



## PERFORMANCE MEASUREMENT MANAGEMENT (PMM) IN THE DIGITAL ECONOMY: THE INSIGHTS FROM LITERATURE

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### Abstract:

Rapid technological development, including the digitalisation of the industry, is changing the operations and management of businesses. Hence, businesses are facing challenges in ensuring that their Performance Measurement Management (PMM) system is contemporary and dynamic whilst dealing with constant change and rapid developments. Along with having to manage huge volume of data of different variability and the emergence of social media, keeping PMM current in today's business setting has proved to be demanding. Therefore, the aim of this paper was to investigate how digitally-driven changes are impacting the management of PMM. A review of literature was conducted to understand how PMM and its elements are transformed by these economy landscape changes in an effort to provide insights for a state-of-the-art PMM system.

### Keywords:

Performance Measurement And Management, Digital Economies, Big Data, Industry 4.0, PMM Change

### Introduction

Businesses are moving towards digitalisation, which is influencing the way they are being operated and managed (Barton and Court, 2012). Rapid technological developments, rapid globalisation and the deconstruction of trade barriers are some of the contributors to these evident transformations (Bititci, Garengo, Dörfler and Nudurupati, 2012). Accompanied by the

emergence of social media and its tremendous growth (20% annually), the digital transformation is altering the business world intrinsically (Kinsey, 2013). As a result, businesses are also seizing the opportunity to measure and manage their organisational performance via social media platforms (Harvard Business Review, 2012). Collectively, these technological advancements are components of the latest industrial revolution, i.e. Industry 4.0. This revolution is transforming the production and industrial management with the help of digitalisation (Rauch, Seidenstricker, Dallasega and Hammerl, 2016). The concept comprises technological advances such as big data, the Internet of Things (IoT), artificial intelligence (AI), cloud-based manufacturing and other supporting technologies, which function as pillars to the integration of human actors, physical objects, intelligent machineries and production processes in an effort to establish intelligent systems that will improve efficiency (Schumacher et al., 2016).

This transformation, however, is not only limited to business models and structure, but is also impacting the connectivity between firms, consumers outreach and the way customers obtain goods, services or even information. To better illustrate how digitalisation has shaped the way businesses operate, for instance, Alibaba, the world's largest retailer, is operating without warehouses. Similarly, Uber owns no vehicles on their own, although they are the largest taxi company. These examples indicate how businesses are moving away from traditional concepts of doing business. New business models and tools are required, since the conventional barriers of the industry have been broken down by digitalisation (Ibarra, Ganzarain and Igartua, 2017; Hasan, 2018). Managers need to understand the impacts of this transformation on the overall operations and management, including their PMM systems.

Existing PMM systems and tools have failed to incorporate the internal and external changes in the environment (Nudurupati and Bititci, 2000; Kueng, 2001; Marchand and Raymond, 2008). Most of the available PMM frameworks are historical, rigid and static in nature. Hence, it is imperative that PMM systems are reconfigured in view of the changes in the internal and external environment in order to ensure business survivability and sustainability. As Kaplan and Norton (1993; 1996) argued, the PMM system of a business should reflect its strategies. As business strategies change over time due to the environmental changes, Melynk et al. (2014) proposed that PMM systems in general should be equipped with more resilient features to reach their full potential, in an effort to ensure their relevance over time. Therefore, it is the purpose of this paper to discuss how the rapid transformation, brought by digital economy and its elements, has impacted Performance Measurement Management (PMM) systems. In doing so, elements of the digital economy, and the impacts of the digital economy on PMM are reviewed in this paper. The analysis is based on secondary sources gathered via journal databases. Additionally, citation tracking were also used in an effort to produce a comprehensive literature review, providing insights into the impacts of the digital economy and its elements on PMM systems as a whole.

## Literature Review

### *Digital Economy*

Digitalisation is one of the important elements of the digital economy. This is especially true, and has been noted by Atkinson and McKay (2007: 7), who reported that the digital economy can be understood as:

*“...the pervasive use of IT (hardware, software, application and telecommunication) in all aspects of the economy, including internal operations of organisations (business, government and non-profit); and transactions between individuals, acting both as consumers and citizens, and organisations.”*

Based on the definition, it can be understood that technological advancements are interlinked with the way businesses operate in this digital economy. The current state of the economy is cultivating investments in technological development, meeting the needs of the market for technology as a catalyst for growth, and common operations objectives such as cost reduction and innovation drivers (Oxford Economy, 2011). The following table summarises the concepts driving the digital economy and its application examples.

Based on the summary in Table 1, big data is a concept that is wide in scope, with high potential and value-added impacts across any type of business sectors (Brown, Chui and Mayinka, 2011; Mello et al., 2014), with the capability of enhancing the decisionmaking processes across areas of a business including finance, marketing, research and development, and so on. This capability provides businesses with huge pools of data (McAfee and Brynjolfsson, 2012; Waller and Fawcett, 2018). Hence, the employment of big data to manage, process and analyse the different forms of data accessible with digitalisation - to add value and to gauge performance in order to help businesses set themselves apart from their competitors through competitive advantage - is considered significant and important (Courtney, 2012; Mello et al., 2014; Wamba et al., 2015).

The Internet of Things (IoT), on the other hand, is a concept that revolves around the idea of application across the floor of a company with elements such as radio frequency identification tags (RFID), and the utilisations of sensors, actuators and so on (Qu, Thürer, Wang, Fu, Li and Huang, 2017; Hwang, Lee and Park, 2017). Fundamentally, there are five main technology-driven concepts of IoT, which are RFID, wireless sensors networks (WSN), cloud computing, middleware and IoT- application software (Tang et al., 2018). To date, the IoT has been widely implemented and utilised in several industries (Flügel and Gehrmann, 2009). Due to its nature, IoT implementation is normally associated with the manufacturing industry in particular. However, the concept is also being employed by various types of organisations due to its function and effectiveness - for instance, warehouses are equipping themselves with RFID-driven management in order to improve their inventory management (Qu et al., 2017). Not being limited to the previous example, the IoT can be utilise in improving supply chain and logistics readiness and performance through the means of detailed and updated information availability (Flügel and Gehrmann, 2009).

Social media represents online tools that focuses on social interaction and usergenerated content (Kaplan and Haenlein, 2010). It is categorised into three main characteristics that differentiate it from other web-based mechanisms: real-time interaction and communication, many-to-many interactions, and user-generated content (Peters et al., 2013; Agostino and Sidorova, 2016). On an organisational level, social media has now been accepted as one of the essential mechanisms used for communication, marketing, retention and market penetration (Hanna et al., 2011; McCaughey et al., 2014; Khan et al., 2014).

In summary, these concepts, if incorporated into PMM, are quite capable of altering the overall governance of a business via effective usage of data and information to help improve and

enhance decision-making processes, strategic planning and the overall operational activities. Therefore, it is imperative that businesses understand the impacts of these technologically-driven concepts on their PMM systems to ensure their effectiveness.

**Table 1: Technological Concepts Driving the Digital Economy**

	Definition	Applications Examples
Big Data Analytics	The analysis of high volumes of data in real time.	<ul style="list-style-type: none"> <li>• Targeted advertising.</li> <li>• Efficient warehouse management by understanding the trends of purchase.</li> </ul>
Cloud Computing	A large virtual warehouse used to store data (no hardware storage needed).	<ul style="list-style-type: none"> <li>• Web-based applications.</li> <li>• Efficient management of IT infrastructure.</li> </ul>
	Definition	Applications Examples
Internet of Things	Sensor-enabled hardware connected via the Internet.	<ul style="list-style-type: none"> <li>• Remote monitoring, i.e. SMART House.</li> </ul>
Artificial Intelligence	Intelligent software that allows machine learning.	<ul style="list-style-type: none"> <li>• High-precision SMT robot.</li> </ul>
Cyber-Physical Production Systems	A mechanism that is controlled or monitored by computer-based algorithms, tightly integrated with the Internet and its users.	<ul style="list-style-type: none"> <li>• Remote detections and diagnoses and condition monitoring of the machines.</li> </ul>
BlockChain	A decentralised distributed, immutable real-time and secure digital ledger, which can be used to virtually store digital identities and farm-to-fork traceability.	<ul style="list-style-type: none"> <li>• Hassle-free money transfer 24/7.</li> <li>• Supply chain monitoring - noting the origin of the materials to ensure the authenticity of the products.</li> </ul>

### ***Impacts of the Digital Economy on Performance Measurement Management (PMM)***

In theory, Performance Measurement Management (PMM) is a dynamic, unified set of metrics designed to measure and evaluate the efficiency of the business operations, for which the data can be employed in related decision-making processes in order to ensure the competitiveness of any business (Neely et al., 1995). In addition, a PMM system manifests these changes internally and externally, accommodating objectives review, modification and prioritisation, accordingly (Bourne et al., 2000). Hence, it is essential for the effective overall governance in regard to the strategic planning and decision-making of an organisation. The increased awareness of the importance of PMM has arisen due to apprehension that the long term success of an organisation depends on the capability of that organisation to meet the demands of all stakeholders, including consumers, employees, suppliers, local community stakeholders, and shareholders. These goals should not only be met, but also measured, despite the fact that their quantification is difficult with regard to properly gauging the organisational performance of an organisation (Adam et al., 2006).

During recent decades, PMM techniques and tools have gained popularity among academicians as well as business communities (Thorpe and Beasley, 2004; Sum Chau, 2008; Franco-Santos et al., 2012). Performance Measurement Management has been implemented and used for various reasons; one application utilises PMM as the mechanism to achieve competitive advantage by constantly responding and adapting to volatile external environments (Sum Chau, 2008; Cocca and Alberti, 2010). Along the same lines, Brewer and Speh (2000) also noted that businesses are utilising PMM as a platform to consistently communicate their strategies into a set of performance measures, such as KPIs and the critical success factors (CSFs). This is simply due to the fact that these KPIs and CSFs are providing these businesses with quantitative and qualitative measurements of critical components of business strategies, which need to be accomplished in order to achieve strong organisational performance (Melkers and Willoughby, 2005). In other words, a clearly defined goal and budget for each KPI and CSF will create awareness among the workforce regarding the expectations the business has of them, hence allowing them to work towards achieving the defined goals. Locke and Latham (2002) using the goal setting theory, explained that clearly defined, specific, difficult goals represent one of the important elements of goal-setting processes, which will lead to improved performances.

Moreover, organisations implement PMM in order to provide better linkages between rewards and performance. Rewards systems have been successfully utilised as the means to motivate individuals to consistently align their goals to the goals of the organisation (Hopwood, 1972). This ensures that motivation of the workforce is optimised by rewarding certain behaviours that are beneficial to overall organisational performance. Not limited to that, effective employment of PMM and the link between rewards and performance will also serve as a control mechanism in monitoring the behaviour of the workforce, as the behaviour that is not rewarded tends to be neglected (Kerr, 1975). Just as importantly, PMM also exerts positive effects on the alignment of an individual's focus and attention to important key factors that contribute to organisational performance - aligning the behaviour of the workforce to the continuous improvement initiatives of the organisation, as well as improving overall individual satisfactions in regards to effective rewards (Martinez, 2005).

Past empirical literature has also proved that businesses implement PMM in order to improve the overall process of their decision-making (De Waal and Kourtit, 2013). In addition, PMM enhances the internal processes of an organisation - for instance, the process of communicating the strategies of the organisation, the overall strategic planning, as well as the betterment of performance-related information (De Waal and Kourtit, 2013). Just as importantly, past research has provided the evidence that the implementation of PMM also improves the budgeting processes, which is also one of the main reasons for organisations to employ PMM (Bunce et al., 1995).

On the other hand, PMM utilisation has also been viewed in a negative light. Previous research has also been able to prove that the utilisation of PMM has shown mixed results (Abernethy and Lillis, 1995; Ittner and Larcker, 1995; Chenhall, 1997; Perera et al., 1997; Banker et al., 2000; Ittner et al., 2003; Kaynak, 2003; Said et al., 2003; Davis and Albright, 2004; Neely et al., 2004). For instance, performance-based rewards may cause agents to manipulate the timing of their performance (Courty and Marschke, 2004). More commonly known as gaming, the agents will modify their performance outcome reporting in accordance with the threshold of particular rewards (Murphy, 1998; Dickert-Conlin and Chandra, 1999; Goolsbee, 2000). For instance, an employee may choose to report his/her performance outcome achieved early in the

year somewhere at the end of the year instead, which is the threshold for bonus payment, in an effort to be better rewarded. In addition, past literature has also been able to establish that financial measures such as profit and return on capital employed encourage short-termism (Hayes and Abernathy, 1980; Kaplan, 1984; Johnson and Kaplan, 1987; Ittner, Larcker and Randall, 2003; Merchant and Van der Stede, 2007). By definition, according to Oxford Living Dictionaries, short-termism is concentration on short-term projects or objectives for immediate profit at the expense of long-term security. It is used to describe a situation in which an excessive focus on short-term results adversely affects an individual's, team's, company's or country's long-term interests. In the context of performance measurement, short-termism can be understood from the definition of Merchant and Van der Stede (2007: 452– 453), as shown below:

*“...a management myopia, an excessive focus on short-term performance, is an almost inevitable side-effect of the use of financial results control systems built on accounting measures of performance.”*

Regardless of the negative impacts of PMM, proper design and utilisation of PMM can lead to improved quality of products and/or services, and contribute to improving the reputation of the business. Moreover, research evidence has shown that organisations with PMM implemented performed better than those without it (Hronec, 1993; Lynch and Cross, 1995; Lingle and Schiemann, 1996, 1999; Kaplan and Norton, 1996; Rheem, 1996; Atkinson et al., 1998; Armstrong and Baron, 1998; Ahn, 2001; Sandt et al., 2001; Ittner et al., 2003; Said et al., 2003; De Waal and Coevert, 2007; Pinheiro de Lima et al., 2009).

However, in today's context, these systems are experiencing changes and transformations that are unavoidable. Along with the digital economy, the increase in speed, the overall improvement of reliability, quality, accuracy, capacity and user-friendly features as a result of digitalisation are some of the many contributors to the adoption of digitalisation across sectors. This explains the interest of both academics and practitioners in understanding and adopting the integration and intelligentisation of overall operations, with the objectives of achieving the efficiency gains and benefits (Zhou, 2013). Manufacturing industries in particular are showing significant interests in obtaining this objective through the streamlining of manufacturing processes and operations (Lanza, Haefner and Kraemer, 2015). In the manufacturing sector, firms are digitally integrated with networked machineries and factories that enable the semi-autonomous operations, which require little to none manual involvement (Monostori, 2014). (refer to Table 1).

In short, concepts such as big data and cloud computing provide businesses with a huge pool of data (McAfee and Brynjolfsson, 2012; Waller and Fawcett, 2018), which can be utilised for more informed decision-making and strategic planning. This explains why big data is employed by businesses to manage, process and analyse the different forms of data accessible with digitalisation to add value and to gauge performance in order to help businesses set themselves apart from their competitors through competitive advantage (Wamba et al., 2015). Davenport et al. (2012) argued that competitive advantage through the usage of big data enables managers to understand their business at micro level, which is achieved through the process of utilising real-time information obtained from digital components like the sensors or radio frequency identification tags (RFID), or any other digitally-driven devices. Understandably, with the

speed of this data collection and its volume, decisions made on previously available data can become obsolete with the arrival of a new set of data (Davenport et al., 2012).

Big data can be defined with the 3Vs, which are volume, variety and velocity, covering the generation, storage, processing and analysis of large data (Russom, 2011; Mello, Leite and Martins, 2014). Volume in this context refers to the huge amount of data, which has increased significantly since the last decade. Volume also refers to the detailed character of these data, which is mainly due to the fact that the accessibility and storage of digital data in this era are more economical (Waller and Fawcett, 2013; McAfee and Brynjolfsson, 2012; Demirkan and Delen, 2013). This can be observed with the collection of data by big corporations - for instance, Google processes 24,000 terabytes of data, and world-famous grocery chain, Wal-Mart, is dealing with more than 2.5 petabytes on a daily basis (Davenport et al., 2012; McAfee and Brynjolfsson, 2012).

Variety refers to the differing types of data obtained (Mello et al., 2014). These data can take many forms, structured or unstructured, as the sources are relatively diverse and new (McAfee and Brynjolfsson, 2012). The mixture of these data includes text, audio, video, images, text messages, retails transactions, genetic codes, information obtained from sensors, GPS signals, social media images and information, and many more types (Stapleton, 2011; McAfee and Brynjolfsson, 2012; Mello et al., 2014). Next, the velocity refers to the speed of collection, processing and application these data (Stapleton, 2011). Not limited to that, these data are also available and obtainable in real-time (Mello et al., 2014).

For instance, in the pre-digital economy, banks would take a long time processing and selecting credit card customer prospects; however, with the help of big data analytics, this process can now be completed in a single day (Davenport et al., 2012; Mello et al., 2014). Thus, big data analytics provide organisations with information to assist their decision-making by effectively utilising the information and knowledge available at hand. The application and utilisation of big data and the intel gathered vary throughout all the business functions of an organisation, which include the processes of understanding business environments, the creation of new products or services to meet customers' needs and demands, and the overall governance of an organisation, which are critical in setting them apart from the competitors (McAfee and Brynjolfsson, 2012; Davenport et al., 2012; Mello et al., 2014).

On the other hand, the availability of high-speed network connections, web stream data, and social media platforms such as Facebook resulted in the higher volume and variety of data (Chen, Chiang and Storey, 2012; Davenport et al., 2012). The challenge now lies in how managers process these data and information into meaningful information that will assist decision-making or strategic planning (Bititci et al., 2012). This is crucial, as accurate usage will enhance managers' overall decision-making processes through the improvement of insights and awareness of the overall business operations (McAfee and Brynjolfsson, 2012). It has been shown that businesses that rely on data-driven decision making exhibit better organisational performance than those which do not (McAfee and Brynjolfsson, 2012). Therefore, it is crucial for organisations to utilise this information in their information system, which might lead to the need to alter the components of PMM adequately to respond to these changes, in order to fully capture the effectiveness of the system for organisational performance.

The emergence of social media is also playing a major role in re-shaping PMM as a whole. Social media is transforming the way businesses operate and interact with stakeholders (Aral, Dellarocas and Godes, 2013). By definition, social media represents online tools that focuses on social interaction and user-generated content (Kaplan and Haenlein, 2010). It is categorised into three main characteristics that differentiate it from other web-based mechanisms: real-time interaction and communication, many-to-many interactions and user-generated content (Peters et al., 2013; Agostino & Sidorova, 2016). On the organisational level, social media has now been accepted as one of the essential mechanisms used for communication, marketing, retention and market penetration (Hanna et al., 2011; McCaughey et al., 2014; Khan et al., 2014). Along the same lines, Nudurupati et al. (2016) argued that social media platforms represent powerful tools that facilitate understanding of the dissemination of information among consumer regarding the brands, products and services, thus providing the business with avenues to evaluate their performance. This notion is further supported by the work of Keegan (2011), who posited that business to customers (B2Cs) and customers to customers (C2Cs) interactios are enhanced through public and transparent communication on social media platforms, hence facilitating engagement opportunities with potential groups of customers, either as marketing avenues or as platforms to obtain feedback on products or services rendered via evaluation.

Moreover, past literature has documented the linkages between the employment of data and information obtained through social media and its impact on strategic planning, market predictions and anticipations and overall firm performance (via the means of realtime data, behaviour patterns of other major players within the same industry or by the expansion of analysis spectrum) (Mislove et al., 2010). Similarly, Jackson (2011) and Bruhn et al. (2012) asserted that social media and the information and data it brings have the potential to exert influence on the brands and share values of an organisation positively or otherwise. In short, the generation and effective utilisation of huge amounts of data through the employment of social media enable organisations to measure and manage their operational efficiency and performance (Sidorova, Arnaboldi and Radaelli, 2016).

Therefore, all these aforementioned examples proved that the incorporation of these components of the digital economy into PMM can potentially alter the overall governance of a business via effective usage of data and information to help improve and enhance decision-making processes. In summary, the literature review has addressed the transformation the digital economy has brought to PMM, and its implementation and management as a whole are documented in Table 2.



**Table 2: Digital Economy Impacts On PMM**

No	Digital Economy Impacts on PMM	Sources of Evidence
1	IoT utilisation to monitor and control the performance of objects and subjects in the business domain.	Chui, Loffler and Robert (2010), Swan (2012), Kamalanathan et al. (2013), Tyagi, Darwish and Khan (2014).
2	The opportunity and needs to effectively process huge amount of data of different varieties.	McAfee and Brynjolfsson (2012), Chen, Chiang and Storey (2012), Davenport, Barth and Bean (2012), Waller and Fawcett (2013), Barton and Court (2012), Bititci et al. (2012), Mello, Leite and Martins (2014), Nudurupati et al. (2016).
3	Big data provides businesses with the ability to deliver value, measure performance and create competitive advantage.	Wamba et al.(2015), Davenport, Barth and Bean (2012), Boyd and Crawford (2012).
4	Big data improves decision-making processes by enhancing the visibility of macro and micro aspects.	McAfee and Brynjolfsson (2012), Davenport, Barth and Bean (2012), Chen, Chiang and Storey (2012), Wamba et al. (2015).
5	Social media is transforming business interactions with stakeholders.	Aral, Dellarocas and Godes (2013), Keegan (2011).
6	RFID utilisation to increase efficiency and effectiveness.	Fosso, Wamba and Ngai (2015).
7	CPS catalyses communications of the value stream networks and their components, which enables IT customisation throughout the organisation.	Lasi et al. (2014), Posada et al. (2015), Valdeza, Brauner, Schaara, Holzinger and Ziefle (2015).

This explains the needs for more empirical research in outlining the changes PMM systems go through as a result of the drastic technological advancements brought by the digital economy. This is imperative, as it will provide organisations with the knowledge and technical know-how in dealing with volatile external environments.

### ***Research on Performance Measurement Management (PMM) & Digital Economy***

Although there are many published literature on PMM, the majority of this research was undertaken without considering the volatile external environment in which organisations are operating. Specifically, the problematic issues for PMM operating in the digital era concerns the instability of the external environment (Nudurupati et al., 2016). This is aggravated by the fact that most PMM systems today are historical, rigid and static in nature (Nudurupati et al., 2010), which results in the lack of capability of these systems to capture and incorporate the rapid changes in the internal and external environments of a business (Nudurupati and Bititci,

2000; Kueng, 2001; Marchand & Raymond, 2008). These drastic changes in the external environment due to digitalisation require organisations to alter their strategy, and consequently their systems of managing performance (Bititci et al., 2012; Melynk et al., 2014). Consequently, Melynk et al. (2014) argued that, to cope with the drastic transformation and instability of the external environment, businesses should focus on developing a flexible PMM approach in order to ensure the smooth incorporation of strategies into their PMM ensuring its effectiveness. This is imperative, as the organisational performance of an organisation is directly interconnected with the developments in its external environment, i.e. the digital economy (Wamba et al., 2015). It has also been noted that the PMM area of research has remained stagnant for the last decade, with no recent breakthrough to add knowledge and value to the conceptualisation of PMM as a whole (Anderson, Busi and Onsoyen, 2014).

Along the same lines, Nudurupati et al. (2016) attempted to provide better insights into the impacts of volatile environments on PMM through their research conducted around a nuclear services company. Based on the findings, their case study illustrates how organisations should re-model their business model by leveraging the technological development of the external environment in order to achieve better organisational performance as well as competitive advantage. This can be achieved by incorporating big data and IoT into PMM, providing the organisation with information and data that will lead to enhanced decision-making and strategic planning (Nudurupati et al., 2016).

Similarly, Melynk et al., (2014) posited that most PMM systems lack the fit between business strategy, external environment and organisational culture. Through their research, they highlighted that poor fit of PMM leads to the inconsistency between what is being measured and considered important and what is actually important for the organisation (Melynk et al., 2014). This research also highlighted the nature of the highly turbulent external environment, which is structural, and through their findings, Melynk et al. (2014) further suggested that the fit between PMM and the aforementioned parameters is directly proportional to the business turbulence. In order to assess the lack of fit between PMM and the environment as well as the strategy, Melynk et al. utilised the three-phase Delphi method to assist the identification of the upcoming trends of the business landscape, and how they would impact the PMM implementation. The findings of the research demonstrate the importance of the fit between the environment, strategy and PMM, with the researchers summarising three fits that organisations should consider in order to ensure the effectiveness of their PMM system (Melynk et al., 2014). In addition, Bititci et al. (2012) highlighted the context within which performance measurement usage is changing, as well as the contextual and emerging trends that lie ahead, and how this will present practical and theoretical challenges to PMM system implementation and management.

Therefore, taking all this aforementioned literature into consideration, the only way forward for PMM implementation and management in organisations is to be responsive and adaptive to the volatile external environment in which the PMM is operating. By taking into account the changes of the environment, as well as the emerging market trends, the PMM system of any particular organisation can be designed and implemented with resilient features, i.e. with the incorporation of technology advancement elements that will be able to ensure the effectiveness of PMM in measuring and quantifying organisational performance against the intended goals of that particular organisation.

## Conclusion

Despite the rapid speed of technological development dawning upon business operations and management, specifically the PMM aspects of the operations, the development of research in regard to PMM has been rather slow and monotonous in the last decade, calling for empirical research to explore PMM and its dimensions further, in view of drastic technological changes. There has been no significant development in PMM-related research in the last decade, and there is an urgent need for more studies to research the development of better PMM with resilient features, to keep abreast of the rapid transformation brought by the digital economy (Anderson, Busi and Onsonyen, 2014). Moreover, the focus of the majority of published empirical research was to understand PMM and its conceptualisation, with the presumptions that businesses are being managed in a stable environment or business domain (Wamba et al., 2015). Thus, previous research did not examine PMM in consideration of the dynamic changes brought by the digital economy (Nudurupati et al., 2016).

Future research should examine potential changes and modification of PMM implementation and management in light of the rapid, technologically-driven changes of the digital economy. Thus, some questions that need to be answered are as follows (i) How has Performance Measurement Management (PMM) altered in light of the change dynamism brought by digitalisation and its elements? (ii) What are the challenges and issues faced by organisations in regard to the changes and transformations brought by the digital economy? (iii) How are altered PMM and its changed indicators are being utilised by organisations to assist their governance (i.e. strategic planning and decision-making processes)? The answers to these questions will provide better understanding of and insights into how businesses can improve their overall decision-making, employee empowerment and strategic planning by employing a proper, suitable and dynamic PMM system.

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