Modeling IT Value based on Meta-Analysis

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***Abstract*—Over the last two decades, research about IT value has been done. The main purpose of IT values research is to determine how IT investment gives impact and value to organization performance. Because of vital role and function of IT, the organization required to understand how IT could create business value. Therefore, an understanding of IT value is needed. Systematic literature review in meta-analysis is required to determine the relationship between IT resources, organization capabilities, organization core competencies, and organization performances. The research was conducted on 53 publications which generate the classification matrix components that have an impact on organization performance. Hypothesis testing results that organization has the best performance on financial, efficiency, and other performance through external capability and core competence. So, indirect effect model is better than direct effect model in explaining IT value.**

Keywords—IT value, the impact of IT, IT resources, organization capabilities, organization core competencies, organization performances, systematic literature review, meta-analysis.

I. INTRODUCTION

Recent research on IT value gives various results on organization performance [1][2]. Research results in IT value mentioned that there is the indirect impact on organization performance through organization capability [5][7][8][9]. This concept is known as "IT-enabled organization capability". Therefore, IT resource holds a very important role in determining organization capability that can create value and profit for the organization performance [3][7][10]. Besides, the research result also states that indirect effect of IT resource on organization performance is influenced by the organization core competence because it can help an organization to coordinate and integrate the skills and proprietary technologies [19]. Michael Porter (1986) explained that the core competence can make companies that run the same business different from their competitors. This difference makes the companies achieve the goals that have been set [20][21][22]. These indicate that without IT, the organization will not be able to use their capabilities and core competencies to run the activities and achieve organization performance. It opens an opportunity and new challenges for the organization to synergize and collaborate IT with capabilities and core competencies since it is not easy to integrate it.

Furthermore, although the research of IT value significantly evolved over last few years, there are still limitations founded in uncovering IT components which could give IT value on the organization and how mechanism and the right model of IT for an organization. Therefore, a meta-analysis is conducted to answer the main problems as follows:

A. How are the concept and the components of IT value creation for the organization?
B. What organization capabilities and core competencies that can maximize IT resources?
C. What organization performances that can be created by IT?
D. What areas can potentially be identified for further research?

II. RELATED WORKS AND RESEARCH MODEL

A. Related works

The research questions in IT value are how IT investments contribute and what IT components contribute to organization performance [11]. It triggers researchers to shift the direction of the research focus from the direct effect to what mechanism of IT contribute to organization performance. Furthermore, how their collaboration and synergies to create business value for the organization. Through this perspective, the researchers in this area have used approach based on process, where IT resources do not directly impact on improving organization performance, but through IT capabilities [12] and IT core competencies [26][27] such as operational capabilities or use of IT, IT personal competence, collaboration capabilities/systems integration, and IT management capabilities [6][7][13][14], exclusiveness of the core competence, added value creations of the core competencies, cost reductions of the core competence, productivity enhancement of the core competence, uniqueness, extendibility [28][29]. This research was developed based on the research result of Liang (2010) [8] by adding organization core competence as new mediator & increasing the number of IT value publications from 2010 to 2016. Therefore, in this meta-analysis, this study will identify and classify components of IT value model: (i) IT resources, (ii) Organization capabilities, (iii) Organization core competencies and (iv) Organization performances.

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B. Research Model

Fig. 1 shows how IT value model effect on organization performances. There are two effects, i.e., the direct and the indirect. Effect of IT resources on organization performances without mediator is the direct effect, while the effect of IT resources through organization capabilities and core competencies as the mediator that bridge IT resources with organization performances called the indirect effect.

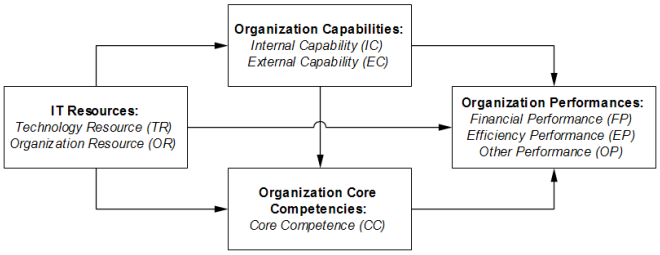

Fig. 1. Research Model

In this systematic literature review, an investigation of IT value on the organization is conducted, both private sector, and public sector. IT resources are examined not only by focusing on IT investment financially, but also by including non-financial, such as IT assets, IT infrastructure, human resources, and IT management. The coverage of unit analysis are also expanded, i.e., other performances that are popular to define a successful in improving organization performance, such as quality data/information and quality service [4][15][16][17] [18]. This study collects publications that are relevant in the database of research journals covered by Scopus, Science Direct, JSTOR and Elsevier. Multiple keywords are used in this study: "IT value", "value of IT", "IT impact", "IT resources", "IT investment", "organization capabilities", "organization core competence", and "organization performance". Finally, this process results 53 relevant publications.

III. Methodology

This research uses systematic literature review as the methodology and meta-analysis to process the data. A systematic literature review is used to determine the dimension of research model components, identify and analysis the variables collected from various publications or previous research. Statistic tests used in this meta-analysis sourced from Rosenthal [25], Hunter and Schmidt [23], and Hedges and Olkin [24]. The average plot of product moment correlation *r* is used as the data basis of meta-analysis (from correlations value on 53 publications), Combined Fisher's Z-score and Fail-safe N (Nfs) as the determiner whether the null hypothesis is accepted or not. The total effect size indicates the effect independent variables on the dependent variables. There are 3 effect groups of the total effect size suggested by Cohen (1997) i.e., in sequence, low effect when (r) > 0.1), medium effect when (r)> 0.3, and high effect when (r) > 0.5 Nfs indicates the number of publications that would be required to nullify the effect. In 95 percent confidential, the significant tolerance level of Nfs is > 5*k+10, where k is the total number of research in each pairwise relationship [25].

IV. Result

A. Grouping of variable's dimensions

Journal publications were collected within the period of last 15 years from the top international journals in the area of the information system and information technology.

1. Organization performances

Organization performances are grouped into three, namely financial, efficiency, and other performance (e.g. intangible performance such as satisfaction, innovation, market share).

TABLE I. Grouping of Organization Performance's Dimensions

Dimensions	Indicators	References
Financial Performance		
Financial Indicator	ROE	[31]
	Growth	[43], [27], [51], [53],[71], [59]
	GDP	[37]
	ROI	[39],[51], [48], [77],[71]
	Sales Revenue	[48], [53]
	ROA	[74], [7], [76], [9]
	Net Margin	[7]
Profitable and Benefit	Profitable	[30], [32], [34], [39], [40], [48],[51], [53], [77], [9],[71], [59]
Eficiency Performance		
Cost Efficiency	Cost Efficiency, Cost Reduction	[6], [78],[68], [73], [76], [70], [28]
Process Efficiency	Production Effectiveness	[40], [50], [73], [52], [28]
	Operasional Efficiency	[65], [39]
	Time Efficiency	[71],[45],[71]
Other Performance		
Market	Market Share, Market Value, Market Development	[31], [39], [44], [48],[71]
Quality	Tobin's Q	[31], [32], [34], [78], [7], [42], [72], [29]
Innovative	Innovative Orientation	[35]
	R&D, Patents,	[78]
	Modified products & New Products	[48], [61], [7]
Statisfaction	Customer Statisfaction	[4],[45],[68], [76], [52]
Strategic	Strategic Benefit	[65]
Risk	Treynor Rasio	[67]
Relationship	Customer Relationship	[77], [69]

2. Organization capabilities

Organization capabilities are grouped into two, namely internal capability and external capability. The Internal capability is the ability to utilize the organization's resources to improve internal controls capabilities, strengthen cooperation between the internal organization, and the capacity of the system and development (managing internal IT relationship, managing internal organization capability, and IT planning and management). The external capability is the ability to adapt to the outside environment of organization, cooperate and share information with the organization partners to meet customer needs and face competitors in the market (external relationship)

TABLE II. GROUPING OF ORGANIZATION CAPABILITIES DIMENSION

Dimensions	Indicators	References
Internal Capabilities		
Managing Internal IT Relationship	IT Operations/Use Capability	[41], [39], [9],[45]
	System Integration, Collaboration	[55]
	Data/Information Sharing	[52], [50], [76]
	Technology Sensing & Responding	[46], [49]
Managing Internal Organization Capability	Knowledge Capability	[43], [54]
	Human Resource Capability	[7], [9]
	Intrapreneurship Culture	[44]
IT Planning and Management	IT Management Capability	[52], [39], [54]
	IT Strategy Planning Capability	[39], [73], [54], [58]
	IT Flexibility	[50], [76]
	Knowledge Management Capability	[51], [52], [74], [75]
External Capabilities		
External Relationship	Customer or Supply Side Capability	[41], [52], [48], [72],[45], [47], [56], [66], [69],[71]
	Relationship Management	[55], [52], [75], [77], [26], [49], [58]
	Marketing Capability	[9], [56]
	Dynamic Capabilities	[79]
	Market Sensing & Brand Management	[66], [70]

3. Organization core competencies

The variables that are mostly used by researchers to represent organization core competencies are related to the product (unique, inimitable, new product development) and none product (IT competence, IT support competence, process oriented dynamic capability, and market competence).

TABLE III. GROUPING OF ORGANIZATION CORE COMPETENCIES DIMENSION

Dimensions	Indicators	References
Core Competence		
Product	Unique & Inimitable	[28], [29], [58]
	New Product Development	[79], [29]
Non Product	IT Competence	[27], [59], [26], [63]
	IT Support	[39]
	Exploitative & Exploratory innovative competence	[61]
	Process Oriented Dynamic Capabilities	[53], [54]
	Market & Integrative Competence	[59], [63]

4. IT resources

There are two variables in the grouping of IT resources dimension, i.e., technology resources and organization resources. Table IV shows matrix results of clustering technology resources that include IT investment, IT infrastructure and IT assets, and organization resources that include the knowledge and human resource.

TABLE IV. GROUPING OF IT RESOURCES DIMENSION

Dimensions	Indicators	References
Technology Resource		
IT Investment	IT Investment	[32], [34], [9], [44], [30],[31], [53]
	IT Budget	[30], [6], [37], [50],[70]
	IT Spending	[72]
IT Infrastructure	IT Infrastructure	[39], [40],[51], [67], [73], [7]
	IT Vendor Support	[35], [46], [67]
IT Assets	IT/Relationship Assets	[78], [7],[45], [77], [35],[51], [73]
	IT Use	[43], [65], [46], [79]
	IT Strategic	[32], [67], [7]
	IT Alignment / Relatedness	[48], [67], [74]
	IT Readiness / Commitment	[35],[51]
	IT Planning and Management	[40], [53], [44], [39], [48]
	Software, System Application	[27], [40], [50], [53]
Organization Resource		
Knowledge Resource	IT training and support	[40]
	Knowledge Resource	[53], [73], [77], [4], [7]
Human Resource	Human Resource Skill	[40], [35],[45], [67], [77], [46]
	Technical IT & Relational IT Skill	[39], [50], [9],[51]
	IT Personel Skill	[55], [66]
	IT Steering Committee	[76]

B. *Model IT value*

1. *Direct effect model*

The meta-analysis result of the direct effect model is shown in Table V. It can be seen that the combined Z Scores of all the hypothesis testing are significant. Nfs of the hypothesis passes their tolerance level of Nfs. It means that IT resources have the positive effect on the organization performances. Their effect size (r) is < 0.3. So, the direct effects between IT resources and organization performances are in low effect. Therefore, direct effect model of IT value is not suggested.

TABLE V. CORRELATIONS BETWEEN IT RESOURCES AND ORGANIZATION PERFORMANCES

Hypothesis Test (H1)	TR-FP	TR-EP	TR-OP	OR-FP	OR-EP	OR-OP
Number.of Studies	14	7	11	7	6	8
Total Samples Size	4955	1604	2678	1490	704	1864
Effect size (r)	0,11	0,11	0,17	0,22	0,27	0,18
Combined Z Scores*	9,01	6,09	9,38	8,62	6,75	8,02
Tolerance Level of Nfs	80	45	65	45	40	50
Nfs (p =0.05)	283,00	61,00	242,00	129,00	66,00	127,00
Hypothesis Supported	**Support Low Effect**	**Support Low Effect**	**Support Low Effect**	**Support Low Effect**	**Support Low Effect**	**Support Low Effect**

*Note: * (p<0.001)*

2. Indirect effect model

a. IT resources and organization performances, organization capabilities as mediator

Table VI shows statistic results between IT resources and organization capabilities. It can be seen that the combined Z Scores of all the hypothesis testing are significant. Nfs of the hypothesis passes their tolerance level of Nfs. It means that IT resources have the positive effect on the organization capabilities. Their effect sizes (r) are > 0.3 and < 0.5. It means that the effects between IT resources and organization capabilities are in medium effect.

TABLE VI. CORRELATIONS BETWEEN IT RESOURCES AND ORGANIZATION CAPABILITIES

Hypothesis Test (H1)	TR-IC	TR-EC	OR-IC	OR-EC
Number.of Studies	12	6	9	5
Total Samples Size	2541	1100	1454	809
Effect size (r)	0,44	0,33	0,47	0,44
Combined Z Scores*	20,88	10,92	18,78	12,49
Tolerance Level of Nfs	70	40	55	35
Nfs (p =0.05)	1352,00	181,00	819,00	199,00
Hypothesis Supported	**Support Medium Effect**	**Support Medium Effect**	**Support Medium Effect**	**Support Medium Effect**

*Note: * (p<0.001)*

Table VII shows that all the hypothesis are significantly supported. The internal capability has the medium effect on other performances (e.g. innovation, satisfaction) but it has low effect on financial performance. However, the internal capability has no effect on efficiency performance. On the other hand, the external capability has the medium effect on organization financial, efficiency, other performances.

TABLE VII. CORRELATIONS BETWEEN ORGANIZATION CAPABILITIES AND PERFORMANCES

Hypothesis Test (H1)	IC-FP	IC-EP	IC-OP	EC-FP	EC-EP	EC-OP
Number.of Studies	9	7	11	8	8	8
Total Samples Size	2351	1554	2354	1485	2176	1612
Effect size (r)	0,27	0,09	0,36	0,40	0,36	0,42
Combined Z Scores*	14,67	7,45	18,92	16,54	18,84	18,66
Tolerance Level of Nfs	55	45	65	50	50	50
Nfs (p =0.05)	496,00	95,00	1015,00	562,00	732,00	718,00
Hypothesis Supported	**Support Low Effect**	**Support None**	**Support Medium Effect**	**Support Medium Effect**	**Support Medium Effect**	**Support Medium Effect**

*Note: * (p<0.001)*

b. IT resources and organization performances, organization core competencies as mediator

IT resources have the medium effect on organization core competencies as shown in Table VIII. The effect sizes of these variables are 0.39 and 0.33. In addition, the relationship between organization capabilities and core competencies is not significantly supported by both organization capabilities, but only on internal capability. Nfs of external capability does not pass tolerance level of Nfs. Furthermore, core competencies and organization performances have the medium effect. The biggest effect of core competencies is in other performances then is followed by financial and efficiency performance. This result can be seen respectively in Table VIII and Table IX.

TABLE VIII. CORRELATIONS BETWEEN IT RESOURCE AND ORGANIZATION, CORE COMPETENCIES, AND CAPABILITIES

Hypothesis Test (H1)	TR-CC	OR-CC	IC-CC	EC-CC
Number.of Studies	6	3	3	3
Total Samples Size	1613	539	651	509
Effect size (r)	0,39	0,33	0,40	0,19
Combined Z Scores*	15,29	10,00	10,66	5,09
Tolerance Level of Nfs	40	25	25	25
Nfs (p =0.05)	360,00	76,00	86,00	18,00
Hypothesis Supported	**Support Medium Effect**	**Support Medium Effect**	**Support Medium Effect**	**Not Support**

*Note: * (p<0.001)*

TABLE IX. CORRELATIONS BETWEEN ORGANIZATION CORE COMPETENCIES AND PERFORMANCES

Hypothesis Test (H1)	CC-FP	CC-EP	CC-OP
Number.of Studies	6	3	6
Total Samples Size	1267	576	1044
Effect size (r)	0.35	0.32	0.36
Combined Z Scores*	12.05	7.70	12.32
Tolerance Level of Nfs	40	25	40
Nfs (p =0.05)	221.00	44.00	232.00
Hypothesis Supported	**Support Medium Effect**	**Support Medium Effect**	**Support Medium Effect**

*Note: * (p<0.001)*

Based on the results of meta-analysis study above, the model of IT value is proposed. The proposed model shows the relationship and the effect of all the variables to organization performances. Fig. 2 shows the direct effect and indirect effect of IT value model. The direct model has the low effect and indirect model has the medium effect. It means IT resource has the best effect on organization performance through organization capabilities and organization core competencies.

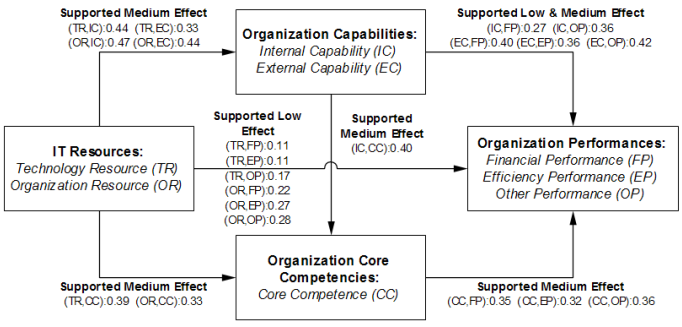

Fig 2. The Result of IT Value Model

V. CONCLUSION

The result of IT value model shows that technology resources and organization resources enhance internal and external capabilities and core competencies toward the organization performances. Through external capability and

core competence, the organization can maximize the IT resources and perform the best performance (financial, efficiency, and others). While the external capability has the possitive effect on all type of performances, internal capability only covers on the financial and other performance. Furthermore, internal capability and organization core competence have positive relationships and medium effect on each other. It means that enhancing capability will enhance the core competence values, and the core competence will enhance the value of capability and then will enhance organization performance. So, the indirect effect model is better than the direct effect model in describing the effect of IT value on organization performances.

VI. LIMITATION AND FURTHER RESEARCH

The meta-analysis study in this research has some limitations. First, the number of publications that uses the core competence as the component of IT value model is limited. Further research needs to enhance the component of organization core competencies, particularly on the dimension and indicators of core competencies. Second, the proposed of IT value model need to be verified and implemented in the IT-intensive organizations. Future research will cover this limitation by verifying and implementing the proposed model in the private industrial organization, such as banking sector and telecommunication organization, and also IT-intensive public sectors.

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