



## Contents

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The Moderating Effect of Industry Environments on the Relationship between IT Asset Portfolios, Efficiency and Innovation in the ERP Context

Winarno, Wahyu Agus; Tjahjadi, Bambang. European Research Studies; Anixis Vol. 20, Iss. 2, (2017): 3-15.

Optimization of the Company Strategic Management System in the Context of Economic Instability

Bondarenko, Tatiana Grigorievna; Isaeva, Ekaterina Anatolievna; Orekhov, Sergey Aleksandrovich; Soltakhanov, Anzor Uvaysovich. European Research Studies; Anixis Vol. 20, Iss. 2, (2017): 3-24.

Selected Behavioural Factors in Client-Initiated Auditor Changes: The Client-Auditor Perspectives

Baldacchino, Peter J; Caruana, Rosalene; Grima, Simon; Bezzina, Frank H. European Research Studies; Anixis Vol. 20, Iss. 2, (2017): 16-47.

The Challenge of Social Innovation: Approaches and Key Mechanisms of Development

Vasin, Sergey Mikhailovich; Gamidullaeva, Leyla Ayvarovna; Rostovskaya, Tamara Kerimovna. European Research Studies; Anixis Vol. 20, Iss. 2, (2017): 25-45.

A Spatial Analysis of Unevenness in the Social-Economic Development of Regional Municipal Units

Mikhailova, Svetlana Sergeevna; Moshkin, Nikolay Il'ich; Tsyrenov, Dashi Dashanimaevich; Sadykova, Erzhena Tsyrenovna; Dagbaeva, Sambrika Dorzho-Nimaevna. European Research Studies; Anixis Vol. 20, Iss. 2, (2017): 46-65.

Behavioral Intention to Use E-Tax Service System: An Application of Technology Acceptance Model

Sondakh, Jullie Jeanette. European Research Studies; Anixis Vol. 20, Iss. 2, (2017): 48-64.



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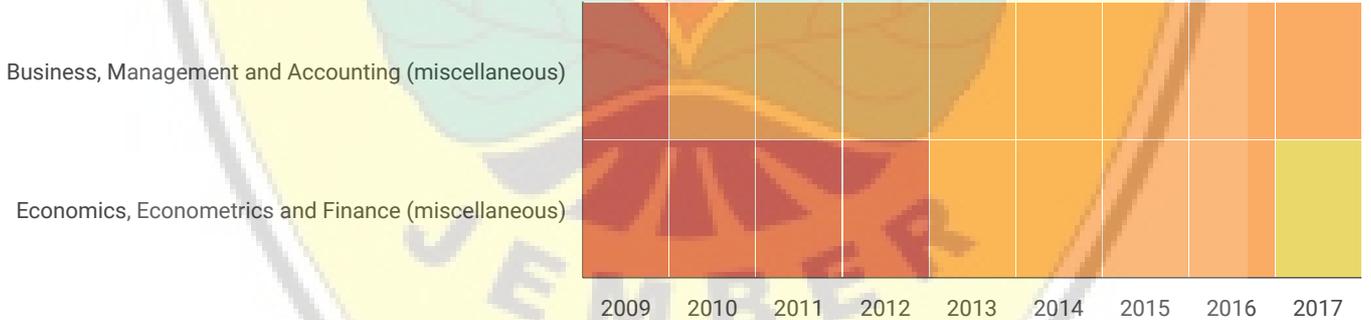
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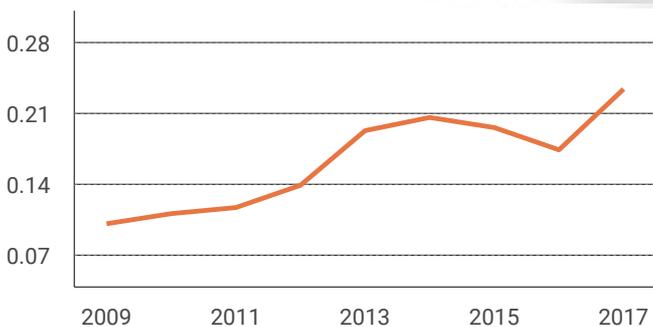
# 19

H Index

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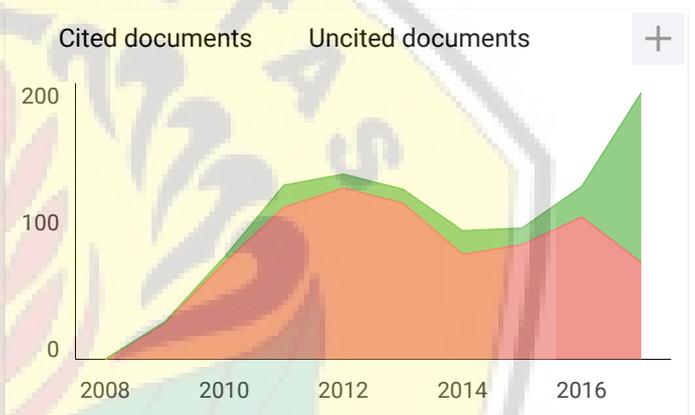
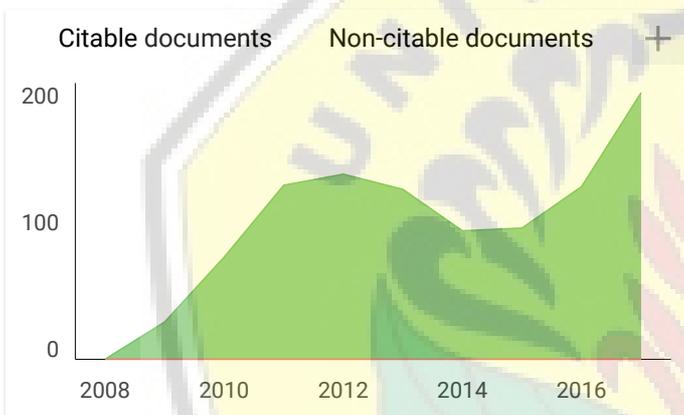
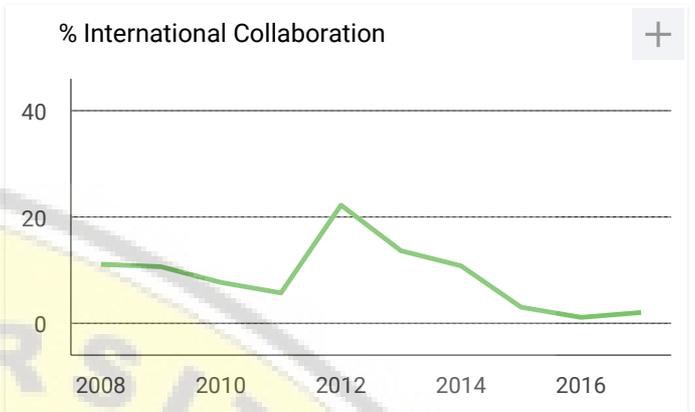
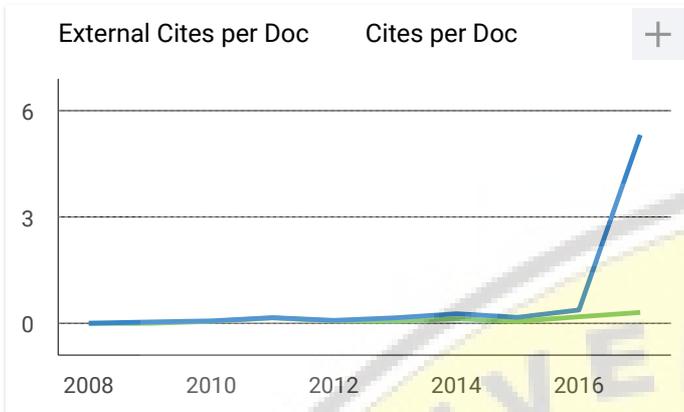
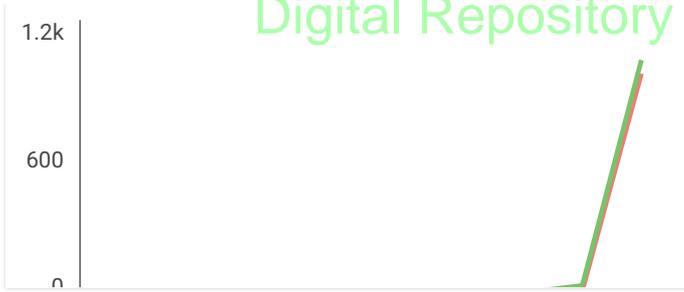
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**Abstract**

Technology investments in the form of ERP systems tend to align the company's information technology (IT) asset portfolio with two main performance results are efficiency and innovation. This study examines the influence of industrial environment on the relationship between IT asset portfolio with efficiency and innovation. The research model is tested using data from 104 observations gathered from 26 companies for 4 years (2009-2012), and data analysis is conducted using a moderated regression analysis. The results show that increase in value of IT assets portfolio will improve operational efficiency, and innovation companies. Furthermore, we find that the industry environment is not moderate the relationship between the of IT asset's portfolio with operational efficiency. On the other hand, industrial environments statistically significant affect the relationship between the IT asset portfolios with innovations. The results imply that the company has implemented an ERP system, investment in IT is not oriented towards the exploitation of IT, but tends to increase the exploration process to the form of innovation.

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## The Moderating Effect of Industry Environments on the Relationship between IT Asset Portfolios, Efficiency and Innovation in the ERP Context

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Wahyu Agus Winarno<sup>1</sup>  
Bambang Tjahjadi<sup>2</sup>

**Abstract:**

*Technology investments in the form of ERP systems tend to align the company's information technology (IT) asset portfolio with two main performance results are efficiency and innovation. This study examines the influence of industrial environment on the relationship between IT asset portfolio with efficiency and innovation. The research model is tested using data from 104 observations gathered from 26 companies for 4 years (2009-2012), and data analysis is conducted using a moderated regression analysis.*

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*On the other hand, industrial environments statistically significant affect the relationship between the IT asset portfolios with innovations. The results imply that the company has implemented an ERP system, investment in IT is not oriented towards the exploitation of IT, but tends to increase the exploration process to the form of innovation.*

**Key Words:** *IT asset portfolios, operational efficiency, innovation, and industrial environment*

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## 1. Introduction

Enterprise Resource Planning system (ERP System) is an integrated information system that designed to integrate all functional areas within an organization in order to achieve the highest point of effectiveness and efficiency. The last decade, a manufacturing company in Indonesia showed an increase in IT investment. Investments in such forms as SCM, CRM, and ERP is the key to success in business competition. Various types of IT investments such as the adoption of ERP system at the company have a different purpose. In the process of aligning IT with business strategy of the company, there are two different processes, namely exploitation and exploration (Benner and Tushman, 2003). During the process of exploitation, the company uses the knowledge to improve efficiency for the organization. Achjari and Wahyuningtyas (2014) stated that IT adoption in the form of ERP aims to cost efficiency and enhance productivity by streamlining and integrating internal business processes. On the other hand, the exploration process, companies are looking for new knowledge, develop new products to improve the market, and improving the performance of innovation (Benner and Tushman, 2003).

The company's decision to exploitation or exploration industry is influenced by environmental conditions. In a static environment, companies will tend to make the exploitation of IT to improve operational efficiencies (Xue *et al.*, 2012). Instead, the environmental conditions are very complex and dynamic; companies tend to explore to improve innovation. Industry's environmental conditions in Indonesia last decade showed the trend of output products manufacturing company has a short life cycle. This shows that the company has led to innovations without abandon operational efficiency. The company orientation can be facilitated by investing in ERP software, because the ERP system is an integrated system that quickly provides information to respond the changing business environment. Xue *et al.* (2012) found that the level of dynamic industry's environment, munificence, and lower complexity, IT asset portfolio will further improve efficiency. Conversely, in an environment with a higher level of complexity, IT asset portfolio will further enhance the company's innovation. Based on the explanation, the researchers will conduct research expansion of Xue *et al.* (2012) with a focus on IT asset portfolio on companies that have invested in IT in the form of an ERP system.

Research related to investments in IT had been made by several researchers is mixed. Research conducted by (Barua and Lee, 1997; Brynjolfsson and Hitt, 1996; 1993; Lee and Barua, 1999; Lichtenberg, 1995; Menon *et al.*, 2000; Kleis *et al.*, 2012; Rodionova *et al.*, 2015; Mihola *et al.*, 2016), shows that investments in IT can increase the output to the company. Anatan and Ellitan (2008) stated that technology plays an important role in improving operational performance such as speed of production processes, reduction of defective products, timely delivery capabilities and increase productivity. On the other hand, several researchers stated that IT investment not associated with firm performance (Chae *et al.*, 2014; Rai *et al.*, 1996; Li *et al.*, 2000; Richardson and Zmud, 2002; Li and Ye, 1999).

Formulating competitive strategy of a company is the most important thing that must be considered in view of the relationship between the company and its environment. The external environment is very influential in the company, so that the environmental changes that occur can give effect to all companies established in the same type of industry (Porter, 1998). The phenomenon of globalization and the revolution in IT make the scope of the manufacturing industries increasingly dynamic, competitive, and complex (Dess and Beard, 1984; Keats and Hitt, 1988; Cipovová and Dlasková, 2016; Robertie, 2016; Bondarenko *et al.*, 2017; Kolchanova and Kolchanova, 2015; Dasanayaka and Sardana, 2015). The decision on the relative level of IT investment in the process of exploitation and exploration industries will be affected by the environment in which the company operates and the need to align business strategy with industry's environment through IT Asset Portfolio (Xue *et al.*, 2012; Thalassinis and Liapis, 2014; Theriou and Aggelidis, 2014).

In a dynamic environment, munificence, and complex, companies should focus on identifying opportunities so that the process of research and development is a radical development that is appropriate to the company. According to Kleis *et al.* (2012) IT can facilitate inter organizational coordination in different ways. IT companies that invest in the form of collaborative technologies, it will be able to increase the responsiveness and creativity in the development into new products. Furthermore, in the process of supply chain, IT can provide flexibility in order with the vendor of the process even with other vendors.

The phenomenon in Indonesia that stated earlier on the manufacturing company is interesting to be explored. This phenomenon motivates researchers to conduct extended research on the research model of Xue *et al.* (2012). This study tries to analyze the influence of the portfolio asset IT to operational efficiency and innovation, as well as a test the contingency theory that takes into account a company's industrial environment. The difference this research Xue *et al.* (2012) on the focused on IT asset portfolio, both aiming for the exploration and exploitation of the internal process perspective, especially in companies that have actually invested in IT in the form of an ERP system. Besides that, implementation process of ERP system in the developing countries such as Indonesia different forms the companies that are already established as the sample on previous research.

The rest of this paper is organized as follows. Section 2 illustrates the conceptual model and hypotheses development. Section 3 material and methods. Section 4 presents the results and discussion. Finally, Section 5 concludes and limitations the paper.

## 2. Conceptual Model and Hypotheses

### 2.1 IT Asset Portfolio

Money and Twite (1995) stated that the benefits from the use of IT into two kinds, that is both tangible and intangible. Tangible benefits are directly affected the profitability to the company, either in the form of a reduction, or cost savings and increased revenue. While the benefits intangible defined as the positive benefits obtained by the company in connection through the use of IT, but does not have a direct relationship with the profitability for the company. Both benefits are divided into two parts, i.e quantifiable and unquantifiable. In fact, most of the attention of management only tangible benefit-quantifiable because it is easy to be calculated and redeemable also look to directly affect the profitability to the company. The use of IT in fixed assets related to the operations within the company is the use of techniques of production or manufacturing. Production or manufacturing techniques to study all matters relating to the production process.

A new theme for the study on the behavior of IT investments stated that the company can increase the alignment between business strategy with the goal to be achieved through IT Asset Portfolio (Ross and Beath, 2002; Aral and Weill, 2007; Havlíček *et al.*, 2013; Břečková and Havlíček, 2013; Theriou and Aggelidis, 2014; Theriou *et al.*, 2014; Epifanova *et al.*, 2015; Akopova *et al.*, 2017). The idea is then developed explicitly by linking IT Asset Portfolio and performance at the company in creating exploitation and exploration process. When a company uses its assets in order to achieve operational efficiency, ERP is an effective tool that can provide better and faster information and cut costs to increase of efficiency (Esteves, 2009). On the one hand, the benefits of ERP is a continuous process with the benefits realized at different levels in different core processes (Nwankpa, 2015). Accordingly, the exploration of the ERP system in the form of collaboration systems and data management systems, to support the company's innovation (Xue *et al.*, 2012).

Aral and Weill (2007) identified four different types of IT asset's portfolio. The first, IT asset's infrastructure aims to provide IT services and provide a flexible base for future business. Second, IT asset transactional aims to automate the process, and cost reduction by increasing the volume per unit. Third, IT asset informational aims to provide information management, accounting, reporting, planning, analysis, and data mining. Lastly, IT strategy associated with the aim of increasing revenue from new products which in this case is an innovation, and infrastructure technologies improve the performance of business in the long term (Aral and Weill, 2007).

## 2.2 IT Asset Portfolios, Operational Efficiency and Innovation

IT investment from the perspective of performance paradox can improve productivity and corporate performance in financial management, human-resource management, information management, capital management, and management of performance or results (Brynjolfsson and Hitt, 1993).

Implementation of the IT strategy in the form of IT asset portfolio can help companies to align business strategy with the company's business vision (Aral and Weill, 2007; Ross and Beath, 2002; Kosinova *et al.*, 2016). The idea is then developed explicitly by linking IT Asset Portfolio and performance with the company in creating exploitation and exploration process. In the context of the ERP system investment, companies have a tendency to create a competitive advantage in the form of efficiency and innovation in the long term. When a company uses its assets to achieve operational efficiency, the company will make the exploitation of ERP system to create value of the firm. The exploitation aimed at improving operational efficiency from the perspective of customers, suppliers, and internal processes or operations. On the other hand, the exploration of IT aimed at improving innovation to accelerate the process of new-product development and innovation.

Based on these explanations, the hypothesis can be formulated as follows:

H<sub>1-A</sub>: IT Asset Portfolio is positively associated with an Operational Efficiency.

H<sub>1-B</sub>: IT Asset Portfolio is positively associated with an Innovation.

## 2.3 IT Asset Portfolio and Efficiency: The Moderating Effects of Industry Environment

Changes in the business world, the phenomenon of globalization and the revolution in IT make the scope of the manufacturing industry increasingly dynamic, competitive, and complex (Dess and Beard, 1984; Keats and Hitt, 1988). Manufacturing companies must always strive to meet the needs of consumers and produce efficiently. This raises problems in various fields, one of which is the problem of efficiency associated with the operations within the company. ERP system adopted by the company is designed to solve this problem by providing cross-functional information quickly and accurately.

Formulating competitive strategy of the company, the most important thing to note is that the relationship between the company and its environment. changes in the external environment may affect the company's internal industrial environments (Porter, 1998). The decision on the relative level of IT investment in the process of exploitation and exploration industry will be affected by the environment in which the company operates and the need to align business strategy with an industry environment through IT Asset Portfolio (Xue *et al.*, 2012). Organizational learning theory suggests that in a more stable environment, superior financial performance

can be achieved through the process of exploitation. Whereas in an unstable environment, superior financial performance can be achieved through the exploration process (Jansen *et al.*, 2006; Levinthal and March, 1993; March, 1991). Besides that, the contingency theory states that there is a relationship between organizational structure and the situation with the effectiveness for the organization. This means that the effectiveness of each type of organizational structure is contingent upon the type of environment encountered.

Based on the explanation, the researchers concluded that the industry environment is a static and less complex; IT asset portfolio has a greater influence on operational efficiency. In contrast, in the industrial environment, more dynamic and complex, IT asset portfolio has a smaller effect on operational efficiency, because the portfolio is done in order to achieve organizational innovation.

Based on these explanations, the hypothesis can be formulated as follows:

H<sub>2</sub>: Industrial environments affect the relationship between IT Asset Portfolio and Opercity.

#### **2.4 IT Asset Portfolio and Innovation: The Moderating Effects of Industry Environment**

When a company operates in a dynamic environment, it shows that the conditions cannot be predicted on customer preferences on the needs of goods and services (Xue *et al.*, 2012). Competition in a dynamic environment requires a radical innovation by introducing new products and services that aim to identify and expand new areas of opportunity. Complex environment is shown with heterogeneous players and a lot of inter organizational interactions and their connections (Xue *et al.*, 2012). This will lead to trouble the company to predict the actions to be carried out competitors.

There are several characteristics of the industrial environment is a dynamic environment, munificent, and complex. Munificent environment, has a high growth rate, and have a high chance for business expansion. Complex environment is shown with heterogeneous players and a lot of connections and interactions inter organizational (Xue *et al.*, 2012). This will lead to trouble the company to predict the actions to be carried out competitors.

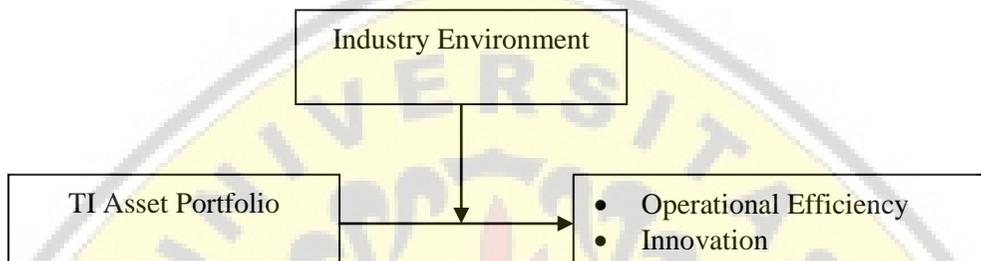
In a dynamic environment, munificent, and complex, the companies should focus on identifying products and new opportunities. So the research and development process is the development of the radical right. Kleis *et al.* (2012) argued that IT can facilitate interorganizational coordination in different ways. IT companies that invest in the form of collaborative technologies, it will be able to increase the responsiveness and creativity in the development into new products. Furthermore, in

the process of supply chain, IT can provide flexibility in order with the vendor of the process even with other vendors.

Based on these explanations, the hypothesis can be formulated as follows:

H<sub>3</sub>: Industrial environments affect the relationship between IT Asset Portfolio and Innovation (Figure 1).

**Figure 1.** Conceptual Model



### 3. Materials and Methods

We collected IT asset portfolio data from their financial statements and annual reports by accessing the official website of Indonesia Stock Exchange ([www.idx.co.id](http://www.idx.co.id)). Researchers focused on manufacturing companies listed in Indonesia Stock Exchange from 2009-2012 with the criteria that the company has implemented an ERP system. Based on these criteria, obtained 104 observations.

To measure the IT asset portfolio in this study by using the ratio between the company's IT assets to total assets for the company (Chwelos *et al.*, 2010; Hitt and Brynjolfsson, 1996). Operational efficiency in this study was measured by the ratio of inventory turnover (ITO) (Hitt *et al.*, 2002; Bharadwaj, 2000). Expenditures for research and development in the company, have an impact on innovation performance that will be able to generate new ideas, models, blueprints and others who will be able to generate patents and new products (Xue *et al.*, 2012). Thus, innovation in this study was measured by the research and development expenditure (R & D Expenditure) as done in the research Xue *et al.* (2012) by dividing the R & D Expenditure by sales. Keats and Hitt (1988) states that in dynamic industry environmental focused more on the discontinuity so that an industry's environment is measured by using the volatility of sales (Sales Volatility - SV). As disclosed (Dechow and Dichev, 2002; Cohen, 2003; Francis *et al.*, 2004; Stroeve *et al.*, 2015), sales volatility is the standard deviation of sales divided by total assets. We also used the total assets as a control for firm size.

Accordingly, we specify our empirical models as follows:

$$Eff_{ITO} = \beta_0 + \beta_1IT + \beta_2SV + \beta_2ITxSV + Size + \varepsilon \quad (1)$$

$$Inn_{R\&D} = \beta_0 + \beta_1IT + \beta_2SV + \beta_2ITxSV + Size + \varepsilon \quad (2)$$

The dependent variables  $Eff_{ITO}$  represents a measure of operational efficiency, and  $Inn_{R\&D}$  represents a measure of innovation. The interaction term,  $IT*SV$ , therefore captures the impact of *industry enviroment* on IT asset portfolio.

#### 4. Result and Discussion

Table 1 presents the descriptive statistics of the variables. The sample mean (median) value are 0.051 (0.027) for IT, 5.323 (5.063) for ITO, 0.075 (0.089) for R&D, and 0.193 (0.155) for SV, do not differ significantly from 0. This means that the curve from the main variables is symmetric. On the other hand, the mean firm size is fairly large (11791.330), compared with the median size (3919.98) of the companies. This shows that the firm size has a positively skewed distribution.

**Table 1. Descriptive Statistics**

Variables	Descriptive Statistics				
	Min.	Max.	Mean	Median	SD
IT	0.000	0.405	0.051	0.027	0.064
ITO	1	12	5.323	5.063	2.467
R&D	0.001	0.203	0.075	0.089	0.042
SV	0.010	0.710	0.193	0.155	0.121
Size	420.714	156591.420	11791.330	3919.985	26015,138

**Table 2. Pearson Correlations**

Variables	Correlation Matrix of Variables				
	IT	ITO	R&D	SV	Size
IT	1				
ITO	0.285**	1			
R&D	0.700**	0.216*	1		
SV	0.214**	0.260**	0.345**	1	
Size	0.067**	0.406**	0.001	0.069	1

**Table 3. Regression Results**

Variables	Dependent Variable – ITO (Model 1)		Dependent Variable – R&D (Model 2)	
	1	2	1	2
	Constant	3.727	3.439	,039
IT	8.522*	12.505*	,431**	0,292**
SV	3.812*	5.423*	,071*	0,013
IT*SV	-	-19,499	-	0,681*
Size	3.609**	3.594**	.000	.000
R <sup>2</sup>	0.265	0.269	,533	0,553
AdjR <sup>2</sup>	0.243	.243	.519	0,535
Observation	104	104	104	104

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*The values in bracket are heteroscedasticity robust standard errors. \*, and \*\* indicate significance at the 5%, and 1% levels respectively.*

Table 2 presents the correlation matrix of all the variables used in our full-model sample. All the main variables have correlation coefficients significant at less than the 1% level. The correlations among the various variables are not particularly high, with most correlations below about 30%. The exception is the correlation between IT assets portfolio and R&D intensity as a measure of firms' innovation activities (70%). The correlations provide preliminary evidence on the relation between the IT assets portfolio with the efficiency and innovation activities generally consistent with our expectations.

As shown in Table 3, IT asset portfolio hypothesis is confirmed in all regression models at 5% level of significant. The results show that the IT asset portfolio can improve the alignment of business strategy to achieve operational efficiency. The results are consistent with the theory that previously disclosed that the investment behavior which states that the company can improve the alignment between business strategy with the objectives of the company through the IT Asset Portfolio (Aral and Weill, 2007; Ross and Beath, 2002). IT exploitation aimed at improving operational efficiency from the perspective of customers, suppliers, and internal processes or operations. When a company uses its assets in order to achieve operational efficiency, the company will make the exploitation of information technology. The results from this study indicate that the IT asset portfolio conducted by the company aims to explore, to maximize the integration of planning and business flexibility. When a company conducts its exploration of IT, it is intended to improve the innovation to accelerate the process of new-product development and innovation. According to (Benner and Tushman, 2003) in the exploration process, companies are looking for new knowledge, develop new products to improve the market, and improving innovation performance.

Researchers also tested the effect of an industrial environment as a moderating variable relationship with the efficiency of IT asset portfolio. The results showed a variable portfolio of IT assets with the industry environment as moderating variables are not statistically significant impact on operational efficiency. In this study indicates that the condition of companies that have implemented ERP systems, investment in IT is not specified needs of companies to exploit IT (operating efficiency) but has led through the exploration process. Xue *et al.* (2012) states that decisions about the relative level of IT investments in the process of exploitation and exploration industry will be affected by the environment in which case the company operates. The future of the manufacturing industry will depend on its ability to respond to changes around the business world. The phenomenon of globalization and the revolution in information technology make the scope manufacturing industry increasingly dynamic, competitive, and complex.

In contrast, IT asset's portfolios with the industry environment as moderating variables are statistically significant effect on innovation. Based on these results, that the tendency of companies in Indonesia that have implemented ERP system directs the utilization of IT assets to new-product innovations. The results are consistent with research Xue et al. (2012). Companies that are in a more dynamic environment, shows that the conditions cannot be predicted in terms of customer preferences on goods and services (Xue *et al.*, 2012). Competition in a dynamic environment requires a radical innovation is to introduce new products and services by identifying and expanding new areas. So that, in these environment conditions more appropriate to IT exploration. The phenomenon of companies that have implemented ERP systems, showing the conditions of intense competition and more dynamic. It is, be a tendency that manufacturing companies in Indonesia direct utilization of IT assets to new-product innovations.

## **5. Conclusion and Limitations**

The study aims to analyze the influence of the industrial environment of the relationship between information technology asset portfolios with operational efficiency and innovation. The study states that there is a statistically significant and positive effect on the asset portfolio of information technology with operational efficiency. On the other hand, the moderating effects of industrial environments not statistically significantly support the effect on the relationship between the IT Asset Portfolios and Operational Efficiency.

The results from this study also suggest that the Environmental Industry statistically significantly affect the relationship between IT Asset Portfolio with Innovations. In a dynamic environment, the greater the company the greater the amount it will invest in IT to support exploration -innovation. In contrast in the condition of the company in a static environment, the greater the company the smaller the amount it will invest in IT investment to support exploration - innovation. In this study there are some limitations in measuring innovation using R & D costs for the components of financial statements that are considered as a reflection of the innovation of the company. Therefore, the possibilities of R & D costs are not all intended for product innovation. Further research should be able to sort out the cost of R & D as devoted toward the development of products compared to the cost for the improvement of internal business processes.

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