



A STUDY ON ERP ASSIMILATION AND BENEFIT REALISATION BASED ON DIFFUSION OF INNOVATION THEORY

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ABSTRACT

Along with the development of information technology, lots of companies implement Enterprise Resource Planning (ERP) systems because ERP systems promise a lot of benefits. Although many companies have successfully implemented ERP systems, not all companies get the benefits of ERP system since ERP systems have not been able to diffuse in the routine of organization. This study examined the influence of organisational factor on enterprise resource planning (ERP) benefits realisation through ERP assimilation process. A conceptual model was developed based on the diffusion of innovation (DOI) theory. The developed model was tested using empirical data gathered from a questionnaire survey. Data processing was done using structural equation modeling (SEM) with the support of Lisrell 8.7 statistical software. The result of hypotheses testing shows that ERP assimilation significantly influences overall ERP benefit. Further, this study found that outcome orientation and communication process influence ERP assimilation process significantly.

Keywords: diffusion of Innovation, ERP assimilation, organisational factors, benefit realisation, SEM, ERP post-implementation.

1. INTRODUCTION

Along with the development of information technology, lots of companies implement ERP systems because ERP systems promise lots of benefits. Although ERP systems have many promising benefits, implementing ERP systems in a company is not easy. One-third of ERP implementation projects are not successful [1] and 60-70% of the ERP implementation cases failed in obtaining the expected benefits [2]. Many companies that have successfully implemented ERP systems do not get the benefits of ERP system because ERP systems have not been able to diffuse in the organisational routines [3, 4] or ERP system does not successfully enter the assimilation phase. Assimilation phase is a phase in which the ERP system has been able to diffuse to the tasks of the organisation and has become a routine activity [5, 6].

To realize the benefits after its implementation (project) phase, ERP system must be assimilated with company daily business processes in the post-implementation stage. Prior studies on ERP implementation mainly focus on ERP implementation project and less attention had been given to post-implementation stage [7]. A number of studies had discussed factors influencing ERP benefits realisation [e.g. 8-10]. Most of them addressed those factors from an individual point of view [e.g. 11, 12]. Limited research had addressed factors related to organisational characteristics. Though the use of ERP system provides benefits to the organisation through individual users, different organisation's characteristics may lead to different ERP post-implementation conditions and different post-implementation situations may result in different benefits realisation in the organisations.

Considering this, there is a need for studies that examine the organisational factors affecting ERP benefits realisation through ERP assimilation process. Though some studies examined ERP overall benefit [e.g. 8], and

some studies had investigated organisational factors influencing ERP assimilation [e.g. 11, 13] very limited study had been done on ERP assimilation and its impact on overall ERP benefit. Therefore this study aims at examining the influence of organisational factors on the ERP benefit realisation, mediated by ERP assimilation process.

2. LITERATURE STUDY

2.1 ERP benefits

ERP which is the development of MRP and MRP II is defined as an information system that consists of modules that are useful to support and integrate with a company's entire business processes to facilitate transactions in the company in real time and integrated [13, 14]. ERP has actually been known since 1990. When it first became known, quite a lot of companies are trying to implement it because the ERP system is believed to provide many benefits for the company. According to [23] ERP benefits can be grouped into 5 categories, namely:

- Operational Benefits
- Managerial Benefits
- Strategic Benefits
- Infrastructure of Information Technology (IT) Benefits
- Organizational Benefits

In this study, the benefits of ERP are viewed as a single entity called the overall ERP benefits.

Although many companies have used ERP systems to support their operation, not all of these companies get the promised benefits as mentioned above. Failure in obtaining the benefits of the ERP system can be caused by the fault of management process in each implementation stage. Therefore, each implementation



stage of the ERP system must be prepared and managed properly so that the overall benefits can be achieved.

2.2 ERP IMPLEMENTATION

According to [5] and [12] ERP implementation cycle consists of three phases, namely:

- Primary phase: the phase in which the decision to implement ERP systems appears and the preparations of ERP implementation begins
- Secondary phase: phase in which employees receive and start using the ERP system.
- Assimilation phase: the phase in which the ERP system has been able to diffuse to the tasks of the organization and has become a routine activity.

The first phase is mostly started when top management decides to adopt ERP systems and finished when ERP project ends. The second and third phase together is an ERP post-implementation stage. This study is focused on the assimilation phase, which is part of the post-implementation stage. Based on Shen and Khalifa (2008), ERP systems assimilation phase is defined as an extension of the ERP implementation phase in which the technology/ERP system is diffused to the work processes in the organization. In this phase the use of the ERP system has become a regular activity in the enterprise [3, 4].

2.3 ERP ASSIMILATION AND THE DIFFUSION OF INNOVATION (DOI) THEORY

Among the studies on ERP assimilation, some used diffusion of innovation (DOI) theory as the basis of their analysis [e.g. 14, 15] and some studies used technology, organisation, and environment (TOE) framework [e.g. 14, 16, 17]. DOI is a theory that explains how, why, and at what rate new ideas and technology spread through cultures operating at the individual and firm level [14]. DOI theory is considered suitable to be used in developing ERP assimilation model in this study because DOI helps to address the ways in assimilating new technology in organisation through analysing organisational ways of working.

In DOI theory, factors that influence the acceptance of information systems is classified into three major groups, namely: individual (leader) characteristic, internal characteristic of organisation, and external characteristic of the organisation. Individual (leader) characteristic describe the attitude of the leader towards change. Internal characteristics of organisation describe organisation characteristics that influence the adoption of innovation in organisation. It includes centralization which is the degree to which power and control in organisation is relatively concentrated in the hands of a few individuals; complexity that explains the extent to which members of the organisation have a high level of knowledge and skill; formalization that explains how an organisation emphasizes rules and procedures to its members; interconnectiveness which defines how units in a social

system are linked by interpersonal networks; organisational slack which explains how available resources not tied to an organisation; and size which is the number of employees of the organisation. External characteristic of the organisation refers to the openness of the system toward an innovation.

3. CONCEPTUAL MODEL AND HYPOTHESES

Based on DOI theory, a conceptual model was developed comprising of 6 internal organisation characteristics as independent variables, ERP assimilation as intervening variable and overall ERP benefit as the dependent variable. Four independent variables were adopted from DOI theory and 2 factors were adopted from other related studies. Those six factors namely outcome orientation [11], complexity [18], formalization [18], interpersonal harmony [11, 18], centralization [11, 18], and communication process [18, 19]. The developed conceptual model is presented in Figure-1.

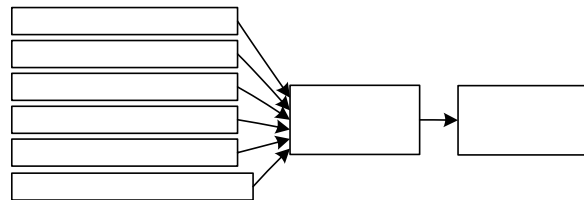


Figure-1. Conceptual model.

3.1 ERP BENEFIT AND ERP ASSIMILATION

[20] Mentioned that there is a strong positive relationship between the use of ERP (ERP assimilation) and return on investment (ROI) in the company. This relationship shows that the assimilation process can be used as an evaluation tool as well as an indicator of ERP project success. Research by [8] also mentioned that improved coordination and work efficiency that happen as the results of ERP usage during the assimilation stage supports the realisation of ERP benefits. When users start mastering the system, users realise the ERP advantages on their works and its capabilities [21].

Hypothesis 1: ERP assimilation has a positive impact on the achievement of overall ERP benefit.

3.2 OUTCOME ORIENTATION

Outcome orientation is defined as the orientation of the company to continue growing and to achieving expected goals [11]. With the culture oriented to achieve the objectives and results, the company will continue using the ERP system to achieve the expected goals. With this the company will continue motivating users to use ERP system in daily activities because it is believed that ERP systems can improve companies' productivity, quality of products and services delivered, and also improve its employees' capabilities.

Hypothesis 2: Outcome orientation positively affects the success of ERP assimilation.



3.3 COMPLEXITY

Complexity in an organisation is indicated by the degree to which members of the organisation have a relatively high level of knowledge and skill [18]. With a high level of knowledge and expertise, organisation members have a tendency to not want to accept the changes [18]. With this situation, organisation is most likely not going to change. In this case, the assimilation of the ERP system is seen as a change that is expected to be done by the company. So, the company with a high level of complexity will tend to resist and not support the assimilation of ERP system because the members do not want to be changed.

Hypothesis 3: Complexity negatively affects the success of ERP assimilation.

3.4 FORMALIZATION

Every organisation or company has rules that underlie every activity undertaken within the company [18]. Formalization of the organisation is defined as the degree to which an organisation has rules and procedures that bind its employee or in other words the organisation emphasizes rules and procedures to their members. With strict rules to use ERP system within company, the company will allow users to continue to use the ERP system and not reject the rules.

Hypothesis 4: Formalization positively affects the success of ERP assimilation.

3.5 INTERPERSONAL HARMONY

In an organisation, an interpersonal relationship between members is needed. The interpersonal relationship is the degree to which the units in a social system are linked by interpersonal networks [18]. Interpersonal itself is a relationship between members or individuals within an organisation that can affect cooperation and conflict within the company [11]. With the harmony in interpersonal relationships, company can reduce attitude of the users to reject applying ERP systems as well as motivate users participation in the assimilation of ERP system. In addition, interpersonal harmony can also affect the distribution of a new understanding regarding the use of ERP systems.

Hypothesis 5: Interpersonal harmony positively affects the success of ERP assimilation.

3.6 CENTRALIZATION

An organisation is said to be decentralized if the control function is held by each individual and not centralized. Centralization is the extent to which power and control of the company is concentrated in the hands of a few individuals [18]. Centralization can regulate the behaviour of employees. A centralized power helps to solve problems and mediate different results [11]. With the centralization of powers, rules and controls for the use of ERP system, all members of the organisation will follow

the rules and control from the central to use ERP system in their daily activity.

Hypothesis 6: Centralization positively affects the success of ERP assimilation.

3.7 COMMUNICATION PROCESS

In an organisation, a good communication process among members is needed. Communication process is a process of exchange of information between organisation members to gain an equal understanding [18]. A good communication process is indicated by how easy members of the organisation get information they need. A good communication process is also measured by how the organisation is able to provide information required by its members [6]. With a good communication, the members in the organisation will have a shared understanding of the benefits of ERP systems.

Hypothesis 7: Communication process positively affects the success of ERP assimilation.

4. DATA COLLECTION AND RESULTS

4.1 DATA COLLECTION

Before collecting the empirical data, operationalisation of the research variables was conducted based on a literature study and the result is presented in Appendix 1. Primary data used in this study were obtained from a survey conducted using a set of questionnaires. A purposive sampling method was used to determine the sample used in this study because only organisation units that meet certain criteria are appropriate to participate in our study. The criteria used in selecting our sample are: the organisation unit (division) that has used ERP systems for at least 1.5 years and there are at least 20 users using ERP systems in the organisation unit. To get our data, one respondent who is the representative of a division (organisational unit) filled in a questionnaire set on behalf of his/her unit. The respondents are either a manager or an important key user within the organisational unit who is considered having a very good understanding about ERP post-implementation activities and assimilation process within the organisation unit.

The data was collected in the period of April-June 2013. 250 questionnaires were distributed and 197 were collected. Out of 197 data, 144 data could be used for further processes (some are not used due to missing data). The data was collected from 73 different national and multinational companies in Indonesia that had implemented ERP systems and had used the systems for at least one year. The profile of sample data is presented in Table-1.

**Table-1.** Respondent profile.

Duration of ERP Use	Number of sample	Percentage
More than 1.5 years	161	91%
Less than 1.5 years	15	9%
Total	176	100%
Sectors		
Manufacture	23	16%
Technology	49	34%
Energy	36	25%
Consumer Goods	9	6%
Service	21	15%
Others	6	4%
Total	144	100%

4.2 MEASUREMENT MODEL EVALUATION

After developing and specifying the measurement model, researcher need to calculate sample size needed for empirical data and to select the estimation method used for data processing [22]. Because author used maximum likely-hood estimation (MLE) in this data processing, sample size needed is 10 time of manifest variable. In this case author used latent variable score (LVS) to simplify the model, so that author only needed 80 samples. The next step of data processing is assessing measurement model validity. This validity depends on construct validity and goodness-of-fit of measurement model. These tests were done using LISREL 8.70 statistical software. Construct validity consist of validity test and reliability test [22]. Validity test was done to measure whether a variable can measure what should be measured [22]. In this case the validity test of measurement model is done to see if the observed variables correctly measure its latent variables. The result of this validity test showed that observed variables CPX3 and CEN1 are invalid (Table-2). Those observed variables which are invalid were deleted to achieve a valid measurement instrument.

Table-2. Validation test result.

Latent Variable	Observed Variable	SLF	T-value	Validity
OB	OB1	0.8	11.07	Good
	OB2	0.86	12.34	Good
	OB3	0.67	8.7	Good
	OB4	0.84	11.96	Good
	OB5	0.71	9.47	Good
	OB6	0.79	10.92	Good
AS	AS1	0.54	6.74	Good
	AS2	0.65	8.15	Good
	AS3	0.9	13.57	Good
	AS4	0.89	13.24	Good
	AS5	0.85	12.24	Good
OO	OO1	0.69	7.5	Good
	OO2	0.83	8.69	Good
	OO3	0.57	6.39	Good
CPX	CPX1	0.99	16.47	Good
	CPX2	0.96	15.59	Good
	CPX3	-0.2	-1.74	Not Valid
FOR	FOR1	0.89	11.99	Good
	FOR2	0.88	11.85	Good
	FOR3	0.62	7.85	Good
IH	IH1	0.74	8.86	Good
	IH2	0.85	10.32	Good
	IH3	0.66	7.96	Good
CEN	CEN1	0.42	5.2	Not Valid
	CEN2	0.99	16.72	Good
	CEN3	0.68	9.19	Good
CP	CP1	0.79	11.02	Good
	CP2	0.86	12.45	Good
	CP3	0.88	13.07	Good
	CP4	0.86	12.42	Good

Besides validity test, we also need to do reliability. This test is done to see the consistency of each observed variable in assessing its latent variables. The result of this reliability test shows that outcome orientation factor is not reliable (Table-3). An observed variable of the outcome orientation need to be deleted to achieve a reliable measurement instrument. In this case we deleted observed variable OO1.

**Table-3.** Reliability test result.

Laten Var.	Observed Var.	CR	VE	Reliability
OB	OB1	0.903	0.61	Good
	OB2			
	OB3			
	OB4			
	OB5			
	OB6			
AS	AS1	0.882	0.608	Good
	AS2			
	AS3			
	AS4			
	AS5			
OO	OO1	0.743	0.497	Not good
	OO2			
	OO3			
CPX	CPX1	0.908	0.831	Good
	CPX2			
FOR	FOR1	0.846	0.652	Good
	FOR2			
	FOR3			
IH	IH1	0.797	0.569	Good
	IH2			
	IH3			
CEN	CEN2	0.833	0.721	Good
	CEN3			
CP	CP1	0.91	0.716	Good
	CP2			
	CP3			
	CP4			

Goodness-of-fit (GOF) of measurement model indicates how well the developed model fit with empirical data gained from the sample. Based on measurement model's GOF result in Table-4, we can see that most of GOF measures are satisfied (9 GOF measures have good fit and 5 GOF measures have bad fit). So it can be concluded that the empirical data fit the measurement model.

Table-4. GOF of measurement model.

GOF	Fit Standard	Measurement Model	
		Estimation Result	Fit level
Chi-Square	Small value $p > 0.05$	453.58 $p=0.00$	Bad Fit
RMSEA	$RMSEA \leq 0.08$ $p \geq 0.05$	0.054 $p=0.30$	Good Fit
ECVI	Small value and near to ECVI <i>saturated</i>	M=4.35 S=5.68 I=51.25	Good Fit
AIC	Small value and near to AIC <i>saturated</i>	M=621.58 S=812.00 I=7329.30	Good Fit
CAIC	Small value and near to CAIC <i>saturated</i>	M=955.05 S=2423.74 I=7440.45	Good Fit
NFI	$NFI \geq 0.90$	0.93	Good Fit
NNFI	$NNFI \geq 0.90$	0.97	Good Fit
CFI	$CFI \geq 0.90$	0.98	Good Fit
IFI	$IFI \geq 0.90$	0.98	Good Fit
RFI	$RFI \geq 0.90$	0.92	Good Fit
CN	$CN \geq 200$	115.15	Bad Fit
RMR	Standardized $RMR \leq 0.05$	0.068	Bad Fit
GFI	$GFI \geq 0.90$	0.82	Bad Fit
AGFI	$AGFI \geq 0.90$	0.77	Bad Fit
Good Fit		9	
Bad Fit		5	

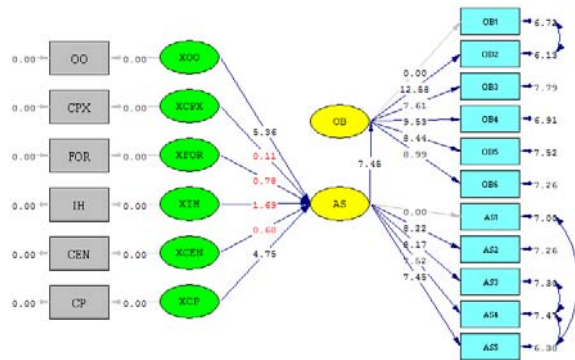
4.3 STRUCTURAL MODEL EVALUATION

After testing the measurement instrument, a structural model evaluation was performed to test the hypotheses. The valid and reliable data gathered from questionnaire was processed using LISREL 8.70. The result of hypotheses testing shows that ERP assimilation significantly influences the achievement of overall ERP benefit. The significant influence of ERP assimilation on the overall ERP benefit is in line with the result of studies by [8] and [10]. Through an optimal use of ERP in the daily activities of the company, information flows in the company get faster, the data contained in ERP system will be updated, and this may influence the decision-making processes in the company.

Besides, the structural test shows that outcome orientation and communication process influence the success of ERP assimilation with 0.05 significance level (see Table-5 and Figure-2).

**Table-5.** Results of hypotheses testing.

Hypothesis		T-value	Result
H 1	ERP Assimilation → Overall ERP Benefit	7.45	Accepted
H 2	Outcome Orientation → ERP Assimilation	5.36	Accepted
H 3	Complexity → ERP Assimilation	0.11	Rejected
H 4	Formalization → ERP Assimilation	0.78	Rejected
H 5	Interpersonal Harmony → ERP Assimilation	1.69	Rejected
H 6	Centralization → ERP Assimilation	0.68	Rejected
H 7	Communication Process → ERP Assimilation	4.75	Accepted

**Figure-2.** Result of structural model evaluation using LISREL 8.70.

Related to outcome orientation of the employees, when the purpose of the organisation has been regarded as the goal of each user, they will do their best to explore and learn to harmonize the system and the business. Besides, promoting outcome orientation culture will enhance the performance and functionality of ERP systems that can affect users' satisfaction. This result is in line with the study by [11].

Regarding the role of communication process, when users are interested in exploring additional functions in the ERP systems and provide suggestions for improvement, systems will be better assimilated in the organization. This finding is in line with the result of the study by [6].

Based on data processing result explained in the previous subsection, we know that there are 3 accepted hypotheses. Those are:

- Hypothesis 1: ERP systems assimilation has a positive impact on the achievement of overall ERP benefit.
- Hypothesis 2: Outcome orientation positively affects the success of ERP assimilation.
- Hypothesis 7: Communication process positively affects the success of ERP assimilation.

For hypothesis 1, this acceptance is in line with P. Ifinedo *et al.* (2011) and Chou and Chang (2008) research. This hypotheses shows that by using ERP in the daily activities of the company, the data contained in ERP system will always be updated. So that the analysis and decision-making processes that use the data may be more valid. On the other hand, by using the ERP system, the flow of information in a company that previously were manually using a file can be faster because all the data that is entered into the ERP system can be accessed by other users in real time.

The acceptance of hypothesis 2 is supported by Bai and Cheng (2010) research. Bai and Cheng (2010) has explained that organisation with a high outcome orientation will continue ERP assimilation process in order to achieve the expected goals. With the motivation of organisation to continue the assimilation of ERP system, organisations will continue to educate users to assimilate ERP, so that ERP systems can improve organisation productivity, quality of products or services, and the ability of employees. When the purpose of the organisation has been regarded as the goal of each user, they will do their best to explore and learn to harmonize the system and the business. On the other hand, promoting outcome orientation culture will enhance the performance and functionality of ERP systems that can affect users' satisfaction. As a result, users will be interested in exploring additional functions in the ERP in order to provide suggestions for improvement.

For hypothesis 7, this acceptance is in line with Tornatzky and Fleischer (1990) research. This hypotheses shows that good communication between members of an organisation can improve the distribution of information held by the members so that each member has same understanding of the benefits of ERP system and motivated to use the ERP system.

Based on analysis above, we can suggest some recommendations for companies to achieve overall ERP benefit. Those are:

- Organisation should be motivated to raise awareness in providing the best performance. Motivation can be done by giving reward and punishment. With the growing awareness to deliver the best performance, organisation will be motivated to use in ERP corporate daily activity because ERP systems are believed to improve their performance.
- Organisation should held an activity that can accommodate equalization understanding between members on the use of ERP systems. These activities may include sharing activities among employees where employees can consult the problems encountered in the use of ERP, while other employees can provide feedback.
- Organisation should always distribute the latest information related to ERP system. That information can contain some improvements and updates of ERP systems, as well as information regarding the ERP system usage guidelines.



- Utilization of ERP systems in the organisation's operational activity should be enhanced because with the absence of the need to use ERP systems in day-to-day operations, the ERP system will not be used. Utilization of ERP systems in the organisation's operational activity can be realized with the use of ERP systems in the overall division task, so there is no division that use paper based files anymore.
- Organisation should integrate the ERP system with other applications used by the organisation. With this integration, organisation members who often use other applications will be motivated to use the ERP system.
- Actualization of data in the ERP system should be improved by always inserting new data into the ERP system, so that the user can use the data of the ERP system real time. The data that is not always updated in the ERP system can make employees lazy to use ERP system because employees have to perform data entry prior to using these data.

5. CONCLUSIONS

This study made an original contribution on the knowledge related to ERP post-implementation management. In this study, the influence of ERP assimilation on ERP benefit realisation was examined. The result shows that ERP assimilation significantly influences overall ERP benefit. This study also examined the influence of 6 antecedents on ERP assimilation and found that outcome orientation and communication process influence ERP assimilation process significantly. Future works can be focused on analysing the influence of other organisational characteristics such as the characteristics of the organisational leaders. Besides, institutionalisation mechanisms are also potential factors to be investigated in future studies.

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