IJEBEG

e-ISSN: 2146-0744

Volume:12 No: 1 Year: 2020

INTERNATIONAL JOURNAL of eBUSINESS and eGOVERNMENT STUDIES

SoSReS

The Social Sciences Research Society

International Journal of eBusiness and eGovernment Studies

e-ISSN:2146-0744

Volume :12 Number:1 Year :2020

International Journal of eBusiness and eGovernment Studies is indexed by the following indexes.

Scopus

Since Year: 2018 Volume:10 No :1
Scopus Index Link
https://www.scopus.com/sourceid/21100867370

DOAJ DIRECTORY OF OPEN ACCESS JOURNALS

Since Year: 2009 Volume:1 No :1
Doaj Index Link
https://doaj.org/toc/2146-0744

SOBIAD

Since Year: 2009 Volume:1 No :1
Sobiad Index Link
https://atif.sobiad.com/index.jsp?modul=dergi-sayfasi&ID=0&magazinename=International%20Journal%20of%20eBusiness%20and%20eGovernment%20Studies

INTERNATIONAL JOURNAL OF EBUSINESS AND EGOVERNMENT STUDIES
Volume: 12 No: 1 Year: 2020

Owner : The Social Sciences Research Society
Head Officwe : İzmir, TURKEY
Publication Type : It is published electronically in Januarry-June and July-December.

Address : Sosyal Bilimler Araştırmaları Derneği
Gazi Bulvarı No 66/602 Gazi İşhanı Çankaya-İzmir TURKEY
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CONTENT

INTERNATIONAL JOURNAL OF eBUSINESS and eGOVERNMENT STUDIES
Vol: 12 **No:** 1 **Year:** 2020 **ISSN**: 2146-0744 (Online) (**pp.** 1-16) **Doi:** 10.34111/ijebeg.202012101
Recieved: 08.09.2019 | **Accepted:** 12.10.2019 | **Published Online:** 01.01.2020

-RESEARCH ARTICLE-

WEARABLE ACTIVITY-TRACKING DEVICE FEATURE PREFERENCE AMONGST SOUTH AFRICAN GENERATION Y STUDENTS

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─Abstract ─

Wearable activity-tracking devices such as pedometers, various electrode-based chest straps, accelerometer-based arm straps, fashion bracelets, jewellery, fitness bands and watches, earphones, and smart clothing have revolutionised health and sports monitoring. Based on the benefits of using this wearable technology, it is no surprise that the adoption thereof has increased rapidly. In 2019, the sports, fitness, and activity monitor market is estimated to generate 2.8 billion USD in global revenue. In South Africa, merely 13 percent of households own some form of wearable technology. Dominating this market is the youth, where 33.7 percent of these individuals are between the ages of 18 to 24 years, thus belonging to the Generation Y cohort. The literature, documenting wearable activity-tracking device feature preference amongst consumers, especially among this cohort, is limited. As such, this study explored South African Generation Y students' feature preferences on wearable activity-tracking devices in order to assist device manufacturers and marketing practitioners in developing and marketing devices that will appeal to this large segment. A non-probability convenience sample of 480 students, registered at three public HEIs in South Africa's Gauteng province, voluntarily completed self-administered questionnaires. A descriptive research design was followed and the captured data were analysed using measures of frequency. The findings indicate that the top five device features preferred by South African Generation Y students are measuring heart rate/blood pressure, tracking steps taken/distance travelled, calculating daily calories burnt, tracking sleep patterns and GPS tracking. In an effort to increase wearable activity-tracking

Citation (APA): Muller, C., (2020), Wearable Activity-Tracking Device Feature Preference Amongst South African Generation Y Students, International Journal of eBusiness and eGovernment Studies, 12 (1): 1-16. Doi: 10.34111/ijebeg.202012101.

device adoption amongst Generation Y students, both local and international device manufacturers need to consider these device feature preferences in order to manufacture and advertise such devices accordingly.

Key Words: Wearable activity-tracking devices, new technology adoption, feature preference, Generation Y, South Africa.

JEL Classification: M31, M37, O30

1. INTRODUCTION

Activity-tracking devices, commonly known as activity trackers or fitness trackers, comprise technology capable of measuring the user's physical movement and health-related metrics (Muller, 2019). These devices are available across various platforms, whether it is an attachable device, cycling computer, or a smartphone application. The wearable technology market, of which certain activity-tracking devices form part, is currently estimated to have a net value of approximately 7 643.1 million USD (R109 billion) and it is expected to increase to 8 592.4 million (R122.5 billion) in 2020 (Statista, 2018a), based on the average exchange rate of $1/R13.26 for August 2018 to July 2019 (Exchange-rates.org, 2019). In addition, within the global wearable technology market, fitness, activity, and sports trackers are projected to increase from 61 million units distributed in 2016 to 187 million units distributed in 2020 (Lamkin, 2016). Despite the mere 13 percent of South African households currently owning some form of wearable technology (Business Tech, 2018), the country had a market penetration rate of 3.81 percent in 2017 for wearable activity trackers specifically, which is projected to increase to 4.83 percent in 2020. To put this in perspective, of the total national population, as recorded mid-year in 2017 which totalled 56 521 900 individuals (Statistics South Africa, 2017), an additional 576 523 individuals will be using a wearable activity tracker within this three-year period. As such, South Africa ranks amongst the global leading economies (Statista, 2018b) and is expected to be the next big market for both smartwatches and fitness trackers (Business Tech, 2018).

The demographic segment that has shown a substantial interest in the wearable technology market is the youth, particularly individuals who form part of the Generation Y cohort. Markert (2004) defines this cohort, referred to as Millennials, as individuals born between 1986 and 2005. This is the first generation to evolve during a period where computers, mobile phones, electronic devices and the internet have been integral elements in their daily lives, which lead to them naturally thriving on technology and its innovations. Moreover, it is

the youth who are more motivated to be proactive in altering their lifestyle patterns in favour of their well-being and will eagerly pay premium prices to reach health-related goals (Gustafson, 2017). Consequently, it is not surprising that 48 percent of global wearable-device users fall within the Generation Y cohort (Marr, 2016). The South African wearable activity-tracking device segment is driven and dominated by the youth, with 33.7 percent of this market comprising individuals aged between 18 and 24 years (Statista, 2018b). In South Africa, the Generation Y cohort comprised roughly 36.2 percent of the country's total population of 56.5 million. The magnitude of this cohort brands them as an important segment for both international and South African device manufacturers, retailers, and e-commerce sites. Owing to the magnitude of this cohort and considering that the youth who are pursuing a tertiary education are attributed by a heightened future-earning probability and trendsetting potential (Bevan-Dye & Surujlal, 2011), an opportunity has emerged to appeal to the student portion of the Generation Y cohort.

Research regarding wearable activity-tracking devices comprises various studies focused around different themes. For instance, the number of studies specifically pertaining to wearable activity trackers totalled 463 between 2013 and 2017 (Shin *et al.*, 2019). Amid the 463 studies, the largest segment (26%) centred on technological functioning; 23 percent comprised patient treatment and medical settings; and 18 percent addressed behavioural change. Furthermore, 17 percent highlighted wearable activity tracker acceptance, adoption, and abandonment; 10 percent focused on self-monitoring; and 6 percent pertained to privacy. These studies, along with more recent research, focus mostly on wearable device reliability and/or validity, comparing different brands and specific models of devices, the accuracy of such devices, medical attributes and patient treatment by means of using wearable technology, promoting physical activity or physical activity intervention, device acceptance and factors influencing the adoption or abandonment of wearable activity trackers, and the privacy concerns posed by using these types of devices (Bassett, Freedson & John, 2019; Bunn, Wells, Manor, & Webster, 2019; Muller, 2019; Jones *et al.*, 2018; Lamont, Daniel, Payne & Brauer, 2018; Muller, de Klerk & Bevan-dye, 2018; Yang, Schumann, Le & Cheng, 2018; Chu *et al.*, 2017; Shinde *et al.*, 2017; Steinert, Haesner & Steinhagen-Thiessen, 2017; Diaz *et al.*, 2016; Kaewkannate & Kim, 2016; Lamb, Huang, Marturano & Bashir, 2016; Roe, Salmon & Twiggs, 2016; Wang *et al.*, 2016; Cadmus-Bertram *et al.*, 2015; Case, Burwick, Volpp & Patel, 2015; Kooiman *et al.*, 2015; Fulk *et al.*, 2014; Lee, Kim & Welk, 2014; Fausset *et al.*, 2013; Noah, Spierer, Jialu & Bronner, 2013). However, the majority of these

studies used smaller samples (between 0-100) and the research and data collection methods were mostly observational, experimental, interventional, or qualitative in nature, with the exception of a few that were quantitative and survey-based. In addition, the target population of these studies mostly comprised participants outside of the Generation Y, university student cohort.

Thus far in 2019, two studies emerged that emphasised wearable activity-tracking device feature preference, one of which included university students as a sample. Hong (2015) explored Korean university students' perception of wearable device features. In the study, participants had to indicate the level of importance of each of nine features, and the results were linked to the product life cycle (PLC) and marketing mix. Similarly, Steinert *et al.* (2017) investigated 12 categorical preferences, including, amongst others, comfort, design, quality, manner of attachment, and synchronisation of five specific fitness trackers using 20 older adults outside of Gen Y as a sample. It is evident that the literature documenting the feature preference of wearable activity-tracking devices amongst consumers, especially among the South African Generation Y cohort, is limited. Hence, this study aims to identify Generation Y students' feature preference of wearable fitness, activity, and sports trackers - collectively termed wearable activity-tracking devices - with the aim of closing the gap in the literature. The findings will assist device manufacturers and marketing practitioners in developing and marketing devices that will appeal to this large segment.

2. LITERATURE REVIEW

2.1. Wearable activity-tracking devices defined

There is much confusion amongst consumers as to the accurate definition of activity-tracking devices. Reinforcing this confusion is that various consumers believe it to be synonymous to smartwatches – a type of wearable industry of its own accord (International Data Corporation, 2016). Granted that both types of wearables comprise related features, fitness trackers are used for producing more comprehensive workout data, whereas smartwatches are suitable for users with a need to remain up to date with calls, emails, and text messages without having to take out their phones (Chang, 2017). Smartwatches are essentially an extension of the user's smartphone. Conversely, an activity-tracking device refers to any physical device or application on smartphones that is capable of tracking the user's movement and metrics on a real-time basis (Muller, 2019) whilst being able to connect wirelessly to an IT device for the purpose of visually displaying the recorded information (Techopedia, 2018; Kingston, 2015). In accordance with this

information, wearable activity-tracking devices are defined as "any type of device that is attachable to the human body, including clothing items, capable of measuring the user's movement and fitness-related metrics, whilst simultaneously providing real-time feedback by means of a smart device"; the emphasis is on these devices being wearable in nature.

2.2. Wearable activity-tracking device types, characteristics, and features

A review of the literature could not divulge research studies or articles that summarise the types of wearable activity trackers that are available on the market at a specific point in time. As such, a brief description of the different types of wearable activity-tracking devices as of the end of 2018 follows. An extensive search identified several types of devices, namely, basic to advanced clip-on pedometers (Van Heerden, 2016); heart-rate based chest straps, arm straps (Halse, 2018), and headbands (Price, 2017); fashion bracelets (Halse, 2018); fitness bands with or without an interface (Nield, 2017); smart clothing (Mackenzie, 2015); smart rings (Van Heerden, 2016); smart jewellery, such as the Swarovski activity crystal (Stuart, 2016); headphones or earphones, known as hearables (Dubey, 2017); smart sneakers (Eadicicco, 2016); smart insoles (Nguyen, 2016); digital and analogue watches, where a combination of the two is also available.

Some of the abovementioned wearable activity trackers use a combination of accelerometers, altimeters, sensors, and algorithms to track the number of steps taken, distance travelled, or calories burnt by the user (Beckham, 2012). Other devices can measure the user's static or optical heart-rate data (Rettner, 2014); record different sport sessions, such as running or cycling (Hong, 2015); and measure stress levels (Nield, 2017). Smart Shirts such as Hexoskin, a type of smart clothing, provide exact cardiac, respiratory, sleep, and activity metrics (Draper, 2018). As these devices evolve, various models allow the user to manually enter the data about the food they consume directly onto the device or corresponding application (Caddy, 2016), and even comprise a posture reminder function or inactivity alert (Bumgardner, 2017) to remind the user to move when becoming sedentary for extensive periods of time in a day. In addition, more advanced models offer additional features such as measuring the user's detailed sleep patterns, being splash-proof or waterproof, having a full-colour display, and synchronising capabilities. Some devices have an integrated GPS system for superior tracking functions and by means of colourful, interchangeable bands (Duffy & Colon, 2016) allow the user to accessorise their devices to suit their attire. The statistical metrics generated by these devices can be shared, if required by the user, with friends through social media channels (Pressman, 2017).

3. METHODOLOGY

3.1. Research design, sampling method, and data collection

The study followed a descriptive research design, employing a single cross-sectional, quantitative research approach. The target population for this study was defined as Generation Y university students aged between 18 and 24 years, who were registered at public South African higher education institutions (HEIs). The sampling frame comprised the 26 registered South African public HEIs (Business Tech, 2015), from which a judgement sample of three campuses located in the Gauteng province were selected: one from a traditional university, one from a university of technology, and one from a comprehensive university. A non-probability convenience sample of 600 students was drawn and 200 questionnaires distributed at each of the three campuses. The researcher and a trained fieldworker collected the data following the mall-intercept approach.

3.2. Research instrument and data analysis

The required data were collected using self-administered survey questionnaires. This survey questionnaire comprised one section focusing on collecting the sample participants' demographic information and another section focusing on participants' background information regarding activity-tracking devices. The questions in the latter section varied between dichotomous-type questions and single-questions necessitating multiple responses. The survey questionnaire included a cover letter that explained the nature and purpose of the study and indicated to participants that their responses would be kept confidential and used for statistical purposes only. The completion of the questionnaires was done on a strictly voluntary basis. The captured data were analysed using the IBM Statistical Package for Social Sciences (SPSS) Version 25 for Windows. The data analysis procedures comprised descriptive statistics, using measures of frequency.

4. RESULTS AND DISCUSSION

Of the 600 questionnaire distributed, 543 were returned. Of the returned questionnaires, 480 fell within the defined target population. As such, this study had an 80 percent actual response rate. Table 1 indicates that there were slightly more females (59.4%) than males (40.2%) and that the majority of the sample fell within the Black/African (89%) ethnicity group. Smaller representations came from other ethnic groups, those are 3.3 percent Coloured individuals, of which 2.1 percent were either Indian or Asian individuals, and 5.2 percent of the sample fell within the White ethnic group. The sample represented all of the age groups,

where the majority of the sample participants were aged between 18 and 21 years. Of the nine South African provinces, only one province (Northern Cape) had no representatives, with the highest representation being from the Gauteng province. There were slightly less responses from the comprehensive university (25.2%) than from the traditional university (37.5%) and the university of technology (37.3%). A description of the sample participants is summarised in Table 1.

Table 1: Sample description

Gender	**%**	**Age**	**%**	**Province**	**%**	**Institution**	**%**
Male	40.2	18	20.6	Eastern Cape	4.0	Traditional	37.5
Female	59.4	19	27.9	Free State	6.7	Technology	37.3
Missing	0.4	20	17.7	Gauteng	52.3	Comprehensive	25.2
		21	17.3	Kwazulu-Natal	4.4		
Ethnicity	**%**	22	9.0	Limpopo	17.5		
Black/African	89.0	23	5.0	Mpumalanga	7.7		
Coloured	3.3	24	2.5	North West	6.5		
Indian/Asian	2.1			Northern Cape	0		
White	5.2			Western Cape	0.6		
Missing	0.4			Missing	0.4		

Descriptive statistics, using measures of frequency, were computed to gain insights into the sample participants' background information pertaining to activity-tracking devices. The questionnaire items requested participants to indicate whether they currently own an activity-tracking device and whether they are interested in tracking their daily activity. The functionality of a smartphone application to measure one's daily activity and advanced metrics is very limited. However, at the time of data collection, wearable activity-tracking devices were still regarded as novel and unknown to the majority of the sample participants. As such, to gain an understanding of the population sample's familiarity with any type of activity-tracking technology, the participants were requested to indicate whether they own a smartphone and whether they had an activity-tracking application installed on the device. The results of the four items regarding participants' activity-tracking device background information are presented in Table 2.

Table 2: Activity-tracking device background information

Item	Yes (%)	No (%)	Missing (%)
Participants' ownership of a wearable activity-tracking device	6.1	93.3	0.6
Participants' interest in tracking their daily activity	76.5	23.3	1.2
Participants' ownership of a smartphone	94.2	5.6	0.2
Activity-tracking application present on participants' smartphone	26.0	73.3	0.6

As indicated in Table 2, only 6.1 percent of the sample owned a wearable activity-tracking device at the time of data collection. Therefore, it is evident that the awareness and adoption of wearable activity-tracking devices is still in the early phase amongst members of the South African Generation Y cohort. However, despite this low ownership of activity-tracking devices, it is reassuring that 76.5 percent of the sample participants had shown an interest in tracking their daily activity. According to Table 2, the majority of the sample participants (94.2%) owned a smartphone, of which 26 percent had some form of activity-tracking application installed on the device. Based on the possession of such applications, albeit by a mere quarter of the sample, and the 76.5 percent of the sample who had shown an interest in tracking their daily activity, it can be deduced that they are more likely to use more advanced technology, such as wearable activity trackers, to track their preferred metrics in future. It is thus imperative for device manufacturers, retailers, e-commerce sites, as well as their relative marketing departments to create awareness of these products amongst members of the Generation Y cohort.

Both local and international device manufacturers, especially well-established brands, should manufacture and market devices that will suit the needs of the target population. In order to assist in uncovering the needs of this target population, a snapshot of the device feature preferences was drawn from a sample of participants in this study. The participants had to indicate their five most favoured wearable activity-tracking device features out of a possible 15 response options. The 15 possible response options as well as the results are presented in Table 3 in descending order of popularity.

Table 3: Frequency responses of Generation Y students' wearable activity-tracking device feature preference

Feature	*f*	%
Measuring heart rate and blood pressure	311	64.8
Tracking steps and distance travelled	224	46.7
Calculating daily calories burnt	207	43.1
Tracking sleep patterns	185	38.5
GPS tracking	185	38.5
Waterproof / water resistant	161	33.5
Multi-sport tracking (swimming, running, cycling, gym, etc.)	140	29.2
Smart notifications	115	24.0
24/7 Activity tracking	112	23.3
Active time	88	18.3
On-screen workout programme	77	16.0
Food logging	77	16.0
Perspiration (sweat) levels	64	13.3
Inactivity alert	36	7.5
Interchangeable bands	16	3.3

Notes for table: Given that participants were able to choose five options; the data should be interpreted with care. For instance, for each feature n=480.

It is evident from Table 3 that a wearable activity-tracking device's function for measuring heart rate and blood pressure was the main priority according to the majority, 64.8 percent, of the sample participants. Tracking steps and distance travelled (46.7%), calculating daily calories burnt (43.1%), tracking sleep patterns (38.5%), GPS tracking (38.5%), and being waterproof or water resistant (33.5%) all received favour by more than 30 percent of sample participants. Wearable activity-tracking devices' ability to measure perspiration (13.3%), alerting the user of prolonged inactivity (7.5%), as well as being customisable by means of interchangeable bands (3.3%) were the three least favoured features among the sample participants. This indicates to device manufacturers where the focus should be regarding device functionality. These findings are in line with a prior study that indicates the prioritisation of features on these devices that track users'

steps and distance travelled, calories burnt, sleep patterns, pulse and blood pressure, diet, and active time (Hong, 2015).

In order to make this data more useful to the industry, which could lead to a more practical implementation for device manufacturers to develop specific devices, retailers, e-commerce sites, and their relevant marketing departments to advertise and promote the preferred features, this study focused on the five most important features of a wearable activity-tracking devices based on the sample participants' responses. The results derived from Table 3 indicate that the top five preferred features amongst the sample participants include measuring heart rate and blood pressure (311 responses), followed by tracking steps and distance travelled (224 responses), calculating calories burnt (207 responses), and tracking sleep patterns and GSP tracking which received the same amount of responses (185) each.

In an effort to increase South African revenues derived from selling wearable activity trackers and consequently boosting the local economy, South African device manufacturers should design and manufacture wearable activity trackers based on Generation Y students' feature preference. Alternatively, local retailers and e-commerce sites should focus on acquiring wearable activity-tracking devices that comprise these features and emphasise their marketing efforts on Generation Y consumers. The availability of a device that is tailored to the needs of the target market will lead to increased sales and market penetration rate amongst these consumers. Owing to the rapid technological advances and ever-changing features, device manufacturers should remain up to date with feature preferences amongst their largest consumer group, which in this case is the Generation Y cohort.

5. LIMITATIONS AND FUTURE RESEARCH

This study had some limitations, one of which was collecting data from a non-probability convenience sample. While extensive demographic questions were used to determine the degree of representativeness of the sample to the target population, the results should be interpreted carefully and not necessarily generalised to the broader South African population, especially since the study only sampled one of the nine South African provinces. Another limitation is that the study used a single cross-sectional research design, which merely provides a snapshot in time. Future research should employ a longitudinal research design, sample each of the nine provinces, incorporate a larger population sample, and use a probability sampling technique. Another opportunity for future research is to sample the broader Generation Y and not limit the research to students registered

at HEIs, as well as include other Generations. As these technologies advance, research should focus on the consumers' preferences based on the latest wearable activity-tracking device features in order to stay up to date with the needs of the target population.

6. CONCLUSION

Increasing the acceptance and subsequent adoption of wearable activity-tracking devices amongst South African consumers, thereby increasing the penetration rate of these devices, depends largely on the manufacturing and supply of products that satisfy consumer needs. This study investigated Generation Y students' wearable activity-tracking devices feature preference in order to assist both local and international device manufacturers, retailers, and e-commerce sites to develop and market these devices to their target population effectively. These entities can use the findings of the study to manufacture and market affordable devices comprising the ability to measure heart rate and blood pressure, steps and distance travelled, calories burnt, sleep patterns, and GPS tracking ability.

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INTERNATIONAL JOURNAL OF eBUSINESS and eGOVERNMENT STUDIES
Vol: 12 **No:** 1 **Year:** 2020 **ISSN**: 2146-0744 (Online) (**pp.** 17-32) **Doi:** 10.34111/ijebeg.202012102
Recieved: 26.09.2019 | **Accepted:** 30.11.2019 | **Published Online:** 01.01.2020

-RESEARCH ARTICLE-

ALLOCATION OF RISK IN PUBLIC PRIVATE PARTNERSHIPS IN INFORMATION AND COMMUNICATIONS TECHNOLOGY

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─Abstract─

A public private partnership (PPP) is an agreement between a public and a private party to achieve a strategic objective. The PPP model is based on three principles: risk allocation and transfer, affordability, and value for money. Traditionally, PPPs have been leveraged for hard service development such as infrastructure development. The advancement of technology within the context of the Fourth Industrial Revolution (4IR) has created new opportunities and risks for PPPs as important mechanisms for the promotion of development. The 4IR has implications for government service delivery, which have brought about an increased demand for service delivery innovation and the development of information and communications technology (ICT). Although PPPs have traditionally focused on hard services, it is important to consider PPPs for soft service delivery. It is therefore necessary to rethink the role of the PPP model as an alternative service delivery mechanism. The aim of this article is to discuss risk allocation in ICT PPPs. The research approach is qualitative in nature. The research method is based on a desktop analysis of literature and secondary data utilising unobtrusive research techniques such as conceptual and documentary analyses. The article identified various risks and opportunities for PPPs for service delivery innovation. These partnerships are often faced with high levels of uncertainty in terms of funding, level of stakeholder commitment, and complex relationships. Other risks include vendor financing, market risk, intellectual property (IP) risk, data governance, and regulatory risk. The deployment of ICT can reinforce and expand PPPs beyond all previous limitations and boundaries. This research makes proposals for good practices for risk allocation in ICT PPPs.

Key Words: public private partnerships (PPPs), risk allocation, information and communications technology (ICT), e-government, blockchain, smart contracts

Citation (APA): Nel, D., (2020), Allocation Of Risk In Public Private Partnerships in Information and Communications Technology, International Journal of eBusiness and eGovernment Studies, 12 (1): 17-32. Doi: 10.34111/ijebeg.202012102.

JEL Classification: O39

1. INTRODUCTION

The world is currently experiencing dynamic changes due to the Fourth Industrial Revolution (4IR), with the rules of change and transformation being continuously rewritten. This phenomenon fundamentally disrupts and transforms the way the world works. A new rubric of technological innovations is characterised by a fusion of technologies that blur the lines between the physical, digital, biological, and neuro-technological spheres. These dynamic changes exert pressure on governments to reinvent themselves to deliver new services and improve existing ones, while operating more efficiently, with greater transparency and a growing focus on the service user (Balkaran, 2010:1-2). Governments often lack the capacity and resources to stay ahead of technological advancement. The rationale behind public private partnerships (PPPs) is to leverage private sector capacity and resources to assist in delivering certain hard and soft public services. PPPs are contractual arrangements between the public and private sector, which are generally long-term in nature. If correctly implemented, PPPs can mobilise socioeconomic goals. The implementation of PPPs stimulates the delivery of continued, lucrative public organisations or services, by mobilising private sector proficiency and conveying a substantial amount of risk to the private sector towards value for money (Nel, 2014). Information and communications technology (ICT) is often difficult to fit into the PPP model (Delmon, 2009:513). This article aims to clarify the role of ICT in PPPs.

A qualitative research approach was used, analysing literature and secondary data through unobtrusive research techniques. Unobtrusive research techniques are non-reactive and information is gathered though public documents. Three types of techniques are observed, namely conceptual, content, and historical/comparative analyses (Auriacombe, 2016:6-10). The article is conceptual and descriptive in nature, and therefore applied conceptual and comparative analysis of secondary data, scholarly literature, and government reports and policies. The aim of this article is to discuss the role of risk allocation in ICT PPP projects. Firstly, a conceptual clarification of ICT and its role in terms of PPPs is provided. Secondly, the article provides an overview of the risks and opportunities regarding ICT PPPs. Critical success factors (CSFs) in ICT PPPs are outlined, and the various PPP models in e-government PPPs are identified. Lastly, an overview of risk allocation in ICT PPPs is provided.

1.1. Conceptualising public private partnerships (PPPs)

A PPP is defined as "any contractual or legal relationship between public and private entities, aimed at improving or expanding infrastructure services" (Delmon, 2011:2). PPPs have become significant mechanisms to address the shortage of government resources and public sector inefficiencies (Kwofie, Afram & Botchway, 2015:59). The benefits of PPPs include accelerated infrastructure development, improved service quality, affordability, sharing of risk, and value for money (Bwanali & Rwelamila, 2016:116). Albertus (2016:25) identified three critical areas of management challenges in PPPs, namely achieving public value and return on government investments, risk sharing and risk management, and PPP governance and public accountability.

2. PPPs AND INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

Limited literature is available on ICT for public service delivery, or ICT PPPs, particularly in developmental and emerging countries (Albertus, 2016:16). Governments should seek to increase connectivity through large bandwidth and technological innovation (Delmon, 2011:174). ICT PPPs have been adopted in developed countries since the late 1990s (Albertus, 2016:17). Africa has ICT infrastructure challenges; an alternative for the lack of investment in ICT infrastructure in Africa is the use of PPPs (Bwanali & Rwelamila, 2016:114). A number of fibre optic backbone systems have been developed by PPPs. Traditionally, PPPs in ICT have focused on fibre optic networks, satellite systems, mobile mast networks, local loop unbundling, securitisation, and video and telecommunication services (Delmon, 2009:514).

A rapidly changing environment due to the 4IR has created new markets in ICT. In addition, the increased demand for technological innovation has exceeded funding and commercial activity available from the public sector (Delmon, 2011:173-174). Most PPPs in the field of ICT have been driven primarily by mobile applications and Internet access (Witters, Marom & Steinert, 2012:84).

2.1. ICT

Albertus (2016:17) defines ICT as "technologies such as the Internet, Intranets, Extranets, ERP and other such technologies, which serve as basic infrastructure for a variety of services and service improvements facilitating effective and efficient public management". The deployment of ICT is essential for development (Haenssgen, 2018:358). ICT policies should be geared towards universal access and the capacity to develop an ICT-driven economy, which

would in turn lead to economic development (Williams, 2012:65). The application of ICT through PPPs can address the speed and access of service delivery (Sharma & Seth, 2011:15). E-government stresses ICT development in government service delivery (Kaliannan, Awang & Raman, 2010:210). More recent PPPs have focused on e-government, management and information systems, broadband, and the introduction of blockchain technology.

2.2. E-government

E-government relates to the manner in which governments make use of ICT to deliver electronic services (e-services) to citizens in an efficient manner (Irani et al., 2012:299). E-government is central to transforming public governance. There is an increased focus on how ready governments are to benefit from ICT development. Innovative e-government initiatives should be sought, incorporating e-readiness performance indicators (Potnis & Pardo, 2010:345). An example of the most e-ready countries include Estonia and Singapore. Estonia has been recognised as the leader in technology and e-government, and as the most tech-savvy society in the world (Schulze, 2019:1; Mumbai, 2013:1).

The advancement of e-government is a move away from traditional procurement mechanisms to a greater reliance on collaborating (Allen et al., 2005:370). The development of e-government is reliant on available technical skills; governments often do not possess the technical capacity to develop such initiatives, which makes PPPs in ICT essential. Narasimhan and Dasa Aundhe (2014:2197) argue that PPP is an "appropriate model for ICT adoption in an e-governance context, especially when the scope and innovativeness of the project is high". Risk sharing in these projects can be beneficial to their success, because these projects are "typically fraught with challenges and uncertainties on the account of the novelty of the project, demanding new ways of thinking and acting" (Narasimhan & Dasa Aundhe, 2014:2197). Nasim and Sushil (2010:344) argue, "A PPP in offering e-government services is a viable alternative towards sustainability and faster growth of e-government initiatives". A move towards digital government is required for governments to fully adapt to the 4IR. Digital government is "the state-of-the art paradigm in public administration science, it entails the provision of user-centric, innovative and agile public services" (Allessie, Sobolewski & Vaccari, 2019:10).

3. RISKS AND OPPORTUNITIES

Nel (2014:46) identified a number of barriers and risks to the successful completion of PPPs in general, namely that there is a lack of government support

for private providers and a lack of oversight; the quality of projects is not ensured; there is a lack of transparency in PPPs; the market of private providers is underdeveloped; there is a lack of buy-in from constituents, public awareness and understanding, and political commitment; inconsistent implementation of legislation; limited programme activity; ineffective procurement; and a lack of emphasis on the environmental performance of PPPs.

Typical risks in ICT include market risk, technology, intellectual property (IP), regulation, and vendor finance. The single most challenging aspect in terms of managing risk in ICT PPPs is the dynamic and changing nature of technology and the industry itself. This risk factor has a spill-over effect; flexibility is therefore key throughout the project life cycle. Possible changes need to be anticipated in advance. The competitive nature of the ICT sector makes it difficult for lenders to obtain revenue certainty. Financing ICT on a limited recourse basis results from the rapidly changing nature of the industry. IP is difficult to manage when changes occur, such as royalty payments increasing or when relevant rights are no longer available. Project specifications will also change when new technology is implemented. A regulatory system is needed that is stable yet flexible enough to protect the integrity of the project. Governments may struggle to keep up with the changing pace in terms of developing and implementing policies to provide a conducive environment for the successful execution of PPPs (Delmon, 2009:513-516).

Delmon (2011:3) identified a number of lessons learned for effective preparation and implementation of PPPs. Firstly, PPPs prepared in a hurry do not receive sufficient technical assistance. A thorough feasibility study is therefore required to determine affordability, value for money, and risk allocation. Secondly, PPPs should be developed as strategic policy projects, aligned to sectoral development strategies. Lastly, the government should play a key role in monitoring the performance of the public and private partners, project implementation, and contract administration (Delmon, 2011:3). Challenges experienced in PPPs include lack of clear government policy, lack of political buy-in, weak public sector capacity, and lack of robust feasibility studies (Bwanali & Rwelamila, 2016:112).

3.1. Risk allocation and sharing

Mouraviev and Kakabadse (2012:264) emphasise that “risk should be transferred to the party best able to manage it with the lowest cost”. Risk allocation entails an agreement to deal with certain risks through a specified mechanism, which may involve sharing the risk or the management of the penalties related to the risk

(Albertus, 2016:xvii). Risk allocation has a direct financial impact on the success or failure of a PPP project. Risk allocation could result in lower overall project costs and provide enhanced value for money when compared to traditional procurement options. The allocation of risk should reflect the specific context and characteristics of the project, as well as the strengths of each party (Albertus, 2016:154).

Depending on the type of PPP, risk allocation in PPPs is treated on a case-by-case basis because circumstances, context, and resources differ from case to case (Nel, 2014:81). For instance, civil law PPP contracts differ from common law contracts in that administrative law generally governs them. Furthermore, it seems that the differences between common law and civil law do not play a significant role when it comes to general risk allocation. In this context, an individual country's background and political objectives are probably more important (Global Infrastructure Hub, 2016:5-6). A successful PPP project must have a workable, commercially viable, and cost-effective risk-sharing approach. The risk-sharing approach is an essential aspect to include in developing the PPP agreement, to ensure that the contractual document creates a bankable risk allocation (Delmon, 2011:95).

PPPs are not homogenous in terms of structure, organisation, and risk allocation (Latteman, Stieglitz & Kupke, 2009:368). There is no one-size-fits-all approach; each individual PPP will have its own way of documenting general risk allocation. The risk allocation summary suggested in Table 1 may provide useful applications for risk allocation in ICT PPPs.

Table 1: Risk Allocation for ICT PPPs

Risk	Appropriate Party	Factors
Planning or Statutory	Public	Planning and statutory process undertaken in advance of tender.
Political	Public	Events of war, civil unrest, change in law, and failure and delays by public sector entities.
Completion	Private	Completion of design, construction, and installation, including the adequacy of the design works, nature of technology to be used, and resources available.
Currency	Public	Monetary regulations and market conditions can limit the extent to which local currency can be converted to foreign currency.

Risk	Appropriate Party	Factors
IP	Public/Private/ Shared	Issues relating to the ownership of IP, including commercialisation, patents, and proprietary information.
Off-Take	Shared	Reduction in and failure of the use of the services provided by the facility.
Misspecification of Output Requirements	Public	Information and resources relevant for output requirements.
Performance	Private	Works adhere to contract specifications regarding performance.
Financial	Private	The private party undertakes the investment and is responsible for the financing of capital expenditure.
Design	Private	A degree of risk sharing can take place, where the public partner has an informational advantage.
Construction	Private	Private sector performance is contractually binding. A degree of risk sharing can take place where the public partner has an informational advantage.
Operation	Private	Private sector performance is contractually binding. A degree of risk sharing can take place where the public partner has an informational advantage.
Utilities	Private	Utilise due diligence and contingency plans as mitigation measures.
Demand	Public	Government provides guarantees.
Sub-Contractor	Private	As mitigation measure, utilise professional indemnity insurance.
Time Schedule	Private	Private sector performance is contractually binding.
Latent Defects	Private	Likelihood or impact can be mitigated through efficient environmental assessment and due diligence.
Maintenance	Private	Efficient facilities management, sub-contractor agreements, and contingency funds can aid risk mitigation.

Risk	Appropriate Party	Factors
Exchange Rate	Public	Government provides guarantees for fixed real exchange rate, hedging of costs, and indexing tariffs.
Changes in the Needs of the Wider Public	Public	The government has the informational advantage and the needs of the public are often affected by policy.
Social	Public	The reaction and interaction between the project and society at large.
Cost Overrun	Shared	Significant percentage should be carried by the private partner, taking into account the economy, efficiency, financial management, and subcontracting arrangements.
Environmental	Public	The reaction and interaction between the project and the natural environment.
Technology	Private	The loss resulting from technological changes or failure.
Legislative or Regulatory	Shared	Neither the public nor private partner has influence over changes in national legislation.
Interest Rate	Private	Apply denomination tools for bargaining.
Residual Value	Private	Ultimate reimbursement to the private partner based on the condition of the facility.
Availability	Private	Penalties applied as risk mitigation if the private partner does not meet output specifications.

Source: Adapted from Delmon (2011:98-112), Nel (2014:80-81), Delmon (2009:190), Iossa Spagnolo and Vellez (2007:4-15) and International Monetary Fund (IMF, 2004:18,31).

Risk should be allocated to the party who is more capable of controlling the risk and who is less risk averse. Furthermore, the roles of the various partners in the PPP will influence the risk allocation. For instance, the issue of ownership of IP rights will be determined by the roles of the various counterparts in the PPP. Typically, the PPP exists to draw on a private sector party's depth of expertise in technology management and in product development, and this is a key factor in determining ownership of IP rights. Agreements generally specify who should own the developed IP because of the activities undertaken within the framework of the agreement. The IP could be owned either by the public partner, the private partner, or it could be shared (Taubman, 2004:17). The risk allocation will also

depend on the PPP model that is followed. Table 2 outlines the various PPP models relevant to ICT.

Table 2: E-government and ICT PPP models

Type of Contract	Duration	Nature of Contract	ICT PPP Example
Service Contract	1-3 years	Technical service	Website design and management, ICT capacity building
Management Contract	3-8 years	Manage operation of government service	Call centre staffing
Lease	8-15	Manage, operate, maintain, and invest in a service	Land for ICT infrastructure development, online registries
Build Operate Own (BOO) or Build Operate Own and Transfer (BOOT)	15-25	Construct and operate facilities necessary for service provision	ICT infrastructure, e-procurement systems, e-business portals, network of kiosks
Concession	15-30	Manage, operate, repair, maintain, and invest in public service infrastructure	Telecom operations and expansion; toll road, bridge, or airport facilities management

Source: Adapted from The Institute for Public Private Partnerships (2009:7)

3.2. Critical success factors (CSFs) for ICT PPPs

Research on CSFs for ICT PPPs is limited; however, case studies from Singapore indicate a number of CSFs, and Taher, Yang and Kankanhalli (2012:3) identified CSFs in e-government projects in Singapore. The CSF concept is a systematic way of identifying the key areas that require management's constant attention, monitoring, and management in order to achieve the strategic objectives of the PPP (Babatunde, Perera & Zhou, 2015:82). The findings from these case studies reveal that best practices include the government's partner's commitment to deploy ICT innovation and re-engineer business processes in response to the new ICT, and the implementation of state-of-the art technology requires management of fault tolerance (Taher et al., 2012:5-6). Table 3 provides a summary of CSFs that can serve as best practices in terms of managing and implementing ICT and e-government projects. The first column outlines the CSF and the second column outlines where in the project life cycle the CSF is relevant; during establishment, development, or all stages.

Table 3: CSFs for e-government PPPs

Project Life Cycle Stage	Factors
Establishment	Feasibility study
	Systematic evaluation of partners
	Clear definition of roles and expectations
	Establishment of key performance indicators and performance monitoring system
	Risk allocation to the relevant parties
	Strong and robust agreement
	Formation of PPP structure
	Adoption of the appropriate project funding structure
	Securing project buy-in from all stakeholders and establishing a common vision
	Clear definition of customer segments and branding and marketing
	Incentivise stakeholder commitment
	Public agency to take joint responsibility for overall business development
Development	All stakeholders should be involved in the review and re-engineering process
	Consolidate and integrate cross-agency requirements
	Revolutionary business process change
	Undergo pilot trials and learn from past experience
	Adopt a phased approach to make vital adjustments and mitigate risk
	Supportive management with high fault-tolerance in the use of state-of-the-art technologies
	Commitment of government partner to continuous ICT innovation and service excellence
All stages	Eco-centric leadership structure
	Commitment from all parties to allocate, time, resources, and efforts
	Willingness to adapt and change mindset

Source: Adapted from Taher et al. (2012:5-6)

3.4. Opportunities for PPPs: Blockchain and smart contracts

Blockchain is the most innovative technology to be considered under the new digital government paradigm (Allessie et al., 2019:10). Blockchain is a novel digital concept for storing data by decentralising and securing trust between parties wishing to perform a transaction (Norberg, 2019:3). Transactions between parties usually take place through a centralised method that involves a third party such as a financial institution, which could result in security risks and financial costs (Alharby & Van Moorsel, 2017:125). The blockchain system works on a peer-to-peer system by combining a high-level of security based on cryptography (Magnier & Barban, 2018:189). It provides a number of benefits. Firstly, it reduces economic costs, time, and complexities in executing information exchange and administrative functions. Secondly, it reduces fraud, bureaucracy, and corruption via smart contracts. Furthermore, it offers increased automation, transparency, efficiency, integrity, security, and auditability. Lastly, it contributes to increased public trust due to effective record keeping and information availability (Allessie et al., 2019:10). Blockchain provides the opportunity to enlarge the contracting space in PPPs through smart contracts (Cong & He, 2019:1754). Blockchain technology processes currency transactions and ensures that transactions comply with programmed rules through smart contracts (Karamitsos, Papadaki & Al Barghuthi, 2018:177).

A PPP is based on the foundation of a solid agreement and contractual arrangement. A contract is a binding agreement between two or more parties. The digital revolution has introduced new opportunities to formalise and operationalise relationships and contracting (Sadiku, Eze & Musa, 2018:538). Smart contracts provide a digital workflow process, whereby a series of binding steps need to be undertaken before an outcome is reached, and the contract ends after the completion of this process. Smart contracts can provide the public sector the ability to ensure certainty and transparency in transactional processes. Over 46 countries across the globe have launched 200 blockchain initiatives (Berryhill, Bourgery & Hanson, 2018:19-20). Smart contracts reduce transaction time and costs as the contracts execute themselves by integrating the Internet of Things (IoT) into the blockchain. Contractual fraud is easily detected, thus enhancing the security of contracts (Min, 2018:35). Solarte-Vásquez and Rungi (2018:34) describe smart contracting as “a proactive contract management approach that highlights the value-creation potential of collaborative contract negotiation design and techniques”. Smart contracts offer a mechanism for smart partnering, which will enhance the efficiency of PPPs, which could increase efficiency in setting clear agreements, automating contract administration and management, and

improving risk allocation. The smart partnership concept shifts the attention from procurement and compliance to collaborative management practices (Saidel, 2017:124). Smart contracting is a proactive approach to operationalising contract theory and to seamlessly integrate operational and financial systems (Solarte-Vásquez & Nyman-Metcalf, 2017:208; Sklaroff, 2017:263). The open sharing of information and open innovation is an effective way of boosting partnership success (Wermeille et al., 2015:4).

4. CONCLUSION

The use of PPPs for ICT and e-government development offers a number of opportunities. The public sector does not have the capacity to fully participate in the 4IR, while PPPs offer the government affordability, value for money, and risk-sharing opportunities in order to develop its digital capabilities to improve service delivery. The deployment of PPPs can improve service delivery and contribute to development. In order for governments to fully participate in the 4IR, robust strategies for ICT PPPs need to be developed. Risk allocation and sharing frameworks can assist in the effective management of PPP agreements. CSFs were identified in this article for consideration in structuring future ICT PPPs. Lastly, recent trends and opportunities to improve PPPs were identified, including the use of blockchain and smart contracts to establish smart partnerships.

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INTERNATIONAL JOURNAL OF eBUSINESS and eGOVERNMENT STUDIES
Vol: 12 **No:** 1 **Year:** 2020 **ISSN**: 2146-0744 (Online) (**pp.** 33-47) **Doi:** 10.34111/ijebeg.202012103
Recieved: 17.09.2019 | **Accepted:** 19.10.2019 | **Published Online:** 01.01.2020

-RESEARCH ARTICLE-

OPEN GOVERNANCE FOR IMPROVED SERVICE DELIVERY INNOVATION IN SOUTH AFRICA

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─Abstract─

The Fourth Industrial Revolution (4IR) is the current and developing environment in which changing technologies and trends such as the Internet of Things (IoT) and artificial intelligence (AI) are changing the way governments function. Governments are increasingly facing new risks and opportunities due to the advancement of the 4IR. Governments need to find ways to adapt to the 4IR. Innovation is a prerequisite for adapting to the 4IR. The aim of this article is to determine the level of public service delivery innovation (SDI) in South Africa in the context of the 4IR. The analysis in this article is based on secondary data and documentary analysis, including unsolicited government documents, reports and legislation, and authoritative scholarly literature. A number of innovation measures for improved service delivery have been adopted in South Africa. These efforts are not, however, embedded within the wider public service, and efforts to improve SDI should be considered. In a global environment of resource constraints and constant change, open governance through multi-stakeholder collaboration may present strategic opportunities to facilitate innovation. The aim

Citation (APA): Nel, D. & Masilela, L., (2020), Open Governance for Improved Service Delivery Innovation in South Africa, International Journal of eBusiness and eGovernment Studies, 12 (1): 33-47. Doi**:** 10.34111/ijebeg.202012103

of these initiatives is to enhance transparency and accountability, and to facilitate public service delivery and citizen participation.

Key Words: Fourth Industrial Revolution, innovation, open governance, partnerships, public service delivery.

JEL Classification: O39

1. INTRODUCTION

The current industrial revolution, referred to as the 4IR, is driven by the rapid and dynamic development of technology. The first three revolutions was also driven by technological advancements, but not at the complex rate that is currently experienced. This article aims to determine the level of public service delivery innovation (SDI) in South Africa in the context of the Fourth Industrial Revolution (4IR). In order to achieve this goal, this article is structured around two objectives. Firstly, this article will identify current SDI approaches in South Africa. Secondly, the various risks and best practices for increased public SDI will be reviewed. In conclusion, recommendations on how to achieve SDI are provided. This research is qualitative, conceptual, and descriptive in nature. A conceptual and descriptive approach to research requires methods allows the generation of contextual and conceptual analysis. Unobtrusive research methods were therefore deemed appropriate for this study. Unobtrusive methods include the analysis of data obtained through non-reactive methods. Unobtrusive methods are presumed to avoid the problems caused by the researcher's presence. The use of unobtrusive methods may overcome methodological weaknesses of interviews and questionnaires, which create attitudes in part because respondents commonly attempt to manage impressions of themselves in order to maintain their standing in the eyes of an interviewer (Bryman, 2000).

1.1. Contextual background on the Fourth Industrial Revolution (4IR)

The term 'Industry 4.0', also known as the 4IR, was first coined in Germany at the Hanover Fair in 2011. The German federal government was at the time developing a 'high-tech strategy' that aimed to promote the "*computerisation of manufacturing processes and systems*" that would accelerate and differentiate the German and European Union production industries from other international markets (Alipour, Ustundag, Cevikcan, Kaya & Cebi, 2018:95-96). PwC (2014:17) describes the 4IR as "*the new level of organisation and control over the entire value chain of the lifecycle of products, it is geared towards increasingly individualised customer requirements*". The scale and scope of the 4IR have made the public sector aware that machine-driven, decentralised, and conventional

methods of public service delivery will not be sufficient, productive, feasible, and sustainable throughout the new revolution (Centre for Public Sector Innovation [CPSI], 2018). The pace and robust technological advancements brought about by the 4IR have necessitated governments around the globe to develop and implement new legislative policies, strategies, frameworks, and approaches that will collectively enable the government, private sector organisations, and civil society to be equally inclusive and participative and portray strong leadership skills and shared responsibilities that will be needed to transition to the 4IR (Department of Telecommunications and Postal Services [DTPS], 2018).

In order for public sector institutions to be knowledgeable, participative, and responsive to the turbulent changes and environments triggered by the 4IR, it needs to strengthen internal infrastructure resources and re-engineer departmental capabilities for ensuring the consistent production of reliable, factual, timely, and accurate data and information outputs. Having data and information assets readily available for quick and sound decision making places public sector institutions in a proactive instead of reactive mode to solve service delivery challenges and assists in finding feasible, sustainable, and innovative public service delivery solutions (DTPS, 2018). In order to achieve this, the government needs to heavily invest in Research, Development and Innovation (RD&I) activities, programmes, and projects that can be utilised as stepping stones to the development and foundation of strategic public SDI policies, frameworks, and models. Establishing funding instruments that could be targeted at exploring, identifying, and analysing unscientific, non-economic, or non-technological innovation factors that contribute to conducive and unconducive public SDI outputs of public SDI inputs and outputs that can be incorporated into public sector institutions could lead to development equally tailored to the various needs of delivering public sector goods and services (Manzini, 2015).

The challenges and opportunities presented by the characteristics and environments brought by the 4IR therefore require public sector institutions to embark on open and collaborative innovation within the public service for transforming, redefining, realigning, and improving the systems and processes for the delivery of public sector goods and services. The 4IR has produced significant elements such as AI, cognitive systems, data mining, and the Internet of Things (IoT) (CPSI, 2018). These elements will therefore enable the government to develop and implement proactive public SDI models and tools that can accurately determine and measure the allocation and utilisation of scarce infrastructure resources to meet public SDI inputs, as well as leveraging conducive, fruitful, and diverse stakeholder partnerships for integrated public SDI outputs. The advanced

technologies brought about by the 4IR hold great potential for significant, impactful, sustainable, and innovative transformation across public sector institutions. Improved service delivery; cost-cutting strategies and programmes; high quality and standardisation of public sector goods and services; improved information and communications technology (ICT) skills, knowledge, and capabilities; and conducive legislative policies, frameworks, models, and approaches are all elements that can be successfully incorporated and achieved within public sector institutions (CPSI, 2018; Department of Public Service and Administration [DPSA], 2018).

1.2. Innovation as a driver for the 4IR

The term 'innovation' originates from the Latin word 'innovare', which translates directly to "to make something new" (Lin, 2006; Lin, 2007). According to the *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, 'innovation' can be defined as "*the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*" (Organisation for Economic Co-operation and Development [OECD], 2005). Innovation within the era of the 4IR has become a significant and an exceptionally important topic of study due to its versatility that cuts across multidisciplinary and multidimensional fields, practices, and organisations. Innovation is widely recognised in academic and professional fields such as economics, engineering, science, and sociology, as well as private sector businesses and public sector institutions, as a key driver of economic growth and development, entrepreneurship, the creation of new products and services, robust market development and penetration, improved organisational efficiency, as well as the creation and delivery of public value to a country's citizenry (Bock, Eisengerich, Sharapoy & George, 2015). In an increasingly competitive global market, innovation has been studied and practised in different contexts by governments; the general public; public-private partnerships (PPPs); small, medium, and micro enterprises (SMMEs); private sector industries; supply chain partners; societal organisations; and academic institutions around the globe (Vaccaro, Jansen, Van den Bosch & Volberda, 2012; Costello & Prohaska, 2013; Baskara & Mehta, 2016).

The public sector identifies innovation as an opportunity to establish relationships that will enhance collaboration between various stakeholders from numerous organisations to improve the delivery of public sector goods and services in order to create and achieve public value. Public sector innovation therefore particularly

considers the development and implementation of and experimentation with new ideas, services, and products into viable, practical, and sustainable public service delivery outputs. Public sector innovation therefore aims to ensure conducive policy development, implementation, and monitoring of public sector innovation inputs and outputs, identifying cost-effective strategies and approaches to utilising scarce public sector resources, promoting social cohesion through refined societal ecosystems, as well as improving the quality, standardisation, and delivery of public sector goods and services to citizens (Sørensen & Torfing, 2011; Osborne & Brown, 2011; Salge & Vera, 2012).

1.3. Public service delivery and innovation

Service delivery involves all the aspects relating to when, how, and where a service is delivered to a customer, and whether it is fair in nature. Service components are usually not always physical products, but instead are a combination of resources (skills and materials) that must be appropriately planned and designed (Martins & Ledimo, 2015). Centralised and rigid public sector institutional practices have been identified as contributing factors to unresponsive public sector institutions and environments, and unintended consequences of poor and low service delivery outputs (Kaul, 1998; Kaul, 2000). Governments around the globe have identified the inherent challenges associated with traditional and outdated public sector organisational designs, hierarchical structures, processes, and functions within government departments. Government institutions are often criticised for their bureaucratic practices and methods in terms of the delivery of public sector goods and services, which have in essence been found to be irresponsive, ineffective, and inefficient to the needs of a country's citizenry. Furthermore, challenges associated with the social, economic, political, technological, and global changes have prompted governments to revaluate and explore new forms and methods of service delivery (Gildenhuys & Knipe, 2000; Kekana, 2004).

As a result, governments have had to identify approaches that could be implemented in order to deal with increasingly demanding, turbulent, and complex public sector institutions and environments (Nolan, 2001; Robbins, 2001). Changing traditional and conventional practices of service delivery requires restructuring and reviewing current service delivery mechanisms and developing new methods that will allow public sector institutions to achieve improved service delivery performance and cost-effective use of scarce resources in order to achieve greater efficiency, flexibility, and more responsive and adaptable public sector goods and services (Gildenhuys & Knipe, 2000; Kekana,

2004). To encourage SDI, there is a need to move beyond traditional approaches to service delivery to more alternative approaches. According to Ford and Zussman (1997:6), 'alternative service delivery' (ASD) can be defined as *"a creative and dynamic process of public sector restructuring that improves the delivery of services to clients by sharing governance functions with individuals, community groups and other government entities*". Within the South African context, the DPSA (2000:13) describes ASD as "*an optimum mix of flexible service delivery programmes, activities and mechanisms that can be strategically utilised to achieve government's service delivery objectives or either directly by government or in cooperation with other sectors such as the private sector or the voluntary sector*". Typical ASD mechanisms include, among others, e-governance, e-government, m-governance, SDI, outsourcing, privatisation, and PPPs. SDI has become a significantly important factor in the survival and profitability of private sector businesses and government institutions for ensuring the delivery of public sector goods and services to the general public. In order to understand the theory and practice of SDI, it is imperative to understand the difference and link between service delivery and SDI. According to Lovelock and Wright (1999:20), service delivery can be defined as *"the actual delivery of physical or intangible products and or services to satisfy the needs and wants of customers or clients*". SDI can therefore be described as the "*overall processes that are applied to developing new service offerings in the organisation*" (Johnston & Clark, 2001:11). Present literature findings have not yet indicated a precise definition of public SDI. This is because SDI has been researched, studied, and practised more extensively by private sector institutions than by public sector institutions.

1.4. Best practices and risks associated with public sector innovation

SDI should be characterised by network organisations, flexible workflows, global sourcing, client and supplier collaboration, continuous innovation, and enabling technology. Some of the risks include a lack of an innovation culture, lack of adequate resources, resistance to change, absence of organisational learning, red tape, and large, slow, and complex organisations (Dawnson & Horenkamp, 2007; Martins & Ledimo, 2015). Public SDI has in most instances become a prolonged process due to the complexity of delivering mass innovative public sector goods and services (Alam, 2002; Baker & Shinkula, 2007; Ordanni & Parasuraman, 2011). Within the public sector, government departments need to position themselves as service delivery organisations with the aim of developing new and creative methods, strategies, models, competencies, and capabilities in the form of specialised knowledge and skills to a country's citizenry. Public SDI consists of a

combination of service delivery components that require an integrated and holistic approach to utilising internal processes, people skills, infrastructure, and scarce resources in order to arrive at well-designed and planned service delivery outputs (Alam, 2002; Baker & Shinkula, 2007; Ordanni & Parasuraman, 2011).

2. CURRENT SERVICE DELIVERY INNOVATION (SDI) APPROACHES

The aim of this article is to determine the level of SDI in South Africa by identifying current innovations in service delivery. The following analysis is based on the most prominent initiatives in facilitating SDI.

2.1. Establishing a National System of Innovation (NSI)

The Department of Science and Technology (DST) and the Department of Trade and Industry (DTI) have set up institutions and adopted policies that endeavour to achieve social and economic goals through innovation as a catalyst for change. This is known as the NSI. The NSI identifies two significant high-level goals: firstly, quality of life and growth; and secondly, wealth creation. Innovation in the public sector should be embedded in the NSI driven by the DST and its strategic partners. In terms of the White Paper on Science and Technology of 1996, the NSI supports three key interests of the government: firstly, the establishment of institutions, organisations, and policies that give effect to the various functions of the NSI; secondly, to facilitate and maintain a constructive set of interactions between those institutions, organisations, and policies; and lastly, to ensure that there is an agreed-upon set of goals and objectives and common vision in place. The White Paper on Science and Technology recognises the role of the government in the NSI, namely policy setting, resource allocation at the national level, and in legislating regulatory frameworks (CPSI, n.d.).

2.2. The Centre for Public Sector Innovation (CPSI)

The CPSI was established in 2001 by the Minister for the Public Service and Administration. It now functions as a government component as introduced by the Public Service Amendment Act (No. 30 of 2007). The CPSI is overseen by the DPSA, and some of its collaborating partners include various government departments, the Innovation Hub, the Canadian International Development Agency, the United Nations Public Administration Network (UNPAN), and the United Nations Development Programme (UNDP) Regional Service Centre. The CPSI's mandate is to partner with public sector organisations to identify innovative solutions and to develop an environment that supports the implementation and sustainability of innovations (CPSI, n.d.). The CPSI aims to identify, support, and nurture innovation in the public service, to improve service

delivery, and to provide the public sector with research and advice on innovative service delivery with a specific focus on government priorities. The CPSI also aims to recognise the successes of stakeholders in the quest for a more effective, efficient, and accountable government. The CPSI has also established a partnership with the United Nations Department of Economic and Social Affairs (UNDESA), serves as the Online Regional Centre for Southern Africa for UNPAN, and participates in the UN Experts Group on the replication of innovations (UNDP, n.d.). The CPSI Annual Innovation Awards focus on recognising achievements in the following areas: partnerships in service delivery, innovative use of ICT, innovating service delivery institutions, and improvement of internal systems of government.

2.3. The Open Governance Partnership (OGP)

The OGP is a multilateral initiative consisting of 79 country members and 20 local members that work alongside thousands of civil society organisations. The OGP Declaration states that members of the OGP are committed "to the principles enshrined in the Universal Declaration of Human Rights, the UN Convention against Corruption, and other applicable international instruments related to human rights and good governance" (OGP, 2011). South Africa was one of the founding members of the OGP in September 2011, and has made a number of commitments that seek to build on existing government- and citizen-led initiatives related to open government in the country. From the South African perspective, OGP commitments are aligned to the five-year national priorities, the National Development Plan (NDP) targets, and the Sustainable Development Goals (SDGs), which are derived from the assessment of South Africa's achievement of the national vision as stipulated in the Constitution. The issue of service delivery is of particular interest to the OGP (OGP South Africa, 2016). OGP South Africa has received high-level and government-wide political commitment and support (OGP South Africa, 2016). Some of the progress highlights of the OGP include the development of the first National Action Plan, and a self-assessment was completed based on the Action Plan, which was reviewed by the Independent Review Mechanism (IRM). The third Action Plan was recently implemented. Furthermore, the OGP portal was developed in collaboration with various government departments, which provides a mechanism for participation, enhanced access to information, and engagement between civil society and citizens (OGP South Africa, 2016). OGP South Africa, in collaboration with the Open Data Institute (ODI), launched the Responsive Cities Challenge, which seeks innovative uses of open data to solve urban, social, and economic issues. Other collaborating partners include The Innovation Hub, Code for South Africa, Open

Data Durban, Geekulcha, and open data champions in Ekurhuleni, Ethekwini, Tshwane, Cape Town, Kimberley, and Upington municipalities. The challenge awards include cash awards and incubation and seed funding to develop further future social, urban, and economic development solutions (Responsive Cities Challenge, 2016).

2.4. E-governance and the use of information and communications technology (ICT)

Other initiatives include the izimbizo, Govt At Work videos, Namola, and GovChat. The Namola application is a safety emergency line to alert public emergency services, such as the South African Police Service (SAPS), local metro police, or fire or ambulances services (Caboz, 2018). GovChat allows citizens to directly contact political office bearers through the WhatsApp Instant Message Service. Furthermore, the Youth Employment Service (YES), launched in 2018, is an innovative effort through PPP engagement to boost the upskilling of the youth. Another innovative initiative is the launch of the Pharmacy Dispensing Unit (PDU), the first of its kind, which leverages digitalisation and ICT to benefit the community (SA News, 2018). Other initiatives cited by the DPSA (2018) include the installation of 1 500 km of fibre in Johannesburg; the implementation of free Wi-Fi hotspots; the CodeTribe Academy, a software development training programme that has trained over 120 township youths; and the establishment of eKasiLabs innovation centres across Gauteng and Cape Access e-Centres that provide multi-purpose centres with Internet and computer access. The OECD's Observatory of Public Sector Innovation (OPSI) identified the following six innovations in service delivery in South Africa, which are based on open governance: the Gauteng Department of Education introduced an online application system in 2015; the length of hospital stay for amputee patients is reduced and their outcomes improved by using Pulsed Shortwave Therapy (PSWT); the Twinning Programme of the Gauteng Department of Education's wider strategic framework and its 'Re-organisation of Schools' strategy; the Memeza Home Community Alarm, which is a public alarm system designed for low-income communities; and the Sunward Park High public school migrated from printed textbooks to a fully digital platform (OPSI, n.d.). Although South Africa has made much progress, more still needs to be done to leverage e-participation and e-governance, as progress has been slow and uneven (Simons, 2018). There is still the lack of an adequate skills pool, a lack of access to infrastructure, and the high cost of access to services (Mzekandaba, 2018). South Africa should invest in all key enablers for the 4IR, including investment in critical, enabling ICT infrastructure to develop a digital economy; RD&I; skills

development; SMMEs, entrepreneurship, and localisation; and labour market restructuring (*Government Gazette*, 2018).

3. OPEN GOVERNANCE FOR IMPROVED PUBLIC SECTOR INNOVATION

Open governance is defined as a core characteristic of democratic systems in which governance relationships and processes … allow the perspectives, needs, and rights of all citizens to be addressed, including those most marginalized (Harlan & Robinson, 2012; Edwards & McGee, 2008). Furthermore, open governance is about instilling *"a culture of governance based on innovative and sustainable public policies and practices inspired by the principles of transparency, accountability, and participation that fosters democracy and inclusive growth*" (OECD, 2016:3). The principles and practices of open governance often vary for countries around the globe due to the influences and characteristics of various political, social, cultural, technological, and economic factors. Governments around the globe have had to reimagine and redefine their current roles, responsibilities, and functions within the context of providing effective and efficient public sector goods and services to their citizenry. The need for robust, flexible, and responsive service delivery outputs have positioned governments towards decentralised and unbureaucratic systems and practices for improved service delivery (Bingham, Nabtachi & O'Leary, 2005). Over the years governments have had to improve their internal governance systems, processes, and practices in order to ensure that the principles of good governance are adhered to throughout the public sector. This has therefore allowed public sector institutions to re-evaluate, restructure, and redesign current organisational systems, procedures, legislative policies and frameworks, embedded cultures and traditions, as well as functional structures of public sector institutions to be driven towards the improvement of fair, equal, accessible, and improved service delivery outputs (Bourgon, 2011). To ensure greater SDI, a better life for all, sustainable development, and greater participation and benefits from the 4IR, the results of this article suggest the adoption of a new governance paradigm of open innovative governance. Leitão, Alves and Pereira (2016) explain that the new paradigm for public administration is founded on different meanings of distinct dimensions of open innovative governance; where open governance means open data and open information, and open innovation means new types of open relationships between citizens, firms, and municipalities. Leitão et al. (2016:1) assert that *"in the context of citizens' rights, open innovative governance is approached as the right to participate in the innovation process of agenda-setting and decision making*". This paradigm necessitates collaboration and cooperation between various

stakeholders in society in championing innovation. Hence, multi-stakeholder partnerships such as the OGP are important governance mechanisms to facilitate and strengthen open innovative governance.

4. CONCLUSION

This article reviewed the nature of the 4IR and the implications of the 4IR for the government. The advent of the 4IR has brought about a number of changes, which have affected all levels of society. Innovation is one of the fundamental building blocks of the 4IR. These changes present a number of implications for governments to consider. Governments are compelled to engage in SDI to be able to participate in the 4IR and to fully benefit from it. SDI implies a shift in the conceptualisation of service delivery to find new and better ways to improve service delivery. The risks and best practices for SDI were identified. Prominent SDI initiatives in South Africa, include establishing a national system of innovation, establishing a CPSI, and the OGP. South Africa has made some progress in establishing institutions that support innovation; however, more still needs to be done to leverage multi-stakeholder partnerships, e-participation and e-governance, skills development, access to infrastructure, research and development, entrepreneurship and localisation, labour market restructuring, and reducing the high cost of access to services. The continued development of open governance initiatives can facilitate SDI, build multi-stakeholder partnerships, and enhance transparency, accountability, and citizen participation. The findings presented in this article is conceptual and descriptive, based on secondary data. Future research should analyse open governance and SDI in specific sectors, using primary data, to derive empirical findings.

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INTERNATIONAL JOURNAL OF eBUSINESS and eGOVERNMENT STUDIES
Vol: 12 **No:** 1 **Year:** 2020 **ISSN**: 2146-0744 (Online) (**pp.** 48-62) **Doi:** 10.34111/ijebeg.202012104
Recieved: 30.09.2019 | **Accepted:** 05.12.2019 | **Published Online:** 01.01.2020

-RESEARCH ARTICLE

MOTORISTS ATTITUDES TOWARDS IMPLEMENTATION OF E-TOLLS IN GAUTENG PROVINCE, SOUTH AFRICA

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─Abstract ─

Transport plays a crucial role in the growth of South Africa. Transportation is responsible for the movement of goods and services as well as people from one point to the other, however, for an effective transport system, there should be good road infrastructure or a good road system to connect all places around the country effectively. This article focuses on the e-toll roads in the Gauteng area. The article aims to determine the attitudes of motorists towards implementation of e-tolls in Gauteng Province. This article considers the following variables, namely e-toll charges, attitude towards e-tolling, e-toll compliance, consumer trust of e-tolls and e-toll use continuation. A quantitative approach was adopted in which a survey questionnaire was used to collect data from 350 road users in the Gauteng Province. Data were analysed with the aid of two software packages, namely the Statistical Package for the Social Sciences (SPSS), version 24.0, and the Analysis of Moment Structures (AMOS), version 24.0. The results of this article provide useful information on the funding of the roads in Gauteng Province of South

Citation (APA): Mosala, K. & Chinomona, E., (2020), Motorists Attitudes towards Implementation of E-Tolls in Gauteng Province, South Africa, International Journal of eBusiness and eGovernment Studies, 12 (1): 48-62. Doi: 10.34111/ijebeg.202012104

Africa. This article also contributes to the limited body of literature on e-tolls; government or policy makers could benefit from the information in this article regarding e-toll charges, attitude towards e-tolling, e-toll compliance, consumer trust of e-tolls and e-toll use continuation.

Key Words: *E-toll charges, Attitude towards e-tolling, E-toll compliance, Consumer trust of e-tolls, E-toll use continuation*

JEL Classification: L1

1. INTRODUCTION

Transport plays an important role in any country's economy as it is responsible for moving all goods and services from point of origin to point of consumption or respective destinations. Kekana (2006) argues that there are several modes of transport, but road transportation is the largest and fastest growing. This is confirmed by Tseng, Lin and Chien (2013) who indicate that road usage increases all the time. Automobile traffic is increasing and travel time is lengthened, leading to congestion and time wasted on roads (Kekana 2006). Peters (2014) states that for a country to realise its economic potential fully, necessary infrastructure such as better roads are required. Kekana (2006) opines that road transport is fast growing and it poses a need for improved roads that can handle high volumes of traffic. Chi and Waugaman (2010) describe non-tolled roads as congested, of lower quality and with too few lanes to drive on. Non-tolled roads are roads that can be used by any individual at no fee charged for the part used/ consumed or rather, at no additional cost. Non-tolled roads often are financed through fuel taxes and vehicle registrations. But with high government standards and increased fuel-efficient cars, fuel taxes are no longer providing enough funds to maintain and develop new roads (Chi & Waugaman, 2010). According to Brits (2010), fuel taxes are inadequate to finance roads. Income from fuel taxes must be combined with other state revenues and should be used according to priorities. Poverty, health and education are more prioritised than road infrastructure, resulting in only approximately 33 percent of the South African fuel taxes being allocated to roads (Brits 2010). Swan and Belzer (2010) argued that replacing fuel taxes with road charges based on road usage and the type of vehicle rather than the type of fuel used, is the solution to insufficient funds for maintaining and developing roads. This was an indication that South African National Roads Agency (SANRAL) was to proceed on its mission of providing and maintaining good roads as cost-effectively as possible (Brits, 2010).

A public outcry of e-tolls, the Opposition to Urban Tolling Alliance (OUTA), which is an organisation opposing e-tolls in Gauteng, is based on the facts that they labelled the e-tolls as irrational, unreasonable and not planned in the best interest of the public (Duvenage, 2013). John Moodey, the Democratic Alliance (DA) political group Gauteng provincial leader, argues that the DA has declared e-tolls as an enemy of the people and they will remove the e-tolls once they win the municipal votes and take over the cities of Tshwane and Johannesburg in Gauteng province (Smith, 2016).

2. PROBLEM STATEMENT

The South African Government is experiencing difficulties with the collection of funds to maintain and build new roads (Duvenage, 2013; Smith, 2016). The money obtained from authorities and from other taxes is used for other important programmes, thus a user charge was introduced on some roads to obtain extra funds for maintaining and building new roads (Kekana, 2008). James and Anne (2010) describe e-tolls as a faster way of getting enough funds to build a new road or to keep roads maintained whilst reducing congestion on the roads. Although the e-toll system may collect funds faster, the public should be consulted beforehand and needs to agree on the implementation thereof and accept the e-tolls. Jakobsson, Fujii and Gärling (2000) argue that some people have a negative attitude towards e-tolls because they believe that e-tolls infringe on their freedom. Road charges are causing people to travel less or to make use of public transport because they cannot afford to pay, which is infringing on the freedom of movement of people. This paper will help understand the attitudes or the frustration of motorists driving through e-tolls, while at the same time helping to understand why the government implemented the e-tolls. This study is of great importance as it will bring light to the origin of e-tolls and make government officials aware of the motorists' attitudes and the voters' relationship that might be jeopardised.

3.2. E-toll charges

E-toll charges may be referred to as road user charges or congestion pricing as the road users are being charged to use the road (Odeck & Kjerkreit, 2010). Congestion pricing is a way of reducing the number of vehicles on the roads, because some motorists will start avoiding the roads where they pay and use ones on which they do not pay. Pricing of e-tolls decreases the time wasted on congested roads and the uncertainty of delays on the road. It also reduces the waste associated with traffic congestion such as carbon dioxide (Decorla-Souza & Whitehead, 2003). The more vehicles are congested on a highway the greater the

volumes of gasses released into the atmosphere and the environment. The price of e-tolls plays an important role in the acceptance of tolls by the public. It is well known that e-tolls were implemented to maintain roads and build new ones, but at the same time, they have to be affordable and accommodate people with a lower income (Peters, 2014). It is very important for the government to be transparent and honest when setting a charge for the e-tolls as this will assist the government gain the trust of motorists. If e-toll charges are not transparent, motorists may view the secrecy of charges as being unfair to them and, as a result, it will make motorists start being against road user charges. Therefore, it is best to know when to disclose information about charges and what to disclose, in that way motorists will have less negative attitude and have more trust on the charging system, ultimately complying with the e-toll system (Ferguson & Ellen, 2013).

H_1: E-toll charges have a significant influence on the attitude towards e-tolls.

3.3. Attitude towards e-tolls

The e-toll system is used to earn funds faster than fuel taxes or vehicle registration levies for building new roads and maintaining existing roads. The safety of roads is increased as the roads are in good condition, less vehicles are travelling on the roads, while the time spent on roads is also decreased (Odeck & Kjerkreit, 2010). As new motor vehicles are being produced to be more fuel efficient and emit less carbon, the overall income on fuel sales was reduced. That, together with the need for an improved road system, motivated the government to introduce an e-toll system (Velaga & Pangbourne, 2014). According to Di Ciommo, Monzón and Fernandez-Heredia (2013), the income level of different motorists has an influence on the attitude towards e-tolls. The result was that Cyril Ramaphosa assigned a team to research on the concerns of the public, which resulted in the financial burden of low income people being only 0.4 percent, as 98 percent of the users of e-tolled roads are middle and higher income earners (Harvey & Mona, 2015). The willingness of motorists to comply with e-toll policies depends on their attitudes towards e-tolls, meaning that once motorits have a positive attitude towards e-tolls they will comply with the e-toll policies (Van Damme & Pauwels, 2016).

H_2: Attitude towards e-tolls has a significant influence on the e-toll compliance.

H_3: Attitude towards e-tolls has a significant influence on the consumer trust of e-tolls.

3.4. E-toll compliance

Edwards and Wolfe (2004) define compliance as a term that includes concepts of obedience, governability, non-resistance and submission, meaning that if road motorists are non-resistant and submissive to the e-toll policies, they will continue supporting the e-toll policies and be committed. According to Jimenez and Lyer (2016), where there is compliance, there is trust. This simply means that motorists trust the e-toll policy and they see the benefits of it thus, they are complying with the policies, resulting in the continuing use of the e-toll and being committed to complying with the e-toll policy. Motorists may see e-tolls as infringing on their freedom of movement, as they will have to minimise their movement and select certain roads to travel, restricting them to the roads they can use. The level of information received by the public before the implementation of e-tolls has an influence on the acceptability of e-tolls (Odeck & Kjerkreit, 2010). In a number of studies using information from the World Values Survey (WVS), Torgler (2003a, 2004) found that trust in government is positively related to individuals' willingness to comply with tax laws in various countries. Other studies have confirmed a positive relationship between trust in government and compliance in various countries (Jimenez & Lyer, 2016).

H_4: E-toll trust has a significant influence on e-toll compliance.

H_5: E-toll compliance has a significant influence on e-toll use continuation.

3.5. Consumer trust of e-toll

Lack of support for tolls could be due to the lack of trust in government, mainly associated with the fact that road users have no information on the implementation of e-tolls or how the government resources are spent, which leads them to believe that government funds are misused (Yusuf, O'Connell & Anuar, 2013). Schmöcker, Pettersson and Fujii (2012) state that trust in government is a crucial factor to the public as it is an important determinant of toll acceptability. The public needs to have some trust in the government that the e-tolls are there to benefit the environment and the society as a whole and not just the government. This will encourage e-toll compliance among the motorists. Velaga and Pangbourne (2014) further state that the system security holds confidential information about motorists; therefore, user privacy should be prioritised. According to Schade and Baum (2006), there is enough evidence that e-tolls are implemented against the choice of the majority of the voters and motorists. In addition, the voters or motorists do not have control or a say over the planning and

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012104

decision making of the implementation of e-tolls. One of the most important determinants of acceptability of road charges is trust in the government.

H_6: Consumer trust of e-tolls has a significant influence on the e-toll use continuation.

4. METHODOLOGY AND DATA ANALYSIS

The article used a non-probability convenience sampling technique to select respondents. A confirmatory factor analysis was applied in examining and testing the relationships between observed constructs and their causal latent constructs while structural equation modelling (SEM) was used to test the hypothesised relationships between constructs.

Table 1: Accuracy analysis statistics

Research constructs		Descriptive statistics		Cronbach's test		C.R. value	AVE value	Factor loading
		Mean	SD	Item-total	α Value			
E-Toll Charges (ETS)	ETS1	4.163	5.420	0.790	0.910	0.909	0.788	0.829
	ETS2			0.867				0.904
	ETS3			0.587				0.587
	ETS4			0.792				0.842
	ETS5			0.839				0.930
Attitude Towards E-Tolling (ATE)	ATE1	3.778	4.149	0.500	0.713	0.713	0.609	0.954
	ATE2			0.517				0.942
	ATE3			0.551				0.556
	ATE4			0.520				0.509
	ATE5			0.500				0.501
E-Toll Compliance (ETC)	ETC3	3.211	3.377	0.511	0.654	0.654	0.503	0.654
	ETC4			0.613				0.679
	ETC5			0.500				0.555
Consumer Trust of E-Tolls (CTE)	CTE1	2.900	4.879	0.597	0.854	0.853	0.708	0.606
	CTE2			0.606				0.671
	CTE3			0.725				0.838
	CTE4			0.775				0.894
	CTE5			0.636				0.674
E-Tolls Use Continuation (EC)	EC1	3.976	5.802	0.503	0.719	0.719	0.611	0.504
	EC2			0.501				0.500
	EC3			0.579				0.700
	EC4			0.603				0744
	EC5			0.519				0.593

A high level of Cronbach's alpha coefficient depicts a higher reliability of the scale. For a set of items to be considered, a minimum of 0.6 for Cronbach's alpha should be accepted. The Cronbach alpha values of the research constructs ranged from 0.65 to 0.91. The lowest value is 0.65, which is acceptable, followed by 0.71 with a good internal consistency; the highest Cronbach alpha of this article has a value of 0.91, which gives excellent internal reliability. The Cronbach alpha coefficient values are well above the recommended level of 0.7; therefore, this indicates a higher degree of internal consistency. Item-to-total correlation and factor loadings were assessed using SPSS. For consistency in assessing the items, factor loadings should be greater than 0.5 (Fornell & Larcker, 1981). As seen in Table 1, the factor loadings of all the measurement items are within the range of 0.5 to 0.9, with the highest value of 0.954 for ATE1 and the lowest value of 0.500 for EC2. All the items are greater than 0.5. Moreover, in this paper, item-to-total was used to assess convergent validity. Table 1 depicts that the item total values ranged from 0.500 to 0.954; these values are all above the recommended threshold of 0.5. Discriminant validity refers to the extent to which a measure is distinct from other measures. Discriminant validity was assessed in this article with the purpose of having confidence in the research results.

Table 2: Correlations between constructs

Research Construct	Construct correlation				
	ETS	ATE	**ETC**	**CTE**	**EC**
ETS	1.000				
ATE	0.660**	1.000			
ETC	0.553**	0.580**	1.000		
CTE	0.599**	0.492	0.605**	1.000	
EC	0.465**	0.588**	0.590**	0.544**	1.000

The correlation between all the constructs is less than the standard threshold of 1.0. Therefore, these results confirm the existence of discriminant validity.

4.1. Confirmatory factor analysis

The degrees of freedom of the chi-square are 2.978, whereby the value should be between one and three, this means that a chi-square value of 2.978 in this article is acceptable and fits the model. Furthermore, Goodness of Fit Index (GFI) (0.901), Normed Fit Index (NFI) (0.904), Relative fit index (RFI) (0.923), Incremental Fit Index (IFI) (0.920), Tucker Lewis Index (TLI) (0.933), Comparative Fit Index (CFI) (0.900) and Adjusted Goodness-of-Fit Index (AGFI) (0.902) meet the recommended threshold of 0.9, which indicates a good model fit. Finally, Root Mean Square Error of Approximation (RMSEA) is 0.078, which is less than the minimum threshold of 0.08 (Hoe, 2008), this results in a good model fit. In totality, scrutinising these eight statistics, it can be concluded that all of them are acceptable and that the data fits the model accurately.

4.2. Structural equation modelling (SEM)

The chi-square value of 2.990, which is below the recommended threshold of three (Hinterhuber & Liozu 2013), as a result this suggests an acceptable model fit. Furthermore, GFI (0.900), NFI (0. 905), RFI (0.907), IFI (0.918), TLI (0.914). However, CFI (0.893) and AGFI (0.867) are close to the normal standard of 0.9. The CFI value of 0.893 and AGFI value of 0.867 are acceptable and fit the model accurately. All results are above the recommended value of 0.9, which means a satisfactory model fit. The value of RMSEA is 0.079, which is below the required threshold of 0.08, thus confirming an acceptable fit of the data to the model. In entirety, examining these nine goodness-of-fit statistics, it can be concluded that all of them are acceptable and that the data fits the model.

4.3. Hypotheses testing

This section discusses the six hypotheses by addressing their validity or acceptance through SEM.

Table 3: Results of hypotheses testing (path modelling)

Proposed hypothesis relationship	Hypothesis	Path coefficient estimates	P-value	Decision
ETP→ATE	H1	0.308	***	Accepted
ATE→ ETC	H2	0.455	***	Accepted
ATE →CTE	H3	0.390	***	Accepted
CTE →ETC	H4	0.501	***	Accepted
ETC→ EC	H5	0.206	***	Accepted
CTE→ EC	H6	0.301	***	Accepted

The levels of the coefficients of all the six hypotheses are significant at a level of $p<0.01$. Significance levels of $p<0.05$, $p<0.01$ and $p<0.01$ are indicators of positive, strong and significant relationships between the research constructs. Based on that, all of the six hypotheses proposed in this article were supported and accepted.

5. DISCUSSION OF RESULTS

Hypothesis 1, stated that there is a positive and significant relationship between e-toll charges and the attitude towards e-tolls. This means that a decrease in the price of e-tolls may have resulted in a better and good attitude towards e-tolls. The article supported and accepted the stated hypothesis (H1). This is due to the fact that a moderate and positive significant relationship was observed between e-toll charges and the attitude towards e-tolls ($r = 0.308$; $p < 0.01$). **Hypothesis 2,** stated that there is a positive and significant relationship between attitude towards e-tolls and e-toll compliance. Table 3 revealed that H2 was found to be supported and acceptable ($r = 0.455$; $p < 0.01$). This finding illustrates that attitude towards e-tolls has great influence on e-toll compliance. **Hypothesis 3,** which pertains to attitude towards e-tolls, has a significant influence on the consumer trust of e-tolls information. This hypothesis was supported and accepted. This decision is based on the fact that there are strong and positive associations established between the two constructs ($r = 0.390$; $p< 0.01$). **Hypothesis 4,** there is a positive and

significant correlation between consumer trust of e-tolls and e-toll compliance ($r = 0.501$; $p < 0.01$). These findings are further validated by a number of studies using information from the World Values Survey. Torgler (2003a, 2004) found that trust in government is positively related to individuals' willingness to comply with laws in various countries. **Hypothesis 5,** stated that there is a positive and significant relationship between e-toll compliance and e-toll use continuation. Table 3 revealed that H5 was found to be supported and acceptable ($r = 0.206$; $p < 0.01$). **Hypothesis 6,** consumer trust of e-tolls and e-toll use continuation has been found to be positively and significantly correlated ($r = 0.301$; $p < 0.01$). This illustrates the fact that road users that trust the e-toll policy and see the benefits of it will comply with the policies, resulting in the continuation of use of the e-toll.

6. LIMITATIONS OF THE ARTICLE

This article was restricted only to the motorists driving on the Gauteng Province roads with e-tolls; other provinces did not form part of this article. Even though the results were valid and reliable, other variables such as marital status, race and occupation, could be investigated. Furthermore, respondents were reluctant to fill in the questionnaire because they were not sure if this article was only for school use or for government use. Only after assuring them that it is strictly for academic use were they were willing to participate. There was very little literature available as there are no or few studies about e-tolls in South Africa.

7. IMPLICATIONS FOR FUTURE RESEARCH

Since this article was only focused on e-toll charges, attitudes towards e-tolls, trust, compliance and commitment in explaining the motorist's attitude towards e-tolls, future researchers may include other constructs such as information sharing, cost reduction methods and better communication between the road users and the government to obtain acceptance or positive attitude towards e-tolls. It has been confirmed that e-toll charge, trust, compliance and commitment are the main factors to achieve a positive attitude towards e-tolls. Therefore, future researchers should try to find methods in which motorists and the government can increase the level of trust, compliance, commitment and lower the e-toll charge.

8. RECOMMENDATIONS

In order to improve e-tolls use continuation, government is encouraged to respect and consider the needs and ideas of the motorists. Motorists are more likely to commit to the e-toll system when their needs are considered.

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INTERNATIONAL JOURNAL OF eBUSINESS and eGOVERNMENT STUDIES
Vol: 12 **No:** 1 **Year:** 2020 **ISSN**: 2146-0744 (Online) (**pp.** 63-78) **Doi:** 10.34111/ijebeg.202012105
Recieved: 13.09.2019 | **Accepted:** 03.11.2019 | **Published Online:** 01.01.2020

-RESEARCH ARTICLE-

CHALLENGES OF ACCEPTANCE AND USAGE OF A LEARNING MANAGEMENT SYSTEM AMONGST ACADEMICS

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─Abstract─

Universities across the globe have invested heavily in a Learning Management System (LMS); however, the adoption and usage is hindered by a number of factors. Recently, a University of Technology (UoT) in KwaZulu-Natal embarked on a major re-circulation drive to embrace student-centred learning. However, this process was stalled by slow maturity use of LMS. Therefore, this paper evaluates the acceptance and usage of an approved LMS amongst academics at a UoT. An e-survey in which 111 academics participated, all having teaching designations, was superseded by semi-structured interviews. A significant finding of the technology acceptance model (TAM) was impugned, in reflecting the gap between low actual usage and high acceptance. Assessments seemed to be given lowest priority, with aspects such as communication and course management receiving highest priority. Little utilized were collaboration tools. Such include blogs, wikis, and a discussion forum. Dedicated training on features of the learning management system, covering its educationally progressive aspects, is of the essence. TAM may require closer scrutiny to account for successful LMS usage at universities.

Citation (APA): Dlalisa, S. F. & Govender, D. W., (2020), Challenges of Acceptance and Usage of a Learning Management System Amongst Academics, International Journal of eBusiness and eGovernment Studies, 12 (1): 63-78. Doi: 10.34111/ijebeg.202012105

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

Key Words: Learning Management System, Technology Acceptance Model, student-centred learning, higher education, academics' acceptance, academics' usage, University of Technology, e-learning

JEL Classification: I23

1. INTRODUCTION

The broad use of electronic technologies embraces the digital-age society and has the potential to enhance the learning experience in the information age. Horton (2011), defines e-learning as the use of electronic technologies to create a learning experience, also allowing for flexibility of using different tools, depending on the users' preference. An e-learning platform is a system running on a web-server, providing companies or universities with the ability to administer, distribute, and supervise teaching and learning activities (Llamas-Nistal, Caeiro-Rodriguez, & Castro, 2011).

An e-learning platform encourages student engagement, thereby promoting the creation of a student-centred model. Butt (2014) defined student-centred learning as an activity in which the student's learning process is guided by the teacher. A heavy accent has been placed on students, moving away from academics. This paradigm shift is described as a shift to student-centred learning. Academics have now to act as mentors, e-moderators, and facilitators, rather than passively transferring learning as verbal communication (Rienties, Brouwer, & Lygo-Baker, 2013). Importantly, e-learning can support a student-centred learning environment, encouraging this shift of focus away from academics onto students.

Thus academics' buy-in, which entails the acceptance and usage level of the system (Alharbi & Drew, 2014), heavily influences the success of LMSs, which have been largely under-utilized by academics. This has been cited as a crucial factor in overall neglect of the system. This study has as its objectives:

- To evaluate the acceptance of the Blackboard amongst academics at a University of Technology; and
- To evaluate the usage of the Blackboard system amongst academics at a University of Technology.

These objectives can shed more light on the acceptance and usage of the LMS (Blackboard) amongst academics in a South African University of Technology (UoT). This paper will examine in detail how universities, students, and academics can benefit from using a LMS; how the use of such a system can

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

augment student-centred learning, together with the significance of academics' enthusiasm for supporting student learning per this means.

2. LITERATURE REVIEW

2.1. Learning Management Systems

LMSs support current pedagogic requirements, in offering both asynchronous and synchronous benefits for students of this age of information. Communication (Llamas-Nistal et al., 2011), accessibility, flexibility, self-paced activity, and interactivity (Abdous, 2013), skill building, and increased availability, improve learning experiences of students, and positively motivate students (Alshammari, Ali, & Rosli, 2016). Advantages like self-paced activity could smooth the transition of leavers from high school to higher education institutions. Consistently accessible and responsive staff is a factor that contributes to a first-year's retention (James, Krause, & Jennings, 2010). Furthermore, LMSs have also been credited with motivating users (students and academics); and increasing participation amongst the students in a class (Alshammari et al., 2016).

2.2. Student-centred learning through LMSs

The shift from an 'industrial age' learning environment to an 'information age' learning environment is inevitable. The information age student's experience and learning can no longer be supported by an outdated model which revolves around academic-centric control rather than shared control (academic/student) of learning (Blewett, 2012). A student-centred environment which engages the student can support the proper use of technology (Revere & Kovach, 2011) by means of guidance provided by both academics and LMSs (Overby, 2011). This may be achieved through information searching, retrieval and generation (Kirkwood & Price, 2014). Such can cultivate a lifelong learning process in which students are capable of solving problems independently. Students can be studying at their convenience, studying being made interesting and entertaining via various methods (Overby, 2011).

Academics, once they have accepted the approach of student-centred learning shift from the role of "sage on the stage" to that of "guide on the side" (Overby, 2011). Students must then actively participate in their own learning, having also to be responsible for organising, analysing, and synthesizing their learning content. Such a stance on student-centred learning leads inevitably to the stimulating of critical thinking and problem-solving in students. The most frustrating challenge is the unpreparedness of academics to alter their ingrained role of transferring content verbally, to accepting the role of facilitator.

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

2.3. Principal Stakeholders' Readiness for LMS

This research was principally concerned with the acceptance and usage of LMS by academics. However, it is also necessary to consider the roles of the complementary actors (university, academics, and students), when such impinges directly on the academics' ability to conduct their roles as LMS facilitators effectively. Learning management systems demand preparedness of all three main stakeholders, namely, the university, the academic, and the student, in addressing needs of the stakeholders and in implementing LMSs successfully.

2.3.1. Academics' readiness for LMS

Edumadze, Ossei-Anto, Edumadze, Tamakloe, and Boadi (2014)'s definition of readiness is given as the individual being willing to engage in the proffered learning system, benefiting thereby. E-learning readiness covers willingness by, for instance, the student, school, or academic, to use e-learning tools, preferring such as the usual delivery mode of instruction (Edumadze et al., 2014).

Obstacles to acceptance and use by academics of LMSs include lack of prior experience with computers or Information and Communication Technology (ICT), inter alia (Eslaminejad, Masood, & Ngah, 2010). Eslaminejad et al. (2010), found that academics had a positive attitude towards e-learning acceptance, but this did not necessarily translate into usage. Computer experience plays a critical role in LMS acceptance and usage as it affects computer attitude (Teo & Noyes, 2011). Someone highly experienced in computers is more liable to engage readily with LMSs than would users having little experience of such. Should a facilitator accept the integration of technology into the teaching and learning, they are likely to have ICT experience (Mahmud & Ismail, 2010).

2.3.2. Universities' readiness for LMSs

Institutional support is defined as "general support, which includes top management encouragement and allocation of adequate resources" (Igbaria, Parasuraman, & Baroudi, 1996). The university plays a major role in ensuring that all role-players are integrated and working in harmony to create an overall positive acceptance and usage of the system. Davis, Bagozzi, and Warshaw (1989), also concluded that organizational support is one of the critical factors promoting system usage. The management of the university is influential in shaping employees' attitudes towards the system's usage (Al-Busaidi & Al-Shihi, 2012) as also stated by (Kirkwood & Price, 2014; Revere & Kovach, 2011). Therefore, the university's readiness starts with management, who must ensure that the network or Internet connectivity (better bandwidth), along with the

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

infrastructure (such as the server), is operating efficiently for LMS to be implemented.

2.3.3. Students' readiness for LMSs

Factors that contribute to students' readiness for LMS usage include, but are not limited to: self-efficacy (Abbad, 2011), computer experience, technical support (Abbad, 2011; and Al-Busaidi & Al-Shihi, 2010), and prior experience (Alharbi & Drew, 2014). Self-efficacy is a personal trait describing an individual's ability to perform certain activities successfully (Bandura, 1978). Low self-esteem can hinder a person's use of LMS, even when compared to an individual with less experience but more self-confidence. This confidence can be developed by providing the student with the necessary training and technical support.

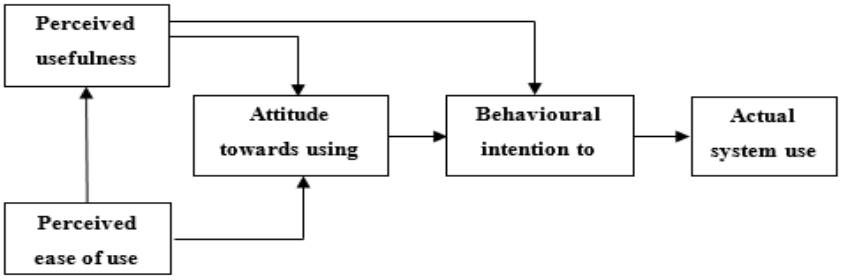
2.4. Theoretical Framework

Publications on information system (IS) or technology acceptance, have been the subject of academic scrutiny and measurement. According to most models, however, technical aspects of IS outweigh the effectiveness of the social elements. Conversely, the TAM or technology acceptance model (Davis, 1989) and the TRA, or theory of reasoned action (Fishbein & Ajzen, 1977) stress the social side of IS. The social aspects of the TAM are arguably one of the most-used theories in the IS field (Al-Busaidi & Al-Shihi, 2010), with the model's results being validated by some researchers (Al-Busaidi & Al-Shihi, 2010; and Lee, Kozar, & Larsen, 2003). However, some studies (Venter, Jansen van Rensburg, & Davis, 2012) offer conflicting results, particularly for LMSs. TAM was used (Figure 1) in the current study as a baseline following a model for LMSs proposed by Al-Busaidi and Al-Shihi (2010) to assess the extent of academics' challenges affecting the acceptance and usage of the LMS.

Davis (1989) suggests that Perceived Usefulness (PU) is directly influenced by Perceived Ease of Use (PEOU), both these determinants directly influencing attitude towards use (A). Furthermore, Behavioral Intention (BI) is directly influenced by 'A' and 'PU'. Additionally, 'BI' influences the System Use (SU).

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

Figure-1: Technology Acceptance Model



Source: Davis, 1989

3. METHODOLOGY

3.1. Participants

The case study took place at a UoT, Durban and Pietermaritzburg campuses, located in KwaZulu-Natal, South Africa. In gathering data from those academics who teach at this UoT, a qualitative, combined with quantitative (mixed-method), approach was employed. Some 550 academics on the permanent staff on all university campuses, were presented with the questionnaire. Only 111 academics responded to the e-survey. In order to access insight and depth sufficient for understanding the topic (acceptance and use of LMSs amongst academics) 10 interview follow-ups were given (Coskuncay, 2013).

The questionnaire contained six sections (1 to 6) with pre-coded and structure questions. Section 1 covered background information; sections 2 to 6 covered constructs (PU, PEOU, A, BI, and SU) used to measure acceptance and usage of the Blackboard system amongst academics at a UoT (Table 1).

Table 1: This Paper's Objectives and TAM Constructs used to Measure them

Objectives	TAM Constructs
1. To evaluate the acceptance level of the Blackboard system amongst academics.	Perceived usefulness, Perceived Ease Of Use, Attitude Towards Using
2. To evaluate the usage level of the Blackboard system amongst academics.	Behavioural Intention to Use, System Use

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

The majority of the questions used to measure the constructs were adapted from existing literature and validated by other studies. Questions were reworded to appropriately fit the study; some questions were developed by the researcher.

3.2. Data Analysis

The data collected from the questionnaire was obtained using a 5-point Likert scale for all the sections (except the demographic section). Data were analysed using SPSS version 22. The following data analyses were performed on the data: Chi-Square Goodness-Of-Fit test which tests variables by category. The aforementioned is a univariate test, finding whether any particular responses are chosen markedly more or less often than others. The Wilcoxon Signed Ranks test which is a non-parametric test, was specifically used in this study to test whether the average value is significantly different from a value of 3(the central score). The Regression Analysis test calculates coefficients of any linear equation, establishing which independent variable (one or more) best forecasts the dependent variable's value.

Interview data were assessed using narrative analysis. The interview questions afforded the respondent an opportunity of evaluating in-depth reasons for responses, beyond those obtained from the pre-coded and structured questionnaire. The interview questions were categorized into two groups:

- Group A (those who do use the Blackboard, even if only to a small extent). The aim was to ascertain the motivating factors for using Blackboard.
- Group B (those who do not use the Blackboard at all). The aim was to ascertain the negative factors accounting for their avoidance of Blackboard.

4. FINDINGS

4.1. Questionnaires

The results of Blackboard usage on the Chi-Square Goodness-Of-Fit test reflected that some 31 per cent of academics avoid all use of the Blackboard system. Some 27 per cent of academics use the system perhaps once weekly. The results of Blackboard usage from the Chi-Square Goodness-Of-Fit test also show that a significant number of participants used the system as a repository (χ^2 (5, N=111) = 18.505, p=.001); and used the system for communication (χ^2(5, N=111) = 31.207, p<.0005). A great number of participants neither use the system for assessment (χ^2(5, N=111) = 96.613, p<.0005) nor for reporting (χ^2(5, N=111) = 88.054, p<.0005). This implies that the system is not exploited to its full capacity. Furthermore, the results of computer skills from the Chi-Square Goodness-Of-Fit

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

test result highlighted that 53% of the academics rated their computer skills good, 31% rated their computer skills excellent, while only 2% rated their computer skills poor.

The results from all of the constructs (Table 2 and Table 3) reflected a noteworthy difference from the central score of 3. It appeared that the System Usage construct had been little used. Participants appeared markedly in agreement on all other constructs. This would suggest that an event occurs between BI and SU, The TAM framework cannot explain the low system usage, despite its high intention.

Table 2: Mean and Standard Deviation

Constructs	No.	Mean	Std. Deviation
Perceived Usefulness	111	3.3724	.85545
Perceived Ease of Use	111	3.4288	.78617
Attitude	111	3.5261	.72359
Intention to Use	111	4.0631	1.00254
System Usage	111	2.5207	1.12727

Table 3: Wilcoxon Signed Ranks Test

Test Statistics[c]							
	Threes - Perceived Usefulness	Threes - Perceived Ease of Use	Threes - Attitude	Threes - Intention to Use	Threes - Tech Factors	Threes - Support Factors	Threes – System Usage
Z	-4.374[a]	-5.225[a]	-6.486[a]	-7.257[a]	-3.980[a]	-5.854[b]	-3.805[b]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000
a. Based on positive ranks							
b. Based on negative ranks							
c. Wilcoxon Signed Ranks test							

Table 2 represents a computed mean and standard deviation of the selected items in each construct, which were used to reflect where there is higher agreement. It also depicts the mean and standard deviation for the following constructs: PU, PEOU, A, BI, and SU. Table 3 depicts the results from the Wilcoxon Signed Ranks test. The average score is calculated for each of these constructs, and tested against a neutral 3. In Table 3, the average scores are noticeably distinct from 3 (text highlighted in grey). However, SU in Table 3 shows a significantly low mean, being less than 3, whilst the others are all above 3. Such would indicate that participants, on the four construct statements, agreed with the majority, that is, PU, PEOU, A, and BI, therefore in all constructs except SU.

Furthermore, under Usage, in Table 2, low usage appears noteworthy (lower than 3). Others, however, are all in significant agreement; which means that most academics

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

lean towards use of the system, albeit there is scant actual usage. Usage over a single daily usage was 5 per cent, with only 4 per cent using the system daily.

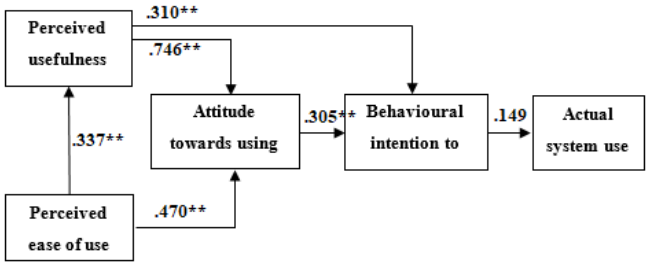
4.2. Interviews

The interview questions were based on Blackboard usage and were categorized into two groups: Group A: participants who do not use Blackboard, and Group B: participants who use Blackboard regardless of the frequency. After recording the interview, it was transcribed. The following themes arose: course management, communication, assessments, support factor, Blackboard update, staff acceptance, support, and incentives.

4.3. Research Model's Path Analysis

The summary of the results from the correlation coefficients of the TAM is depicted in Figure 2. The result reflects noteworthy correlation of all constructs of the model, save SU and BI. A single asterisk (*) in the research model's correlation coefficient path (Figure 2) reflects a level of significance of 0.05; while a double asterisk (**) reflects a significance level of 0.01.

Figure-2:Research model coefficients' path



This section of the paper will highlight only the most significant route of the model, as indicted by the value of the higher coefficients. It appears from the results that both PEOU (r=.470, p<.0005) and PU (r=.746, p<.0005) are predictors of A. Strong and medium correlation, strong predictors, respectively, had positive correlations with A. The SU is, however, not notably correlated with BI (r=.149, p=.118), the strength being low. This result indicates a gap between SU and BI. However, this discrepancy may be attributed to factors unique to the studied university. Furthermore, this result is not in accordance with the TAM. The TAM maintains that BI is the principal determinant of any IS.

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

5. DISCUSSION

Use of LMSs by academics was reflected in interview and e-survey results. Results were consolidated and interpreted in evaluating LMS usage and acceptance by the above-mentioned users at a university of technology.

5.1. LMS Usage

Benefits such as flexibility, interactivity, accessibility, and self-paced learning are being attained by correct application of an LMS (Abdous, 2013), increasing availability and skills development (Alshammari et al., 2016). In assessing usage of LMSs, Pearson's analysis tests of correlation and regression were conducted. The Pearson's correlation test and the regression analysis test revealed that the correlation between SU and BI is not significant; and the BI does not predict SU at all. The findings from the current study concur with all of TAM's determinant relationships, except for behavioural intention and actual usage. A study by Venter et al. (2012) investigated the factors that either promote or hinder students' LMS acceptance and usage. Venter et al. (2012)'s research unearthed a positive, albeit weak relationship between behavioural intention and usage of an LMS. These findings would indicate a need for TAM to be revised, thereby allowing for other factors to be taken into account.

It was discovered per the interviews that the principal use of the system was communication and course management; the LMS was least used for evaluation purposes, despite the fact that it could be beneficial to students for self-assessment after each concept covered. Academics are also encouraged to incorporate LMS assessments into their final course mark. In addition, the assessment marks can be automatically featured, thereby reducing academics' workload, providing speedy response and assessment of progress. In general, interview results were aligned with those of the questionnaire. This highlighted the course management and communication as aspects most used. The aspect of assessment was largely neglected. The Kruskal Wallis test (Table 4) offered LMS experience as a crucial element in system usage. Such a result would be expected at a higher learning institution.

Computer skills' correlation with Actual Usage reflected that the greater the skills of the academic, the more the system would be used. Such is supported by the contention in literature that proficient use of technology exerts a positive influence on LMS usage. In other words, those academics most adept on the computer are likely to be less fazed by an LMS than academics not technologically experienced (Fishbein & Ajzen, 1977). Thus, LMS acceptance is

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

greatly influenced by technological skills, for instance, with computers (Fathema & Sutton, 2013). Experience of ICT will be aligned with decisions on integrating technology with teaching and learning (Mahmud & Ismail, 2010). The Behavioural Intention to Use factor agreed notably with all statements on the element Behavioural Intention to Use. BI, as reflected in the results, correlated positively with PU (r =.310, p =.001) and A (r =.305, p =.001): medium strength was shown for both. It was also confirmed in the findings on TAM, that Perceived Usefulness and Attitude towards Using correlated positively with Intention to Use (Davis et al., 1989), which was also noted by (Alharbi & Drew, 2014).

Table 4: Kruskal Wallis Test - LMS Experience vs System Usage

	N	Mean	Std. Deviation
None	28	1.4929	.75715
<1 yr	18	2.3111	.98988
1 - 2 yrs	31	2.9161	.88057
3 - 4 yrs	12	2.7500	1.11559
>4 yrs	22	3.3182	.99649
Total	111	2.5207	1.12727

Test Statistics[a,b]

	System Usage
Chi-Square	35.873
df	4
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: 1.6. (recoded) How long have you used, or have been using a Learning Management System (LMS)? (In general, not only the Blackboard)

5.2. LMS Acceptance

On the Wilcoxon Signed Ranks test, results indicated that most academics agreed that the system was both useful and simple to use, therefore they had a positive attitude towards use of the LMS. This finding concurs with the results of Davis (1989) and Venkatesh and Bala (2008) that attitude towards use is greatly influenced by perceived ease of use, and perceived usefulness. A similar study on academic behaviour towards acceptance of an LMS, yielded congruous findings. Academics accepted that the LMS was useful as a tool in learning and teaching, and easy to use (Fathema & Sutton, 2013), which concurs with the results of this

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

study. The participants, on usefulness of the Blackboard system, indicated that this system saved time and simplified their teaching activities. It was noted that those who used the system did so selectively, ignoring certain features possibly for their unfamiliarity, or out of indifference. Neglected features included student tracking, and the forum for discussion and collaboration. Such features add greatly to support for student-centred learning.

A noteworthy correlation was indicated on Perceived Usefulness, the medium strength being (r =.470) with the high-strength Perceived Ease of Use (r =.746). The findings concurred with those of (Alharbi & Drew, 2014). In answering this question, regression analysis was conducted. Results reflected that Perceived Usefulness (β = .663, p<.0005) and Perceived Ease of Use (β = .247, p<.0005) significantly predicted Attitude Towards Using. It was noted that, not only did participants believe that use of the Blackboard system was enjoyable and far from boring; but, importantly, they believed that the system was worth the expending of time and effort in assessing of students, course management, and preparing of content.

6. LIMITATIONS AND FUTURE RESEARCH

The study acknowledges some limitations and also provides a recommendation for future studies. Academics' challenges are a focal concern of South African literature. LMS acceptance and use is limited; however, the international literature is relevant. Studies assess which of the factors raised is applicable to this case: challenges reviewed in the literature could also apply to a UoT. This study can be used to further investigate other challenges found within academia context.

7. CONCLUSION

The results of the objective that evaluated Blackboard's use by academics reflected the gap between acceptance and usage of the system. These results show that academics do intend to use the approved LMS. However, only a few actually use it. Even fewer use it for student-centred learning activities. Factors that contributed to academics using LMS infrequently, or not at all, included their level of computer skills, and LMS experience. This would seem to indicate that more intensive training should be offered, upskilling all academics with teaching responsibility on deploying LMS systems.

Vol 12, No 1, 2020 ISSN: 2146-0744 (Online) Doi: 10.34111/ijebeg.202012105

Meanwhile, the results of the objective that evaluated the acceptance of the Blackboard system amongst academics revealed that acceptance was reasonably high. Most academics considered the LMS positively, finding it both easy to use and useful. The university should exploit this positive attitude towards acceptance and use of the system. An educational drive should be initiated, highlighting the benefits of such a system. This would be seen as giving support to the learning experience of students now in the digital age. While LMSs are complex systems, if implemented properly, and if the needs of the all the key stakeholders are satisfied, the rewards can be enormous. Therefore, continuous training is critical to ensure that LMSs are utilized to their full capacity. Incentivizing academics to use LMSs will act as a catalyst in integrating LMSs into the teaching and learning culture(s) of the higher education institutions.

TAM has been proven in numerous studies to successfully account for acceptance and usage in the business environment. However, it was inadequate to successfully account for usage in a university environment; and these results are similar to another, comparable study (Venter et al., 2012). Therefore, the current use of the TAM model within a higher education context appears to need further scrutiny.

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INTERNATIONAL JOURNAL OF eBUSINESS and eGOVERNMENT STUDIES
Vol:12 **No:**1 **Year:**2020 **ISSN:** 2146-0744 (Online) (pp. 79-90) **Doi:** 10.34111/ijebeg.202012106
Recieved: 30.01.2020 | **Accepted**: 15.03.2020 | **Published Online**: 15.03.2020

HERD BEHAVIOR IN TERMS OF SOCIAL PSYCHOLOGY: THE EXAMPLE OF CRYPTO ASSET MARKETS

-RESEARCH ARTICLE-

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-Abstract-

The four main causes of sudden price fluctuations in crypto asset markets are speculative news within the scope of global developments, positive market perceptions that increase the price, rising stock market values, and herd behavioral tendencies on crypto assets. The purpose of this study is to examine herd behavior trends in terms of social psychology, exemplified by the crypto asset market. In this framework, firstly, the daily yield pricing of twenty-two crypto assets with the highest transaction volume was examined in the period of August 2013 - December 2019, and then the trend of herd behavior of these assets on the market was investigated. Cross Sectional Absolute Deviation (CSAD) method was used to measure the herd behavior trend. The analysis revealed the presence of herd behavior trend in regime 1 and regime 3 models.
Keywords: Social Psychology, Herd Behavior, Crypto Asset, Cross Sectional Absolute Deviation (CSAD), Cryptocurrency.
JEL Classification: G1, G2

1.INTRODUCTION

Crypto coins are gaining popularity against classical currencies due to their dynamic structure. The interest of investors and researchers in the crypto asset market has moved from a focus on a single virtual currency towards researching the structure and features of the asset market. The production of these assets has a completely user-based model, it draws attention because it is controlled by no government or central authority (Ağan and Aydın, 2019: 2). However, the increasing demand for these assets and the limited amount that can be produced has led to the emergence of sub-currencies for each virtual currency. Rapidly growing since 2013, Bitcoin also encourages the creation of other coins with different functions. In addition, the design and usage of cryptocurrencies provides an alternative for users in facilitating the process of ownership, transactions and money creation.

Unlike traditional currencies, cryptocurrencies do not require trusted third parties to address authorization or other security issues. The decentralized structure of cryptocurrencies allows security issues to be addressed through special algorithms. Security against external threats and

Citation(APA): Hotar, N., (2020), Herd Behavıor in Terms of Social Psychology: The Example Of Crypto Asset Markets, International Journal of eBusiness and eGovernment Studies, 12 (1): 79-90. Doi:10.34111/ijebeg.202012106

attacks is provided by a technology called "blockchain". Since the first appearance of crypto assets in 2009 with the broad-market volume of Bitcoin, more than 2000 cryptocurrencies have been released and are now open to trading in international markets.

It is becoming increasingly difficult for economists to understand the recent collapse in stock markets. The financial economy's theoretical foundationsare based on the assumption of the effectiveness of markets (Fama, 1970). In addition, the assumption that individuals act in a way that maximizes their interests is the basis for strong theories for investors in the field of finance. However, researchers have found empirical evidence which contradicts the assumptions of traditional finance theories. While this process contributes to the development of behavioral finance, researchers are now aware that investors may act irrationally (Aydın & Ağan, 2016: 98). Therefore, investor psychology and the effect of psychological factors in the decision-making process can cause many anomalies in the markets, and affect the functioning of the market structure. Behavioral finance reveals that investors engage in systematic deviations from rationality. According to behavioral finance, individuals decide under the influence of their cognitive bias and herd behavior, which leads to financial market ineffectiveness, fragility, and the presence of anomalies. Crypto asset markets are observed to be largely in line with the ideas posed by behavioral finance advocates for financial markets.

Behavioral finance studies aim to explain the behavior of professional and non-professional investors with theories derived from social sciences, such as psychology, sociology, social psychology and anthropology. This study focuses on the herd behavior in terms of social psychology. Herd behaviour in financial markets often arises from trends in investors' cognitive and psychological prejudices. This tendency has been observed and researched in financial institutions, especially during the global financial crisis. The purpose of this study is to measure investors' tendency towards herd behavior through price movements in the crypto asset market. Another goal to examine the crypto asset market under the following hypothesis: crypto-investors have limited resources and abilities to process the weak prior knowledge and information. This study contributes to the literature by providing social psychology perspectives on the expanding crypto money market. In this context, firstly, a literature review was conducted, and then method and analysis results were evaluated.

2. LITERATURE REVIEW

There is no consensus on how to value crypto assets stored with an encryption technology. Some researchers find Bitcoin and other encryption transactions fraudulent, while others see it as the technology of the future, and because of this disagreement, financial analysts rarely recommend cryptocurrencies. Cryptocurrency markets are highly dependent on socially produced ideas and events, as many who participate the cryptocurrency markets are young, inexperienced investors who are easily influenced by social media, chat rooms and various online forums. Crypto assets can lead to unfair price levels, unless a balance between earnings and loss can be achieved. Cryptocurrency traders are unlike stock traders in that they are not sensitive to negative shocks, which do not automatically lead to high sales in the cryptocurrency market. Herd behavior requires the coordination of the ability to observe the actions of others or a price movement (Devenow & Welch, 1996). Such mechanisms are found in crypto asset markets; it continues to develop in the internet era, where networks and social media facititate the sharing of ideas and information. In fact, the business transactions of large cryptocurrency holders called "whales" can be easily observed via "crypto currency whale watching" through websites that allow the tracking of whales and their transactions. Another factor is that Bitcoin and other crypto assets are not considered securities.

In their studies, Şanlısoy and Çiloğlu examined the emergence of cryptocurrencies and how the savings income of central banks would be affected by this process and evaluated the future of the global reserve money system (Şanlısoy and Çiloğlu, 2019).

In the context of behavioral finance, herd behavior is defined as a decision-making approach characterized by imitating the actions of others, or "a situation where rational people start to act rationally by imitating others' judgments while making decisions". In other words, it is defined as any behavior similarity / difference transmitted by the interaction of individuals (Hirshleifer and Hong Teoh 2003).

In their studies, Bevan-Dye (2018) examined the social media behavior of university students in generation Y. The importance of electronic word-of-mouth communication (eWom) is emphasized. In this study, 311 student's data were used in 4 different campuses in South African universities. The data of these students such as information link sharing and product link sharing on Facebook were examined. Thus, the results of students' affecting each other were examined. Structural equation modeling, correlation analysis, constructvalidity analysis and reliability analysis were used as data analysis method.

According to Graham (1999), herd behavior can be organized in four different categories: informational herd, reputable herd, researcher herd, and experimental herd. In informational herd behavior, individuals choose to ignore their private information (optimally) and imitate the actions of individuals (Banerjee 1992; Bikhchandani, Hirshleifer and Welch 1992). In the context of Bayesian reasoning, it refers to the process of updating information by gradually reducing the previous weight, as new and supposedly more powerful information is presented in a sequential order. In other words, it assumes that the likelihood ratios, which are characterized as private signals, are limitless. As a result, individuals in the chain of later events; due to the overwhelming nature of their beliefs, prejudices, and psychological tendencies, the chain of events may be imitated, and consequently this will not provide useful information for individuals.

Herd behavior among investors has been described as volatility changefulness, and addressed in empirical studies, which reveal that a short-term popular behavior can be observed in financial markets (Lakonishok et al. 1992; Christie & Huang, 1995; Chang et al., 2000; Hwang & Salmon, 2004; Demirer et al., 2010).

In recent years, many researchers have focused their various analyses on Bitcoin due to its unique features and outstanding performance (Cheah & Fry, 2015; Urquhart, 2017; Katsiampa, 2017). The interest of investors and researchers on Bitcoin is related to approaches that try to understand, explain and analyze the key features of the crypto asset market, rather than just focusing on a digital currency. Corbet et al. (2018) examines the presence of balloons in Bitcoin and Ethereum, underlining that key findings (mixed chain, block chain and liquidity) do not cause any balloons in the market. Wei (2018), examining the efficiency of cryptocurrencies, highlights the positive relationship between the efficiency of cryptocurrencies and transaction volume. Platanakis et al. (2018) claims that diversification through Bitcoin, Litecoin, Ripple and Dash is as equally effective as optimal diversification.

Attempts by economists and investors to understand herd behavior have attracted great attention in recent years. Christie and Huang (1995); Chang et al. (2000); Gleason et al. (2004) investigating the US stock exchange, rejected the hypothesis of the absence of herd behaviour. However, Chiang and Zheng (2010) provided evidence of herd behavior in developed European countries. Chiang and Zheng (2010)'s position, however, conflicts with the earlier literature showing no herding in either the Chinese (Demirer et. al, 2010) or advanced markets (Chang et al., 2000).

Crypto assets appear to exhibit excessive returns and volatility from time to time without relying on a report. Irrational investors who rely on unproven information operate on this market without fully analyzing the risks. Therefore, investors are observed to follow the behavior of others regardless of their own analysis. This can cause potential herd behavior. Bouri et al. (2018), taking into account structural breaks and nonlinearity, Chang et al. (2000) showed that there is a herd behavior in the cryptocurrency market by using the Cross Sectional Absolute Deviation (CSAD) criterion.

Poyser (2018) investigated the April 29, 2013 - April 3, 2018 period for 100 cryptocurrencies, and Chang et al. (2000) investigated whether herd behavior is in existence by using CSAD criterion and Markow Switching approach. In the both of these studies they found that investors deviated from the financial asset pricing approach and followed the community when feeling pressure in the market. In contrast, Bouri et al. (2018) used the rollling window analysis to emphasize that the herd has changed over time in the market. Vidal-Tomás et al. (2018) analysed 65 digital currencies and they found that the smallest cryptocurrencies developed as the same way with the largest ones.

3. DATA

The study investigates whether there is a tendency towards herd behavior in the crypto asset market. Since the trend of herd behavior is also more likely to occur in high frequency data (Christie & Huang, 1995), the analysis included the daily prices of 22 major, high trading volume cryptocurrencies (Bitcoin, Ethereum, Ripple, Tether, Bitcoin Cash, Litecoin, EOS, Binance Coin, Stellar, Tron, Cardano, Tezos, Neo, Cosmos, Dash, IOTA, UNUS SED LEO, NEM, Maker, Ethereum Classic, USD Coin, Huobi Taken), which combined represented an average of more than 85% of the market value from August 2013 to December 2019.. The criteria and constraints used for data and the definition of the highest trading volume are: (i) Market value, (ii) Market volume, (iii) Availability of data for estimation. In this framework, the empirical study investigated whether herd behaviour was present in crypto asset market, using the 22 cryptocurrencies with the highest trading volume with the specified criteria. The closing prices of cryptocurrencies are obtained from the internet address https://coinmarketcap.com. Analyzes were made in the R program.

4. METHODOLOGY

To date, several methods have been developed to test the empirical herd in the prices environment. Herd behavior in financial markets was analyzed using different methodologies (Lakonishok et al., 1992; Wermers, 1995; Hwang & Salmon, 2004; Christie & Huang, 1995; Chang et al., 2000). In the literature section, it is stated that direct observation of investors' actions is the best approach to testing herds, due to the coordination mechanism and the potential to lean towards social convention. However, direct observation is almost impossible, due to the privacy in the cryptocurrency market. In this study, therefore, crypto asset prices were followed as a coordination mechanism for the trend of herd behavior. Given that the herd cannot be measured directly from financial markets, the literature has developed different proxies to detect herd behavior based on return regression tests. This study uses the methodology of Chang, Cheng and Khorana (2000), an improvement on Christie and Huang's (1995) original methodology. Christie and Huang (1995) argue that herd behavior occurs mainly during market fluctuation (Galariotis et al., 2016). Due to the increasing uncertainty in these periods, market participants tend to follow the collective behaviour of the market. When these behaviors are reflected in returns, deviations from market returns will decrease, due to the tendency to cluster around the market average. The criterion showing these deviations is the CSAD - Cross Sectional Absolute Deviation method (Doğukanlı & Ergun, 2011). According to this method of detecting deviations, the herd trend is observed when there is no deviation

from the mean or trend. This method was first used by Christie and Huang (1995). The Cross Sectional Standard Deviation (CSSD) criterion was proposed by Christie and Huang (1995), and Chang et al. (2000) developed Cross Sectional Absolute Deviation (CSAD) criteria, which is the method used in the current study.

Chang et al. (2000) 's Cross Sectional Absolute Deviation (CSAD) criterion is a method that takes into account structural breaks and nonlinearity. For this reason, in this study, it is investigated whether herd behavior is in question by using the preferred CSAD criterion and Markow Switching approach.

The CSAD method can be formulated as follows:

$$CSAD_t = \frac{1}{N} \sum_{i=1}^{N} |R_{i,t-} \ R_{m,t}| \quad (1)$$

$R_{i,t}$ i. i shows the return of the asset at the moment of t, $R_{m,t}$ shows the market return

In the study, the CSAD model was estimated as follows:

$$CSAD_t = \alpha_{S_t} + \beta_{S_t}|R_{m,t}| + \gamma_{S_t} R_{m,t}^2 + \phi_{S_t} CSAD_{t-1} + \varepsilon_t \quad (2)$$

where $\varepsilon_t \sim N(0, \sigma_{S_t}^2)$.

Following terminology and variables were used to test whether there is herd behavior in the cryptocurrency market in the model. CSAD: the horizontal cross-section absolute deviation coefficient, R^2_{mt}: crypto return and R_{mt}: the absolute value of the difference of the weighted market return.

Transition probabilities p_{ij} are defined as the probability switching from regime $j = 1,2,3$ to regime $i = 1,2,3$, giving the transition probability matrix

$$P = \begin{bmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & p_{32} & p_{33} \end{bmatrix} \quad (3)$$

The regime duration for regime $i = 12,3$ is defined as $\tau_i = 1/(1 - p_{ii})$. Here P_{11} gives the possibility of being in the first regime in the next period, when the process is in the first regime; P_{22} gives the possibility of remaining in the second regime while the process is in the second regime. P_{12} gives the possibility of switching to the second regime in the next period while the process is in the first regime. In addition, the parameters must fully meet the probability rules, that is, they must be statistically significant (Aydın & Kara, 2014: 36).

5. HERD BEHAVIOR IN THE CRYPTO ASSET MARKET: EMPIRICAL RESULTS

Descriptive statistics for the data used for the CSAD model are shown in Table 1. The average of the CSAD variable, consisting of 12409 observations, is 3.8005. The standard deviation of the variable is 2.8326. The observations of this variable range from 0.0285 to 40.8122. The skewness value shows that the observations of the CSAD variable are right-skewed, and the kurtosis value indicates that the observations of this variable are clustered closer to the average, that is, it shows a rather steep distribution. According to Jarque-Bera statistics, the error term shows a normal distribution. Ljung-Box statistics show that there is autocorrelation in the CSAD variable at the 1st and 5th delays, while the ARCH statistic shows that variance varies in both 1 delay and 5 delays. However, these effects are eliminated in 5 lag lengths.

Analysis of the yield curve of the crypto asset market shows a volatility cluster in 2014. Volatility greatly increased during this period, but tended to return to the average in the post period. However, volatility increased after 2017 and returned to the average in the post-2019 period, providing some evidence for the presence of herd trend.

Table 1: Descriptive Statistics

	CSAD	$\lvert R_m \rvert$	R_m^2
N	12409	12409	12409
Mean	3.8005	3.1068	23.6550
S.D.	2.8326	3.7428	93.5987
Min	0.0285	0.0010	0.0000
Max	40.8122	53.2046	2830.7323
Skewness	4.0056	3.7852	16.9515
Kurtosis	29.9258	27.2999	415.0673
JB	96105.9970***	80370.9440***	17364898.4040***
Q(1)	470.6125***	237.0609***	145.5849***
Q(5)	1161.4403***	683.0719***	287.7634***
ARCH(1)	77.1522***	100.9143***	3.0455*
ARCH(5)	99.8536***	154.3119***	13.7481**

The table shows descriptive statistics for the cross-sectional absolute deviation (CSAD), absolute market returns ($|R_m|$) and squares of the market returns (R_m^2). In addition to number of observations (n), standard deviation (S.D.), the mean, maximum (Max), minimum (Min), kurtosis, and skewness, the table also displays the first [Q(1)] and fourth-order [Q(5)] Ljung-Box test for autocorrelation, Jarque-Bera normality test (JB),fourth-order [ARCH(5)] and the first [ARCH(1)] test for autoregressive conditional heteroskedasticity. Superscripts ***, **, and * denote significance at 1%, 5%, and 10% level, respectively. See the note to Figure 1 variable definitions.

Due to the differences in the dynamic structure of the variables examined, and the data-dependent structure of the CSAD model, there may be differences in the number of regimes and regime definitions for each series (Aydın & Kara, 2014: 39). In the models, it is estimated that, under the assumption of the same the variance, the number of regimes is 3 for each series, in line with Christie and Huang (1995).

According to Christie and Huang (1995), in order to verify herd behavior, the coefficients of the predicted regressions should be statistically significant and negative. Negative and meaningful coefficients mean that investors behave similarly during stressful market periods. In the Model; Regime 3 is the period with the highest volatility, Regime 2 is the most positive period with volatility, and Regime 1 is the period with the best value and volatility.

Figure 1: Market return (x axis : Years, y-axis: Rate of return)

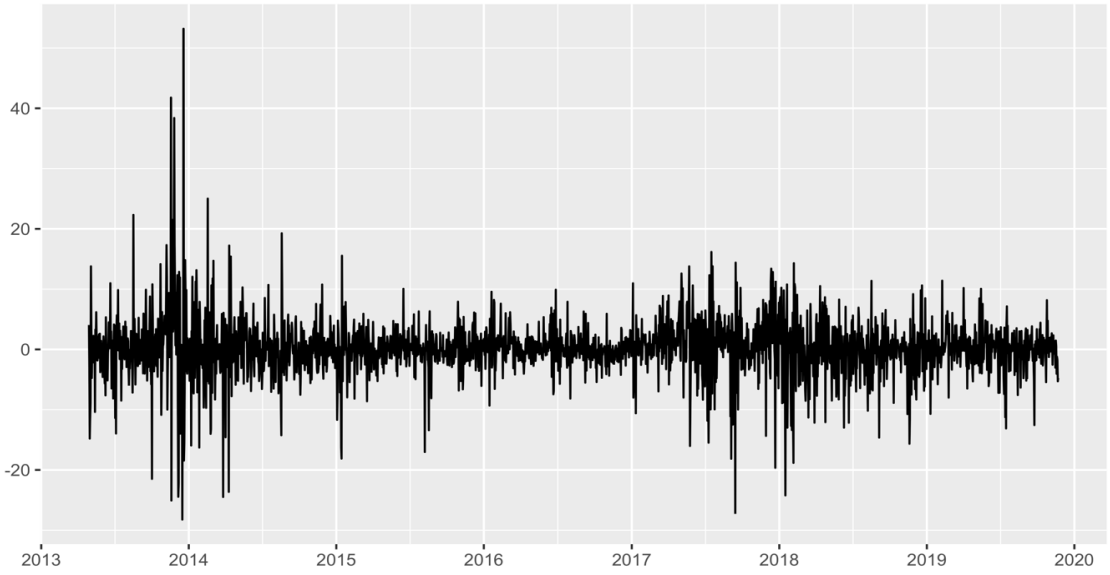


Table 2: Parameter Estimates

Parameter	Estimate	S.E.	t-statistics
Regime 1			
α_{S_t}	1.742*	0.091	19.163
β_{S_t}	0.214*	0.023	9.520
γ_{S_t}	-0.000	0.002	-0.200
ϕ_{S_t}	0.182*	0.031	5.858
σ_{S_t}	0.726		
R^2	0.437		
Regime duration	15.414 days		
Regime 2			
α_{S_t}	5.080*	0.841	6.041
β_{S_t}	0.805*	0.126	6.372
γ_{S_t}	**-0.006**+	0.003	-2.000
ϕ_{S_t}	-0.033	0.067	-0.490
σ_{S_t}	4.546		
R^2	0.451		
Regime duration	2.905 days		
Regime 3			
α_{S_t}	1.726*	0.142	12.135
β_{S_t}	0.335*	0.037	8.997
γ_{S_t}	**-0.012***	0.002	-5.950
ϕ_{S_t}	0.326*	0.030	10.727
σ_{S_t}	1.688		
R^2	0.287		
Regime duration	8.915 days		
Transition probabilities			
	Regime 1	Regime 2	Regime 3
Regime 1	0.935	0.000	0.055
Regime 2	0.000	0.655	0.058
Regime 3	0.065	0.345	0.888
	AIC	BIC	logLik
	8790.028	8952.805	-4383.014

Note: * and + denotes significance at 1% and 5%, respectively.

According to the results predicted in Table 2, the probability of the regime remaining in the period with the highest volatility (Regime 3) was 88.8%, while in the period when the volatility was low (Regime 2), the probability of the market remaining in the period with low volatility again was 65.5%. The probability of monitoring a period in which the market returns are highest with a high return (Regime 1) is 93.5%. These results suggest that regime 1 and regime 3 are more stable than regime 2 for the crypto asset market, and that the herd members follows each other. It is seen that the probability of the market going to the 3rd regime when it is in the 2nd regime is 5.8% and likewise the possibility of going to the 2nd regime when it is in the 3rd regime is 34.5%. This result shows that a volatile market was unable to immediately reduce its volatility e volatile due to the herd effect. On the other hand, as can be seen from Table 2, only Regime 1 and 3 are statistically significant, revealing that herd tendency is not observed in

Regime 2. Statistically significant coefficientsin regimes 1 and 3 indicate a tendency to herd behavior.

Figure 2: Regime specific and conditional residuals of the MSH (3) model

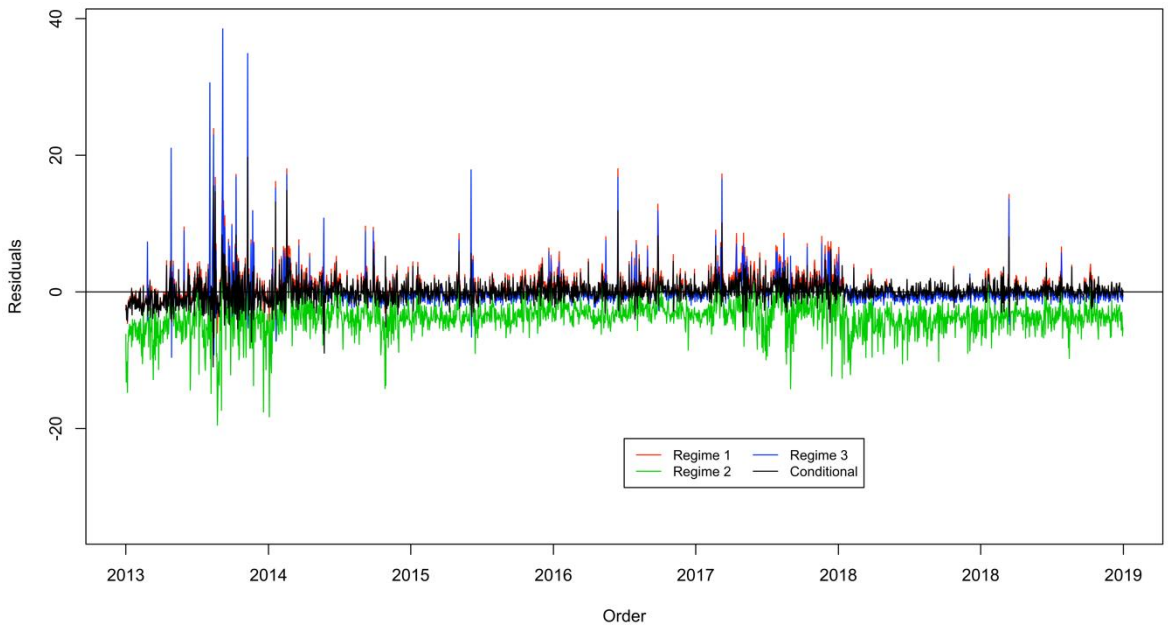
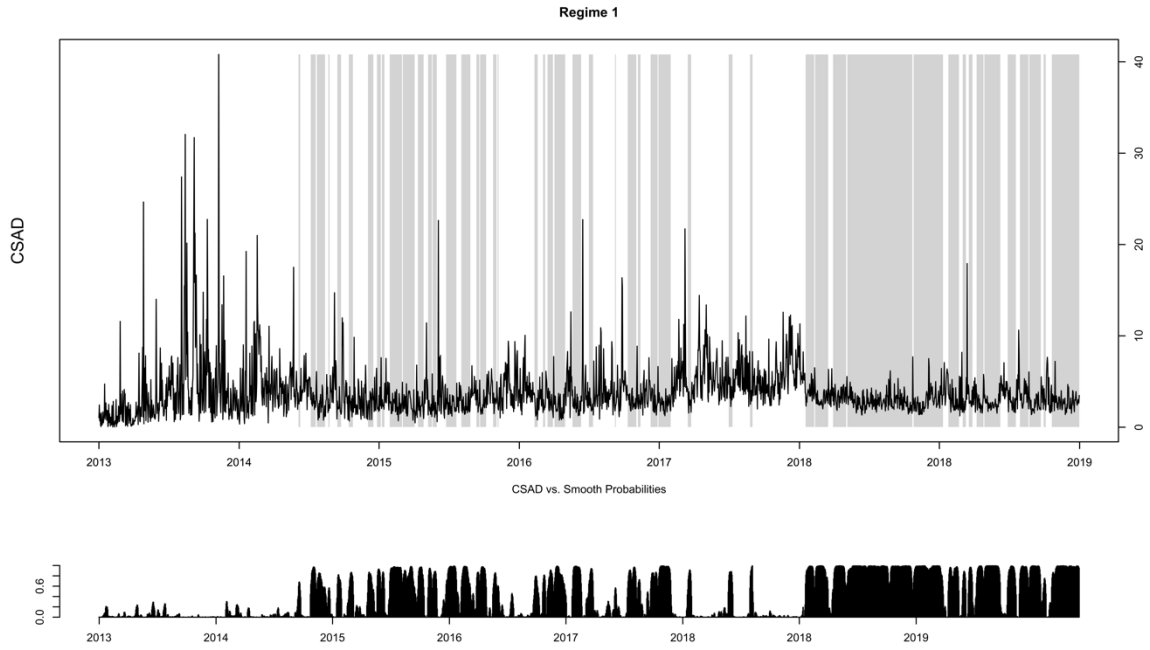


Figure 3: Smoothed regime 1 probabilities of the MSH (3) model



When the results are evaluated for the market; regarding regimes 1 and 3, which stated that the returns reached the highest, and are the most volatile, respectively, it is observed that they tend to remain, due to herd effects. The expected time estimated with $\tau_i = 1/(1 - p_{ii})$ for each regimen was determined as approximately 15414 days for regime 1, 2905 days for regimen 2 and 8915 days for regime 3. From this point of view, it can be said that the regime with highest volatility and most intense herd psychology dominates the crypto asset market.

Figure 3 shows the frequency distribution of herd tendency behavior in regime 1. While the herd trend in late 2013 accelerated the price of the crypto asset, it is observed that the herd trend

has a higher frequency in January and August, and at the beginning of the month. Regime 1; It is the model with the highest volatility in both average and trend statistically.

Figure 4: Smoothed regime 2 probabilities of the MSH (3) model

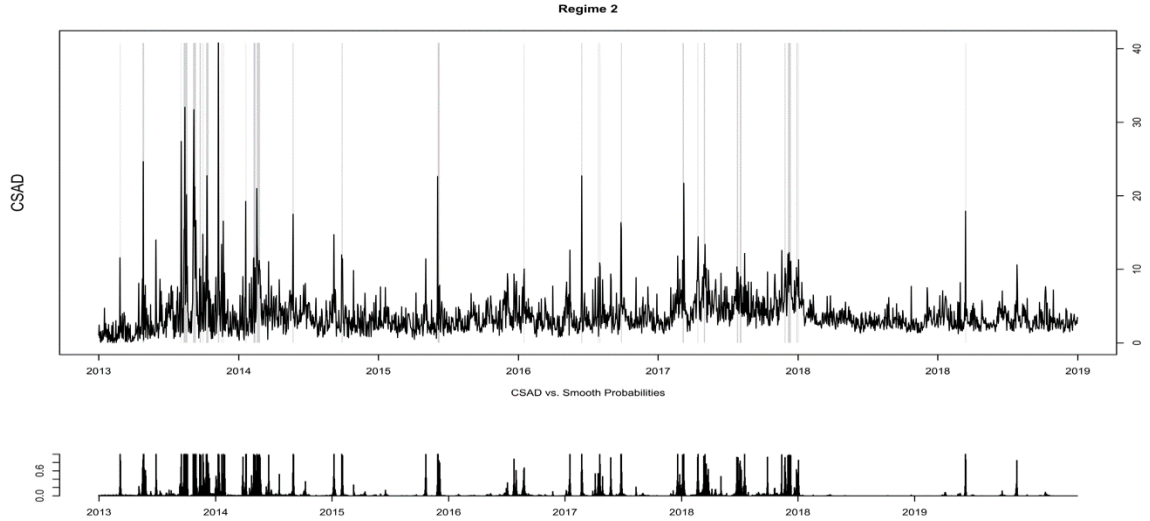


Figure 4 shows the frequency distribution of herd tendency behavior in regime 2. Although the coefficients are in positive relationship,, no herd tendency is observed.

Figure 5: Smoothed regime 3 probabilities of the MSH (3) model

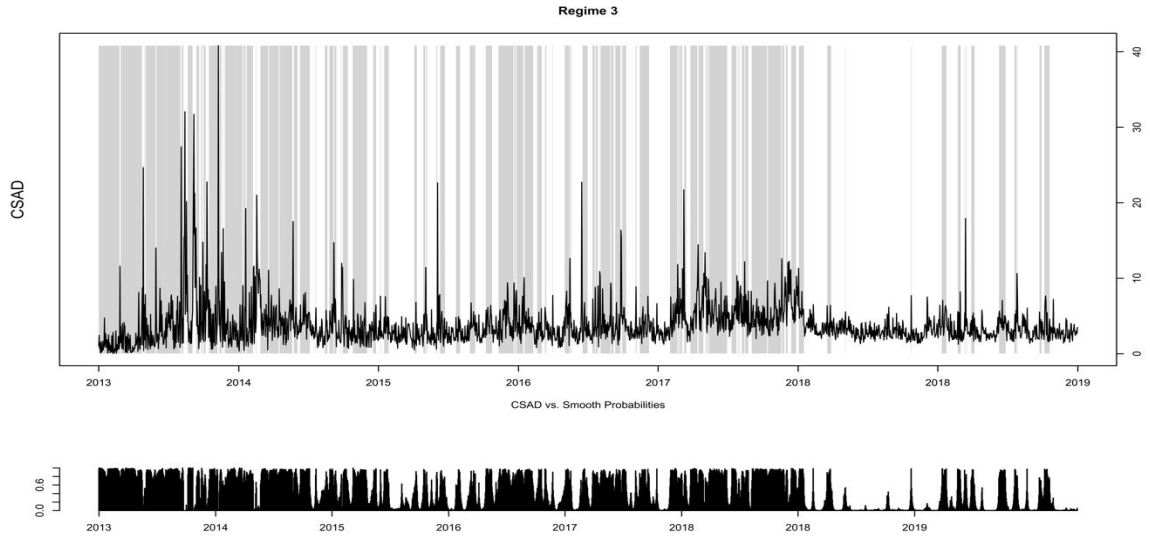


Figure 5 shows the frequency distribution of herd tendency behavior in regime 3. In this regime model, the average and trend volatility is highest and the coefficients are significant. Although this is the worst regime in terms of volatility,, herd tendency is observed in certain period intervals.

5. CONCLUSION AND EVALUATION

Herd behavior is defined in social psychology as individuals' following the the decisions of their group, overruling their own preferences. Herd behavior is considered the most influential behavioral trend in the process of individuals' investment decision making.

Some studies in the literature support the herd behavior in the crypto markets, while others have reached the opposite conclusion. . According to Gama Silva et al (2019), cryptocurrency investors are more affected by negative than by positive information, showing risk aversion in the loss domain. In the current study, the Cross Sectional Absolute Deviation method was applied to investigate the herd trend reflected on the market among all active cryptos. Findings show that investors' tendency to show herd behavior is positive in Regime 1 and Regime 3 models. The analysis of daily frequency data reveal that the coefficients are statistically significant in these regimes.

Movements in the global financial markets cannot be considered independent from each other, and actions in the direction of trading between professional and non-professional investors will also interact at certain times. Any positive / negative shock reflected on the market will affect the value of the crypto asset. As the value of these assets increases, their growing use an investment tool will increasetheir value even further. . Therefore, herd behavior will continue to affect the market. In this study, herd behavior was measured with secondary data, and analysis results demonstrated its existence. However, the results in this study can be extended by investigating potential herd behavior in field studies, to shed further light on the causes of this behavior.

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