JOURNAL OF INFORMATION SYSTEM AND TECHNOLOGY MANAGEMENT (JISTM)

www.jistm.com

EXPLORING THE ADOPTION OF ARTIFICIAL INTELLIGENCE IN INSTITUTIONS OF HIGHER LEARNING

Shahrizal Nazri[1], Mohamed Azlan Ashaari[2*], Hazrieffendy Bakri[3]

[1] Graduate School of Business, Universiti Sains Malaysia, Malaysia
     Email: shahrizal@usm.my
[2] Graduate School of Business, Universiti Sains Malaysia, Malaysia
     Email: azlan@usm.my
[3] Graduate School of Business, Universiti Sains Malaysia, Malaysia
     Email: hazrieffendy@usm.my
*   Corresponding Author

Abstract:

In every sector of the economy, artificial intelligence (AI) is becoming more feasible, and higher education service is no exception. At an unparalleled pace, both within and outside the classroom, AI opens the possibility for institutions of higher learning (IHLs) to become scalable. This paper proposed a research framework for AI adoption of in IHLs. The research aims to examine the determinants that significantly affected AI adoption among IHLs. This study presents an interpretation of the Technology-Organisation-Environment (TOE) theory for the adoption of AI. The research framework derived from the TOE theory, where the context of technological, organisational, and environmental are vital for IT adoption. It discussed the development of hypotheses that consisted the determinants for the adoption of AI from the context of technological (relative advantage and compatibility), organisational (resources availability, top management support and organisation size) and environmental (government regulation and competitive pressure).

Keywords:

Artificial Intelligence, Institutions Of Higher Learning, Adoption, Conceptual Paper

Introduction

While the impact of artificial intelligence (AI) on different industries is unclear, institutions of higher learning (IHLs) must educate their graduates for any dynamic changes to the global graduate labour market that might occur. The advancement of innovation in information technology (IT), such as artificial intelligence (AI), undeniably transforms lives and jobs. Such

developments are so significant and pervasive in society that the 'Fourth Industrial Revolution' (IR4.0) is referred. There is much debate about how in different industries this IR4.0 will play out and where it will leave those non-adopters behind.

There is no question that AI has already impacted specific areas that use human labour, such as the implementation of automated cashier systems in supermarkets, but there is still much confusion when it comes to how AI could impact highly qualified workers. As IHLs concentrate on educating their graduates for higher-skilled employment, they must consider the possible impact of AI on employment and tailor their teachings and processes accordingly.

An array of terms, like machine learning, intelligence systems, intelligent behaviour, intelligent agents, have been used in artificial intelligence (AI) meaning (Popenici & Kerr, 2017). The AI deemed in the earlier to be machines that can think, reason, and determine like human beings. This view has also evolved to take universal AI at the human level into account, for instance, actions similar to a human being and illuminates the environment as a human being (ZawackiRichter, Marín, Bond, & Gouverneur, 2019).

AI is transforming all business which results in expanded curiosity in AI, its subdomains, and associated spheres such as machine learning and data science (Forbes, 2020). According to Gartner, 37 per cent of organisations are yet struggling to identify their AI strategies by which AI can be incorporated into their organisation and how AI can support their organisation (Gartner, 2018). AI has also evolved to strengthen ecosystems of decision-making and customer experience re-creation (PwC, 2019). AI has grown into the research area in various disciplines and businesses, involving marketing, engineering, medicine, accounting, finance, science, economics, law and education (KPMG, 2020). Projects like self-driving vehicles, healthcare, and new media are being applied AI already (Forbes, 2020). However, while there has been significant literature of AI, this has not been the case for determinants for AI adoption by organisations, especially the institutions of higher learning (IHLs)(Popenici & Kerr, 2017; Zawacki-Richter et al., 2019).

The outlook of IHLs is intrinsically associated with advancements on innovative technologies (Popenici & Kerr, 2017; Wong, Li, & Choi, 2018; Zawacki-Richter et al., 2019). AI open new perspectives and challenges for IHLs, with the capacity to fundamentally alter IHL internal architecture and its governance. Adaptive learning and AI are highlighted as essential advancements in the technological innovation of educational prominently with adoption time of 2 to 3 years (EDUCAUSE, 2018). AI adoption among IHLs is projected to rise by 43 per cent by the year 2022 (EDUCAUSE, 2019). This trend of interest quickly has a substantial impact on IHLs (Popenici & Kerr, 2017). For instance, 50 new professorships for AI education and research newly promoted by Technical University of Eindhoven in conjunction with an Artificial Intelligence Systems Institute inauguration (TUe, 2019).

Newly found ethical consequences and threats come in with the AI adoption, Even though the immense prospects that AI may allow impacting the IHLs (Popenici & Kerr, 2017; ZawackiRichter et al., 2019). For instance, it could be enticing for IHLs in times of limited budget, to substitute teaching by practical programmed AI solutions. IHLs' academicians and administrators may worry about expert systems, intelligent tutors, and chatbots will replace their careers. AI can expand the capabilities of learning analytics. However, such solutions

involve massive volumes of data, involving faculty and students' classified information, which increases severe concerns of data protection and privacy.

To date, IT adoption has been the focus of a significant amount of empirical research on IT innovation (Aboelmaged, 2014; Yang, Sun, Zhang, & Wang, 2015). To create a competitive advantage and to safeguard and retain the advantage, IT was first investigated. Recently, AI adoption in an organisation will improve productivity and help managers in making data-driven decisions (Ma & Siau, 2018; Zawacki-Richter et al., 2019). Research has shown that only 6 per cent of organisations have been adopted AI and 59 per cent of organisations still considering for adoption of AI (Gartner, 2019). The result showed that in terms of organisational adoption, it is unclear how to incorporate AI into a corporate strategy, although the danger of entirely ignoring AI is much greater (Gartner, 2019). Therefore, the lack of IT study exploring AI adoption, and the increasing curiosity in AI is driving this study to explore the determinants of AI adoption in IHLs to build a competitive edge and education sustainability. This paper aims to examine the determinants of AI adoption among IHLs. Therefore, the research question in this study is what the determinants of AI adoption among IHLs are?

Next section is the review of literature which containing the underlying theories for providing a theoretical framework for AI adoption is discussed. It also discussed the determinants of AI adoption in IHLs and the development of hypotheses. The final section was the conclusion section.

Literature Review

Underlying Theory
Numerous leading models and theories have influenced the area of IT adoption in recent years such as technology acceptance model (TAM), theory of planned behaviour (TPB), unified theory of acceptance and use of technology (UTAUT), diffusion of innovations (DOI) and the technology-organisation-environment (TOE) theory (Ajzen, 1991; Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Rogers, 2003; Tornatzky & Fleischer, 1990; Venkatesh, Morris, & Davis, 2003). Of the above, the TOE and DOI theories constitute the organisational most influential theories and frequently used as underpinnings theory for other studies and theories on IT adoption by organisations (Chong, Ooi, Lin, & Raman, 2009; Oliveira & Martins, 2010). In discussing a specific IT adoption atmosphere, various adoption models and ideas must be combined to provide a more comprehensive overview of the adoption situation (Oliveira & Martins, 2010). The Iacovou, Benbasat, and Dexter (1995) model, derived from the TOE theory and created in the environment of IT adoption in the organisations, is a notable instance of improving a renowned theoretical basis for a study context.

The TOE theory covers three contexts that affect IT adoption: technological, organisational, and environmental (Tornatzky & Fleischer, 1990). The context of technological is based on the accessibility and features of IT innovation. It implies to all IT innovation that applies to the organisation. The context of organisational signifies the organisation's attributes, such as associating forms, communication practices, size, and limp. Finally, the context of environmental examines the potential and constraints of IT innovation, including the characteristics and business composition, facilities of technology support, government regulation and the activities of other actors that may affect IT adoption (Ahmadi, Nilashi,

Shahmoradi, & Ibrahim, 2017; Dholakia & Kshetri, 2004; Lin, 2014; Tornatzky & Fleischer, 1990).

Research Framework and Hypotheses Development

The essential model of the proposed research framework is from the context of technological, organisational, and environmental that significant effect on AI adoption. The proposed research framework (see Figure 1) derived from the TOE theory and the development of hypotheses were justified based on a theoretical interpretation and refer to empirical finding from similar research areas (Jaakkola, 2020; Klockner & Pillay, 2019).
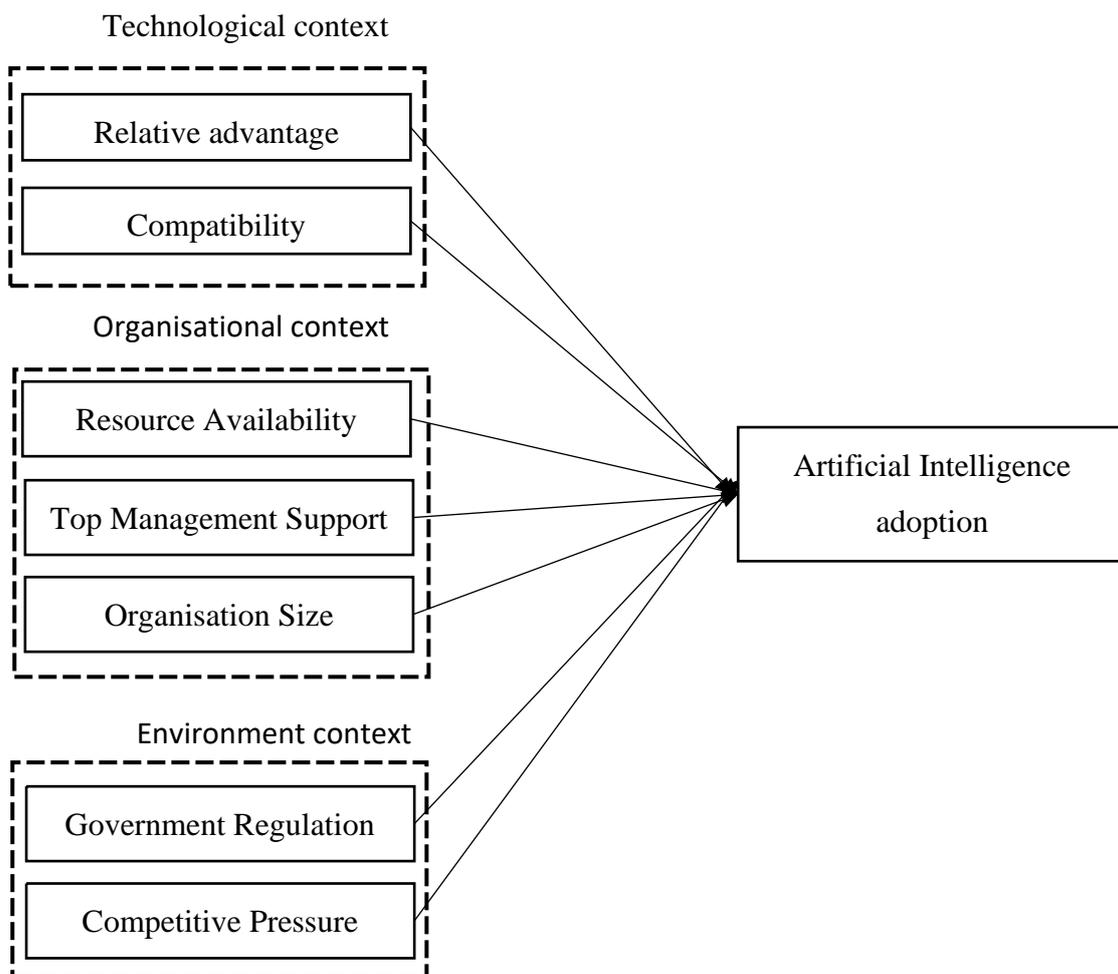

Figure 1: Proposed Research Framework

Relative Advantage

The relative advantage means the perceived advantage of IT adoption by the organisation (Rogers, 2003). The perceived benefits of IT innovation have a significant effect on IT adoption by organisations (Rogers, 2003; Wu & Chen, 2014). In this research, AI's perceived benefits relate to the extent of AI is better than other rival IT innovation (Ahmadi et al., 2017). Prior studies have a positive relationship between the relative advantage and the IT adoption (Aboelmaged, 2014; Ahmadi et al., 2017; Boonsiritomachai, McGrath, & Burgess, 2016; Ifinedo, 2011; Yang et al., 2015). AI allows organisations to gain a competitive edge, lower costs, opportunities to shift to new markets, improve top-line revenues, increase efficiency and

increase human intelligence (Hinojo-Lucena, Aznar-Díaz, Cáceres-Reche, & RomeroRodríguez, 2019; Zawacki-Richter et al., 2019). Machine learning, deep learning and natural language generation enable businesses to have a competitive edge when AI is adopted (Zawacki-Richter et al., 2019). Hence, the following hypothesis is suggested:

H1: The relative advantage of AI has a significant positive effect on AI adoption.

Compatibility
The compatibility refers to innovation's level and capacity to deliver value and knowledge whilst meeting the requirements of anticipated adopters (Rogers, 2003). Previous researches have shown a positive correlation between compatibility and IT adoption (Ahmadi et al., 2017; Ifinedo, 2011; Yang et al., 2015). Successful transformations of AI need a strong AI business case and should make parallel with current policies (Hinojo-Lucena et al., 2019; ZawackiRichter et al., 2019). Previous empirical studies have shown that a more critical match the diffusion of innovation that contributes to adoption (Ifinedo, 2011; Rogers, 2003). Hence, the following hypothesis is suggested:

H2: The compatibility of AI has a significant positive effect on AI adoption.

Resources Availability
The organisational resource availability has identified as a determinant in IT adoption (AdlerMilstein & Bates, 2010; Oliveira & Martins, 2010; Soares-Aguiar & Palma-dos-Reis, 2008). Administrators will promote IT innovation once facilities, capital, and human resources are accessible (Chong et al., 2009). A study on ERP adoption found that unavailability of resource avoided SMEs in Taiwan from investing in ERP (Scupola, 2003). The adoption of AI usually needs financial resources and specialised staff because of its high cost and complexity (Sahay & Ranjan, 2008). Hence, the following hypothesis is suggested:

H3. The resource availability of an organisation has a significant positive effect on AI adoption.

Top Management Support
Top management support implies to a top management dedication to IT adoption (Ifinedo, 2011; van de Weerd, Mangula, & Brinkkemper, 2016). The studies acknowledge top management support as a determinant and argued that a deficiency of support does not enhance an organisation's competitive advantage and increases its failure to accept innovation (Raguseo & Vitari, 2018; Wieder & Ossimitz, 2015). Supplying capital funds and allocating resources, top management support may also have a significant positive impact on IT adoption (van de Weerd et al., 2016; Yang et al., 2015). For instance, top management support has been significant to encourage the adoption of cloud computing and e-business for IT adoption studies (Ifinedo, 2011; Yang et al., 2015). In general, AI adoption is a strategic move to drive business transformation (Hinojo-Lucena et al., 2019). Thus, this research posits the following hypothesis:

H4: The top management support has a significant positive effect on AI adoption.

Organisation Size
Size of the organisation directly affects IT adoption (Aboelmaged, 2014; Hatta, Miskon, & Abdullah, 2017; Lee & Xia, 2006). Previous research has shown that large organisations are

more capable of embracing technology (Aboelmaged, 2014; Hatta et al., 2017; Lee & Xia, 2006; van de Weerd et al., 2016). Likewise, larger organisation face significant competitive pressure (Aboelmaged, 2014; Hatta et al., 2017). The study also found that, since larger organisations have more fiscal and specialised resources, organisation size has a positive effect on IT adoption (Aboelmaged, 2014; Lee & Xia, 2006). Thus, this research posits the following hypothesis:

H5: The size of an organisation has a significant positive effect on AI adoption.

Government Regulation
Government regulation has been identified as one of the variables that IHLs need to consider (Ma & Siau, 2018; Scupola, 2003). Government regulation refers to the government's encouragement to promote AI adoption by the organisations. In this study, different policies applied by different governments (Ma & Siau, 2018; Scupola, 2003). Thus, this research posits the following hypothesis:

H6: Government regulations has a significant positive effect on AI adoption.

Competitive Pressure
The competitive pressure cultivates to accelerate organisations to look for new tactics to raise organisational effectiveness and productivity, that manages organisations accomplishing competitive edge (Aboelmaged, 2014; Alshawi, Missi, & Irani, 2011; Themistocleous, Irani, Kuljis, & Love, 2004). Substantial empirical studies have acknowledged competitor pressure as a determinant to IT adoption (Yang et al., 2015). AI will promote creativity and generate new opportunities for staffs and organisations (Hinojo-Lucena et al., 2019; Zawacki-Richter et al., 2019). The capacity to apply AI to enhance customer experience and decision-making affect AI adoption (Aboelmaged, 2014). Thus, this research posits the following hypothesis:

H7: The competitive pressure on an organisation has a significant positive effect on AI adoption.

Conclusion
This study proposed a research framework for AI adoption among IHLs. The research aims to examine the determinants that significantly affected for AI adoption among IHLs. This study presents an interpretation of the TOE framework for AI adoption by IHLs. The research framework derived from the TOE framework where the contexts of technological, organisational, and environmental are developed for AI adoption by organisations. It discussed the development of hypotheses that consisted the determinants for AI adoption from the contexts of technological (relative advantage and compatibility), organisational (resources, organisation size and top management support) and environmental (government regulation and competitive pressure). To verify and validate the framework, a quantitative methodology analysis approach is recommended.

References
Aboelmaged, M. G. (2014). Predicting e-readiness at firm-level: An analysis of technological, organisational and environmental (TOE) effects on e-maintenance readiness in manufacturing firms. *International Journal of Information Management*, *34*(5), 639–651. https://doi.org/10.1016/j.ijinfomgt.2014.05.002

Adler-Milstein, J., & Bates, D. W. (2010). Paperless healthcare: Progress and challenges of an IT-enabled healthcare system. *Business Horizons*, *53*(2), 119–130. https://doi.org/10.1016/j.bushor.2009.10.004

Ahmadi, H., Nilashi, M., Shahmoradi, L., & Ibrahim, O. (2017). Hospital Information System adoption: Expert perspectives on an adoption framework for Malaysian public hospitals. *Computers in Human Behavior*. https://doi.org/10.1016/j.chb.2016.10.023

Ajzen, I. (1991). Theory of Planned Behavior Measure. *Organisational Behavior and Human Decision Processes*, *12*(1), 1–8. https://doi.org/10.1037/t15668-000

Alshawi, S., Missi, F., & Irani, Z. (2011). Organisational, technical and data quality factors in CRM adoption - SMEs perspective. *Industrial Marketing Management*, *40*(3), 376–383. https://doi.org/10.1016/j.indmarman.2010.08.006

Boonsiritomachai, W., McGrath, G. M., & Burgess, S. (2016). Exploring business intelligence and its depth of maturity in Thai SMEs. *Cogent Business and Management*, *3*(1). https://doi.org/10.1080/23311975.2016.1220663

Chong, A. Y.-L., Ooi, K.-B., Lin, B., & Raman, M. (2009). Factors Affecting the Adoption Level of C-Commerce: an Empirical Study. *The Journal of Computer Information Systems*, *50*(2), 13–22. https://doi.org/10.1080/08874417.2009.11645380

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly: Management Information Systems*, *13*(3), 319– 339. https://doi.org/10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two. *Management Science*. https://doi.org/10.1088/20587058/30/1/43

Dholakia, R. R., & Kshetri, N. (2004). Factors Impacting the Adoption of the Internet among SMEs. *Small Business Economics*, *23*(4), 311–322.

EDUCAUSE. (2018). *Horizon Report 2018 Higher Education Edition*. Retrieved from https://library.educause.edu/~/media/files/library/2018/8/2018horizonreport.pdf

EDUCAUSE. (2019). *Horizon Report 2019 Higher Education Edition*. https://doi.org/ISBN 978-0-9968527-5-3

Forbes. (2020). How Is AI Used In Education -- Real World Examples Of Today And A Peek Into The Future. *Forbes*. Retrieved from https://www.forbes.com/sites/bernardmarr/2020/08/10/what-is-the-artificial-intelligencerevolution-and-why-does-it-matter-to-your-business/#5e15bd2f547b

Gartner. (2018). *How to Build a Business Case for Artificial Intelligence - Smarter With Gartner*. Retrieved from https://www.gartner.com/smarterwithgartner/how-to-build-a-business-case-for-artificialintelligence/

Gartner. (2019). *Gartner Survey Reveals Leading Organisations Expect to Double the Number of AI Projects In Place Within the Next Year*. Retrieved from https://www.gartner.com/en/newsroom/press-releases/2019-07-15-gartner-surveyreveals-leading-organizations-expect-t

Hatta, N. N. M., Miskon, S., & Abdullah, N. S. (2017). Business Intelligence System Adoption Model for SMEs. In *Pacific Asia Conference on Information Systems (PACIS) 2017 Proceedings*.

Hinojo-Lucena, F. J., Aznar-Díaz, I., Cáceres-Reche, M. P., & Romero-Rodríguez, J. M. (2019). Artificial intelligence in higher education: A bibliometric study on its impact in the scientific literature. *Education Sciences*, *9*(1). https://doi.org/10.3390/educsci9010051

Iacovou, C. L., Benbasat, I., & Dexter, A. S. (1995). Electronic data interchange and small organisations: Adoption and impact of technology. *MIS Quarterly*, *19*(4), 465–485.

Ifinedo. (2011). An empirical analysis of factors influencing internet/E-business technologies adoption by SMEs in Canada. *International Journal of Information Technology & Decision Making*, *10*, 731–766. https://doi.org/10.1142/S0219622011004543

Jaakkola, E. (2020). Designing conceptual articles: four approaches. *AMS Review*. https://doi.org/10.1007/s13162-020-00161-0

Klockner, K., & Pillay, M. (2019). Theorising and theory building in the safety sciences: A reflective inquiry. *Safety Science*, *117*(March), 250–256. https://doi.org/10.1016/j.ssci.2019.04.023

KPMG. (2020). AI: The new power generation. Retrieved from https://home.kpmg/xx/en/home/insights/2020/02/ai-the-new-power-generation.html

Lee, G., & Xia, W. (2006). Organisational size and IT innovation adoption: A meta-analysis. *Information & Management*, *43*(8), 975–985. https://doi.org/https://doi.org/10.1016/j.im.2006.09.003

Lin, H. F. (2014). Contextual factors affecting knowledge management diffusion in SMEs. *Industrial Management and Data Systems*. https://doi.org/10.1108/IMDS-08-2014-0232

Ma, Y., & Siau, K. L. (2018). Artificial intelligence impacts on higher education. In *Thirteenth Midwest Association for Information Systems Conference*, *42*, 1–5. Retrieved from http://aisel.aisnet.org/mwais2018http://aisel.aisnet.org/mwais2018/42

Oliveira, T., & Martins, M. F. (2010). Understanding e-business adoption across industries in European countries. *Industrial Management & Data Systems*, *110*(9), 1337–1354. https://doi.org/10.1108/02635571011087428

Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, *12*(1). https://doi.org/10.1186/s41039-017-0062-8

PwC. (2019). *Governance is the foundation of responsible AI*. Retrieved from https://www.pwc.ch/en/insights/digital/governance-is-the-foundation-of-responsibleai.html

Raguseo, E., & Vitari, C. (2018). Investments in big data analytics and firm performance: an empirical investigation of direct and mediating effects. *International Journal of Production Research*, *56*(15), 5206–5221. https://doi.org/10.1080/00207543.2018.1427900

Rogers, E. M. (2003). *Diffusion of Innovations*. (E. M. Rogers, Ed.), *The Free Press* (Fifth). New York, USA: Free Press.

Sahay, B. S., & Ranjan, J. (2008). Real time business intelligence in supply chain analytics. *Information Management & Computer Security*, *16*(1), 28–48. https://doi.org/10.1108/09685220810862733

Scupola, A. (2003). The Adoption of Internet Commerce by SMEs in the South of Italy: An Environmental, Technological and Organisational Perspective. *Journal of Global Information Technology Management*, *6*(1), 52–71. https://doi.org/10.1080/1097198X.2003.10856343

Soares-Aguiar, A., & Palma-dos-Reis, A. (2008). Why do firms adopt E-procurement systems? Using logistic regression to empirically test a conceptual model. *IEEE Transactions on Engineering Management*, *55*(1), 120–133. https://doi.org/10.1109/TEM.2007.912806

Themistocleous, M., Irani, Z., Kuljis, J., & Love, P. E. D. (2004). Extending the information system lifecycle through enterprise application integration: a case study experience. In

37th Annual Hawaii International Conference on System Sciences, 2004. Proceedings of the, (pp 8), IEEE. https://doi.org/10.1109/HICSS.2004.1265558

Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation. Lexington Books*. Lexington, MA: Lexington Books. https://doi.org/10.1007/BF02371446

TUe. (2019). *TU/e announces EAISI: new institute for intelligent machines*. Retrieved from https://www.tue.nl/en/news/news-overview/11-07-2019-tueannounces-eaisi-new-institute-for-intelligent-machines/

van de Weerd, I., Mangula, I. S., & Brinkkemper, S. (2016). Adoption of software as a service in Indonesia: Examining the influence of organisational factors. *Information and Management*, *53*(7), 915–928. https://doi.org/10.1016/j.im.2016.05.008

Venkatesh, V., Morris, M. G., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly: Management Information Systems*, *27*(3), 425–478. https://doi.org/10.2307/30036540

Wieder, B., & Ossimitz, M. L. (2015). The Impact of Business Intelligence on the Quality of Decision Making - A Mediation Model. *Procedia Computer Science*, *64*, 1163–1171. https://doi.org/10.1016/j.procs.2015.08.599

Wong, B. T. M., Li, K. C., & Choi, S. P. M. (2018). Trends in learning analytics practices: a review of higher education institutions. *Interactive Technology and Smart Education*, *15*(2), 132–154. https://doi.org/10.1108/ITSE-12-2017-0065

Wu, I. L., & Chen, J. L. (2014). A stage-based diffusion of IT innovation and the BSC performance impact: A moderator of technology-organisation-environment. *Technological Forecasting and Social Change*, *88*, 76–90. https://doi.org/10.1016/j.techfore.2014.06.015

Yang, Z., Sun, J., Zhang, Y., & Wang, Y. (2015). Understanding SaaS adoption from the perspective of organisational users: A tripod readiness model. *Computers in Human Behavior*, *45*, 254–264. https://doi.org/10.1016/j.chb.2014.12.022

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(1). https://doi.org/10.1186/s41239-019-0171-0