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INFORMATION TECHNOLOGY IMPLEMENTATION AND ITS PERFORMANCE IN EDUCATIONAL INSTITUTION USING THE COBIT FRAMEWORK

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Abstract. *Implementation of information systems and technology that is already running needs to be evaluated on the performance of the system and its level of maturity, both in companies and in educational institutions including vocational high schools. In the context of learning in secondary schools, including vocational schools, the application of e-learning has also begun to be applied. This study tries to see to what extent the implementation of information systems and technology in vocational high schools has gone well. Evaluation of system performance is seen from the human side, namely teachers, students, and management staff, based on the side of the learning implementation process, the information technology platform used, and the information system management side that is implemented. A number of concepts and methods used include the IT Balanced Scorecard concept, COBIT 5 framework, factor analysis method, and regression analysis method. The results showed that there were 5 new factors, namely systems availability, systems security, systems quality, systems measurement, and systems performance, which were the main factors in measuring system implementation performance.*
Keywords: COBIT framework, Performance, IT Balanced Scorecard, Implementation, Measurement model

1. **Introduction.** To determine the effect of information technology on the performance of information systems in supporting education, it is necessary to measure the maturity of information technology using the Control Objectives for Information and Related Technology (COBIT) model [1]. Educational institutions are expected to measure the success of the application of information technology in supporting the performance of information systems with a control process based on four COBIT domains. This study will analyze the application of information technology through the process of controlling information technology based on the COBIT framework, to obtain new factors that can be used to

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predict how much influence it will have, by using the linear regression method. Previous research conducted using the COBIT framework has been carried out in relation to the worksheet information system audit in the organization, which states that there are 3 domains that can be evaluated and the level is determined [2]. Its capabilities are EDM (Evaluate, Direct and Monitor), APO (Align, Plan and Organize) and MEA (Monitor, Evaluate and Assessment). Collaboration of the two research methods which include factor analysis, and regression analysis, will be tried to be developed as a prototype to obtain factors, new factors that affect the learning process of educational institutions [3]. The end result is the formation of a mathematical model that can describe current conditions that occur and can also be used to build strategies in the future.

2. Literature Review.

2.1. **Information technology maturity.** The concept of information technology maturity is used to determine the extent to which managers use computer-based information systems [4]. For maturity in information technology there is a formalization in planning, controlling, organizing, and integrating activities related to information technology. With the maturity level of information technology, management can measure the position of the information system process by assessing what is needed to improve it.

2.2. **Information technology performance.** One of the methods for assessing governance performance IT is to use the IT Balanced Scorecard. Assessment of governance with the IT Balanced Scorecard is required for seeing the extent to which the strategy is woven, the vision, mission and goals to be achieved in the institution [5]. Improving information technology governance performance is the main reason for building and implementing an IT governance balanced scorecard [6].

2.3. **Utilization of information technology.** The use of information technology is the benefit expected by information technology users in carrying out tasks whose benchmarks are based on the frequency of use and the diversity of applications performed [7]. The system obtained from the use of information technology has accuracy and timeliness so that it can increase efficiency and effectiveness in the implementation of work when compared to manual or conventional methods, so that information technology can be beneficial in supporting activities.

2.4. **COBIT framework.** Based on the COBIT 5 website, COBIT 5 is a framework forefront of corporate IT governance and management. COBIT 5 itself, is the result of the development of the previous COBIT (Control Objectives for Information and Related Technology) framework which was developed for 15 years and issued in 2012. The COBIT 5 framework is based on 5 basic principles, which can be seen in [8], as shown in Figure 1.

The first principle meets stakeholder needs, and states that COBIT 5 provides all processes and enablers to support creation of business value using IT [9]. To ensure all the needs of stakeholders fulfilled, COBIT 5 created a balance scorecard concept that includes company goals, and IT goals. The second principle is to include end-to-end, claiming that COBIT 5 includes all functions and processes within the company, which is not only focused on IT functions, but treats information and related technology as assets which needs to be managed like any other asset in the company. In fulfilling this principle, COBIT 5 provides the RACI (Responsible, Accountable, Consulted, Informed) chart which includes the role of business and the role of IT in the process [10]. The third principle is the application of an integrated framework, as an alignment with other relevant standards and frameworks, so that companies are able to use COBIT 5 as a general governance framework and an integrator. This principle brings together all the knowledge previously known in the various ISACA frameworks (COBIT, VAL IT, Risk

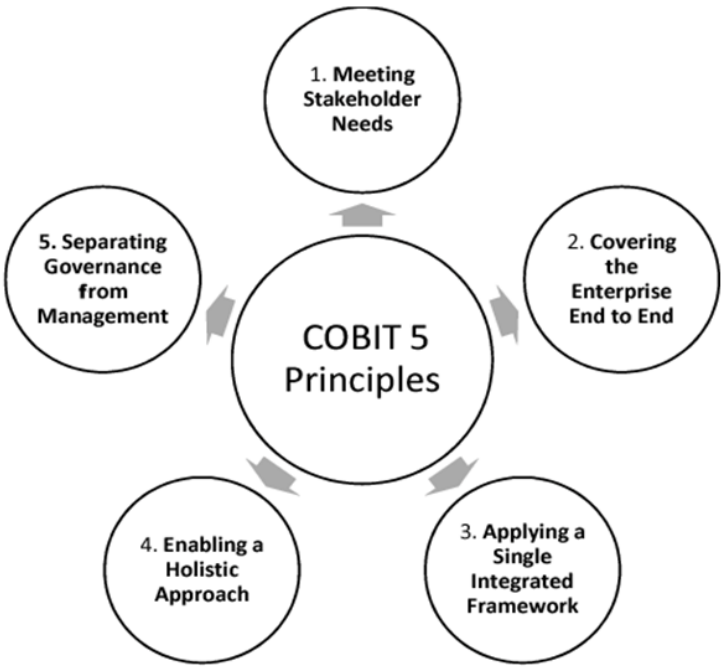

FIGURE 1. COBIT 5 framework

IT, BMIS, ITAF, etc.). The fourth principle is a holistic approach, namely COBIT 5 views that each enabler influences each other and implementing COBIT 5 implementation will be successful. The fifth principle is that separating governance from management, COBIT makes a fairly clear distinction between governance and management. They include different activities, require different organizational structures, and serve different purposes.

The main objectives of developing COBIT 5 for information security, describe information security on an enterprise including

1) Responsibilities for IT functions on information security;
2) Aspects that will improve the effectiveness of leadership and information security management such as organizational structure, rules and culture;
3) Information security relationships and networks to enterprise goals.

Meet the needs of enterprises to

1) Maintain security risks at authorized levels and protect information against people who are not authorized or authorized to make modifications that could result in chaos;
2) Ensure services and systems can be used sustainably by internal and external stakeholders;
3) Follow relevant laws and regulations.

Using COBIT 5 for information security provides a number of capabilities related to information security for companies so that they can generate company benefits such as

1) Increase cost-effectiveness due to better and easier integration;
2) Increase user satisfaction;
3) Improve the integration of information systems within the company;
4) Increase support for innovation and competitiveness;
5) Improve the management of costs associated with the information security function;
6) Better understanding of information security.

2.5. **Factor analysis.** Following are the process steps using factor analysis [11].

1) The first stage
   Determine what factors will be used to evaluate the systems: people factor, process factor, and technology factor.
2) The second stage
   After knowing what factor are used, the next step is determining the right indicators and appropriate. These indicators can be used to determine the value of the information related to the things that will be evaluated.
3) The third stage
   The next stage is to develop a questionnaire from factors and indicators that have been obtained. Questionnaire was distributed to the respondents according to the research targets and the results of questionnaire were collected for analysis to the next stage.
4) The fourth stage
   After the questionnaire was collected, the results are recorded and analyzed. At this stage, we did the analysis test with the reliability test, factor analysis and regression. Of each test phase analysis will be obtained of each new factor and indicator and analysis models.
5) The fifth stage
   After getting a new factor, results of the analysis made a conclusion that will be used as advice to the organization.

2.6. **Regression analysis.** Regression analysis is a statistical technique to form a model in determining the causal relationship between two or more variables. This model is a function of these variables and is used to understand, explain and predict observed system behavior [12].

3. **Methodology.** Figure 2 shows a research design and its stages that have been carried out to obtain the results of the expected research objectives. The data used in this study are premiere data obtained by a questionnaire method about maturity, performance, and utilization of technology and implementation of information systems obtained from state vocational high schools. The number of samples is 3 state vocational high schools [13].

Application system is one strategy to remain competitive and continue to develop the company. In carrying out this strategy, the company requires precise measurements to find out whether the strategy is running according to the targets set and running well in the long run. In this case study factors that have been determined and derived from the literature study will be used as a way to evaluate the performance of information technology from the perspective of internal users [14]. The data processing is carried out based on the factor analysis method and the factors will be sought what indicators are formed so that the appropriate factors and the right models are obtained to evaluate the performance of information technology in the company.

In this process, to get good measurement results, several stages will be carried out in measuring the performance of information technology using the IT Balanced Scorecard [15] where the stages of the process include

1) Formulate problems that occur in the object of research and conduct literature studies to get references and methodologies that will be used in solving these problems.
2) Based on the results of the literature study, continued with the determination of the main factors used in this study which are based on the IT Balanced Scorecard concept, including
   a) Factors of corporate contribution;
   b) Factors of user orientation;
   c) Factors of operational excellence;
   d) Factors of future orientation.

3) After determining the main factors that will be used, then proceed with the search for indicators for each of these factors using relevant literature studies.
4) Conducting a questionnaire by compiling statements in accordance with predetermined factors and indicators then distributed to respondents to get primary data for analysis.
5) From the data obtained from the questionnaire, then the data is processed and analyzed to get the results of the assessment.
6) Compile an appropriate and systematic report on the results/conclusions obtained to be useful for further research and provide advice/recommendations to the company.
7) Based on research reports, the company can carry out a planning process for what actions need to be taken to continue to improve the performance of information technology in the company in the future so that it can run better and in harmony in achieving the company's business goals.

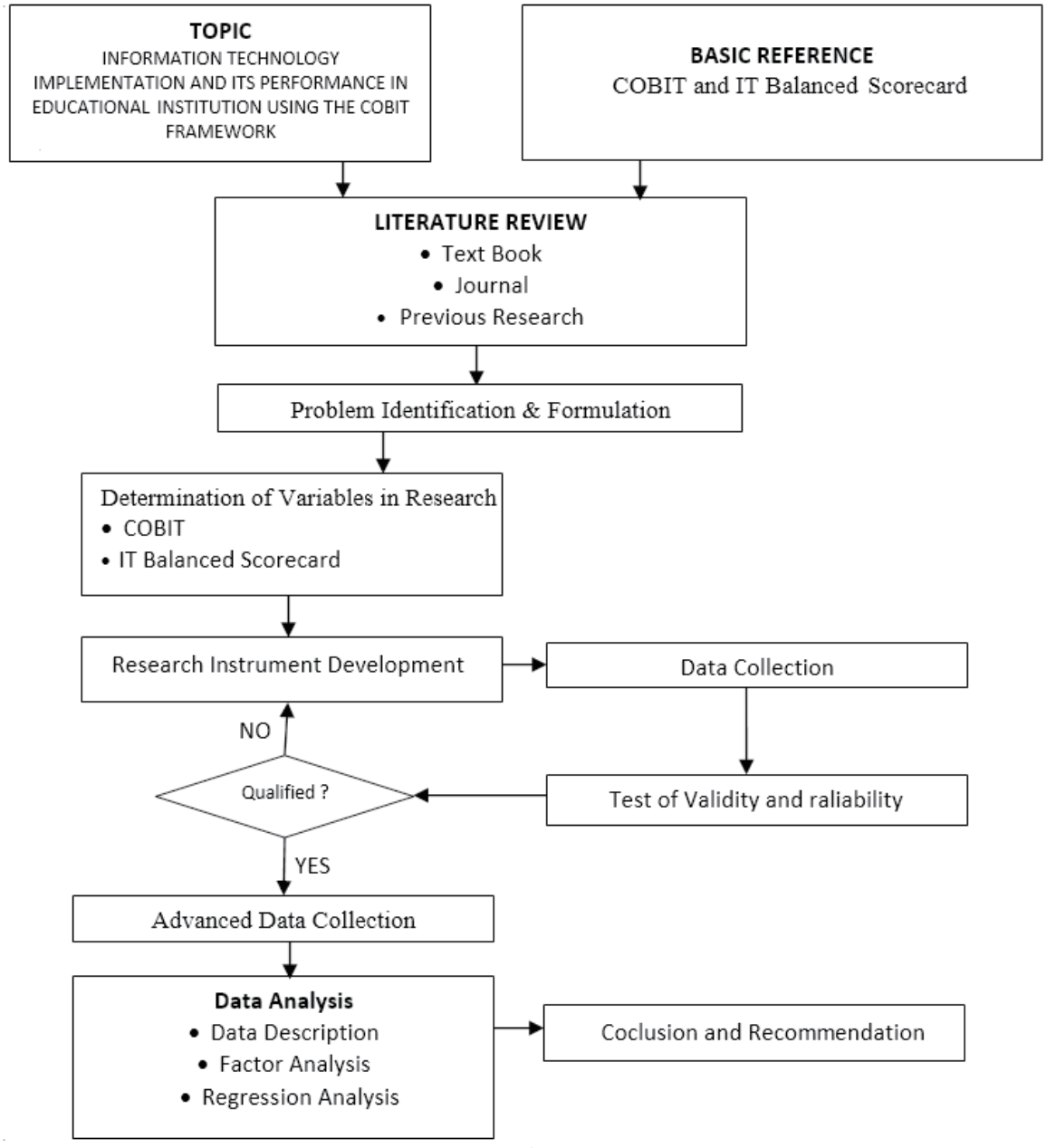

FIGURE 2. Research design

4. Result and Discussion.

4.1. **Overview of respondents.** Based on the results of distributing the questionnaires that have been collected, only 105 questionnaires can be processed. Principles 3 (2.86%), Deputy 15 (14.29%), Teacher 51 (48.57%), Administration 30 (28.57%) and IT staff 6 (5.71%).

4.2. **Research model test results.** The results of the SPSS output show that the Cronbach's Alpha of the 31 variables is 0.914 so that the instrument used in this study is considered reliable for the statements in each of the variables used in this study. And for the results of the validation using SPSS, of the 105 questionnaires that were processed all of them were valid and ready to be used for research data.

4.3. **Factor analysis results.** By utilizing the correlation relationship between variables, new variables will be used which are less in number than the initial number. From the results of the factor analysis, there are 5 new factors that affect the implementation of information systems. The complete results of the full factor analysis are in Table 1.

The results of the factor analysis show that there are 5 factors that affect the implementation of information systems which explain the total variance of 90.06%, the details of which are systems availability 17.47%, systems security 31.17%, systems quality 15.75%, systems measurement of 12.41% and systems performance of 13.26%.

4.4. **Multiple regression results.** By obtaining 5 new variables: systems availability, systems security, systems quality, systems measurement, and systems performance as independent variables, the next analysis is to build a regression equation model by looking at the effect of these five variables on the current state of information system implementation variables which are expressed by the dependent variable and determined from the factor values and the respondent's level of understanding of the system that has been used. By using the multiple regression formula the researcher gets the following results:

$$Y = 7.848 + 0.193X_1 + 0.242X_2 + 0.047X_3 + 0.795X_4 + 0.387X_5$$

where:

Y = Implementation model
X_1 = systems availability
X_2 = systems security
X_3 = systems quality
X_4 = systems mesurement
X_5 = systems performance

The results of testing the regression equation using the coefficient of determination with SPSS software processing produce as Table 2.

From Table 2 the factors that affect the information system are 80.7%, while 19.3% are influenced by other factors.

The authors found that the use of COBIT 5 as a governance framework managing corporate IT has been very widely implemented. The authors also found that COBIT 5 is not only used at the company level, but also at the national level in several countries. To get to know the COBIT 5 framework better, the author reviews previous research through literature studies. The results of the literature study show that the use of COBIT 5 is already very popular, but the implementation of COBIT 5 itself often fails due to a lack of knowledge and information on the framework. Given that this framework can be used end-to-end within an organization, of course it will be very complex to adopt COBIT 5 as a whole. Therefore, many examples of cases show customization in adopting COBIT 5, and there are even several studies that have tried to create a standardized framework for determining IT processes for certain business fields or organizations [40]. Seeing the many implementations, articles and studies on COBIT 5, the authors made the decision

Table 1. Factor analysis results

Factor	Variable	Weight	Indicators that form factors	Factor name
1	AI4	0.776	Service request, or other change request [16]	systems availability
	PO4	0.738	Working with other organizations [17]	
	PO8	0.693	Quality management system [18]	
	PO7	0.663	Human resource management IT [19]	
	PO3	0.657	Direction of technological determination [20]	
	PO10	0.652	IT project management [21]	
2	DS10	0.693	Data resources and system security [22]	systems security
	DS11	0.671	Managing infrastructure technology infrastructure [23]	
	DS6	0.629	User training and education [24]	
	DS2	0.627	Capacity and IT performance measurement [25]	
	PO1	0.552	Information technology plan definition [26]	
	DS3	0.534	Services sustainability [27]	
	DS1	0.526	Servive level definition and management [28]	
	DS4	0.524	Systems security definition [29]	
3	DS8	0.644	Manage the configuration [30]	systems quality
	ME2	0.622	IT Governance readiness [31]	
	DS7	0.586	IT service management [32]	
	AI7	0.522	Systems changes installation solution [33]	
4	AI3	0.745	Availability of operation [34]	systems mesurement
	PO6	0.615	Management of communication aims and direction [35]	
	AI2	0.533	Application software maintenance [36]	
5	PO2	0.745	Information architecture definition [37]	systems performance
	ME1	0.615	IT performance controling [38]	
	PO5	0.533	IT investment governance [39]	

Table 2. Conclusion of the coefficient of determination

Correlation coefficient (R)	0.898
Closeness of relationship	Very strong
Determination coeficient	0.807
Level of influence	80.7%
Other influence	19.3%
Adjusted R2	0.797

to use this framework as an evaluation and recommendation tool in dealing with cases encountered in the research site.

5. **Conclusion.** From the results of the factor analysis carried out in this study, it was found of 5 new factors that affect the implementation of the information system in state vocational high schools, namely systems availability, systems security, systems quality, systems measurement, systems performance. The results of data processing with coefficient of determination resulted in a correlation coefficient of 89.8%, while data processing

with regression analysis obtained a determination coefficient of 80.7%. So this research is based on the results of data processing taken from the coefficient of determination result from the factors obtained from information technology maturity, and the performance and utilization of infrastructure has a strong influence on the implementation of information systems by 89.8%. The formation of a mathematical model can describe current conditions that occur and can also be used to build strategies in the future.

REFERENCES

[1] W. Sardjono, B. S. Laksmono and E. Yuniastuti, The social welfare factors of public transportation drivers with online application as a result of the 4.0 industrial revolution in transportation, *ICIC Express Letters*, vol.14, no.4, pp.361-368, 2020.

[2] A. I. Molina, Ó. Navarro, M. Ortega and M. Lacruz, Evaluating multimedia learning materials in primary education using eye tracking, *Computer Standards & Interfaces*, vol.59, pp.45-60, 2018.

[3] H. M. Astuti, F. A. Muqtadiroh, E. W. T. Darmaningrat and C. U. Putri, Risks assessment of information technology processes based on COBIT 5 framework: A case study of ITS service desk, *Procedia Computer Science*, vol.124, pp.569-576, 2017.

[4] D. Proença and J. Borbinha, Maturity models for information system – A state of the art, *Procedia Computer Science*, vol.100, pp.1042-1049, 2016.

[5] M. Froger, F. Bénaben, S. Truptil and N. Boissel-Dallier, A non-linear business process management maturity framework to apprehend future challenges, *International Journal of Information Management*, vol.49, pp.290-300, 2019.

[6] H. A. Jardali, F. Abdallah and K. Barbar, Measuring intentions among employees toward the use of a balanced and information system: A conceptual approach using the theory of planned behavior and the technology acceptance model, *Procedia Economics and Finance*, vol.26, pp.1146-1151, 2015.

[7] W. Sardjono, E. Selviyanti and W. G. Perdana, The application of the factor analysis method to determine the performance of IT implementation in companies based on the IT balanced scorecard measurement method, *Journal of Physics: Conference Series*, vol.1538, DOI: 10.1088/1742-6596/1538/1/012026, 2020.

[8] W. A. Barnett, M. Hu and X. Wang, Does the utilization of information communication technology promote entrepreneurship: Evidence from rural China, *Technological Forecasting and Social Change*, vol.141, pp.12-21, 2019.

[9] M. Wolden, R. Valverde and M. Talla, The effectiveness of COBIT 5 information security framework for reducing cyber attacks on supply chain management system, *IFAC-Papers OnLine*, vol.48, no.3, pp.1846-1852, 2015.

[10] W. Sardjono and F. Firdaus, Readiness model of knowledge management systems implementation at the higher education, *ICIC Express Letters*, vol.14, no.5, pp.477-487, 2020.

[11] A. S. Rahman, Z. Khan and A. Rahman, Application of independent component analysis in regional flood frequency analysis: Comparison between quantile regression and parameter regression techniques, *Journal of Hydrology*, vol.581, DOI: 10.1016/j.jhydrol.2019.124372, 2020.

[12] M. Yousef, K. F. Hussain and U. S. Mohammed, Accurate, data-efficient, unconstrained text recognition with convolutional neural network, *Pattern Recognition*, vol.108, DOI: 10.1016/j.patcog.2020.107482, 2020.

[13] S. A. Wulandari, A. P. Dewi, M. R. Pohan, D. I. Sensuse, M. Mishbah and Syamsudin, Risk assessment and recommendation strategy based on COBIT 5 for risk: Case study SIKN JIKN helpdesk service, *Procedia Computer Science*, vol.161, pp.168-177, 2019.

[14] P. V. Mangili, L. S. Santos and D. M. Prata, A systematic methodology for comparing the sustainability of process systems based on weighted performance indicators, *Computers & Chemical Engineering*, vol.130, DOI: 10.1016/j.compchemeng.2019.106558, 2019.

[15] T. Haryanti and A. Pribadi, E-commerce service design readiness using ITIL framework with IT balanced scorecard objective (case study: university e-commerce), *Procedia Computer Science*, vol.161, pp.283-290, 2019.

[16] I. Lee, Cybersecurity: Risk management framework and investment cost analysis, *Business Horizons*, vol.64, no.5, pp.659-671, 2021.

[17] S. Mansfield-Devine, Rating the risk: How to assess the dangers of working with other organization, *Computer Fraud & Security*, vol.2019, no.3, pp.16-19, 2019.

[18] G. Breda and M. Kiss, Overview of information security standards in the field of special protected industry 4.0 areas & industrial security, *Procedia Manufacturing*, vol.46, pp.580-590, 2020.

[19] C. E. Oehlhorn, C. Maier and T. T. Weitzel, Human resource management and its impact on strategic business-IT alignment: A literature review and avenues for future research, *The Journal of Strategic Information Systems*, vol.29, no.4, 2020.
[20] Z. Yang, S. Shao, M. Fan and L. Yang, Wage distortion and green technological progress: A directed technological progress perspective, *Ecological Economics*, vol.181, DOI: 10.1016/j.ecolecon.2020.106912, 2020.
[21] H. Tohidi, Human resources management main role in information technology project management, *Procedia Computer Science*, vol.3, pp.925-929, 2011.
[22] I. B. Sperstad, M. Z. Degefa and G. Kjølle, The impact of flexible resources in distribution systems on the security of electricity supply: A literature review, *Electric Power Systems Research*, vol.188, DOI: 10.1016/j.epsr.2020.106532, 2020.
[23] Widjajarto, M. Lubis and U. Yunan, Architecture model of information technology infrastructure based on service quality at government institution, *Procedia Computer Science*, vol.161, pp.841-850, 2019.
[24] K. F. Tschakert and S. Ngamsuriyaroj, Effectiveness of and user preferences for security awareness training methodologies, *Heliyon*, vol.5, no.6, 2019.
[25] A. Kitsantas, A. L. Baylor and S. E. Hiller, Intelligent technologies to optimize performance: Augmenting cognitive capacity and supporting self-regulation of critical thinking skills in decision-making, *Cognitive Systems Research*, vol.58, pp.387-397, 2019.
[26] T. (Carol) Li and Y. E. Chan, Dynamic information technology capability: Concept, definition, and framework development, *The Journal of Strategic Information Indonesia Systems*, vol.28, no.4, 2019.
[27] J. Zhang, N. Yin, S. Wang, J. Yu, W. Zhao and B. Fu, A multiple importance-satisfaction analysis framework for the sustainable management of protected areas: Integrating ecosystem services and basic needs, *Ecosystem Services*, vol.46, DOI: 10.1016/j.ecoser.2020.101219, 2020.
[28] S. Chen, W. Yang, H. Yoshino, M. D. Levine and A. Hinge, Definition of occupant behavior in residential buildings and its application to behavior analysis in case studies, *Energy and Buildings*, vol.104, DOI: 10.1016/j.enbuild.2015.06.075, 2015.
[29] A. J. Bidgoly, Robustness verification of soft security systems, *Journal of Information Security and Applications*, vol.55, DOI: 10.1016/j.jisa.2020.102632, 2020.
[30] H. Barham and T. Daim, The use of readiness assessment for big data projects, *Sustainable Cities and Society*, vol.60, DOI: 10.1016/j.scs.2020.102233, 2020.
[31] S. Balasubramanian, V. Shukla and R. Saloum, A readiness assessment framework for blockchain adoption: A healthcare case study, *Technological Forecasting and Social Change*, vol.165, DOI: 10.1016/j.techfore.2020.120536, 2021.
[32] R. Yandri, Suharjito and A. Zahra, Evaluation model for the implementation of information technology service management using fuzzy ITIL, *Procedia Computer Science*, vol.157, pp.290-297, 2019.
[33] M. Tian, Turning a technology into many solution: A case study of embedding an information system, *Journal of Business Research*, pp.23-39, 2019.
[34] L. Aha, K. Salminen and L. Semeraro, DTP2 control room operator and remote handing operation designer responsibilities and information available to them, *Fusion Engineering and Design*, vol.86, nos.9-11, pp.2078-2081, 2011.
[35] K. A. Johnston, M. Taylor and B. Ryan, Emergency management communication: The paradox of the positive in public communication for preparedness, *Public Relations Review*, vol.46, no.2, 2020.
[36] S. Liu, X. Chen, Y. Ma, J. Yang, D. Cai and G. Yang, Modelling and in-situ measurement of dynamic behavior of asphalt supporting layer in slab track system, *Construction and Building Materials*, vol.228, DOI: 10.1016/j.conbuildmat.2019.116776, 2019.
[37] J. Xu, W. Lu and K. Chen, 'Cognitive facility management': Definition, system architecture, and example scenario, *Automation in Construction*, vol.107, DOI: 10.1016/j.autcon.2019.102922, 2019.
[38] S. Liu and Z. Deng, How environment risks moderate the effect of control on performance in information technology projects: Perspectives of project managers and user liaisons, *International Journal of Information Management*, vol.35, no.1, pp.80-97, 2015.
[39] S. Wijayana and D. Achjari, Market reaction to the announcement of an information technology investment: Evidence from Indonesia, *Information & Management*, vol.57, no.7, 2019.
[40] U. L. Yuhana, S. Rochimah, E. M. Yuniarno, A. Rysbekova, A. Tormasi, L. T. Koczy and M. H. Purnomo, A rule-based expert system for automatic question classification in mathematics adaptive assessment on Indonesian elementary school environment, *International Journal of Innovative Computing, Information and Control*, vol.15, no.1, pp.143-161, 2019.