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Literature Review of Technology Adoption Models at Firm Level; Special Reference to E-Commerce Adoption

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This paper aims to find-out the technological adoption models which were adopted by the researchers during the recent past for their technology adoption studies at a firm-level, especially on e-commerce adoption and implementation. Hence, this study focused on 50 empirical studies related to the technology adoption in different contexts within the past ten years and identified TOE and DOI theories, which are mostly applied or adopted by the researchers.

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Literature Review of Technology Adoption Models at Firm Level; Special Reference to E-Commerce Adoption

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Abstract- With the onset of the fourth industrial revolution, technology has become a decisive part of human lives, and is used to speed up the processes of individuals and firms. The connected life employing the internet such as the adoption of e-commerce, which is an innovative technology adoption by firms as part of their business strategies is also one of the elements in the fourth industrial revolution. The successful innovative adoption is a critical task for any company and therefore, during the past few decades, the researchers have applied a few technological adoption models for their studies at the firm level.

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I. INTRODUCTION

In the technology advancement era, Information and Communication Technologies (ICT) have become an integral part of modern humans' lives. People use technology to speed-up their necessary processes (Sigerson, Li, Cheung, and Cheng, 2017). On the other hand, the internet becomes an essential service of every life, and eventually, it was the best innovator, which enhances the lives of many (Garín-Muñoz et al., 2019).

In the new era, a series of innovations that leverage the internet could have a significant impact on the global trades. Currently industries are at the commencing of the fourth industrial revolution. The third industrial revolution was launched in the 1960s and called as a computer or electronic revolution, which used electronics and information technology to automate production. The fourth revolution is building on

the third revolution, and it is the fusion of technology (Chinoracký & Čorejová, 2019). The use of Artificial Intelligence (AI), Internet of Things (IoT), Cloud computing, Machine learning (ML), etc. involves speeding up the process and enhancing performance (Syam & Sharmab, 2018). The fourth industrial generation classifies firms into two main segments; wholly digital companies, such as Google, Yahoo, LinkedIn, Facebook, etc. which are purely internet-based business models. Partly digitalized or going-digital are the companies that are different from the existing "brick-and-mortar" businesses that are adopting digital technologies into their existing business (Eden, 2018). The connected life using the internet is also one of the elements in the fourth industrial revolution, such as the adoption of e-commerce (Xu, David, & Kim, 2018). E-commerce is a business strategy and modern trending art of trading goods and services using the internet. Predominantly, there are different types of e-commerce channels that are operating in the global market, and it is the place where all the parties involved in the transaction receive benefits equally. Both parties can make decisions while the occurrence of the transaction (Nair, 2017).

Several technology adoption models that were introduced by diverse researchers' in both perspectives of individual and firm-level of studies.

II. MODELS OF TECHNOLOGY ADOPTION

The Technology Acceptance Model (TAM) developed by Davis (1986) is widely referred to as the Information System (IS) success model. TAM enables us to comprehend and explain user behavior in IS implementation. The model suggests two factors of "perceived usefulness" and "perceived ease of use" that influence the use and success of the system and address the issue of why users accept and reject the information system. This model is an adaptation of the well-known model of the social psychology domain; the Theory of Reasoned Action (TRA) model by Fishbein and Ajzen (1975) and explains how a person's attitude and subjective norms affect that person's behavioral intention. The Theory of Planned Behavior (TPB) by Ajzen (1985, 1991) is also an extension of TRA. It suggests that behavioral intention is jointly determined

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by a person's attitude and subjective norms, like TRA, but with the addition of perceived behavioral control.

The TAM has been continuously studied and expanded. The two upgrades are TAM2 by Venkatesh and Davis (2000) and UTAUT by Venkatesh (2003). TAM2 rationalized the fact that perceived usefulness is depending on other factors, including the user's experience, voluntariness, subjective norm, image, job relevance, and result demonstrability. The theory of Acceptance and Use of Technology (UTAUT) aims to explain a user's intention to use IS and subsequent usage behavior. The theory holds the four constructs of performance expectancy, effort expectancy, social influence, and facilitating conditions. The first three elements influence the behavioral intention, and the fourth element is a direct determinant of user behavior. Gender, age, experience, and voluntariness of use are moderating the impact of the four constructs on usage intentions and behavior.

The Diffusion of Innovations Theory (DOI) was introduced by Rogers (1995), which explained the process of the members of a social system, communicated an innovation through specific channels over time, known as diffusion. The theory explained that the innovation and adoption transpired after going through several stages, including understanding, persuasion, decision, implementation, and confirmation. The Technology, Organization, Environment (TOE) framework was introduced by Tornatzky and Fleischer (1990), which depicts the entire process of innovation, which entrepreneurs adopt and implement those innovations within the context of a firm. Moreover, the TOE framework is an organization-level theory that explains three different elements of the firm, which influence the adoption decisions of technological innovation.

In the recent past, the Integrated model for the adoption of e-commerce among SMEs (IMAES) was

introduced by Sanchez-Torres and Juarez-Acosta (2019). This model, integrated with the theory of contingency, DOI, and TAM. Further, the Technology Readiness Index (TRI) was introduced by Parasuraman in 2000. The model contends the tendency of individuals to pursue and utilize new technologies to achieve their goals. TRI measures the readiness of individuals to use new technologies and consists of four dimensions: optimism, innovativeness, discomfort, and insecurity.

Nevertheless, the theories of TAM, TPB, TRA, and UTAUT concentrate primarily on the individual level perception of technology acceptance and DOI, TOE, and IMAES are at the firm level theory of technology adoption. TRI is the combination of individual and companies' level perception of technology readiness.

III. FIRM-LEVEL TECHNOLOGY ADOPTION MODELS

As described above, there are few firm-level perceptions of technology adoption models.

a) *Technological, Organizational, Environmental (TOE) Framework*

TOE framework of Tornatzky and Fleischer 1990, identifies three aspects of an enterprise's context, that influence the process of adoption and implementation of technological innovation: The context portrays both the internal and external technologies relevant to the firm. The technological context denotes the internal current practices and equipment of the firm, and available technologies external to the firm. The organizational context refers to the descriptive measures about the organization, such as scope, size, and managerial structure. The environmental context is the arena in which a firm conducts its business, which consists of its industry, competitors, and government involvement.

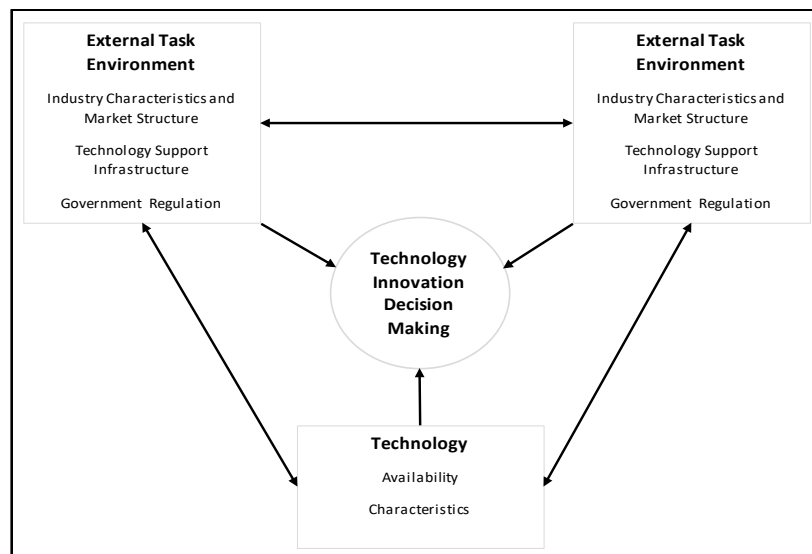


Figure 1: Technological, organizational, and environmental framework (Tornatzky and Fleischer 1990)

b) Diffusion of Innovation Theory (DOI)

DOI is a theory of new ideas and technology spread through cultures, operating at the individual and firm-level. DOI theory sees innovations as being communicated through specific channels over time and within a particular social system (Rogers, 1995). Individuals possess different degrees of willingness to adopt innovations. Roger categorized the individuals into five adoption stages, such as innovators, early adopters, early majority, late majority, and laggards.

The innovation process in an organization is more complex. The DOI theory at the firm level is emphasized; the innovativeness is related to three independent variables such as Individual (leader)

characteristics describes the leader attitude toward change. The Internal characteristics of organizational structure include; centralization of power and the control in a system are concentrated in the hands of a relatively few individuals, complexity is an organization member possess a relatively high level of knowledge and expertise, formalization is an organization emphasizes its members' following rules and procedures, interconnectedness is the units in a social system linked by interpersonal networks, organizational slack is uncommitted resources are available to an organization and size is the number of employees of the organization. The External characteristics of an organization refer to system openness.

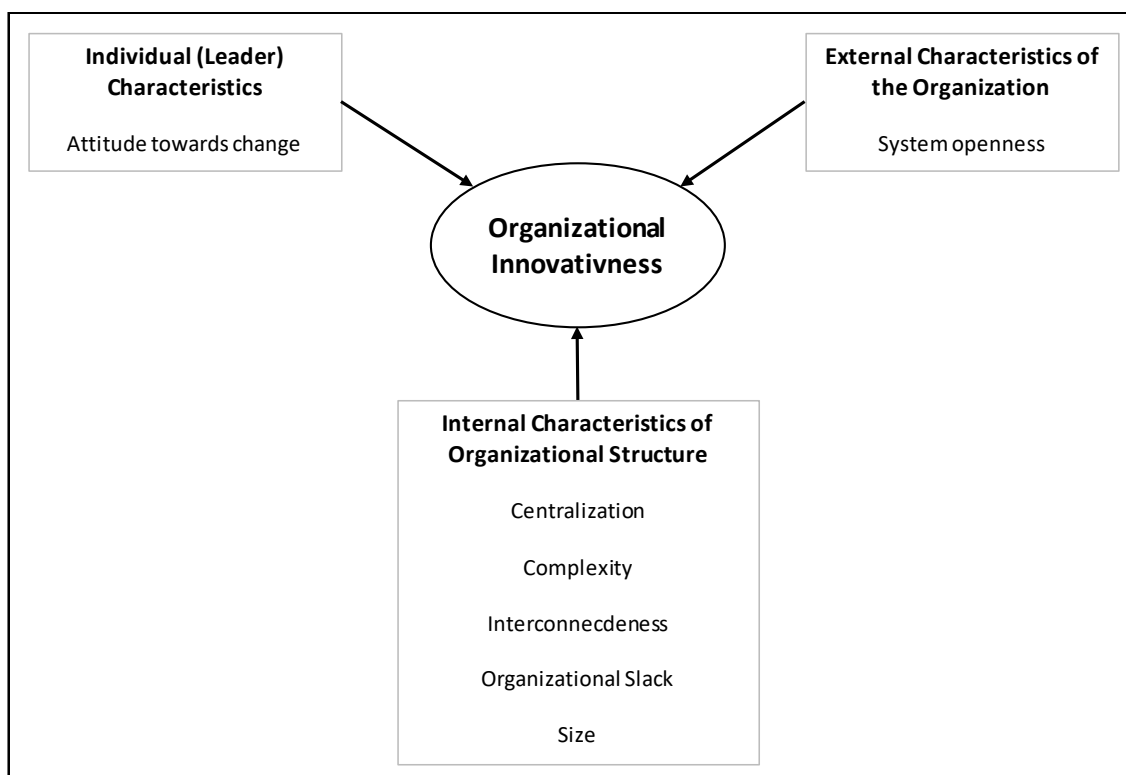


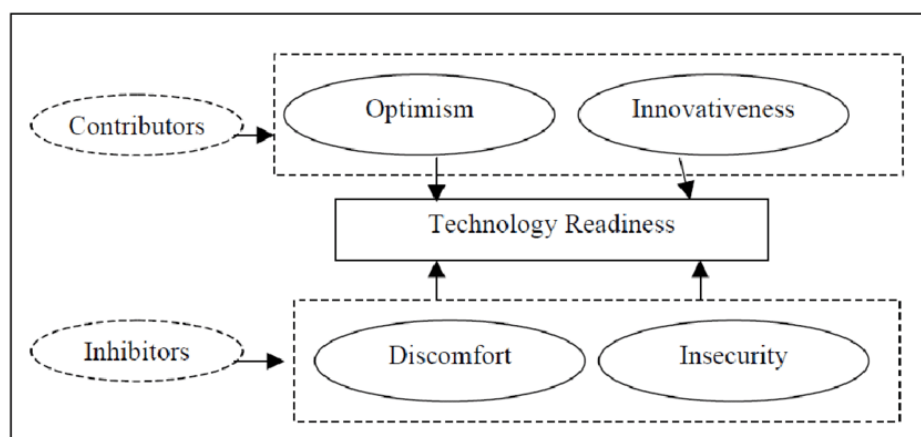
Figure 2: Diffusion of innovations (Rogers 1995)

c) Technology Readiness Index (TRI)

TRI was developed by Parasuraman (2000) to measure the beliefs and thoughts of using new technology in general. There are two different perceptions of the use of technology in the individual and firm-level. The positive view consists of optimism and innovativeness, and the negative view consists of discomfort, and insecurity.

The optimism dimension represents a positive perception of the use of technology and its benefits of using technology to improve work efficiency and performance in the workplace and at home. The innovativeness dimension refers to the degree to experiment with technology and be at the forefront of trying out the latest technology-based products or services.

The dimension of discomfort indicates a sense of lack of technological mastery and confidence in using the latest technology. The insecurity dimension refers more to mistrust of technology-based transactions and doubts about the capabilities of the technology.



Source: Parasuraman (2000, p. 34)

Figure 3: Technology Readiness Index (Parasuraman, 2000)

IV. EMPIRICAL LITERATURE

This study focuses on technology adoption models at firm-level with special emphasis on e-commerce adoption. The researcher reviewed 50 empirical studies from 33 countries, representing nine

(09) regions such as Asia, Africa, Middle East, European Union, North America, Central America, South America, Eastern Europe, and Oceania, within the past ten years from 2011 to 2020 and five (05) empirical studies for each year.

Table 1: Number of Countries (Regional-wise) and Studies

World Region	Countries	No of Countries	No of Studies	%
Asia	India, Sri Lanka, Pakistan, Indonesia, Malaysia, Singapore, Taiwan, Thailand, Vietnam, China, Korea	11	20	40%
Middle East	Iran, Iraq, Jordan, Kuwait, Saudi Arabia, UAE	6	12	24%
Africa	Ghana, Morocco, Kenya, Nigeria, Uganda, Zimbabwe, South Africa	7	8	16%
European Union	Greece, Spain, Portugal	3	3	6%
Eastern Europe	Turkey	1	2	4%
North America	USA, North America	2	2	4%
Central America	Mexico	1	1	2%
South America	Botswana	1	1	2%
Oceania	Fiji	1	1	2%
		33	50	

Twenty (20) studies from the Asian region were reviewed, which is 40% of the total empirical and twelve (12) studies from the Middle East and eight (08) studies from the African region. 80% of the empirical have found in Asian, the Middle East, and African regions (Table 1).

Table 2: List of Empirical Studies and Theory Used

No.	Authors	Year	Country	Type of Study	Theory Used
1	Putra & Santoso	2020	Indonesia	E-Business	TOE
2	Abed	2020	Saudi Arabia	Social Commerce	TOE
3	Yoon, Lim, & Park	2020	Korea	Smart Farms	TOE
4	Ezzaouia & Bulchand-Gidumal	2020	Morocco	IT in Hotels	TOE
5	I. & Sm.	2020	Malaysia	E-Commerce	TOE
6	Oliveira, Martins, Sarker, Thomas, & Popovič	2019	Portugal	SaaS Adoption	TOE
7	Govinnage & Sachitra	2019	Sri Lanka	E-Commerce	TOE and TAM
8	Phiri	2019	Zimbabwe	E-Commerce	DOI and TAM
9	Dahbi & Benmoussa	2019	Morocco	E-Commerce	TOE
10	Yadav & Mahara	2019	India	E-Commerce	TOE
11	Alnaser, Alrawashed, & Saeed	2018	Jordan	E-Commerce	TRA, TPB, TAM and DOI
12	Zaboon, Ganawi, & Dakhil	2018	Iraq	E-Commerce	TOE
13	García-Moreno, Moreno, Nájera-Sanchez, & Pablos-Heredero	2018	Spain	E-Business	TOE
14	Mohamed, Jenal, & Hanawi	2018	Uganda	E-Commerce	TAM
15	Abbas & Abdullah	2018	Pakistan	E-Commerce	TPB
16	Lim, Baharudin, & Low	2017	Malaysia	E-Commerce	TOE
17	Chand & Kumar	2017	Fiji	E-Commerce	TOE
18	Basarir-Ozel & Mardikya	2017	Turkey	E-Commerce	TAM
19	Ismail, Tean, Mohd Sam, & Pei	2017	Malaysia	E-Commerce	TOE
20	Agus & Taufik	2017	Indonesia	E-Commerce	DOI
21	Esmailpour, Hoseini, & Jafarpour	2016	Iran	E-Commerce	TAM
22	Awiagah, Kang, & Lim	2016	Ghana	E-Commerce	TOE and TPB
23	Choochinprakarn	2016	Thailand	E-Commerce	TOE and eMICA
24	Al, Al-Masaeed, Al-Qaisi, & Hunaiti	2016	Jordan	E-Commerce	TOE
25	Chatzoglou & Chatzoudes	2016	Greece	E-Business	TOE
26	Rahayu & Day	2015	Indonesia	E-Commerce	TOE
27	Garg & Choeu	2015	South Africa	E-Commerce	TOE and DOI
28	Vargas-Hernández	2015	Mexico	E-Commerce	General
29	Al-Alawi and Al-Ali	2015	Kuwait	E-Commerce	TOE
30	Al-Bakri & Katsioloudes	2015	Jordan	E-Commerce	DOI and TAM
31	Astuti & Nasution	2014	Indonesia	E-Commerce	TRI
32	Alsaad, Mohamad, & Ismail	2014	Jordan	E-Commerce	DOI
33	Lin	2014	Taiwan	Supply Chain Management System	TOE
34	AboelImaged	2014	UAE	E-Maintenance Readiness	TOE and TRI
35	Cao, Jones, & Sheng	2014	USA	Hospital RFID Patient Tracking	TOE
36	Poorangi, Khin, Nikoonejad, & Kardevani	2013	Malaysia	E-Commerce	DOI
37	Acilar & Karamasa	2013	Turkey	E-Commerce	TOE and DOI
38	Shemi & Procter	2013	Botswana	E-Commerce	TOE
39	Sila	2013	North America	E-Commerce	TOE
40	Triandini, Djunaidy, & Siahaan	2013	Indonesia	E-Commerce	TAM
41	Kenneth, Rebecca, & Eunice	2012	Kenya	E-Commerce	CAT, SM, IAM, TAM and ECBM
42	Ekong, Ifinedo, Ayo, & Ifinedo	2012	Nigeria	E-Commerce	TOE and DOI
43	Li & Xie	2012	China	E-Commerce	TOE
44	Huy, Rowe, Truex, & Huynh	2012	Vietnam	E-Commerce	TOE
45	Wang & Hou	2012	Singapore	E-Commerce	TOE
46	Tarawneh & Allahawiah	2011	Jordan	E-Commerce	TOE
47	Senarathna & Wickramasuriya	2011	Sri Lanka	E-Commerce	TOE
48	Ghobakhloo, Arias-Aranda & Benitez-Amado	2011	Iran	E-Commerce	TOE
49	Alam, Ali, & Jani	2011	Malaysia	E-Commerce	DOI
50	Alghamdi, Drew, & Al-Ghaith	2011	Saudi Arabia	E-Commerce	DOI

The majority of technology adoption studies, particularly e-commerce adoption at the firm level, have adopted either TOE or DOI theory or combination of both. Limited studies have found that one of the main theories was adopted with another technology adoption theory (Table 02).

Putra and Santoso (2020) adopted the TOE framework in their study to investigate the interrelationships amongst contextual factors that influence e-business utilization and its impact on the performance of SMEs in Indonesia. Similarly, Yoon, Lim, and Park (2020) investigate the factors affecting the adoption of the smart farm in Korea, using the TOE framework. Ezzaouia and Bulchand-Gidumal (2020) applied the TOE model to examine factors in influencing the adoption of information technology (IT) in the hotel industry in Morocco.

Oliveira, Martins, Sarker, Thomas, and Popovič (2019) used the TOE framework to understand the SaaS (Software as a service) adoption in Portugal. They further explore the moderating effects of the environmental context in the adoption of SaaS and how it shapes the direct influences of the technological and

organizational setting of the TOE model. Also, Govinnage and Sachitra (2019) examine the adoption of e-commerce in the retail SMEs sector by using the TOE framework and TAM in the Sri Lankan context.

E-commerce adoption and its impact on customer satisfaction by using TRA, TPB, TAM, and DOI theories were investigated by Alnaser, Alrawashed, and Saeed (2018) in Jordan. Moreover, García-Moreno, Moreno, Nájera-Sánchez, and Pablos-Heredero (2018) used the TOE framework to study the organizational factors impacts on e-business adoption in Spain.

Indeed, Aboelmaged (2014) applied the TOE and TRI theories to analyze the TOE effects on e-maintenance readiness in manufacturing firms in the United Arab Emirates. Furthermore, Lin (2014) used TOE to study the adoption of electronic supply chain management systems in Taiwan, and Cao, Jones, and Sheng (2014) used the TOE framework for the study of the adoption of hospital RFID patient tracking in the USA. DOI theory was adopted by Poorangi, Khin, Nikoonejad, and Kardevani (2013) to examine the e-commerce adoption in practitioner firm SMEs in Malaysia.

Table 3: Number of Empirical for each Theory

Theory	No of Studies	%
TOE	27	54%
DOI	5	10%
TAM	4	8%
TOE and DOI	3	6%
TOE and TAM	1	2%
TOE and TRI	1	2%
TOE and TPB	1	2%
TOE and eMICA	1	2%
DOI and TAM	2	4%
TRI	1	2%
TPB	1	2%
TRA, TPB, TAM and DOI	1	2%
CAT, SM, IAM, TAM and ECBM	1	2%
General	1	2%
	50	

According to the empirical analysis (Table 3), the majority of the studies, 54% (27) have used the TOE framework to examine the technology adoption, and

10% (05) have adopted DOI theory for their studies. Another 8% (04) applied TAM and 6% (03) used TOE and DOI both for their studies.

Oliveira and Martins (2010), study reiterates that the majority of firms in 27 countries of the European Union had used the TOE framework for technology adoption studies.

V. CONCLUSION

The purpose of this review is to identify theoretical models that were commonly adopted by the researchers for the technology adoption studies at the firm level, especially in e-commerce adoption and implementation, in different contexts.

Hence, based on the extensive review of the 50 empirical studies conducted in 33 countries, it is evident that the TOE was the most adopted framework at the firm level of technology adoption studies within the past 10 years. Technological-Organizational-Environmental factors are considered as the fundamental elements of innovative technology adoption in any organization. The DOI theory is the second-largest theory applied by the researchers.

This study helps future researches and recommends them to adopt these commonly tested theories in different contexts in the recent past, especially e-commerce related adoption studies at firm level.

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