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## The performance impact of digital technology adoption in procurement: A case study of the manufacturing industry in the Eastern Economic Corridor, Thailand

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### ABSTRACT

#### Article history:

Received May 28, 2023

Received in revised format July 29, 2023

Accepted October 18 2023

Available online

October 18 2023

#### Keywords:

Procurement

e-Procurement

Digital technology adoption

Digital transformation

The procurement process is part of Purchase to pay (P2P) that consumes huge company costs. There are many procedures that need to be performed related to data. Without digital technology it might cause human error which will lead to issues in higher cost and will create a lot of delay in the procurement process. To improve procurement performance, selecting the right technologies that will create performance impact is quite a challenging task for the company. This study aims to examine the impact of digital technology adoption on procurement performance and to examine the mechanism through which digital technologies impact procurement performance. Target groups are medium and large manufacturing companies in the Eastern economic corridor, Thailand. In research findings, there is data supporting our hypotheses that digital technology adoption in procurement has a positive impact on procurement performance in cost and cycle time reduction. As a result of the moderation effect, reducing human errors, data availability and responsiveness moderated the positive impact between technology adoption and procurement cost reduction. The effect between technology adoption and procurement cycle time reduction has positively been mediated by reducing human errors and data availability. However, responsiveness rejected the hypothesis that mediates the relationship between technology adoption and procurement cycle time reduction.

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### 1. Introduction

There are many processes in procurement such as generating purchase requisition (PR), purchase order (PO), good received (GR), etc. (Rahman et al., 2019). Procurement processes are complex and need to involve many parties as there are three stages in procurement including sourcing stage, purchasing stage and payment stage (Agarwal et al., 2007). If the company will only use humans to perform tasks manually or work by using paper-based, it will cause huge effort to the team since they will need to maintain data for every procurement process (Bienhaus & Haddud, 2018). Therefore, if there is any mistake in payment or any process caused by human error, it will create company issues in the auditing process and reduce organization's credibility (Daher et al., 2017). With digital disruptions, the way of working in each company is currently changed and technology has been adopted in the working process (Barnes et al., 2003). In this era, many working capitals have been changed from human workers to automation processes using new technologies. Advanced technologies are being used in business processes to help the company and create a huge impact to company performance. The Thai government has announced an action plan to develop digital infrastructure in the Eastern Economic Corridor (EEC) which covers three provinces including Chachoengsao, Chonburi and Rayong (EECO., 2020). This research study aims to understand and measure performance impact from using digital technology in procurement functions. If the company located in EEC can improve performance impact from digital transformation, the results from this study can be applied to the expansion of other industrial estates. Companies are willing to minimize cost and cycle time of the procurement process as much as possible. There are a lot of technologies available in the market, many of them can be used in the company but it is also costly. To

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select the right technology to the right function is quite a challenging task for the company. Companies located in EEC Thailand, may have some functions that are still using manual processes. When choosing technology to replace human tasks inside the function, the thing that companies should consider is performance impact. As the price of implementation of one system is high, companies will need to select on which task that generates high benefits to the company. From the problem formulation, this study purpose to measure performance impact of procurement function in EEC industrial estate, the following questions will be addressed to meet the research objectives:

**RQ1:** What is the impact of digital technology adoption in the procurement operation on cost reduction?

**RQ2:** What is the impact of digital technology adoption in the procurement operation on cycle time reduction?

**RQ3:** What is the mechanism (i.e., data availability, responsiveness, human errors) through which digital technology adoption in the procurement operation influences procurement performance?

This study will help to confirm if the company performance has been improved because of digital technology used in procurement processes or not by following research objectives:

1. To examine the performance impact of digital technology adoption in procurement-on-procurement performance (i.e., cost and time reduction).
2. To understand how the impact of digital transformation on procurement performance is taking place (i.e., the mechanism)

Research results will help companies evaluate their company performance impact from technology uses in procurement. Also from the research findings, companies can know that technology that they are currently using is helpful or not. Apart from that they will also know which technology helps improve company and procurement performance.

## 2. Literature Review

Procurement is a part of supply chain management (SCM) process in which the main task of the function is to take care of identification, sourcing, and managing resources that a company requires to operate business (Lysons & Farrington, 2020). In the procurement function, purchasing tasks are focusing on products or services ordering from vendors, process to manage inventory and to pay vendor invoice. To make the supply chain process streamline, all parties need to improve their processes (Christopher, 2013). In Porter (1985) value chain, procurement operations are not in primary activities but located in support activities category. The support activities act as an integration function that supports most of the company activities. Not only procurement but there is technology development that helps all of the functions inside the company as supporters to improve business processes. The procurement market is now competitive from rapid changes that will make companies face higher complex and challenging tasks. Innovation will need to be adopted to be more effective in the procurement process. New business model and concept in procurement has been created since organizations faced with radical changes by adopting their processes to increase potential of innovations and pressure using technology like Artificial Intelligence, Big data, or AI, which are part of "Hybrid supply chain network" (Porter & Heppelmann, 2014). As there are many steps or processes in procurement operation, with the adoption of advanced technology to support procurement, there are steps that can use technologies to support their operation tasks. There are many technologies available to use in procurement operations, it can be separated into four categories. Four categories and technologies are including:

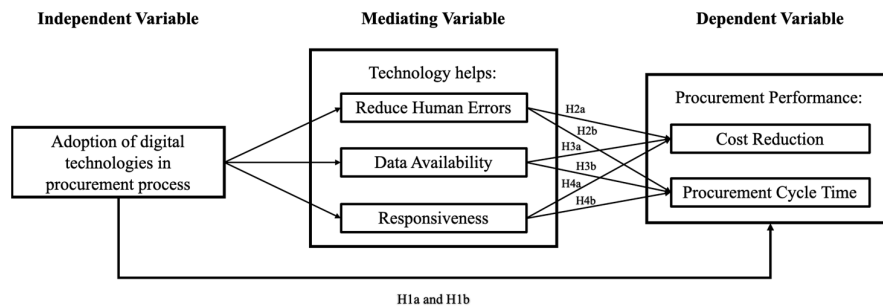
1. Connectivity and communication: IoT, Cyber security
2. Data, Intelligent and analytics: big data and analytics
3. Human to Machine and Machine to Machine: Manufacturing technology and VR
4. Advanced Procurement: Autonomous transport and advanced robotics

There are many factors that can influence digitization in procurement and the key drivers to generate profit and competitiveness of the organization digital transformation are from Artificial Intelligence (AI) and big data. Procurement strategy, demand planning, offer request, offer evaluation, negotiation, supply agreement, quantity determination, purchase order, material transport, material reception and inspection are procurement steps that can use listed technologies to help reduce human tasks. For tasks and cost elements related to demand analysis costs, supplier selection, and direct procurement costs can select these technologies including big data, data analytics tool, manufacturing technologies, IoT, cloud, virtual (VR) or augmented reality, cyber security, and robotics.

## 3. Research Framework and Hypothesis

Based on research objectives and literature reviews, the research conceptual framework has been developed with three groups of variables; The independent variable is adoption of digital technologies in the procurement process. A dependent variable is procurement performance which breaks down into cost reduction and procurement cycle time. Mediating variables connected between independent and dependent variables as variables that serve to pass on those influences including reducing human errors, data availability and better reaction to emergency. Adopting digital technology can enhance performance by

accelerating efficiency, decreasing mistakes, and decreasing cycle time. The procedure can be streamlined, made faster, and more accurate using computerized systems. To complete the purpose of the study, eight hypotheses were developed to test and confirm the result by following research objectives and conceptual framework.



**Fig. 1** Conceptual Framework of the study

**Hypothesis 1a and 1b:** In this research study, the following hypotheses (H1a – H1b) will be tested to determine the positive impact of digital technology adoption on procurement.

**H1a:** *The more the use of digital technologies in the procurement process, the higher the cost reduction.*

**H1b:** *The more the use of digital technologies in the procurement process, the lower the cycle time.*

**Hypothesis 2a and 2b:** *Human error reduction mediates relationship between technology adoption in procurement and procurement performance.*

**H2a:** *The more the use of digital technologies in the procurement process, the lower the human errors, and this, in turn, reduces the procurement cost, i.e., Reducing human error mediates the relationship between the use of digital technologies in the procurement process and cost reduction.*

**H2b:** *The more the use of digital technologies in the procurement process, the lower the human errors, and this, in turn, reduces the procurement cycle time; i.e., Reducing human error mediates the relationship between the use of digital technologies in the procurement process and procurement cycle time.*

**Hypothesis 3a and 3b:** *Data Availability mediates relationship between technology adoption in procurement and procurement performance.*

**H3a:** *The more the use of digital technologies in the procurement process, the higher the data availability, and this, in turn, reduces the procurement cost, i.e., Data availability mediates the relationship between the use of digital technologies in the procurement process and cost reduction.*

**H3b:** *The more the use of digital technologies in the procurement process, the higher the data availability, and this, in turn, reduces the procurement cycle time, i.e., Data availability mediates the relationship between the use of digital technologies in the procurement process and procurement cycle time.*

**Hypothesis 4a and 4b:** *Company responsiveness mediates relationship between technology adoption in procurement and procurement performance.*

**H4a:** *The more the use of digital technologies in the procurement process, the higher the responsiveness, and this, in turn, reduces the procurement cost, i.e., Company responsiveness mediates the relationship between the use of digital technologies in the procurement process and cost reduction.*

**H4b:** *The more the use of digital technologies in the procurement process, the higher the responsiveness, and this, in turn, reduces the procurement cycle time, i.e., Company responsiveness mediates the relationship between the use of digital technologies in the procurement process and procurement cycle time.*

#### 4. Research Methodology

The design of this research created based on a conceptual framework, to collect data quantitative methods has been selected. The questionnaire has been developed and designed to test eight hypotheses by using Seven-Point Likert scale. For sample size, there are almost eighty-thousands of companies located in EEC or Eastern development of Thailand as mentioned by the Department of Business Development (DBD). Medium and Large companies will be selected as samples for this research (Allal & Finnegan, 1999). The appropriate sample size for this study focusing only one industry, one function and two sizes

of company would be around 100. Most companies in EEC are small enterprises but it might not be suitable to respond to this survey as they might not invest on new technology, so researchers would not define it as a true population.

**Table 1**  
Seven Likert scale criteria for preference level ranking

Average Score between	Preference Level / Level of Important	Average Score between	Preference Level / Level of Important
0.00 – 1.00	Extremely Less Important	4.01 – 5.00	Important
1.01 – 2.00	Very Less Important	5.01 – 6.00	Very Important
2.01 – 3.00	Less Important	6.01 – 7.00	Extremely Important
3.01 – 4.00	Neutral		

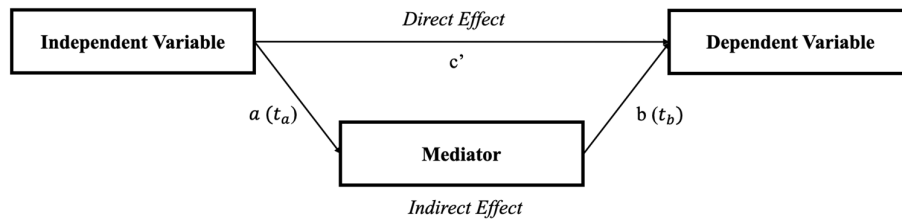
Source: Braunsberger, K., & Gates, R. (2009)

**Table 2**  
Standard Value

Test Value	Significant Level	Specification
Probability Value (p-value)	$p < 0.05$	Significant
Test Statistic (t-value)	$p > 0.05$	Not significant
	$t > 1.96$	Significant
	$t < 1.96$	Not significant

Source: Bevans, R. (2022), Frost (2022)

To analyze data collected from 100 respondents, each item has been summarized by using statistical analysis of average to see which items are the highest and lower. Questionnaires collected from manufacturing companies located in EEC will calculate average as a whole EEC to see overall results and calculate separately by medium and large company sizes. Simple linear regression and moderated regression have been used to confirm relationship between variables. t-value or t-stat calculated higher than 1.96 and p-value is less than 0.05 can conclude that there is significant relationship between variables and can accept alternative hypothesis proposed.



**Fig. 1** Coefficients of Mediation effect

Source: Woodworth's (1928) S-O-R model

In regression analysis, beta value and R square calculated are also used to interpret the relationship between variables. R square calculated explained percentage of change from one variable to another. The Sobel test use to test whether a mediator carries the influence of an independent variable to a dependent variable, Sobel (1982).

**5. Results and Finding**

One hundred responses collected have been calculated to prove research hypotheses by followed from research framework. Descriptive statistics including mean and standard deviation has been used to analyze each questionnaire item. To analyze the relationship between variables and to test hypotheses, regression analysis has been calculated. The Sobel test can be used to analyze moderation effects between independent and dependent variables with moderators. Also, the Sobel test will be used to measure the difference between direct and indirect effects of variables proposed in the research model.

**Table 3**  
Summary of Descriptive Statistics for all variables

No.	Technology Adoption in Procurement (TA)										Procurement Performance (PP)				Technology Mechanism (MD)					
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	5	
N	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Mean	5.93	5.89	6.11	6.06	5.93	6.23	6.20	5.73	6.29	6.17	5.70	5.67	5.95	5.98	5.88	5.74	6.04	5.94	6.11	5.80
S.D.	.95	.91	.84	.86	.91	.83	.72	1.08	.86	.78	1.13	1.00	.87	.84	.72	.63	.78	.69	.66	.88

*5.1 The Effect of Adoption of digital technology in procurement process to Procurement Performance*

As mentioned in the research model and hypotheses that this study would like to determine relationship and impact of digital technology adoption in procurement process to procurement performance, research findings have been concluded and conducted t-test to test proposed hypotheses. t-value and p-value have been used to analyze the relationship between variables.

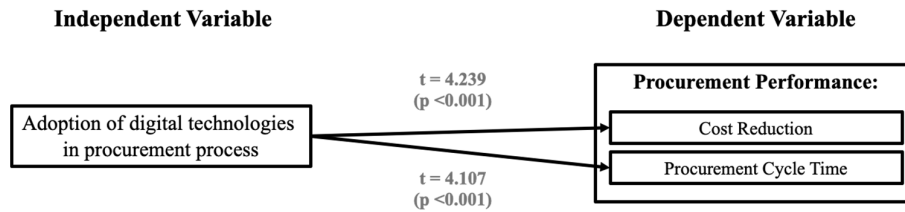


Fig. 2. A flow of relationship between independent and dependent variable

According to Table 2, there are two hypotheses which are the relationship between technology adoption in procurement to cost reduction in procurement (H1a) and relationship between technology adoption in procurement to cycle time reduction. The probability for both hypotheses is less than 0.001 which means that the relationship between two variables is significant.

**Table 3**  
t-Statistic and p-value of relationship between independent and dependent variable

Independent Variable	Dependent Variable	Test Statistic	p-Value
Adoption of digital technologies in procurement process	Procurement Performance: <i>Cost Reduction</i>	4.239	< 0.001
	<i>Procurement Cycle Time</i>	4.107	< 0.001

Note: n=100

Results of hypothesis H1a and H1b can be summarized as shown in Table 4. Both t-values are higher than the acceptable rate of 1.96 and the higher rate of t-value or show that there is higher evidence in contradiction of null hypothesis, then reject the null.

**Table 4**  
Hypotheses results of relationship between independent and dependent variables

	Hypotheses	Results
H1a	The more the use of digital technologies in the procurement process, the higher the cost reduction	Supported
H1b	The more the use of digital technologies in the procurement process, the lower the cycle time	Supported

5.2 The Moderating Effect of Indirect and Direct Effect

As proposed in research models and hypotheses, in this research study there is a technological mechanism that is a mediator between the relationship of technology adoption in procurement and procurement performance. Six hypotheses, H2a – H4b which are proposed to test moderating effect will be analyzed and interpreted to result in flow and table which has been measured using t-test and examined using criteria of significance level in the following section to prove hypotheses. Sobel test has been used to test multiple mediators (Preacher & Hayes, 2008).

5.2.1 Mediation effect between technology adoption in procurement and cost reduction in procurement

Moderation analysis has been calculated and is present in Fig. 3 and Table 5. Technology mechanism which generates human error reduction, increase of data availability and company responsiveness was examined as a moderator for the relationship between technology adoption in procurement and procurement performance, i.e., cost reduction. To test the moderation effect, three hypotheses including H2a, H3a, and H4a have been proposed.

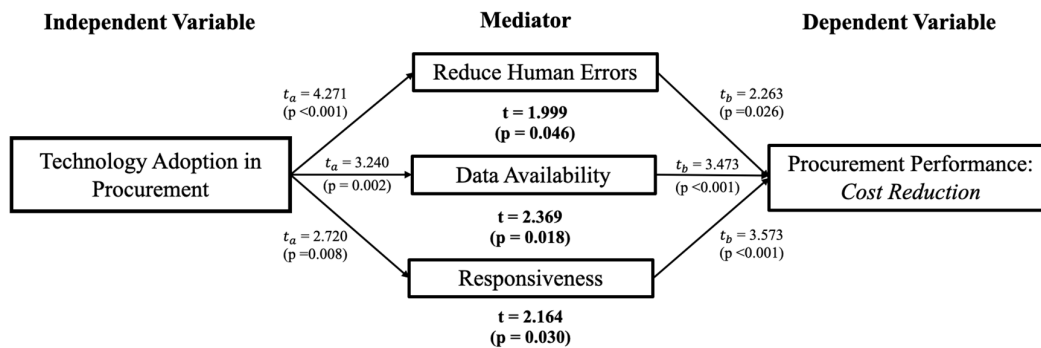


Fig. 3. Flow of mediation effect from independent to dependent variable (Cost Reduction)

**Table 5**  
The Sobel Test of Mediation effect of Independent on Dependent Variable (Cost Reduction)

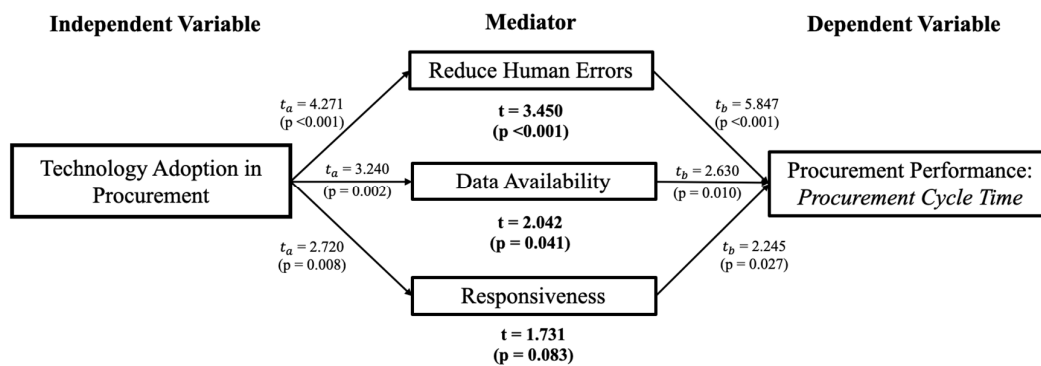
Independent Variable	Mediator	Dependent Variable	Test Statistic	p-Value
Adoption of digital technologies in procurement process	Reduce Human Error	Procurement	2.000	0.046*
	Data Availability	Performance:	2.369	0.017*
	Responsiveness	Cost Reduction	2.164	0.030*

Note: Test statistics (t-test stat) = t value, \* Significance

From statistic calculation, when compared t-value of three moderation effect between technology adoption in procurement and cost reduction in procurement, the highest t-value is a moderation effect with “Data Availability” (t = 2.369); i.e., The best mediator that mediate relationship between technology adoption in procurement and cost reduction in procurement is data availability. All statistical analysis for mediation effect from technology adoption to procurement cost reduction, hypotheses proposed are all accepted.

5.2.2 Mediation effect between technology adoption in procurement and procurement cycle time reduction in procurement

Fig. 4 and Table 6 illustrate calculated results from moderation analysis. Technology mechanism which generates human error reduction, increase of data availability and company responsiveness was examined as a moderator for the relationship between technology adoption in procurement and procurement performance; i.e., cycle time reduction.



**Fig. 4.** Flow of mediation effect from independent to dependent variable (Proc. Cycle time)

**Table 6**  
The Sobel Test of Mediation effect of Independent on Dependent Variable (Procurement Cycle Time)

Independent Variable	Mediator	Dependent Variable	Test Statistic	p-Value
Adoption of digital technologies in procurement process	Reduce Human Error	Procurement Performance:	3.450	< 0.001*
	Data Availability	Procurement	2.042	0.041*
	Responsiveness	Cycle Time	1.731	0.083**

Note: \* Significance, \*\* In-Significance

From statistical, when compared t-value of two accepted moderation effect between technology adoption in procurement and cost reduction in procurement, the highest t-value is a moderation effect with “reduce human error” (t = 3.450); i.e., The best mediator that mediate relationship between technology adoption in procurement and procurement cycle time reduction is to reduce human error. From three hypotheses proposed to test mediation effects between technology adoption in procurement and cycle time reduction in procurement, two has been accepted, but one hypothesis measuring company responsiveness mediation effect between technology adoption and cycle time reduction in procurement (H4b) has been rejected. Therefore, from statistical calculations shown in Table 5 and Table 6 to test mediation effects that influence relationship between independent and dependent variable, hypotheses results can be concluded as listed in Table 7. From eight hypotheses proposed, seven relationships were supported or created an impact between variables, and one was rejected or did not create impact between variables.

**Table 7**  
Hypotheses results of mediation effects.

	Hypotheses	Results
<b>H2a</b>	The more the use of digital technologies in the procurement process, the lower the human errors, and this, in turn, reduce the procurement cost; i.e., Reducing human error mediates the relationship between the use of digital technologies in the procurement process and cost reduction.	Supported
<b>H2b</b>	The more the use of digital technologies in the procurement process, the lower the human errors, and this, in turn, reduces the procurement cycle time; i.e., Reducing human error mediates the relationship between the use of digital technologies in the procurement process and procurement cycle time.	Supported
<b>H3a</b>	The more the use of digital technologies in the procurement process, the higher the data availability, and this, in turn, reduces the procurement cost; i.e., Data availability mediates the relationship between the use of digital technologies in the procurement process and cost reduction.	Supported

	Hypotheses	Results
<b>H3b</b>	The more the use of digital technologies in the procurement process, the higher the data availability, and this, in turn, reduces the procurement cycle time; i.e., Data availability mediates the relationship between the use of digital technologies in the procurement process and procurement cycle time.	Supported
<b>H4a</b>	The more the use of digital technologies in the procurement process, the higher the responsiveness, and this, in turn, reduces the procurement cost; i.e., Company responsiveness mediates the relationship between the use of digital technologies in the procurement process and cost reduction.	Supported
<b>H4b</b>	The more the use of digital technologies in the procurement process, the higher the responsiveness, and this, in turn, reduces the procurement cycle time; i.e., Company responsiveness mediates the relationship between the use of digital technologies in the procurement process and procurement cycle time.	Rejected

## 6. Discussion and Conclusion

Direct effect or impact from digital technology adoption in the procurement process to procurement performance has positive results. The moderation effect of technology mechanisms that help improve procurement performance has been measured, five moderation effects between dependent and independent have been accepted and one has been rejected from statistical calculation. When digital technologies are used in procurement functions, it can help improve decision making, reduce information asymmetry and support transactions across functions which lead to reduced costs (Roeck et al., 2020). The cost of transaction in procurement can be reduced due to paperless operations when the company has replaced paper-based work with digital technologies. Use of e-procurement helps to improve company processes, increase procurement performance, productivity, management system, administrative cost and time saving. Syed also mentioned that 60 percent of time can be reduced from using e-procurement. Time can be reduced when tasks inside procurement functions have been performed using an online system or when manual tasks have been replaced by technologies. In conclusion, there is related literature to support hypotheses H1a and H1b that measure impact of digital technology adoption in procurement function on procurement cost reduction and cycle time reduction. Cost and time will be reduced if companies adopted more technology into their organization to help create streamlined operations and reduce repetitive tasks by humans.

Most of the company's losses are from human errors. To adopt digital technology inside the procurement function, Dekker (2017) said that more technologies used inside the function does not remove the potential of human error, but technology will be used to relocate humans and change or improve the process. Moreover, to solve this issue, repetitive tasks or risky tasks that might create mistakes from humans will be replaced by digital technology. Technology adopted cannot help a company to reduce cycle time by itself, but to make it effective is to improve the procurement process to reduce duplicate and manual tasks, then finally automating the process with the technology adopted. Human errors can be reduced when humans have better decision making. In conclusion, companies often use digital technology to reduce human errors which lead to cycle time reduction. In this era, data availability in companies has been discussed widely. The term that is mostly used is "Big data". When there is technology adoption inside the procurement function, it makes the company more transparent, employees with authorization can access the database, which can help the company to justify cost saving and cost effectiveness from data availability inside and across company functions (Mackey & Cuomo, 2020). Also, when a company can finish the negotiation process in procurement faster, it can reduce lead time and will benefit procurement cycle time reduction. In conclusion, when companies adopt technology to increase data availability to access anywhere and anytime to make the process done faster and easier can reduce procurement cycle time. To be competitive among competitors, responsiveness is important, and a company needs to understand the processes to react faster to emergency situations. If the procurement process is not stable, it can create higher costs in the procurement function. On the other hand, if a company can create a stable process in procurement, it will create an impact which helps the company reduce procurement cost (Tomino et al., 2012). Apart from responsiveness that can influence the relationship between technology adoption and cost reduction in procurement, companies may have different responsiveness directions and approaches to take actions or set their strategies on time-based reduction. The company cannot have less processing time in procurement when their responsiveness has been improved by technologies. The technology will help to not create delays or bottlenecks in the process from emergencies and to shorten or lower the cycle time in procurement (Bag, 2016).

## 7. Limitation and Scope of future research

The limitation for this research study was a difficulty in data collection from companies in EEC. Researchers took a long time to collect hundreds of responses from manufacturing companies since the government database that provides company basic information does not have company email. As this research has focus only performance impact of digital technology adoption in procurement function located in EEC area, medium and large manufacturing area as a scope of research, in the future research small size of company can be used to be a sample to analyze whether how many task that company has perform using digital technology and impact to the performance. Moreover, there are many more aspects of technology mechanisms that future research study can select as moderators to prove the relationship between independent and dependent variables.

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