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Technology Elements that Influence the Implementation Success for Big Data Analytics and IoT- Oriented Transportation System

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ABSTRACT

The objective of this paper is to identify the elements of the technology factor that influence the successful implementation of big data analytics and IoT-oriented transportation system. This paper discussed the qualitative approach that was used to collect data. The data were collected by using a systematic literature review and in-depth interview in a case study. An in-depth interview in the case study was chosen in response to a knowledge gap for research in the area of big data analytics and IoT-oriented transportation system. The findings from the systematic literature review, and the case study showed that technology is a core factor to be considered for the successful implementation of big data analytics and IoT-oriented transportation system. This paper acts as a starting point for developing technology models for big data analytics and IoT oriented transportation system.

Key words: Transportation system, big data analytics, IoT, success factors.

1. INTRODUCTION

The development of the internet has brought two famous technologies within IT evaluation which are big data analytics and IoT. Data analytics has been used by many businesses to improve their profits. Customer needs can be better achieved with data analytics by tracking the patterns of data and conducting a good analysis on it in order to obtain the results that are needed. [1-3]. In order to stay competitive, big data analytics can provide companies with the required data to recognize and change their actions in a way that suite their business. Big data is the data that is large in value, which requires an advanced technology that can analyze and make a good understanding of it [1, 4]. In addition, the IoT paradigm depends on the identification and use of a large number of heterogeneous physical and virtual objects that are connected to the world wide web [5-7]. IoT allows different objects to communicate with each other, as well as the in-context invocation of their capabilities services towards adding value applications. The first IoT applications are based on RFID (Radio Frequency Identification), and wireless sensor networks in different applications fields such as healthcare, smart cities, transportations, etc [8-10]. The quick development of the engineering, such as, in the mobile communication short-range and enhanced energy proficiency is relied upon to create a pervasive association of things [5, 8, 11]. This will definitely result in the generation of tremendous measures of information, which affect to be laid in, treated, and accessed.

The aim of this paper is to identify the technology elements that influence the implementation success of IoT and Big data analytics in the transportation system. The next section presents a review of past related studies on technology models, the third sections presents the methodology used in this study, whereas the fourth section shows the case study, the fifth section presents the research finding and the last section is the conclusion.

2. TECHNOLOGY MODELS FOR IOT AND BIG DATA ANALYTICS IN THE TRANSPORTATION SYSTEM

The technology models attend to both hardware and software technology needs in implementing IoT and big data analytics in an intelligent transportation system [12-14]. Table 1 presents a summary of past related studies on technology models for big data analytics and IoT oriented transportation system.

Table 1: Past related studies on technology models

Model	Theory/Model used (where applicable)	Results	Reference
Infrastructure (Hardware & Software)	NIL	A novel design of vehicle management system, intelligent internet-of-vehicles management system (IIVOMS) to address issues indwelling in urban traffic.	[14]
	The statistic and the dynamic cloud sub-models.	The efficiency of cloud computing based on both cloud datacenters and vehicular datacenters (ITS-Cloud) using BLA to solve load balancing problems.	[15]
	NIL	IoT impacts vehicle energy consumption and reduction.	[16]
	IOT model	IoT technology enables the development of the transport system to become more intelligent, safe, harmonious, and energy-efficient.	[17]
	NIL	IoT supports time management, bus efficiency, crowd management, time savings and the number of options provided to users. The technical architecture for a predictive analytics application that uses IoT in predicting arrival timings of buses and the crowd in each of the buses.	
	NIL	Cloud architecture applications for control and traffic monitoring.	[19]
	Naïve Bayes model and a Logistic Regression models	A novel software architecture for the vehicular data clouds in the IoT environment, which has the capabilities to integrate numerous devices available within vehicles and devices in the road infrastructure.	[20]
	NIL	Attack vectors and countermeasures are identified as risk prevention strategies in IoT.	[21]
	NIL	Transaction handling in IoT, Data management in IoT, security, and privacy in IoT.	[22]
	Naïve Bayes model and a supplying Regression model	A computer code design for information conveyance within the IoT	[23]

		infrastructure.	
	NIL	Technologies can provide sustainable transportation solutions and improve road safety.	[13]

The table above shows that comprehensive IoT technologies, such as autonomous vehicles, independent learning systems, unmanned aerial vehicles, augmented reality, big data, bionic enhancements, cloud logistics, digital identifiers, and sensor technology, are required as an infrastructural backbone [12, 14]. The data centers with protective security and big data analytics support is also an important technological infrastructure for IoT and big data implementation [18, 19]. Attack vectors and countermeasures are identified as necessary risk prevention strategies in IoT technologies [21, 24, 25].

3. METHODOLOGY

This study, being a qualitative research method, employs elements of exploratory and single case study analysis. The exploratory approach is to generate a guiding working framework for the study, especially in instances of little or no previous related studies, and the case study, also as qualitative research, covers the in-depth exploration of an individual, phenomenon or event [26]. First this research used a systematic literature review to strength the problem and to identify the success elements related to technology, then an in-depth interview was conducted with experts in the field of big data analytics and IoT based transportation system to validate the findings from the systematic literature review and to identify the elements that could not be derived from the systematic literature review. The literature review is taken from IEEE Xplore, Science Direct, Springer, Web of Science, and Google Scholar. These are studies published, either as conference proceedings or journal articles about within the years of 2008 and 2018. A total of 87 articles were identified, but only 33 met the inclusion criteria set for this study, and just 8 addressed the research focus of this study. Duplicate and irrelevant studies based on the theme and the search strings are excluded. The data was analyzed using Nvivo software to generate themes and sub-themes.

4. THE CASE STUDY OF iMOBILITY FLEET MANAGEMENT

A single case study was chosen to identify technology implementation success elements for big data analytics and IoT based transportation system within the transpiration sector. Experts within the field of big data analytics and IoT oriented transportation system were chosen in this study. The case study focuses on the technology success elements that have been deployed within iMobility fleet management system to identify the elements needed for an intelligent transportation system.

iMobility Fleet Management System is a UniMAP startup company in Malaysia with a total of 10 years of combined R&D experience in technology. Leveraging in-house developed and owned technology, iMobility fleet management system also known as fleet.ceastech is delivering total solutions using IoT, robotics, sensing, and analytics [27]. In the transportation sector, technical skills and expertise for technology service are guaranteed and when there is sufficiency of software for vehicles handling there is high probability for success of IoT-oriented transportation system. Figure 1 shows the technology factor and related elements on the success of big data and IoT oriented transportation system.

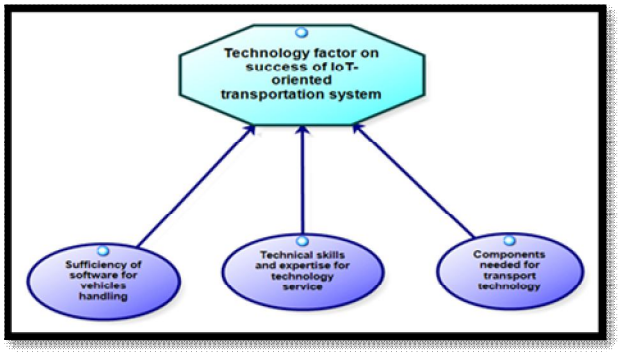

Figure 1: Technology factor on the success of IoT-oriented transportation system

4.1 Components for Transport Technology

The components required for an effective transport system cannot be underestimated, because the transportation industry is one of the largest growth areas for electronics and implanted computers. The intelligent transportation systems, in particular, the intelligent highway are prime target markets for the commercially available board- and system-level solutions. Therefore, as part of attempt to find answers to these issues, this study's interviews revealed the following sub-themes as shown in Figure 2.

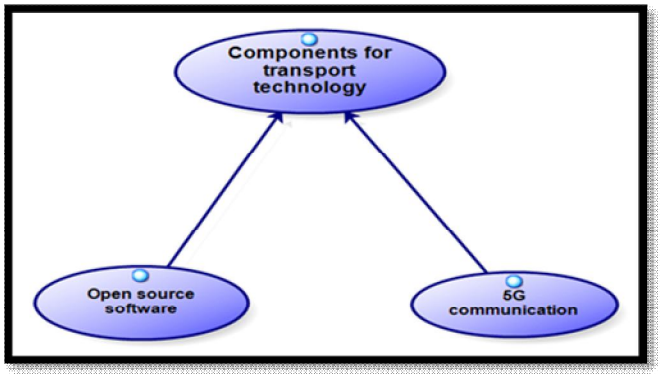

Figure 2: Components required for success of IoT transportation systems

4.2 Technical Skills and Expertise for Technology Service

Technical skills are the capabilities needed to handle intelligent transport tasks. They are practical and often relate to mechanical, information technology, mathematical, or scientific tasks [28]. Within this sub-theme, Figure 3 showed that technical skills and expertise are necessary for technology services such as the transport system in modern times.

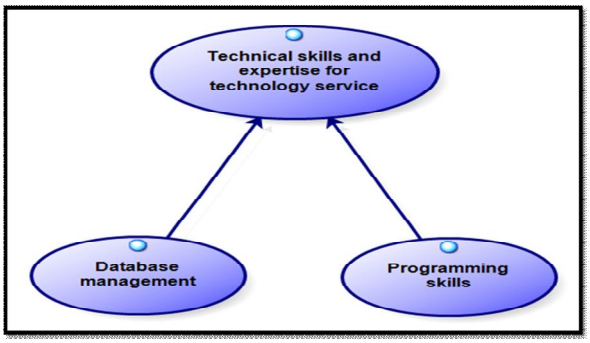

Figure 3: Technical skills and expertise for technology service

4.3 Sufficiency of Software for Vehicles Handling

The sufficiency of software vehicle handling is identified as one of the sub-themes for the accomplishment of the technology factor for IoT-oriented transportation system success. Figure 4 shows the sub-themes of the software sufficiency for vehicle handling.

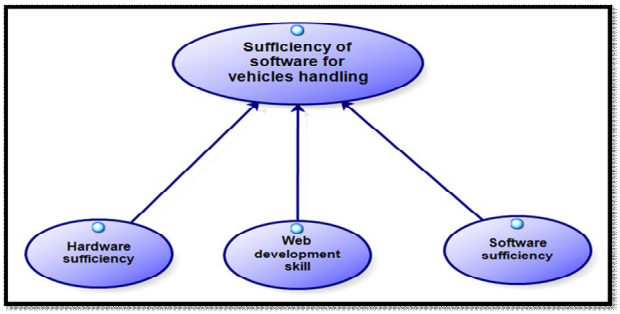

Figure 4: Sufficiency of software for vehicles handling.

5. RESULTS AND DISCUSSIONS

The findings of the SLR revealed that there are very few empirical articles related to the core focus of this study. This accounts for the availability of only 8 out of previously-found 87 articles and 33 articles that matched the inclusion criteria. The preliminary study showed that infrastructure is core factors to be considered in the successful implementation of big data analytics and IoT-oriented transportation system. Table 2 shows a summary of the systematic literature review findings.

Table 2: Summary of the implementation success factors as the general findings of the Systematic Literature Review (SLR)

Factor	Element	Sub-themes
Infrastructure	Software	Augmented/Virtual reality
	Hardware	IoT/cloud computing software architecture
		Autonomous vehicles

In addition, the technology factor was fully discussed by informants. The factors with the most source and occurrences were open-source software and software efficient. Table 3 shows the identified themes and sub-themes of the technology factor.

Table 3: Technology factors identified from the qualitative analysis

Factor	Elements	Sub-themes
Technology	Software sufficiency for vehicle handling	Hardware sufficiency
		Software sufficiency
		Web development skills
	Technical skills and expertise	Programming skills
		Database management
	Transport technology components	Open-source software
		5G communication

The results obtained from the systematic literature review and the in-depth interview of the case study were combined to produces a technology success factor model for big data analytics and IoT-oriented transportation system as shown in Figure 5.

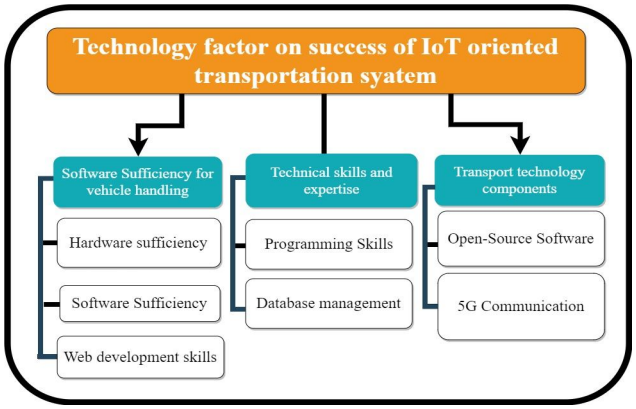

Figure 5: Big data analytics and IoT success factors

6. CONCLUSION

Technology has been widely adopted because of the suitability, effectiveness, and swiftness of values it brings to the business. With the rise in the acceptance of information technology, the implementation of technology for the

transportation system has gained ground quickly. Through a systematic literature review and in-depth interview with experts in iMobility fleet management system this study was able to identify the technology implementation success elements. In a future study, case studies can be extended to various industries to develop adjusted big data analytics and IoT technology model.

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