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The Usage of Information System as the Determinant of Successful Implementation of Business Model in Construction Project Based: A Study of Construction Companies in Indonesia

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Abstract*---The success business model in construction project become interesting topic to be investigated by the researcher mainly due to the fact that the failure of the construction companies are rampant. The main problem that has been found form this research is that opinion of the user in Information System (IS) contribution is significant to the projects' success. Therefore, the objective of this research is to investigate the significant effect of IS towards the projects' success through individual and organization. The variable of this research consists of system quality, information quality, intention to use, user satisfaction and individual impact. All variable was linked and analysed by using Smart PLS3 to investigate the validity, reliability, direct and indirect effect. The result showed that all variables and indicators have valid that indicated by loading factor and AVE value higher than 0.5. Direct effect analysis have CR value higher that t-table (2.00) and indirect effect has t-stat higher than t-table. Its mean that all variables and indicator of this research were significant or have a positive effect between variables. This research proved that the usage of the information system contribute significantly towards the successfulness of the implementation of the business model in the construction companies particularly in West Java, Indonesia.*

Keywords*---Construction companies, Business model*

I. INTRODUCTION

Improving Indonesia's infrastructure is the top priority of the policy of the current Indonesian President. Hence, by improving connectivity across Indonesia, this will help to reduce the economic gap throughout the country, thus achieving the last principle of Indonesia's National Basic Principle, "Social Justice for All Indonesian People". The huge gap would resulted an unhealthy balanced between the rich and the poor that may cause a chaotic situation whereby the social relationship amongst the people would be affected greatly. Thus, the information system should play the role to highlight to the current government on the areas that need to be improved and thus would create justice to all the people in Indonesia.

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In the government's National Medium-term Development Plan (RPJMN) 2015-2019, which focuses strongly on infrastructure development, a budget of around Rp4,769tr is needed for its infrastructure development over 2015-2019. However, not all will be funded by the State Budget. The government will allocate Rp1,941tr of its State Budget (41.3% of the required total funding) to build infrastructure, while SOEs and the Infrastructure budget allocation in APBN 2018 (Rp tr) private sector are expected to support state infrastructure.

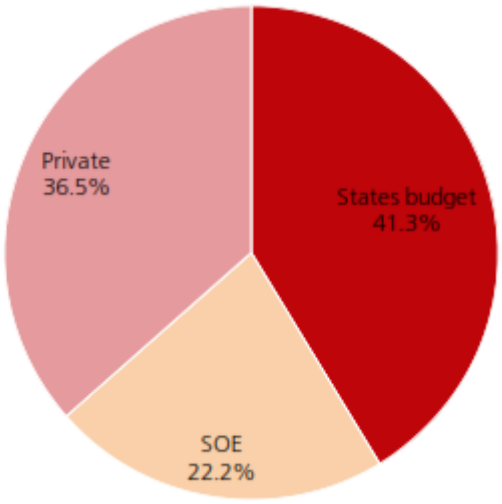

Figure 1:*Infrastructure funding plan for 2015-2019 National Medium-term Development Plan (DBS Group Research, 2018)*

The Indonesian government has allocated Rp410.7tr for its infrastructure budget in 2018 that represents a 5.8% y-o-y increase. Despite its decision not to increase fuel prices amid rising global crude oil prices and introduce more subsidy-centric policies in 2018, its solid commitment to infrastructure spending can be seen in the ratio of infrastructure budget over total government spending, which stood at 18.5% – flat y-o-y but still much higher than the previous regime's c.10%.

In terms of the breakdown of the infrastructure budget, the Ministry of Housing, which is responsible for providing affordable housing to the low income segment, receives a 26% allocation of the total government spending or Rp107tr. The Ministry of Transportation only gets less than half of the amount, at Rp48.2tr. The Special Allocation Fund (DAK) and State Asset Management Institution (LMAN) are given 2018 budget allocations of Rp33.9tr and Rp41.5tr respectively.

As such, we expect Indonesian contractors' orderbook to remain solid given the country's slower-than expected infrastructure development. We expect new contracts for companies in our coverage to grow at a CAGR of 5.03% in FY18F-FY20F (vs CAGR of 30.17% in FY10FY17), as we take into account the soft economic growth outlook and global economy uncertainties such as the currently escalating US-China trade war.

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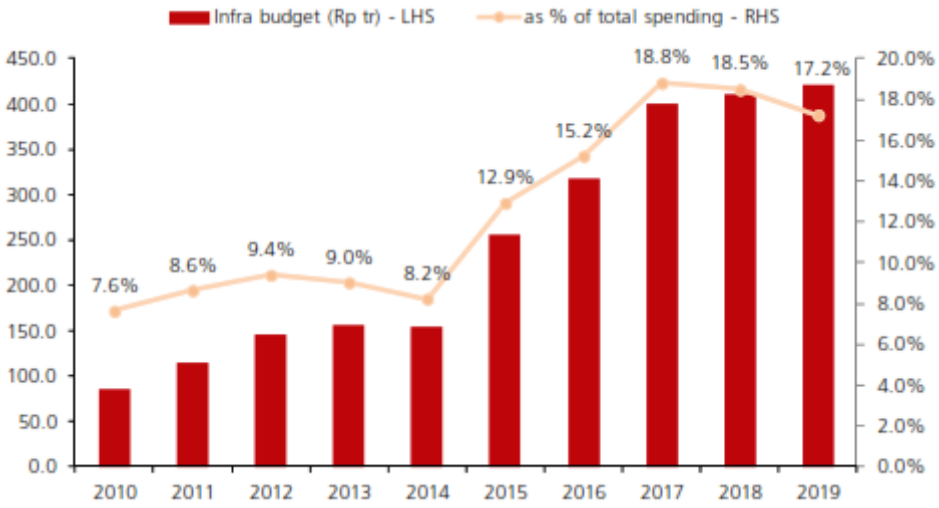

Figure 2:*Infrastructure budget vs overall spending (DBS Group Research, 2018)*

The project life cycle Projects are usually divided into project stages (i.e., definition, planning, execution and delivery stages) to provide better management and control. Collectively these project stages are known as the project life cycle.

The project life cycle typically passes through four stages, i.e. definition, planning, execution, and delivery (Loh et al., 2010). The starting point begins the moment the project is given the go-ahead (when a contract agreement is signed). Project effort starts slowly, builds to a peak, and then declines to delivery of the project to the customer.

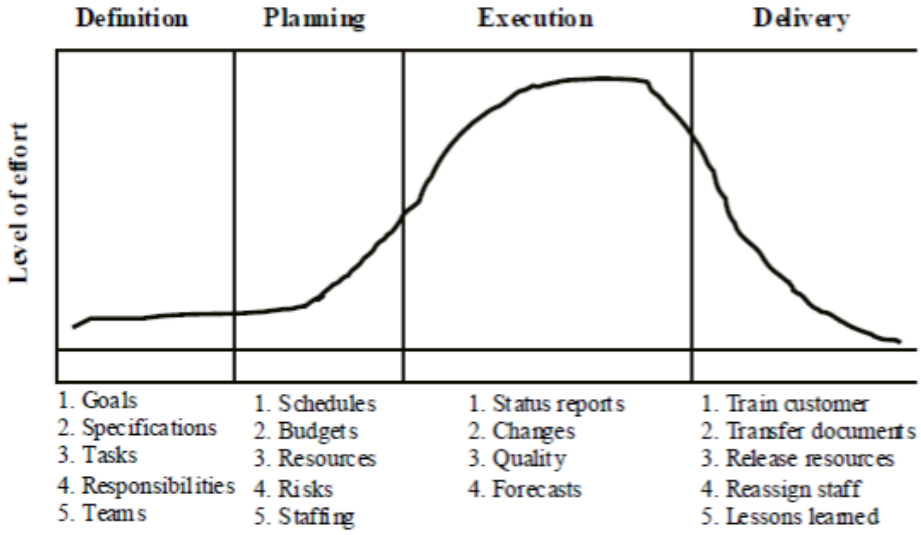

Figure 3:*Project life Cycle (Lee, 2006 and Lee and yu, 2012)*

Definition stage – specifications of the project are defined, project objectives are established, project teams are formed and major responsibilities are assigned. Planning stage – plans are developed to determine the project steps, beneficiaries, timeframes, quality standards and budget. Execution stage – the major portion of the project work takes place – both physical and mental. Time, cost and specification measures are used for control. The project managers have to ensure that the project is on schedule within the budget and meeting specifications. They have to also check if any changes are required. Delivery stage – delivering the project product to the customer, may involve customer training and transferring documents (Mohemad et al., 2010).

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All construction information produced, utilized and shared among project participants is intended to contribute to the success of a particular project (Hartmann et al., 2009). Under the traditional procurement method, the main producers of construction information and stages may listed in Table 1. Moreover, construction information is produced and utilized in all the design and production phases by the project participants (Sacks et al., 2010).

Table 1:*Production and use of project information (Ahlemann, 2009)*

Information producer	Project phase	Form of information	Information user
Client	Conception	Brief	Architect
Architect	Feasibility	Report	Client
	Design	Drawings	Client, Quantity Surveyor, engineer, contractor
	Construction	Revised drawings	
	Commissioning	As-build drawings	Client
Engineer	Design	Drawings	Architect, Quantity Surveyor, contractors
	Construction	Revised drawings	
	Commissioning	Operating / Maintenance Manual	Client /Ultimate users
Quantity surveyor	Design	Cost estimates and Bills of quantities	Architect, client
	Construction	Cost Report. Final Account	Architect, client, contractor
Contractor	Construction	Progress report. Contractual claim	Architect, QS, client
	Commissioning	Maintenance manual	Architect, client
Material suppliers	Construction	Material availability and supply report	Contractor

Information systems may be classified according to their primary function. Seven major systems under this classification in accordance with Love and Irani (2003) are:

1. TPS (Transaction Processing System) – supports basic operational tasks in each functional area
2. MIS (Management Information System) – supports functional managers
3. OAS (Office Automation System) – supports office workers
4. GSS (Group Support System) – supports people working in groups
5. ISS (Intelligent Support System) or KWS (Knowledge Works System) or KBS (Knowledge Based System) – supports knowledge workers, using ES (expert systems) and ANN (artificial neutral network)
6. DSS (Decision Support System) – supports managers and analysts
7. EIS (Executive Information System) or ESS (Executive Support System) – supports executives

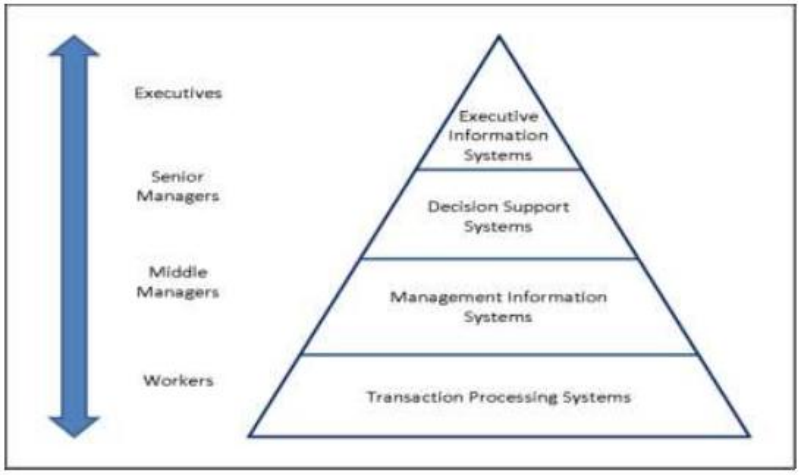

Figure 4:*Pyramid of Information Systems (Azhar, 2011)*

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Fewings (2008), Nicholas & Steyn (2011) stated, that ISs can be used alongside any project regardless specific industry for support of project management. In this case they may be treated as PMIS (Project Management Information Systems). According to Nicholas & Steyn (2011), PMIS can be used for the following functions during project:

- Scheduling and Network Planning
- Resource Management
- Budgeting
- Cost Control and Performance Analysis
- Reporting, Graphics and Communication

At present, computer-based PMIS can be involved in each stage of project, throughout all phases of the project life cycle, from Conception through Definition and Execution to Phase Out.

II. INFORMATION SYSTEMS IN CONSTRUCTION AND PROPERTY INDUSTRIES

Fewings (2008) highlighted major areas where Information Systems can be successfully used in construction projects. DSS may be used for human resources planning during critical periods of project. KBS may be useful to support estimating and integrated systems connected with CAD, as well as to support costing and planning systems. IES may be used to summarize project information for director and client level. These ISs may be helpful in monitoring of a business plan and project goals, providing data analysis (e.g. cash flow, production targets) and comparison between projects. Information has to be presented in the format most suitable for users' level, particularly graphs and colours must be used.

Major types of Information Systems got a different level of implementation in construction and property industries. Examples of various IS used in both industries are described below.

1) TPS, those are designed to process routine transactions efficiently and accurately.
2) OAS support staff working in the offices, and
3) GSS support workers working in the groups and are getting more popular in CPI. Calendars, web-basedcollaborative tools, document processing and sharing tools are being better known in CPI.
4) MIS, those produce fixed, regularly scheduled reports based on data extracted and summarized from the firm'sunderlying transaction processing systems to middle and operational level managers to identify and inform structuredand semi-structured decision problems
5) KWS or KBS, are used in case of concept of Knowledge Management is adopted by stakeholders of CPI. It is fairlynew, but is already often used approach. Informal and formal solutions for KM are used within CPI organizations.
6) DSS are used for decision making on senior managers level. There are functions, which can be supported by DSSwithin CPI
7) EIS or ESS, which support the high ranking executives, being slowly adopted in CPI. These IS are mostly used fora long-term planning and forecasting.

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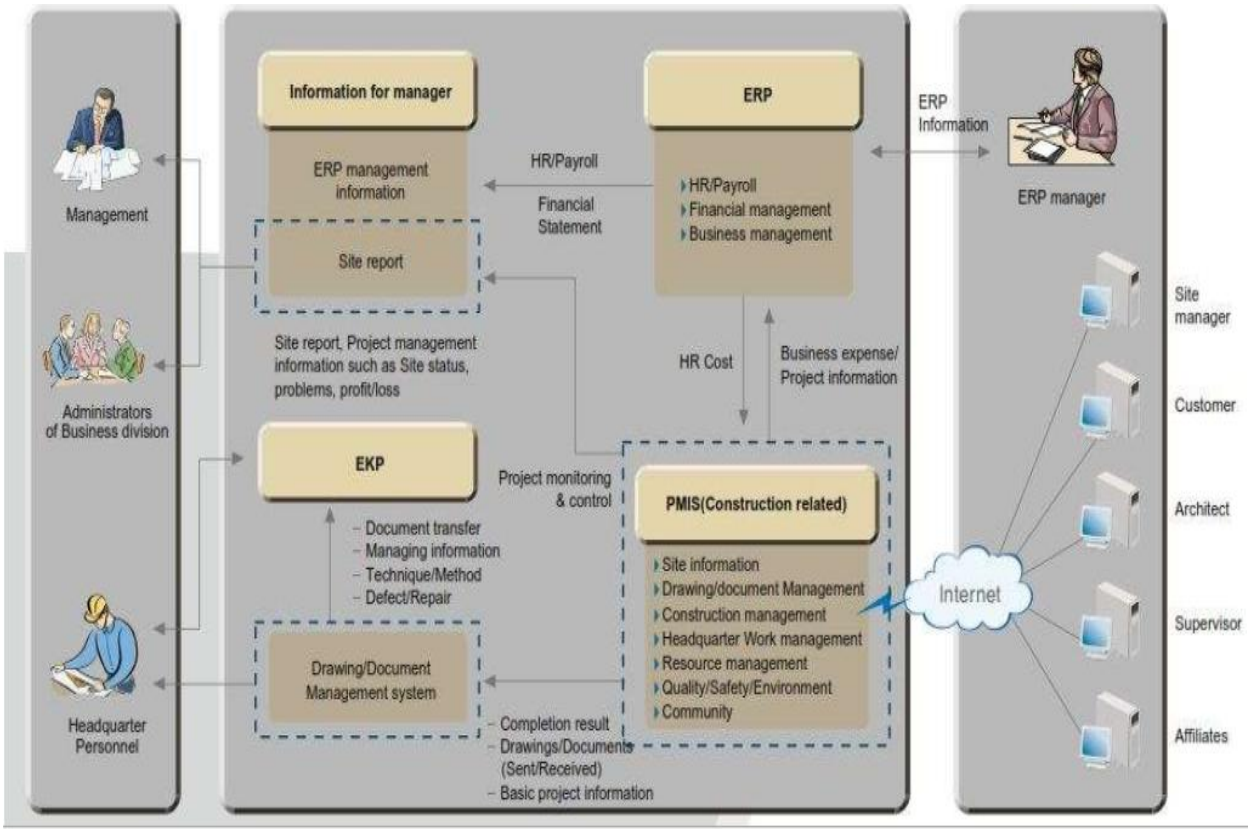

Figure 5:*Project Management Information System*

III. METHODOLOGY

III.I. Research Variable

In this research, developing success model consists of some variables which are system quality, Information quality, intention to use, user satisfaction and individual impact. All the variables has some indicator to measure the effect of each variables as listed in Table 2.

Table 2:*Variables and indicator of this research*

No.	Variable	Indicator
1.	System quality (X)	Navigation(X_1)
		Reliability (X_2)
		Portability (X_3)
		Respond Time (X_4)
2	Information quality (Y_1)	Accuracy (Y_{11})
		Relevancy(Y_{12})
		Completeness(Y_{13})
		Up to date(Y_{14})
3	Intention to use	Specific usage (Y_{21})
		Actual usage (Y_{22})
		Intention (Y_{23})
4	User satisfaction	Happy to use (Y_{31})
		Comfort to use (Y_{32})
		Satisfy to use (Y_{33})
5	Individual impact	Shorter time in finishing the project (Y_{41})
		Improve the quality of human resources (Y_{42})
		On job action (Y_{43})

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The indicator aimed to measure the significance effect of the variables and each variable was consists at least three indicators. Indicators of system quality are navigation, reliability, portability and respond time. Indicators of information quality are accuracy, relevancy, completeness and up to date. Indicators of intention to use are specific usage, actual usage and intention. Indicators of user satisfaction are happy, comfort and satisfy to use the IS. Indicators of individual impact are shorter time in finishing the project, improve the quality of human resources and on job action.

III.II. Model Development

Research model of this research was consists of 1 independent variable (system quality (X)) and four dependent variables (information quality, intention to use, user satisfaction and individual impact that signed as Y_1-Y_4) as shown in Figure 6.

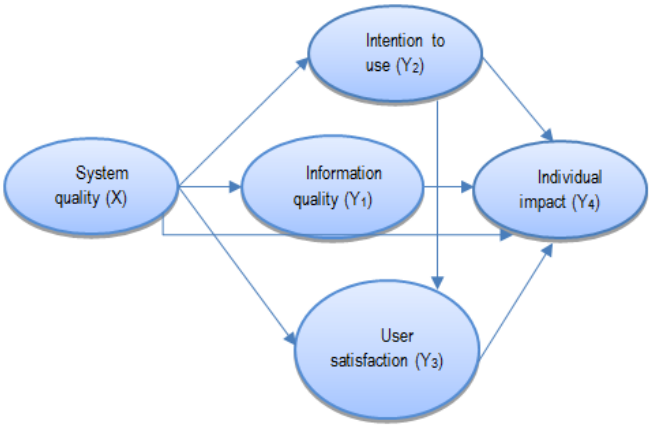

Figure 6:*Approached research model*

Figure 6 shows the models that consists of 8 relations between variables which are correlation between system quality to Information quality, system quality to intention to use, system quality to user satisfaction, Information quality to individual impact, intention to use to user satisfaction, intention to use to individual impact and user satisfaction to individual impact as well as system quality to individual impact. All the relation will be investigated the direct and indirect effect by using Smart PLS3.

III.III. Population and Sample

This research was conducted in Jakarta, Bogor, Depok, Tangerang and Bekasi (Jabodetabek) Region, Indonesia. The research object was government and private construction companies in Jabodetabek Region. The respondent of this research was dividing into three levels which are Project Manager (PM), Vice PM and Site coordinator as listed in Table 3.

Table 3:*Respondent of this research*

No.	Position	No. Respondents
1.	PM	23
2.	Vice PM	13
3.	Site coordinator	69
	Total	105

This research was collected in some construction project that used the similar information system technology which called by EVA, GL-PRO, E-counting and OPECS software.

IV. RESULT AND DISCUSSION

IV.I. Model analysis

The success model of this research was analysed by sing Smart PLS3 in order to investigate the Average Variance Extracted (AVE), loading factor, direct and indirect effect. The simulation result of success model is shown in Figure 7. The detail of validity and reliability of all indicators is listed in Table 4.

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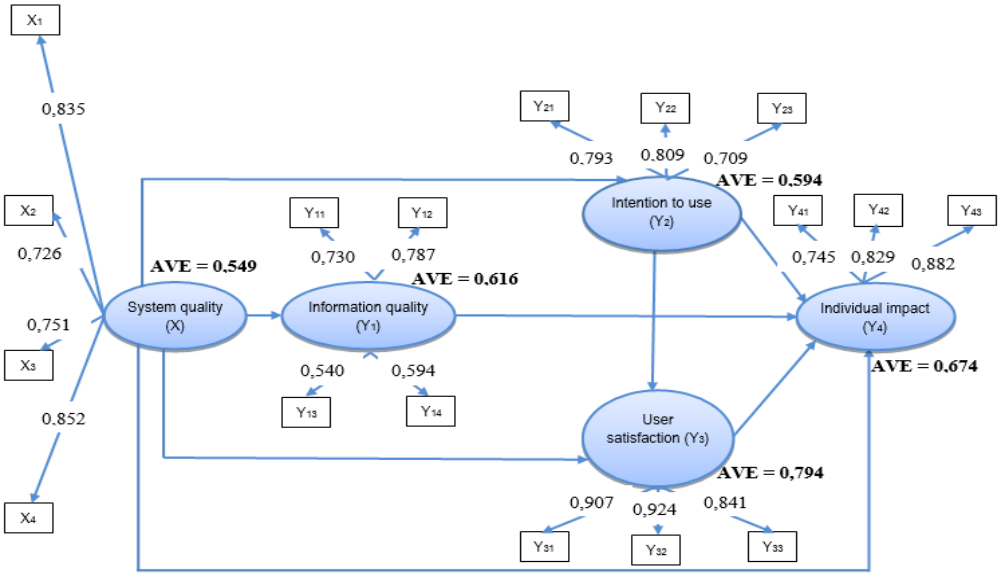

Figure 7:*Simulation result of success model*

IV.II. Validity and reliability analysis

Convergent validity was measured to determine the validity of indicators that indicated by loading factor value that has a limit of 0.5. when the indicator has loading factor more than 0.5 which mean that it has positive relation. Reliability of the variables was indicated by discriminant reliability (AVE) value that has limit of 0.5. Positive relation showed when the variable has discriminant reliability more than 0.5. The validity and reliability data of research variables are listed in Table 4.

Table 4:*Validity and reliability data of research variables*

No.	Variable	Indicator	Loading factor	AVE	Information
1.	System quality (X)	X_1	0.835	0.616	Valid and reliable
		X_2	0.726		Valid and reliable
		X_3	0.751		Valid and reliable
		X_4	0.852		Valid and reliable
2	Information quality (Y_1)	Y_{11}	0.730	0.549	Valid and reliable
		Y_{12}	0.787		Valid and reliable
		Y_{13}	0.540		Valid and reliable
		Y_{14}	0.594		Valid and reliable
3	Intention to use	Y_{21}	0.793	0.594	Valid and reliable
		Y_{22}	0.809		Valid and reliable
		Y_{23}	0.709		Valid and reliable
4	User satisfaction	Y_{31}	0.907	0.794	Valid and reliable
		Y_{32}	0.924		Valid and reliable
		Y_{33}	0.841		Valid and reliable
5	Individual impact	Y_{41}	0.745	0.674	Valid and reliable
		Y_{42}	0.829		Valid and reliable
		Y_{43}	0.882		Valid and reliable

From Table 5 shows that all indicators in each variable are valid and all variables are reliable which means that all data that achieved in this research was appropriate. The loading factor for all indicators in range of 0.540 – 0.924 and the AVE value of variable system quality, information quality, intention to use, user satisfaction and individual impact are 0.616, 0.549, 0.594, 0.794 and 0.674, respectively.

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IV.III. Direct effect analysis

Direct effect analysis was conducted to investigate the direct relation between variables which indicate the contribution of each variable. This research has 8 relations as listed in Table 5. The direct effect of variables was achieved when the critical ratio (CR) is higher that t-table: 2.00 or 0.05.

The direct effect analysis between system quality to Information quality has CR value of 5.174, system quality to intention to use has CR value of 4.572, system quality to user satisfaction has CR value of 2.205, Information quality to individual impact has CR value of 2.104, intention to use to user satisfaction has CR value of 3.254, intention to use to individual impact has CR value of 2.343 and user satisfaction to individual impact has CR value of 2.067 as well as system quality to individual impact has CR value of 2.893. All CR values have higher that t-table 2.00 which means that all relation were significant. However, there is one relation that in close to t-table value i.e. user satisfaction to individual impact which may due to satisfy of the Isis not too effect to the individual performance as long the IS well used by the user.

Table 5:*Direct effect of research variables*

No.	Relation between variables	Estimate	CR	Information
1.	System quality (X) → Information quality (Y_1)	0.438	5.174	Significant
2.	System quality (X) → intention to use (Y_2)	0.366	4.572	Significant
3.	System quality (X) → user satisfaction (Y_3)	0.226	2.205	Significant
4.	Information quality (Y_1) → individual impact (Y_4)	0.263	2.104	Significant
5.	Intention to use (Y_2) → user satisfaction (Y_3)	0.365	3.254	Significant
6.	Intention to use (Y_2) → individual impact (Y_4)	0.242	2.343	Significant
7.	User satisfaction (Y_3) → individual impact (Y_4)	0.251	2.067	Significant
8.	System quality (X) → individual impact (Y_4)	0.392	2.893	Significant

IV.V. Indirect effect analysis

Indirect effect analysis was carried out to investigate the relation between external and internal variable through the connector between variables. The indirect effect is shown by Tstat. Value that have to higher that t-table (2.00) to achieve the significant effect. All the indirect effect data is listed in Table 6.

Table 6:*Indirect effect analysis of research variables*

No.	External relation	Connecter	Internal relation	Tstat.	Indirect
1.	X	-	Y_1	-	-
2.	X	Y_1	Y_2	2.570	0,010*
3.	X	Y_1	Y_3	4.068	0,000*
4.	Y_1	Y_2 and Y_3	Y_4	2.969	0,003*
5.	Y_2	-	Y_3	-	-
6.	Y_2	Y_3	Y_4	2.086	0,040*
7.	Y_3	-	Y_4	-	-
8.	X	Y_1, Y_2 and Y_3	Y_4	2.015	0,044*

Indirect effect of system quality to intention to use has Tstat value of 2.570, system quality to user satisfaction has Tstat value of 4.068, Information quality to individual impact has Tstat value of 2.969, intention to use to individual

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impact has Tstat value of 2.086 and system quality to individual impact has Tstat value of 2.015. All relation between variables have a significant indirect effect which the indirect effect value is below that 0.05.

The development of success variable model has successfully developed by using smart PLS3 software by investigating the validity, reliability, direct and indirect effect of all variables and indicators. The variable in this research that divided by 5 variable which are system quality, information quality, intention to use, user satisfaction and individual impact were valid and reliable. All variables has CR value higher than t-table of 2.00 also in indirect effect analysis all variable have Tstat higher than t-table 2.00 and have lower than 0.05 which means that all variable in this research have a significant effect.

V. CONCLUSION

The research showed that the usage of the information system would affect the successfulness of the implementation of a business model in the construction company of the business industry. The relevancy of the information system towards the successfulness of the implementation of the strategy could not be denied and this research proved that the usage of the information system has benefited the firm to achieve the desired level of success and contributed significantly towards the successfulness of the strategies and to achieve the goals of the firm.

This research also showed the organization could become the learning organization as it stimulate the creativities of the employees in implementing the ideas and the efficiency of the information system would lead to the high level of employees' satisfaction. Hence, the self-esteem of the workers and the commitment of the employees has been found to become better with the usage of the information system which leads to the high level of efficiency.

Thus, it enhanced the level of job satisfaction among the employees and create a sense of belongings among themselves. The good bonding among the employees and the good relationship with the management would resulted the high level of organizational commitment and thus, contribute to the higher performance of the individuals and the company as a whole. The usage of the information system has been proven to benefit the people in the firm as the efficiency level has been increased significantly and thus contribute to the stakeholders such as the public and the shareholders. It promotes better relationship between the companies and the customers and hence resulting in high level of customers' satisfaction.

In a financial aspects, the costing and the budgeting are the two areas that has been found to be improved significantly in implementing the business model. The estimation of the cost has been found to be more accurate and thus, would increase the level of efficiency and the cost of production has been found to be significantly improved in this research. The internal business environment that consist the infrastructures, the organisational culture and the functional departments has been found to be improved by the usage of the information system. The collaboration amongst the functional department has contributed the successfulness of the implementation of the business project in sync with the mission and the vision of the company has been found in this research. The level of synergy among the workers and the commitment of the workers has been increased significantly by the usage of the information system.

The business processes has been found to become more efficient as the information has been disseminated throughout the organisation. The clear vision and the mission by the top management which is understood by all levels has contributed to the success of the implementation of the business model of the construction companies in this research. The process of business process re-engineering (BPR) has been performed proved that the organisation is promoting the organisational development (OD) throughout the organisation. The emergence of the correct and reliable information help the managers to make better decision throughout the business processes. Hence, the level of satisfaction amongst the workers has been found to be increased significantly. The level of creativity and the sense of belongings has increased due to the fact that the ideas from the employees has been taken as consideration by the management of the firm. The strong culture could be promoted to achieve the competitive advantage of the firm in the industry. The needs of the customers have been fulfilled with the efficient internal business processes and the usage of the information system has been found beneficial to know the needs of the customers and thus, leads to know the latest market trend and the importance of the product and services towards fulfilling the needs of the potential customers.

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The competition in the industry has contributed to the price war and thus, through the information system, the companies knew the correct strategies to be implemented and therefore, the companies need to rely heavily on the core-competency of the firm in order to achieve competitive advantage. Thus, by the usage of the reliable information system, the companies would be able to rely on their market niche and throughout market segmentation, the cost of marketing could be reduced significantly, which resulted in higher profit for the firm. Finally, the support from the top management has been found to be significantly benefited the companies by having a strong communication between them and the employees by way of effective communication through an efficient information system. The knowledge and the information are critical to achieve the successfulness of the implementation of the strategies within the firm. As such, the knowledge management (KM) has been found to be one of the critical factors to be implemented by the firm in order to achieve greater position in the market share. As a matter of fact, KM could be used as a tool to promote better understanding among the workers and the top management to become more productive and alert on the upcoming threat by the competitors and they need to be ahead of the competition. Thus, KM should be promoted by the companies to enhance the productivity level of the employees in the company and the level of profit would be improved by knowing the desired goals of the organization by way of an accurate information system.

VI. ACKNOWLEDGMENT

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