. After all, RPA is expected to become ally of human workers instead of competitors. That's the original purpose of introducing RPA to organizations.

B2: Although I did have some problems in the modeling process, but I agree that, in the beginning of RPA application, construction model can make people feel more comfortable and

confident to accept RPA. As far as I know, due to the lack of shared understanding of RPA application, people may have some extreme recognition of RPA. Someone think they are free from their jobs and there is nothing that they need to pay attention to. And the others think that they will be fired soon once they RPA shows excellence in many aspects. So, in order to save their jobs, they showed negative attitudes to RPA application. I think both of them do not have enough motivation to coordinate with RPA and deliver better performance.

And if the process model can be Ill generated, I agree that the four acts are quite representative. By introducing a set of formal concepts to show the aspect of coordination, flow chart can be strongly supported.

A: For the creation methodology of construction model and process model, do you have any other suggestions and comments?

B1: I like DEMO methodology a lot for making me get to know these two aspects. One is the classification of human capabilities, and the other is the separation of responsibility. I hope to use this methodology for a few more times so master it better in the future.

B2: It is quite interesting to me as Ill since I have never used some modeling methodology like this before. Although I ran into some issues in the modelling process, it was just these issues that make me rethink about the process. Previously, for the flow charts, it was just step by step, nothing so special, everything just happens so naturally. In this sense, DEMO is a very powerful tool to the flowchart mindset. It is supplementary and complementary. As for the suggestion, it is related to the issue that I just mentioned. I think when the company starts to use DEMO, according to the specific case, it should determine the classification criteria for the human

capabilities and the acts in the process model. If so, in the following steps, the modelling can be realized in a standardized way.

A: I think you just made a very good point. Actually, in DEMO methodology sets, I have two more methodologies. One is called Action model, and it is to model the action rules of the actor roles. And the other is called State model, it is to model the state space of the production. And these two methods can help with the standardization of the process modeling. I can introduce them to you if there will be any opportunity.

Case 2 weekly report generation – Fund company

Process description: RPA scraps online data from specific websites and calculate the required indexes and then save the data into database. RPA invites analyst to send their weekly reports every Friday. RPA capture required data from the reports and save the data into data base. Then RPA make the reports by inserting data into report template and send emails to the employees.

A: Xiaohan Tian

B1: Software engineer

B2: Software engineer

A: Hi! I would like to ask that do you guys found it easy and clear to use the extended DEMO methodology when you Was creating construction model and process model?

B1: I did not have any major problems, and my final models are quite concise and understandable.

B2: For me, the methodology itself is easy to understand and to use. But I guess that maybe one of the reasons for this is that, each of the RPA process has a very clear process description and established flow chart. And these materials enable us to share a common understanding about each process. Therefore, when I was using DEMO methodology, due to my comprehensive understanding to the process itself, I did not hesitate that much to implement each step.

A：Could you give me some specific examples, when you guys Was creating construction model and process model, what kind of problems did you encounter with? And did you find some relative advantage of process model and construction model?

B1: My biggest struggle was to differentiate the transaction from the steps in the flowcharts. According to my understanding, they are quite different, right? I feel like transaction tries to represent one responsibility unit, instead of one step in the flow chart. And this responsibility unit certainly include several steps and therefore the one transaction is more abstract. However, since in the subconscious, I am too familiar with everything of flowchart. Every time when I try to define one transaction, I need to get rid of that established mindset first. The other thing that I did pay attention to is the actor roles. Once the actor roles Was defined accordingly, I feel like the responsibility distribution becomes clear.

B2: My struggle was kind of similar. Previously, all the models that I built Was kind of related to flow chart, inertia thinking has been established, like step by step following the process flow and build the model. So how to avoid the impact from this thinking was a bit challenging. Take one specific example, when I was identifying the transactions, I did that for several times to confirm there Was no overlaps betIen different responsibility unit. And once the transactions Was confirmed, a concise and clear skeleton was also shown. And here my understanding is that, although you can then easily determine the relating actor roles, special attention is still needed. Because here, you are not separating one employee to the other. And as far as I understood, one employee can play as several actor roles, which means that he or she might be assigned with several responsibility units.

A： Yeah, your understanding is correct. In order to emphasize the responsibility assigned to employees, DEMO differentiates different executors from each other. In practice, one employee usually has a set of responsibility. DEMO makes this setting be clearer, which can contribute to the implementation of managerial decisions that constitute the predefined visions set up by managers.

B1： I have one question for process model. Except for these four acts, would it be possible for us to create other acts in the very beginning Because I think these four acts are not enough. Obviously, it may occur the situation of rejection. So, an act of reject is necessary.

A： Let me explain about this a bit. So, in the original DEMO modeling methodology, it does include some of the other acts, including reject. Here, what I provided to you guys can be counted as one ideal case of process and therefore it only includes four acts. HoIver, since DEMO is still evolving, I think maybe in the future new acts will be proposed.

B2： Yeah, although I did not consider about the case of “reject”, I was a bit struggling when I tried to map specific action into these four acts. Sometimes, I think the actions cannot be simply concluded as any one of the four acts. But sure, I agree that these four acts are quite representative. They provided a way to describe the coordination in a process by an abstract way.

A: After comparing your models with my models, do you guys have any problems or comments?

B1: I noticed that our classification of the transactions is almost the same. But it seems that I have some different ideas about the classification of actor roles. Could you please explain a bit more about that?

B2: I have the same question. Can you briefly talk about your reasoning process?

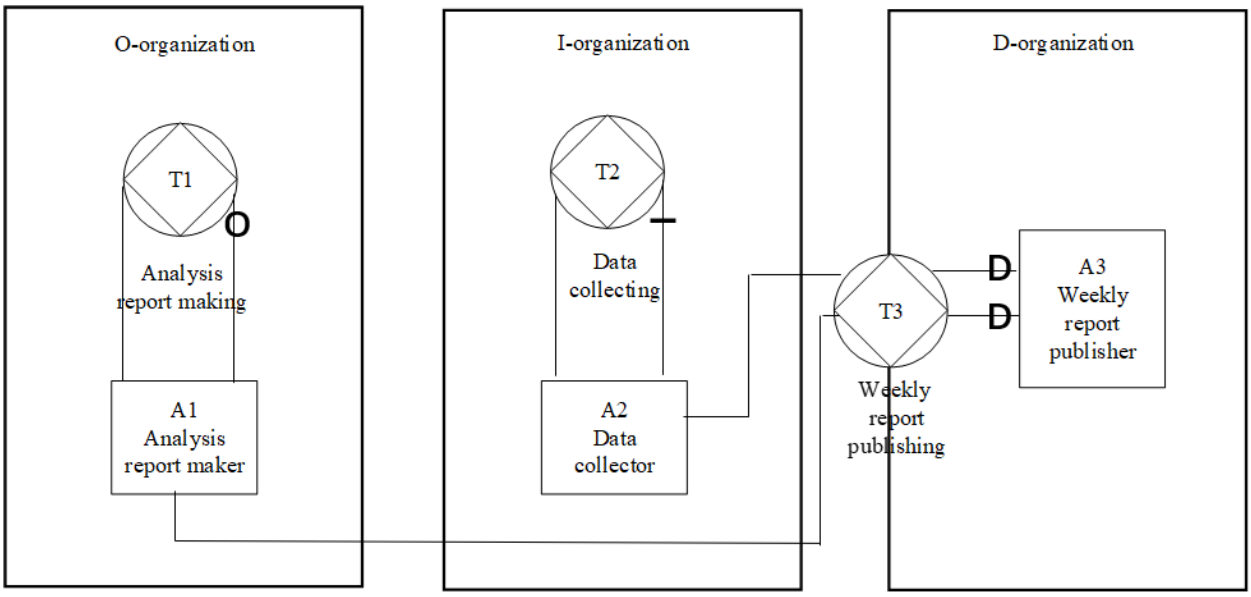

Figure 7 Construction model of weekly report generation (Created by Xiaohan Tian)

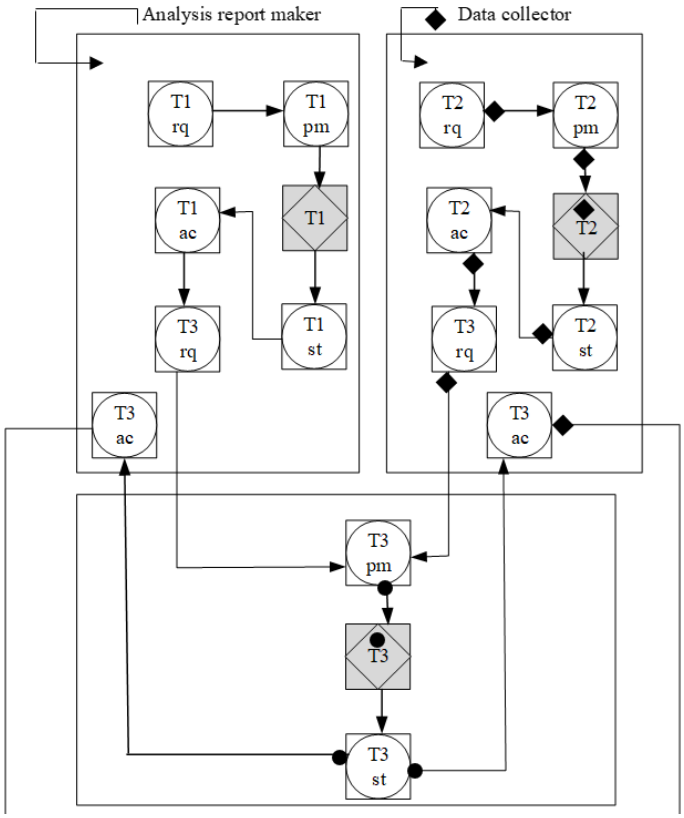

Figure 8 Process model of weekly report generation (Created by Xiaohan Tian)

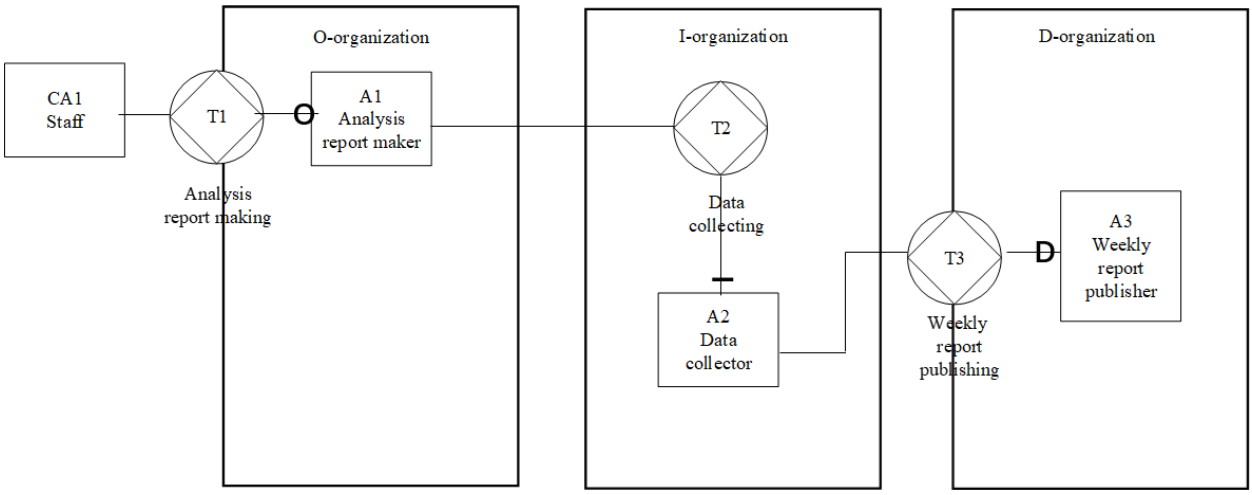

Figure 9 Construction model of weekly report generation (Created by B1)

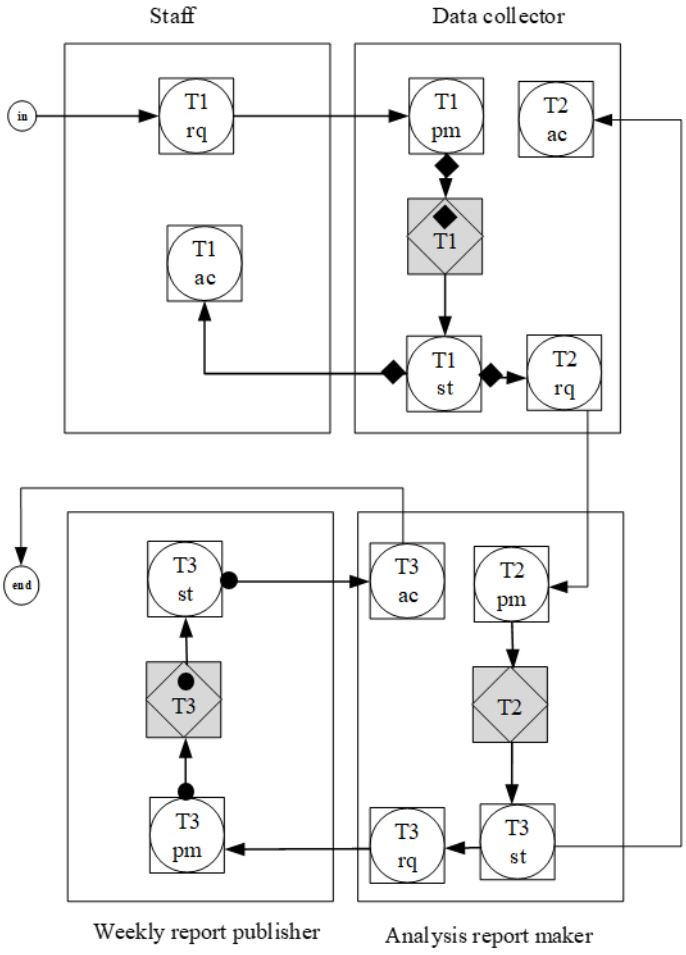

Figure 10 Process model of weekly report generation (Created by B1)

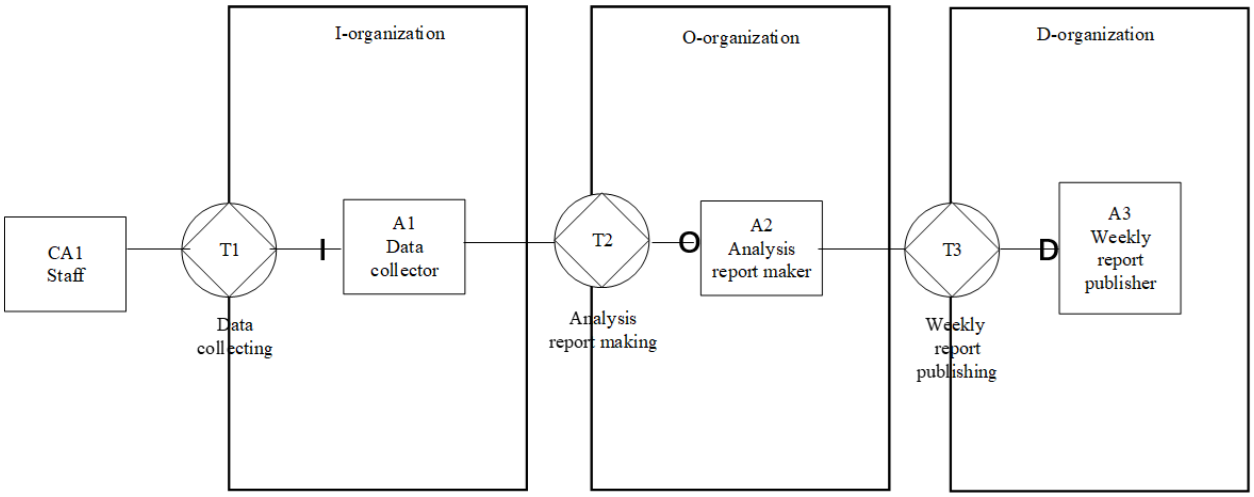

Figure 11 Construction model of Iekly report generation (Created by B2)

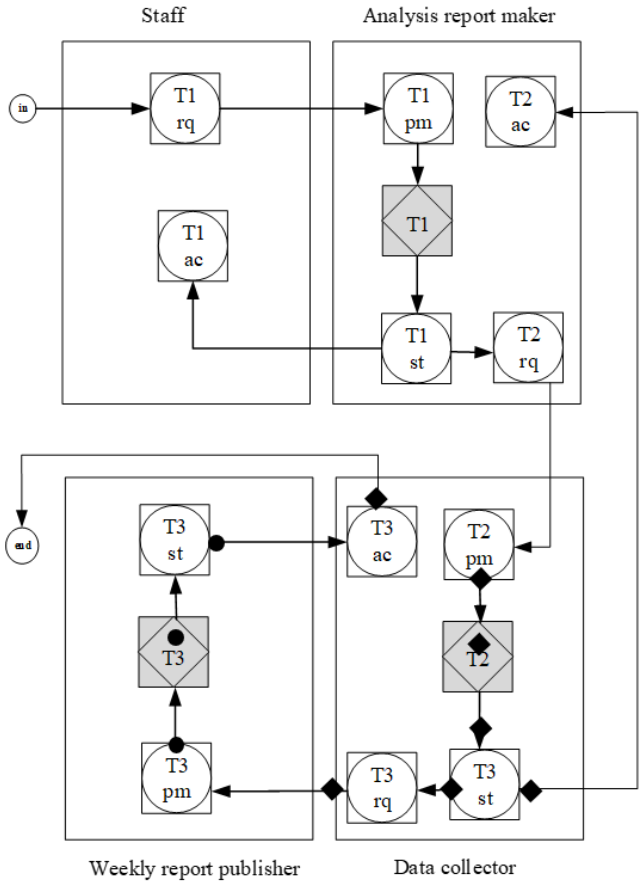

Figure 12 Process model of Iekly report generation (Created by B2)

A： Yeah, sure. Let me start with the construction model. I noticed that, for B1, in your construction model, initiators for transaction 1 and transaction 2 are staff and report maker, respectively. But actually, for transaction 1, the responsibility scope of report maker and staff overlaps. In this transaction, report maker self-activated the transaction. Then, for transaction 2, the action of RPA to remind analyst to send report might get you a bit confused. For data collecting action itself, RPA was set up to send the reminder and therefore the whole transaction is also self-activated. For B2, I am not going to repeat the same explanation. But I would like to talk about the issue that you put i-organization in front of the o-organization. I feel like you Was impacted by the flowchart thinking. Even though data collecting happens before the report making, according to the DEMO methodology, I consider about the o-organization and illustrate it first and then followed by i-organization and d-organization.

Then, let me explain about the relating process model. Since both in transaction 1 and 2, self-activations exist. Accordingly, the process steps should be included in the actor roles as Ill. Similarly, the activation of transaction 3 is supposed to be wait until the close of transaction 1 and 2, in RPA application, this situation may also happen to human workers and the illustration of self-activation in process model encourages employees to do this if required.

B1: Sounds reasonable, it makes sense that if considering about the responsibility distribution, transaction 1 and 2 are supposed to be self-activated.

B2: I can understand the self-activation point. But if you talk about the process model, it is quite confusing. How to make request to itself and then make the promise. How to better understand the self-activation in process model?

A: I think you can understand like this, first of all, you don't have to be trapped into the word meaning. For instance, in transaction 1, you can understand like, you make yourself clear about the task that you need to do (request), then you prepare to do the task (promise) then you do the task(execution), and check the task result (state) and then decide whether the result is fine(accept). Make sense?

B2: hmm, somehow it works. Maybe I need model more process and then I can get the DEMO sense.

So, after the creation of construction model and process model, what kind of impacts do you think that it may bring to the RPA application?

B1: I think it will improve the promotion of RPA application. Since now in our company, the RPA application is still in trial, now it is not widely used in many departments. In this sense I think Construction Model can provide a shared vision to the managers of other departments in the first place, you know, by using a simple but a classic way to tell them what exactly RPA is . Also, the consulting company just provided a full-track solution. The employees are still a bit confused and not to mention the name of RPA can easily get people confused. Most people thought there would be one physical robot join the office. So, in this sense, construction model as a very concise model to tell employees what is going to happen, instead of scaring employees with this fancy word ending with a "robot" term. it can be relatively easily accepted and understood by employees.

B2: Yeah, just like what he mentioned. Since the solution provided by the consulting company was delivered in a very completed way. Limited interactions Was made between the consultants and the employees. By reading the flow charts, most of the employees may have some basic

positive image about RPA since it can save a lot of working hours. But essentially, I feel like that people are waiting from something consistent from the beginning. something like Construction model can provide to them, a clear big picture that can give them one unchanged image in their future use of RPA.

B1: And for the process model, I think it can support the flow charts a lot. Since these acts can help people get to know how to coordinate with RPA in a concrete way. And a point can be made here is that RPA can only be supportive, but it will never replace human workers. Therefore, human worker should still pay attention to monitor and deal with exceptions on time.

B2: Yeah, I also agree with this. When employee deals with each process, process model can make employees comprehend more about their own responsibility and their colleague's responsibility. And if consider about specific transaction, the human capability enhanced or imitated by RPA are also illustrated in the process model. In this sense, it can improve the coordination between stakeholders in the RPA application. Also, if there occurs problem, it enables people to trace back the source. And further, after the application of RPA, how employees can re-prioritize their skills and capabilities and eventually deliver better performance can also be beneficial from the viewpoints provided by DEMO. For instance, most of the time, not only employees should focus on how to better perform performa capabilities. And then if some informa and forma-performed capabilities cannot be coped with RPA. Of course the human workers should give timely response. But also it can provide a shared toolkit to inspire the managers start to think about how to adjust the tasks of their employees and achieve the best balance between the RPA work and the human work.

A： Yeah, actually Construction model can not only help organizations understanding and applying RPA, it can also encourage organizations re-consider and re-prioritize their human resources, and further improve the performance of the organizations. And these two points can work as managerial suggestions. As for process model, I believe that it can somehow make employees feel that they are still relevant and the only thing that is going to change is that they will have one strong and powerful ally.

B1, B2： Yes, I kind of have the same opinion to the potentials of construction model in RPA application. And agree that process model can somehow contribute to make employees feel that they should still be proud of their work and try to coordinate with RPA and deliver better performance.

A: For the creation methodology of construction model and process model, do you have any other suggestions and comments?

B1: Firstly, I would like to say thank you to DEMO for the new viewpoints it brought to the RPA application, and I think I can be equipped with one powerful tool when I need to make the RPA progress report to other department manager just in a few minutes.

And. I am sure these viewpoints can help employees to better use and coordinate with RPA. Since I am an engineer, RPA is not a miracle or mystery to me. But since RPA claimed that target customers of RPA are not engineers but people with no engineering background. Trying to make them understand RPA in a comprehensive way is not an easy thing. For instance, “AI” is so much more popular than required. Everything tries to make them related to AI. And this

scared human workers. They thought RPA is some advanced intelligent machines that will make them fired soon. Of course, they would not feel comfortable to RPA application.

B2: Yeah, this is probably the emotion for the first stage when they heard that some of their jobs will be done by RPA soon. And in the second stage, the emotion turned into some negative response. Since now RPA is doing the boring parts of my job, I can just be relaxed. They didn't then spend some time thinking about what else things that they can do for their jobs and improve the quality. One of the reasons is that, they lost their way. They have no idea how to response in a proper way. But construction model provides a plan and a solution. By getting to know the capability performed in the process, they can optimize their advantage and skills for a better personal growth in the long run. And by responsibility illustration, it will definitely help employee get accustomed to the RPA application in a timely way.

B1: About suggestions and comments, just like what I mentioned. I agree that DEMO can represent the skeleton of a process. However, since I have just used DEMO for once, DEMO as a very abstract modeling methodology, I am not really sure if it is possible that DEMO can also provide standardized solution if I apply it to other cases.

B2： For me, I think the names of the four acts can be adapted to the case of RPA application. I mean, the function is still the same, but the name can be customized a bit more to illustrate the involvement of technology. Or maybe it is also possible to add a few more acts.

A：B1 I can understand your concern. But until today, DEMO has evolved from the origin for a long time. And it has been justified by many practical cases. So, the further application and usage can be Ill guaranteed. But the point that you just made reminded me that, when an

organization starts to use DEMO, it is very necessary to make shared understanding about DEMO. And in the application process, people should also be careful about the different interpretations. **B2** I really like your proposal. Since the core of DEMO is human-oriented, for a long time, the tasks done by machine and technology are considered as the second focus. However, with the occurrence and development of RPA and AI, it makes people to rethink about the connections and relations between human and technology. How to better coordinate with each other and work for creating a better society has become a serious topic.